1873.

VICTORIA.

LOW LANDS COMMISSION.

PROGRESS REPORT.

PRESENTED TO BOTH HOUSES OF PARLIAMENT BY HIS EXCELLENCY'S COMMAND.

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Victoria, *by the Grace of God, of the United Kingdom of Great Britain and Ireland* QUEEN, *Defender of the Faith:*

To *our trusty and well-beloved The Right Worshipful* THE MAYOR OF MELBOURNE, *The Worshipful* THE MAYOR OF EMERALD HILL, *The Worshipful* THE MAYOR OF SANDRIDGE, *The* PRESIDENT OF THE CHAMBER OF COMMERCE, *The* CHAIRMAN OF THE SHIPOWNERS' ASSOCIATION, JAMES LORIMER, *Esquire,* JOHN HUTCHINSON BLACKWOOD, *Esquire,* SAMUEL AMESS, *Esquire,* JAMES PATTERSON, *Esquire, M.P.,* THOMAS MCPHERSON, *Esquire,* WILLIAM HENRY CUTTS, *Esquire, M.D.,* DAVID CLARK, *Esquire,* WILLIAM MCCREA, *Esquire, M.B.,* SAMUEL RAMSDEN, *Esquire,* JOHN MCILWRAITH, *Esquire,* JOSEPH HENRY KAY, *Captain R.N., F.R.S.,* WILLIAM WILKINSON WARDELL, *Esquire,* THOMAS HIGINBOTHAM, *Esquire, C.E.,* GEORGE GORDON, *Esquire, C.E., and* CLEMENT HODGKINSON, *Esquire:*

GREETING:

Whereas *the Governor of our Colony of Victoria, with the advice of the Executive Council thereof, has deemed it expedient that a Commission should forthwith issue* to enquire into the best means of making available the low lands adjacent to the western and southern sides of the City of Melbourne, and situated on both banks of the River Yarra; to suggest what portions of the above lands ought, in the opinion of the Commission, to be specifically reserved by the Crown for the purpose of constructing canals, docks, wharves, roads, tramways, and other works of public utility, and further in carrying out the enquiry to keep in view not only the best and most economical application of the said lands for commercial and public purposes, but likewise the expediency of appropriating them in such a way as may be least calculated to injure the health of the inhabitants of the City and its suburbs: **Now know ye** *that We, reposing special trust and confidence in your knowledge and ability, have thought fit to constitute and appoint, and by these presents do constitute and appoint you the said* MAYOR OF MELBOURNE, THE MAYOR OF EMERALD HILL, THE MAYOR OF SANDRIDGE, THE PRESIDENT OF THE CHAMBER OF COMMERCE, THE CHAIRMAM OF THE SHIPOWNERS' ASSOCIATION, JAMES LORIMER, JOHN HUTCHINSON BLACKWOOD, SAMUEL AMESS, JAMES PATTERSON, THOMAS MCPHERSON, WILLIAM HENRY CUTTS, DAVID CLARK, WILLIAM MCCREA, SAMUEL RAMSDEN, JOHN MCILWRAITH, JOSEPH HENRY KAY, WILLIAM WILKINSON WARDELL, THOMAS HIGINBOTHAM, GEORGE GORDON, *and* CLEMENT HODGKINSON, *to be our Commissioners for the purposes aforesaid:* **And** *We do by these presents give and grant unto you full power and authority to call before you or any three or more of you such person or persons as you shall judge likely to afford you any information upon the subject of this our Commission, and to enquire of and concerning the premises by all other lawful ways and means whatsoever:* **And** *We will and command and by these presents ordain that this our Commission shall continue in full force and virtue, and that you our said Commissioners or any three or more of you shall and may from time to time, and at any place or places, proceed in the execution thereof and of every matter and thing therein contained, although the same be not continued from time to time by adjournment:* **And** *We do hereby appoint our trusty and well-beloved The Right Worshipful* THE MAYOR OF MELBOURNE *to be Chairman of you our said Commissioners:* **And lastly**, *We direct that you do, with as little delay as possible, report to us under your hands and seals your opinions resulting from the said enquiry.*

In testimony whereof *We have caused these our letters to be made patent and the seal of our said Colony to be hereunto affixed.*

Witness *our trusty and well-beloved cousin the Right Honorable* JOHN HENRY THOMAS VISCOUNT CANTERBURY, *of the City of Canterbury in the County of Kent, and* BARON BOTTESFORD, *of Bottesford in the County of Leicester, in the Peerage of the United Kingdom of Great Britain and Ireland, Knight Commander of the Most Honorable Order of the Bath, Governor and Commander-in-Chief in and over the Colony of Victoria, &c., &c., &c., at Melbourne, this twelfth day of August, One thousand eight hundred and seventy-two, and in the thirty-sixth year of our Reign.*

By His Excellency's Command, *CANTERBURY.*

J. G. FRANCIS.

ENTERED on Record by me in the Register of Patents, Book 17, page 144, this sixteenth day of August, One thousand eight hundred and seventy-two.

W. H. ODGERS.

No. 2988.

Chief Secretary's Office,
Melbourne, 19th August 1872.

Sir,

By direction of the Chief Secretary I have the honor to transmit herewith an instrument under the hand of His Excellency the Governor, appointing you and the other gentlemen named therein a Royal Commission to enquire into and report upon certain matters connected with the low lands on the south and west of the city.

I also desire to bring under your notice the attached copy of a minute by the Governor in Council, made on the 5th instant, enlarging the scope of the duties of the Commission beyond the original limits of enquiry assigned to it, and request that it may receive due consideration.

I have the honor to be, Sir,
Your most obedient servant,
W. H. ODGERS.

The Right Worshipful the Mayor of Melbourne.

B 9252.

Order in Council, made 5th August 1872, *enlarging the scope of the above-recited Commission.*

1st. To indicate, after consulting existing engineering plans, sections, and reports, and after considering evidence of engineers, merchants, shipowners, marine surveyors, and nautical men, what lands ought, in the opinion of the Commission, to be now definitely withheld from sale or occupation for the purpose of constructing on such lands a ship-canal, docks, wharves, or other works for the improvement of the Port of Melbourne, also works for rapidly carrying off flood-water from the Yarra.

2nd. To suggest some definite scheme, based on reliable engineering data, for the reclamation of the swamps and other low-lying badly-drained land west and south of the City of Melbourne, and for the improvement of the approaches to Melbourne, by the removal of the present repulsive aspect of such land.

3rd. To devise measures for fixing the sand drifts in the Sandridge Bend, and along the beach south of Emerald Hill, and for creating a sward of grass on the land covered by such sand drifts.

4th. To define boundaries of a portion of land to be occupied for the purpose of carrying on noxious trades, subject to the stringent provisions suggested by the late Commission on noxious trades.

PROGRESS REPORT.

To His Excellency Sir George Ferguson Bowen, *Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Administrator of the Government of the Colony of Victoria, &c., &c., &c.*

May it please Your Excellency,

In pursuance of the Commission issued by His Excellency the Right Honorable John Henry Thomas Viscount Canterbury, Governor of the Colony of Victoria, &c., and dated the 12th day of August 1872, appointing us Commissioners for the purpose of enquiring into the best means of making available the low lands adjacent to the western and southern sides of the City of Melbourne; to suggest what portion of the above lands ought, in our opinion, to be specifically reserved by the Crown for the purpose of constructing canals, docks, wharves, roads, tramways, and other works of public utility; and further, in carrying out the enquiry, to keep in view not only the best and most economical application of the said lands for commercial and public purposes, but likewise the expediency of appropriating them in such a way as may be least calculated to injure the health of the inhabitants of the city and its suburbs; and also to consider the additional subjects referred to us by a minute of the Governor in Council, made on the 5th day of August 1872, enlarging the scope of the duties imposed upon us beyond the original limits of the above cited Commission: we have the honor to report—

That having obtained, by the courtesy of the Right Worshipful the Mayor and the Council of the City of Melbourne, the use of a room in the Town Hall wherein to hold our meetings, we held the first meeting on the 29th August 1872, and thirty-two meetings have since been held.

We have received evidence from several persons, professional and otherwise, relating to the subject-matter of this enquiry, also statistical returns from the departments of Lands, Public Works, and Trade and Customs; the evidence and reports of previous Commissions, Boards of Enquiry, and Select Committees have been carefully consulted, especially the exhaustive evidence and documents attached to the report of the Royal Commission on Harbor Improvements and a River and Harbor Trust, of 1860.

To enable us to suggest what portion of the said low lands ought, in our opinion, to be reserved for the many purposes indicated in the Commission, as well as to suggest some practical scheme for reducing the liability of these lands to floods, it was found to be an absolute necessity to procure accurate surveys of the Yarra and Saltwater rivers, to have the levels of the lands accurately taken, and the reliable data of former floods collected, so that calculations might be made of the volume of water of the highest floods requiring to be conveyed by the river or other channel to the sea. For these purposes the Government placed a sum of money at our disposal, which has been carefully and economically expended.

After carefully considering the whole of the evidence submitted herewith, and the surveys and documents above referred to, we are of opinion—

1. That, to render the low lands available, the first object to be attained is to secure such lands from floods as far as practicable; and, in our opinion, this can be most economically and effectually done by the improvement of the Yarra as hereinafter described.

2. We have had several schemes submitted for our consideration. Of these, three have been selected as being the most likely to accomplish the objects in view; they are—

(1.) The widening of the river from Prince's bridge to the gasworks, at Melbourne, and from thence by a direct channel from the river at the gasworks, to a point in the Bay west of the Hobson's Bay Railway.

(2.) The widening of the river from Prince's Bridge along its course to Fisherman's Bend; a cutting from that point to a point in the river below the junction, and the deepening of the river throughout.

(3.) A channel or new course for the river from the gasworks at Melbourne to a point in the river near its mouth, in the line of the flood channel recommended by the Flood Board of 1864.

All these schemes are identical as to width, 300 feet at the bottom, from Prince's Bridge, and depth, 22 feet at low water, and each is designed to make access to the city practicable for the ships that have now to discharge their cargoes in Hobson's Bay, and to facilitate the discharge of flood waters into the Bay.

The first scheme is for a direct channel to the Bay, and has the support of a number of witnesses who, having had experience of the dangers and delays caused by the present tortuous and difficult channel of the River Yarra, desire to obtain the shortest possible channel for shipping between Melbourne and the Bay. But the weight of the professional evidence which we have taken is emphatically opposed to this scheme, on the ground that it would be impracticable in consequence of the expense to keep the mouth of a direct channel open. Even the costly and, in many respects, objectionable expedient of carrying piers into deep water in the Bay would, according to this evidence, fail to effect the object.

The second scheme proposes to widen and deepen the present channel of the river, and to cut off the loop at Fisherman's Bend. This scheme has much to recommend it in the fact that a considerable length of the river already affords about one-third of the sectional area required. It has also the advantages of retaining the present mouth of the river and of being the least expensive of the three schemes. On the other hand, it would not reduce the distance between Melbourne and the Bay so much as either the first or the third scheme.

The third scheme is to divert the course of the river in the line of the channel proposed by the Flood Board of 1864, the depth, however, being increased from 12 feet to 22 feet. We believe this scheme to be the best of the three, because it retains the present mouth of the river and at the same time greatly reduces the distance between Melbourne and the Bay. It will also furnish a large quantity of material for raising the low-lying land in its vicinity to a level at which it will become valuable. On these grounds we recommend the adoption of this scheme.

3. We recommend further that Prince's bridge be taken down and rebuilt in the line recommended by the Flood Commissioners of 1864, and from a similar design to that furnished by them; that the rock or reef on which the present bridge stands be excavated to a depth of 22 feet below low-water mark, and that the area of water-way below the same level at the new bridge shall not be less than 3500 square feet.

We recommend also that the Hobson's Bay Railway bridge and the Falls bridge be removed, and that the reef on which the latter stands be excavated to a depth of 22 feet below low water, and to a sectional area sufficient for the passage of such a flood as that of 1863. In rebuilding these bridges care must be taken to make them of sufficient capacity, and they should be constructed with as few piers as possible.

We are of opinion that, from Prince's bridge to Church-street bridge, at Richmond, the channel of the river should be widened and deepened so as to reduce the level of a flood such as that of 1863 within safe limits.

4. With reference to the improvement of the West Melbourne Swamp, we, after careful enquiries relative to the levels of such swamp and cost of raising portions of it to such height as to be above reach of flood, have arrived at the conclusion that it would be inexpedient to incur the enormous expenditure requisite to render any portion of the low-lying ground west of the railway eligible for the extension of the city for purposes of residence. We therefore recommend that the West Melbourne Swamp be enclosed and drained, so as to be made suitable for purposes of recreation as a park or for cultivation or grazing, but not in any case for residences or as sites for manufactories. With reference to the piece of low land lying between the Railway and Adderley street, we are of opinion that until it

is drained no effective remedy can be applied to improve it. The drainage above recommended will effect this ; and we suggest that the Railway department should, as far as possible, use any surplus excavation at its disposal in raising the level of the land.

5. As the low lands on both sides of the river are at present but of small value, and as any improvements made in the harbor approaches to the city will greatly increase their value, we recommend that the whole should be reserved from sale ; that no new applications for leases of these lands be granted, and that no existing leases be renewed. The lands thus referred to are those comprised within the following boundaries :—The left bank of Saltwater River from its junction with Yarra to crossing of Victorian Railway ; thence by Victorian Railway and Spencer street to Yarra ; thence by Yarra to Prince's Bridge ; thence by Sandridge road to point of crossing of the St. Kilda line of railway : thence by St. Kilda line to Sandridge line of railway ; thence by Sandridge line to Hobson's Bay ; thence by Hobson's Bay and Yarra to commencing point.

6. A scheme for the drainage and improvement of the West Melbourne Swamp, as recommended, and a plan for docks to accommodate the shipping which will be able to navigate the proposed new channel, together with the other subjects referred to us, are engaging our attention, and will be dealt with in a future Report which we hope shortly to lay before Your Excellency.

Dated at the Town Hall, Melbourne, the twentieth day of June 1873.

(Signed)	O. FENWICK, Chairman,	(L.S.)
	JOHN NIMMO,	(L.S.)
	SAML. P. LORD,	(L.S.)
	JAMES LORIMER,	(L.S.)
	W. HENRY CUTTS,	(L.S.)
	D. G. CLARK,	(L.S.)
	W. McCREA,	(L.S.)
	JOSEPH H. KAY, Captain R.N.,	(L.S.)
	W. W. WARDELL,	(L.S.)
	T. HIGINBOTHAM,	(L.S.)
	G. GORDON.	(L.S.)

GEORGE A. MOURITZ,
Secretary to the Commission.

MAY IT PLEASE YOUR EXCELLENCY,

We, the undersigned members of the Royal Commission on Low Lands South and West of the City of Melbourne, decline to sign the above Report on the following grounds :—

1. In our opinion the evidence submitted to us points out the first or direct scheme as the cheapest in construction, and also in maintenance—notably so in construction, in comparison with the scheme (No. 3) recommended in the Report, the difference being, in round numbers, for the excavation and dredging alone £250,000 ; but this does not cover all the difference; provision for sheet piling has not been made in any of the estimates submitted; but as this may be necessary in either of the schemes, the difference between that required for a canal two miles long and for a canal five or six miles long must be added to the above sum of £250,000.

Appendix 17.

Appendix 14.

2. It is also our opinion that, however much we are disposed to value the abilities and judgment of the professional members of the Commission who differ from us, yet the amount of engineering evidence that has been collected by previous enquiries should not be ignored, and, therefore, we cannot concur in the statement of the Report "that the weight of professional evidence is against the first scheme, on the ground that it would be impracticable, in consequence of the expense, to keep the mouth of a direct channel open ;" on the contrary, we are strongly of opinion that this evidence which we are directed by our instructions to consult and consider, as well as the facts recorded in the evidence attached, give a large preponderance of professional evidence in support of the view that but little or no annual expense will be incurred in keeping the mouth of a direct channel free from travelling sand, should such a quality of sand exist beyond the line of low water.

Appendix 20.

Appendix 16,

3. In our opinion it does not appear from the evidence that piers to extend into deep water in the Bay are absolutely necessary, while the evidence of cost shows that, if they are required, they need not necessarily be costly.

Appendix 14.

4. We object to the scheme (No. 3) recommended in the Report, and to that of widening the river (No. 2), because it appears from the evidence of one of the professional members of the Commission and other witnesses who emphatically state that the river cannot keep its mouth clear at a greater depth than 14 feet, and that only with the assistance of dredging. As, therefore, the distance and quantity to be dredged in either scheme is so much greater than the first scheme, we are of opinion it would be unwise to incur so large an annual expenditure as would be entailed by the adoption of either of these schemes.

Mr. Higinbotham, 1860, 2193.

Capt. Ferguson, 1858, 743; 1860, 996.

5. At first sight it may appear that No. 3 scheme (that recommended in the Report) will give more material for raising the adjacent lands, because of its extreme length. Yet, as the greater portion of such lands will be further from the centres of population, and as they will be for a much longer period before they are required for settlement than those raised by the excavations from No. 1 scheme, the greater immediate increased value of the latter will more than compensate for the difference in quantity, if any, which the former may be supposed to give.

Mr. Birnie, 1872, 587, 616, 617.

6. We, therefore, strongly recommend the adoption of the first scheme, because it is the shortest and most easy of access from the Bay ; because it affords, by reason of its shortness, the surest means of relieving the city from floods ; because by its adoption, rather than the second scheme, the present river frontages will be available and valuable for numerous trades and industries requiring water accommodation ; because the lands reclaimed by it will be of more immediate value than by any other scheme ; because it is the cheapest both in construction and maintenance, and will take less time to construct than any other ; and because the saving in both towage and time will be of considerable value to the shipping and mercantile interests.

Appendix 15.

7. We are also constrained to differ with our colleagues in the interpretation of the clause in the commission which directs us "to keep in view the economical application of said lands for commercial and public purposes," that the following expression of opinion is not within the scope of the powers conferred upon us. We, therefore, would urgently press upon the Government the recommendations of previous Commissions that a Harbor Trust should be created, to have the control and direction of all matters connected with the Port of Melbourne and the conservancy of the river. When it is considered that over half a million pounds have been expended upon the River Yarra and the wharves at Melbourne, with such apparently small results, it is patent that works of such magnitude should be entrusted to a body specially charged with them only, and which could be held responsible to the Parliament and the public for economic and efficient discharge of the duties. Harbor works being reproductive, not only directly but indirectly, by facilitating and cheapening the operations of trade, thus benefiting all classes of the community throughout the colony, is a sufficient reason why they should be systematically planned and vigorously carried out. The returns appended to this Report of the tonnage dues and wharfage rates collected at the Port of Melbourne indicate an amount of trade that would fully warrant the expenditure necessary to effect the improvements of the port herein recommended.

Appendix 9.

Appendices 5 and 11.

8. In other respects we concur in the above Report.

Dated at the Town Hall, Melbourne, this fifteenth day of July 1873.

THOMAS O'GRADY, (L.S.)
W. H. SMITH, (L.S.)
JAMES PATERSON, (L.S.)
SAMUEL AMESS, (L.S.)
JAMES REID, (L.S.)
J. B. PATTERSON, (L.S.)
T. J. STURT, M.D., (L.S.)
JOHN McILWRAITH, (L.S.)
R. W. CARRICK. (L.S.)

GEORGE A. MOURITZ,
Secretary to the Commission.

MINUTES OF EVIDENCE

TAKEN BEFORE ROYAL COMMISSION ON LOW-LYING LANDS.

THURSDAY, 5TH SEPTEMBER 1872.

Present:

O. FENWICK, Esq., in the chair;

C. Hodgkinson, Esq.,	T. McPherson, Esq.,
W. McCrea, Esq., M.B.,	D. Clark, Esq.,
Capt. Kay, R.N.,	J. Reid, Esq.,
T. J. Sturt, Esq., M.D.,	S. Amess, Esq.,
W. H. Cutts, Esq., M.D.,	E. D. Joyce, Esq.

Fredk. Harding, Esq., District Surveyor for Melbourne, examined.

F. Harding, Esq., 5th Sept. 1872.

1. Will you produce a plan showing the lands held under lease and license on the south bank of the Yarra?—Yes; the portion colored green represents leaseholds, and the yellow the licenses.

2. What is the total area held under lease and license?—About 109 acres.

3. Nearly the whole of one side is held by the Crown?—A good deal on both sides of the river.

4. The whole, is it not?—No, only a portion of land abutting on the south-east side of the railway.

5. The whole of the land abutting on the south side of the Yarra, is that disposed of?—Not the whole of it.

6. How many acres are available on the south side of the Yarra, right down to the Bay, taking in Sandridge Bend and up to the Sandridge road?—There is very little available on either side of the Sandridge road for leasehold; it is nearly all sold.

7. What amount of land remains not let or licensed in the locality specified?—There are about twelve acres in that locality, north-east and south-west of Clarendon street.

8. What is approximately the total extent of land left unoccupied between the Yarra and Sandridge road and Prince's bridge and Ferrers street?—About 30 acres.

9. Out of the total number of lessees and licensees, how many are lessees and how many licensees?—About 31 lessees and 78 licensees (annual).

10. When do their terms expire—all at one time?—No, all at different periods.

11. Are they being renewed again?—We have not had any leases fallen in yet.

12. Are there not some 21 years?—Yes.

13. Out of the total number of leases and licenses, how many of the sites held by them are held for purposes which come within the meaning of the noxious trades?—If you include all the wool-washing establishments and soap and candle and boiling-down works, there are about 20 to 22.

14. How many acres do those 22 hold?—All the licenses and leases taken up average about an acre each; the total area leased and licensed is 109 or 110 acres.

15. Do any of the lands held under lease interfere at all with the proposed river improvements as designed by the department of Public Works?—No. All the noxious trades that I have enumerated are held under license, except one, and that is the lease of Ascherberg, late Robertson and Wagner's.

16. Is that upon the line of the canal?—That is in the Sandridge Bend.

17. When was that granted?—Under the Presidency of Mr. Grant.

18. Lately, since the last Royal Commission on Noxious Trades, is it?—Yes.

19. How long has that lease been given to Ascherberg for?—Seven years.

20. There is about a year or eighteen months gone, is there not?—No, three or four months only.

21. The land at the back of the barracks, is that leased or licensed?—It is not at present available for leasing or licensing.

22. Do you know how many acres there are upon the Fisherman's Bend, between the Yarra and Sandridge, from the crossing of the railway down to the Bay?—I should think 1600 acres about.

23. There is only one license granted in that portion?—The yellow blocks are licenses that have been there many years—they are annual licenses.

24. There is one granted for seven years?—Yes, upon certain conditions.

25. Will you get us the date of application for that, and when the deed was granted?—It is all within six months.

26. Was it distinctly understood that there is only one lease in the whole of that large number of acres, 1600, at Fisherman's Bend?—There is one lease issued.

27. And only one?—Only one issued. Another lease is pending—that is Felton and Grimwade's—a new thing.

28. The sulphuric acid factory?—Yes; the first site they applied for was found to be in the reserve.

29. That includes the site for the new proposed canal?—Yes, within the 1600 acres.

30. In the proposed line, how many licenses or leases are there, and within the reserve on either side of it?—Kitchen's is in it; he has been there, I think, 12 or 13 years.

31. Is that lease or license?—License.

F. Harding, Esq., *continued*. 5th Sept. 1872.

32. Are there any leases ?—Yes, Sinnott's dock lease is just upon the borders ; it may not be in the actual line of the canal ; there is a limit of deviation of 25 chains wide, and the canal would probably be in the middle of it.

33. Is there no other lease ?—No. Only one is pending—applied for.

34. Then really in the actual line of the canal there is no lease granted that might interfere somewhat with the reserve on either side ?—Yes.

35. This strip of land 25 chains wide—does it include the scheme which Mr. Christie brought under notice for a ship canal some years ago ?—I cannot answer exactly for the locality of his scheme ; there were three or four schemes.

36. What is the extent of land reserved for canal and dock purposes upon that plan ?—The width of the reserve or limits of deviation are 25 chains wide, a 300 feet channel is the width.

37. Are you aware of a plan for widening the Yarra higher up, a scheme embracing the perfect drainage of all the lands, in the form of a ship canal ?—Yes.

38. What is the depth of the channel proposed ?—I cannot answer that question.

The witness withdrew.

Mr. Robert Adams examined.

Mr. R. Adams, 5th Sept. 1872.

39. Will you look at the plan produced, and point out to the Commission in what respect the scheme you suggested some years ago differs from the scheme subsequently proposed by the Flood Commission ?—This is my scheme ; not my first scheme, but my second, at least nearly so.

40. Your first scheme had not a continual bend in it ?—No.

41. What is the reason for this continual bend in a ship canal ?—It is neither harm nor good.

42. Would not the first, on a straight line, be better ?—I should have set it out in a straight line.

43. There is nothing in the nature of the ground to require an alteration ?—No ; it is almost a level all through.

44. What are your reasons for considering this position a better outlet for the canal than the site selected by Mr. Christie and Mr. Bell, which went into Hobson's Bay ?—My reason was simply this, that this place was protected at the mouth, and therefore would not silt up ; and not only that, the outlet provided by nature for the Yarra waters would not be interfered with.

45. You consider the danger of silting-up would be very great in the other place ?—No doubt of it at all. I made my first scheme to that point at first, but I abandoned it altogether ; the waves beat upon the rocks down at the Red Bluff and disintegrate the stone into sand, and that causes silting.

46. Then you think the cost of dredging would be very great if that opening were adopted ?—It would be very serious.

47. You do not think that site would be a suitable place ?—It would not in my opinion. I know this much, that when the floods came in 1863 the water broke through the Sandridge lagoon, and made a channel about 9 feet deep, and three or four days after the floods were over, that outlet was filled up again.

48. But the place, you say, is absurd, or impossible to keep open; is the other place, the place for the canal ?—Yes, the sand travels along the shore ; there is no doubt about it.

49. By destructive you mean that no dredging could combat it ?—That is what I mean.

50. Have you noticed the works now being done by the Public Works department down towards the mouth of the Yarra ?—No, not particularly.

51. Would the deepening of the boat channel, such as they have made, tend to protect the part of the Yarra opposite the proposed outlet of the ship canal from silt ?—I think so ; but I do not see why there should be any silt of any consequence, for the flow of the water runs around the shore alongside Williamstown.

52. You are aware that there has been an enormous amount of silting upon the Williamstown side ?—Yes, but I know there is a strong current round that side.

53. In your opinion is there any part of the beach from the mouth of the Yarra down to below St. Kilda that would be eligible for the mouth of a canal ?—I do not think so ; it is against my views.

54. It is your views we want ?—It is against my views altogether.

55. Would your objections hold good if the mouth of the canal, instead of being just at the Bay, were further out, and it were protected by groins ?—The groins would simply collect the sand ; as the sand beat along the shore it would come against the groin and stop there ; two streams of water come in contact, and where the two meet there is bound to be a deposit.

56. Then it would be the same coming down the Yarra ?—No ; the sand never blows up so far.

57. Are you aware that the tide blows it up till it rises up in the swamps to a great height ?—It does, simply because the flood water cannot get away.

58. The water must be blown up ?—It is heaped up in the Bay no doubt.

59. If you can shorten the line connecting two points in a current of water, would it not prevent the silt ?—It would do something, but I do not think the fall is great enough ; in this case it is a mere nothing, as the fall is hardly perceptible.

60. The southerly winds now blow the water up the Yarra ?—Yes.

61. Would it affect a channel in the direction of the gasworks ?—Yes, just in the same way.

62. To an equal degree ?—Just in the same way.

63. To a greater degree if the distance be short ?—The water would rise to a certain height whichever way the channel empties. I believe the water piles up outside the Heads—from Bass' Straits, in the first instance.

64. It is the indirect action of the wind and not the direction of the wind upon the water of the river ?—No, not at all ; it is the action of the wind upon the whole level of Port Phillip ; the Bay water is heaped up, and it does not matter much where you make your channel in respect to outlet.

65. You have not had an opportunity of taking any borings along this line ?—I think they have been taken.

66. They were in connection with Mr. Christie's line ?—I know they were taken across here [*pointing to the plan*]—namely, between Melbourne and Sandridge, near the railway pier.

67. Were those borings satisfactory in regard to your canal?—Yes, it is a good clay bottom when you get through the sand.

68. Have you any doubt that, upon the line originally laid out by you, they would be equally satisfactory?—I have no doubt they would be.

69. Do you recommend this, upon the whole, as being the best plan you know?—I think it is decidedly; the only thing is, I would make it something like double the width of the channel proposed by the Government.

70. What is the width of that?—About 300 feet.

71. You think the canal as indicated upon this plan should be made wider and straighter?—Yes, just so; but I think the straightening of but little importance.

72. And by that means could you utilize more land on each side by the earth coming out of it?—Yes. This is what I would recommend for the section of a canal—a wide channel to take the flood waters off, for it is manifest that any depth below the water in the Bay is of no use at all as to letting off the flood water; it is only the water over the dead water in the Bay that will readily escape. My notion is to make a wide channel to take the flood water, and a narrow one, 300 feet wide, or whatever width is wanted, for the canal.

73. Then you would have two distinct channels?—I mean one about 3 feet deep for flood waters, and the other about 23 feet for a canal.

74. Did you make any estimate of the cost of the work?—I did some years ago, but it is a long time ago; I could easily give you a reliable estimate.

75. Would you advise the Commission to take some borings along the line you suggest?—I think it would be a good plan to do so, certainly.

76. Did you ever make any calculation what depth of water you would get at the mouth of the river?—I think it is about 14 feet.

77. Was that the depth you anticipated for the canal?—No, you would have to go through the bluestone.

78. Then you would have to deepen the river as well?—Yes; my notion is to make Hobson's Bay eventually a great basin, with wharfs extending from Williamstown to Sandridge.

79. Have you got your original plan?—Yes, if I can find it; but travelling from office to office some of those plans have been mislaid. What we used to do at the East and West India Docks is a very simple thing, and might be adopted here. It is to have a steam-tug, with a kind of rake dropped over the stern; this rake can be raised and lowered with a winch; take it up to the mouth of the river and rake the stuff out with it, and lift the rake and go back.

80. It would be very little use doing that if it is washed up with the next tide again?—No; but it is cheaper than lifting it.

81. Do you intend the canal to be permanently open?—Yes.

82. Then would not the river silt up?—That part of the river cut off by the canal you must look upon as gone altogether.

83. It would be done away with?—I should look upon it as worthless.

84. If steamers stick in that part of the river now with the silting-up, would it be any better after the canal was opened?—Decidedly it would; it is the two currents meeting each other and the breaks in the river that cause the silting-up.

85. And for that very reason is it not likely that the silt would accumulate more if you had an opening nearer to the mouth of the Yarra, than if you had the mouth in a direct course?—I think not. I found that, when I was in the Railway department, the outward current was along the Williamstown shore.

86. By putting a breakwater alongside of the mouth, would that do any good?—No; it would catch the sand and hold it.

87. And so prevent its getting into the canal?—Yes; but in time it would get round the breakwater.

88. Is there depth enough far out in the Bay there for any chance of the sand to be washed past there by means of a breakwater or groin?—If you were to put a breakwater there the sand would break against it and travel onwards to end of the breakwater until the channel became choked.

89. But is the depth of water sufficient to give it a chance of being washed past there?—No; because it only can travel a certain distance, for when it gets into the lee of the land the effect of the wind stops.

90. And there is not depth of water enough to ensure the permanency of a depth of water, even with a breakwater?—No, I believe not; I used to have that idea.

91. Is the Hobson's Bay Railway pier silting up?—It is to a certain extent; but when you introduce a new element, that is, the having the water running in two currents, and the direction changed, it makes a great difference in the state of affairs; at present there is a chance that the sand might meet the tide and be carried away altogether.

92. What is your opinion of the statement made by Mr. Doyne, that the filling up of Port Phillip Bay is only a question of time, and that eventually the Yarra will go down to the Heads?—I have no doubt it will eventually.

93. If you want to take the storm water from the Yarra?—Then the best way is to go through St. Kilda Park.

94. That would utilize the land, but would not make it anything like the commercial value like the other that you proposed lower down?—That is all; it would merely carry off flood water.

95. Could you take it from above Richmond?—It would be very heavy work; the fall would be enormous; the water coming down there would be a perfect torrent. The mistake about the Yarra improvements is that the bridges are all too narrow in span.

The witness withdrew.

Adjourned to Thursday next, at Three o'clock.

THURSDAY, 12TH SEPTEMBER 1872.

Present:

O. FENWICK, Esq., in the chair;

Capt. Kay, R.N.,	T. J. Sturt, Esq., M.D.,
W. McCrea, Esq., M.B.,	D. Clark, Esq.,
T. McPherson, Esq.,	J. Reid, Esq.,
C. Hodgkinson, Esq.,	W. W. Wardell, Esq.,
S. Amess, Esq.,	W. H. Cutts, Esq., M.D.,
S. P. Lord, Esq.,	George Gordon, Esq., C.E.

James Orkney, Esq., examined.

J. Orkney, Esq., 12th Sept. 1872.

96. Will you give the Commission any information you can upon the subject of their labors?—I may say I have been acquainted with the subject before the Commission for twenty years. I have watched with considerable interest the different improvements and blunders made during that time. It has suggested itself to my mind that the harbor approach to the city could be effected in a very simple and reproductive manner by proceeding to effect large improvements either in the River Yarra, or by a direct canal from Hobson's Bay. A canal I consider the preferable scheme; although more costly in the first instance, it would in the end answer the purpose to a much greater extent—in fact it would suit the wants in all time coming probably, whereas the river is continually being dredged, and after all barely suffices for a very moderate-sized class of shipping. I expected that Government or individual enterprise would have accomplished that object before this. To my regret I find lands alienated which should have been reserved for the purposes of a canal, with its maritime and mercantile adjuncts, without proper consideration of value. I am aware that Commissions had been appointed heretofore, and that they recommended a canal or something tantamount. The Government of the day seemed, in appointing those Commissions, to be in earnest, but, after getting the reports, took no further action. Meanwhile conflicting and obstructive interests have grown up; sites have been granted for some businesses which might have found a more appropriate situation elsewhere. My idea is that a canal should be made, with wharves along both sides, and that no more land should be alienated until that plan be adopted or discarded altogether. I have seen to-day, upon the table, plans of a canal, I think, recommended by a former Commission—[*referring to a plan*].

97. This plan shows both schemes, that of the Flood Commission and of Messrs. Christie and Bell?—Yes; I think a direct cut is the proper thing, for the scour of the river is scarcely appreciable, the rise and fall being so little, and the greater length of that channel over the shorter does away with any advantage. This plan—[*taking up a plan on the table*]—shows better what my idea is: going pretty nearly parallel with the Hobson's Bay Railway, debouching about the middle of Fisherman's Bend, you there get into comparatively deep water at once; taking the other course you get into the mud banks at the mouth of the Yarra, which would require constant dredging on account of the formation. I have looked at the matter from an engineering and commercial view. There can be no difficulty in constructing the proposed works; the value of the reclaimed lands would more than pay the cost. The great extension of harbor accommodation, and the averting of floods during storms by allowing the water free means of escape. Assuming the canal to be nearly two miles in length, 200 yards wide and 8 yards deep, the excavations would be about 5,632,000 cubic yards, which I would be very glad to undertake at 2s. per cubic yard. I believe it may be done for much less.

98. Have you taken into consideration the height of the sand hills in making that calculation?—This is merely an approximation—it is not from any of those lines.

99. Do you take into consideration the sand hills?—Yes; I reckon over and under high water, making the cost of excavations £563,200; I estimate the wharfs and approaches to cost £800,000—amounting in the aggegate to £1,363,200, for the excavations of canal, the wharfs along both sides, approaches extending to the city, and a dock for ships to lie in. To meet that outlay, I propose that the frontages along wharfs on both sides of the canal, having a depth of 10 chains, should be offered for sale at say £100 per lineal foot; two miles would thus amount to £1,056,000, but, for convenience, the payment could extend over 21 years. The yearly instalments would amount to £50,285 towards the purchase. There would be a very large area of improved land in reserve for sale at a future time.

100. But you have only taken one side of the canal in that calculation?—Yes, perhaps the lands at lower end of canal might not be utilized for some time. If money were borrowed to construct the canal at five per cent., the estimated cost being £1,363,200, the interest would amount to £68,160 per annum. If the yearly payments to account of land sold were not sufficient to meet interest of loan and incidental expenses, the deficiency may be met by harbor dues, as raised in Glasgow and elsewhere. I may mention, that when in Scotland two years ago I called at the Clyde Trustees' office and got this list of river and harbor dues.—[*The witness produced and handed in a paper.*]

101. Are you aware that the whole of the land within the black lines has been reserved from sale especially with reference to this canal?—Yes; I waited with a deputation from the Chamber of Commerce, on the then Commissioner of Lands and Mr. Hodgkinson on the subject.

102. The reserved land is about double the width you say is necessary for your canal?—Yes, but it should all be reserved meanwhile, as the lands adjacent to canal will acquire exceptional value, and advantage should be taken of that to defray the expense of making the improvements.

103. The scheme that you were engaged in some years ago, did you propose to carry the wash of the Yarra into the mouth of the canal where it joins the Yarra, and do away with the Yarra from the point of the canal to the Saltwater junction?—No, I do not think it would militate against the canal if it were left open, there is so little scour.

104. Would it not be an improvement to keep the mouth of the canal clear, by closing up the Yarra at its mouth?—I consider it unnecessary.

105. Would it not materially assist in keeping it clear?—I do not think so. I have seen the Suez canal and other canals. I saw a similar work at Belfast; the old Lagan River is very similar to our Yarra, and they have no difficulty there in the deposit in the diverted channel.

106. Did you have the proposed canal surveyed at the time you were engaged in it?—I was acting with some gentlemen in it; there were borings taken.

107. What was their result?—All favorable; the excavations since quite confirm them—for instance, the excavation of the lately made gas-holder upon north bank of the river; there could be no better stuff; it would stand almost perpendicular.

108. Stiff clay?—All stiff clay; and that upon the dock of Sinnott and Hughes, south side, was splendid—in fact it required no facing up at all; it would stand almost perpendicular; nothing could be better.

109. What depth were the borings?—Thirty feet.

110. Every 30 feet?—No, that was the depth. I forget the intervals, but I think they are to be had somewhere. The whole of that information is to be had, I think. I believe the Royal Commission that Mr. Lord was upon had it.

111. Have you a plan showing the position of the canal?—No, I have not. I think I saw that with Mr. Cowderoy, the secretary to the Chamber of Commerce, some time ago.

112. Would you indicate upon this plan, submitted to this Commission by the Lands department, where your canal started from the Yarra?—I would start the width of the canal from the gasworks.

113. And how far would your line, the centre of the canal, be from the Hobson's Bay terminus?—Very nearly half a mile from the Hobson's Bay Railway, according to the scale.

114. Was your original line so far to the westward as that?—I am not quite sure.

115. Then, if the line of your canal—the eastern line—is as far from the Hobson's Bay Railway as that, you will see upon the plan that it interferes with no vested interests but one?—The canal itself, but there is the reclaiming of the land on both sides.

116. Is the point indicated opposite the gasworks the intended eastern bank?—Yes.

117. And it was 600 feet wide?—Yes.

118. According to this plan, then, your canal would be altogether outside the reserve made at the instance of the Chamber of Commerce—to the westward of it altogether?—Yes, that is the mistake that has been made; they ought to make the reserve in the map altogether westward of the railway and north of the railway.

119. It appears that on your canal only two sites are held under lease or license, only one small site, and only half the other?—Every part of the scheme is to raise the adjoining lands to prevent any water from spreading over those low lands and make them valuable.

120. This plan shows all the land taken up, to the present day, between your canal and the railway. You see it is almost infinitesimal as compared with the area left untouched?—That is quite a recent thing; the reserve has only been made within the last eighteen months or two years, and should be extended.

121. At any rate, in the whole space lying west of your canal, which is 200 yards wide, there are only six sites held under lease or license?—I am not impugning their action in reserving the land for the canal only, but I say the whole land should be reserved until the canal is either adopted or discarded.

122. Your site is not identical with Mr. Christie's?—I do not think so—it may be so by accident.

123. Yours was made before Mr. Christie's?—Yes.

124. Did you ever consider the question of keeping open the mouth of the canal?—Yes, you get into deep water there almost at once; it would be scarcely appreciable what would deposit there.

125. Did you take any soundings in front of the mouth of it?—Yes, and the harbor-master was favorable to that particular site.

126. Have you consulted the Admiralty surveys that have been made of late years?—I have only read about them. I have not seen the soundings—I have read what was in the newspapers about them, that is all.

127. Did you contemplate carrying any groins out clear of the sand?—Yes, decidedly, that would be necessary.

128. Were your borings fixed with regard to any datum, so that the depths of the respective strata passed through could be fixed?—Yes, there was a datum fixed.

129. If your plans could be found you would be, therefore, in a position to give a section along the centre line?—Yes, right throughout.

130. Would such section be plotted to a datum of high or low water mark?—Yes; I think it was high water mark.

131. On what do you base the value of the land you propose to sell; do you include, in stating that you include two miles of land on each side, any land round a basin that might be formed, or docks?—No, merely take a single line of frontage to canal.

132. What was the estimate of £1,363,200 for docks and so on; was not there frontage round those docks?—It was only upon the canal itself.

133. But there would be frontage round the basins?—Decidedly.

134. Would not that enhance very greatly the value of land at the docks?—No doubt, and it would afford a new outlet to the Victorian railways, also, for bulky articles or heavy ones from the country.

135. Have you estimated the area of the land round the docks?—No. I thought that perhaps the Government might require the land for their own convenience. I am assuming that the canal would accommodate, for years to come, all the shipping—ships would be berthed alongside—the docks and so on would come as an after-affair; it would be inevitable; the canal may become too small. All the land westward of the railway station should be reserved.

136. Have you taken into consideration at all the enhanced value of the lands outside of the immediate frontage to the canal?—I just give a very low estimate to show that any one would be struck with it—to be valued without any subdivision—I say £100 a foot without any cross or parallel streets at all; it goes far, indeed, towards constructing a canal and wharfs.

137. Would it, in fact, in your opinion, enhance the value of the low-lying property outside the immediate frontage to the canal?—No doubt of it.

138. To what extent?—In its present state it is almost without value, but that would make it equal in value to land in Melbourne.

139. By filling up with what would be taken from the other part and make it all suitable for building sites?—No doubt; such an amount of excavation would spread over an immense area, improving all the lands both east and west of the canal.

140. Does your plan or estimate include no bridges?—Not above falls; it is all below that.

J. Orkney, Esq., *continued*, 12th Sept. 1872.

141. Then you do not touch the river above the beginning of your canal?—No; it is not proposed to do anything to the natural river above the junction of the canal; that is pretty well now that the Government have undertaken it.

142. The flood cannot pass the bridges to get to your canal unless the bridges are enlarged or removed?—I was more immediately speaking of the canal.

143. How did you get your opinion that the mouth of the canal would not silt up with a southerly gale?—It is a little exposed to a southerly gale, but we do not have winds generally much from the south; it is from the south-west and south-east—south-west prevailing.

144. I understand you to have asked the Chief Harbor-master of the day?—No; Captain Fullarton.

145. And did he think that it would not silt up?—He expressed himself so in a general way; my experience of such outlets in other places would lead me to infer that there would be no great danger. I have noticed the River Clyde since the first three-masted vessel went up, a little barque laden with tea from China, in 1835; she had to wait nearly a week for spring tides to take her up; she drew about 13 or 14 feet; now such steamers as the iron-clad *Black Prince*, drawing 20 feet, can steam up or down the Clyde with ease and safety.

146. Have you ever considered the future extension of the city of Melbourne, which must extend in some direction or other—would any of the land at Batman's Swamp be desirable to be made available?—Yes, decidedly; reserve it for docks if the canal is settled upon; the swamp upon the north side of the Yarra should be reserved for docks.

147. What would the docks become?—Conveniences for loading and discharging ships near Melbourne, and the remaining lands would be raised from the excavations from the canal and sold for manufacturing and commercial purposes.

148. Forming, in fact, an extension of the city in that direction?—Yes.

149. Did you ever consider the question of draining the upper swamp, Batman's Swamp?—No.

150. Have you any information as to what the levels are?—No.

151. At times, you know, it is perfectly covered with water?—Yes, I know that. It is, I think, perfectly futile to attempt to drain it in its present state.

152. It is not from the Yarra it is flooded, is it?—From the Yarra and Saltwater River, and possibly from the drainage of the western part of the city—you could drain it, of course, by dyking and having a system of sluices and pumps.

153. Your opinion is that a canal for the well-being of the city is a necessity; and that, as a commercial speculation, no doubt it would pay?—No doubt about it.

154. Your former scheme was merely for a canal—not for docks?—A canal primarily, and docks afterwards.

155. Your scheme and calculations are for a canal only?—Yes.

156. Do you consider there would be any more difficulty in keeping the mouth of a straight canal clear?—I think it would clear itself better the more direct and the shorter it is.

157. Did you ever take any particular notice of the depth of the water at particular points?—Yes, I know the original and natural bed of the Yarra very well.

158. Do you know how near the deep water comes to the mouth of the proposed canal?—A very short way out.

The witness withdrew.

Robert Adams, Esq., further examined.

R. Adams, Esq., 12th Sept. 1872.

159. Do you produce the plans that were asked at the last meeting?—I do; my proposition is much the same as the scheme recommended by the Government Commission. I took the line I did take because it was the shortest line. I have proposed a broad channel 15 chains wide, intending it to be 3ft. 6in. deep to carry off flood water alone; but if a canal be made as well, I propose to make the deep water either at one side or in the centre, with piers run out for ships. My object in making the flood channel shallow and wide was, that the water being heaped up in the Bay here should have a broad and ready means of outlet, which is the great want. There are three obstructions in the way of letting off the water; the first is Prince's bridge, the second is the Hobson's Bay Railway bridge, and the third is the Falls bridge; and as long as they exist in their present state, it is utterly impossible to prevent a flood at the lower parts of Melbourne.

160. You consider the best means of relieving Melbourne from flood would be to take a channel through what is known as the Military Reserve—the Albert Park?—Yes, merely for flood.

161. You think that the impediments to carrying away a flood, even by a very large ship canal, are such that, even if a ship canal be constructed, a flood channel should be also made?—I see no objection to it; my channel, of course, would keep itself open, for the rush of water would be so great, and the outlet would be broad.

162. Would such a channel be useful in other respects besides taking off floods?—Simply as a boating channel.

163. Would it not prevent a large extent of land becoming unwholesome, which is now so?—That is rather a sanitary question, but I think it would.

164. But do you think a flood channel would be absolutely necessary if a canal can be made and the bridges properly constructed?—My canal as proposed would I think answer all these purposes.

165. And the storm-water canal would be unnecessary if the bridges were made sufficiently large?—If you want to prevent the flood water from coming below Prince's bridge, so as to allow the three bridges to remain as they are, obviously the proper way is to make a flood channel.

166. Would not the advantages to be derived from a flood channel through the Military Reserve and Albert Park be commensurate with the expense, when it is borne in mind that the stuff from the channel would raise all the low-lying ground between Emerald Hill and the Brighton road, and render it suitable for extension of the city?—Yes, I think so. But the St. Kilda Railway would have to be crossed for an outlet.

167. I understood at the last meeting you would construct, from the data upon the sections then produced, a section from the Yarra to the Bay—have you done that?—No.

168. From what you see of this section upon the table, do you think it would be a costly operation?—Not at all.

169. Would the cost be more than commensurate with the benefits?—I think that the ground is peculiarly eligible for such a plan.

170. But that is only intended to carry off the storm water?—Yes.

171. Would the cost of making a storm-water channel be greater or less than widening the river from the bridges?—I have no data to say what the cost of widening would be. I believe it would be more costly to widen the river than to make a storm-water channel.

172. This is not from calculation; it is simply from a rough approximation that you now speak of the relative cost of the two operations?—I have never gone into that question at all; but I have no doubt that to make a storm-water channel would be cheaper than widening the river.

173. But simply widening the river merely at Prince's bridge to a sufficient width to carry the water down to the canal, would it cost more or less than making a direct storm-water channel?—The former would cost more, for you have to make three expensive bridges.

174. Would widening the river at the three bridges obviate the necessity of a flood channel through St. Kilda Park?—No.

175. You are aware that there are about 120 acres of low-lying ground which is now quite unsuitable for any purpose, owing to its being exposed to flood, and being nearly a swamp. If the land were reclaimed by a storm-water channel, what would be the value of it per acre, taking into consideration the value of the land in Emerald Hill?—I could hardly answer the question; of course, at present, the value is nominal.

176. What would be the comparative value between the land reclaimed in that way and land such as reclaimed by a canal such as Mr. Orkney has spoken of?—Of course it would be enormously increased.

177. That canal would enormously increase its value?—Yes.

178. But the canal proposed by Mr. Orkney would not relieve the city of floods?—Only partially.

179. That being the case, would not it be also expedient to also construct a storm-water channel, seeing that it would render land worth £150,000 which is now not worth anything?—I think if there is no early probability of a canal being constructed to take ships, it would be expedient to make a storm channel.

180. Supposing Prince's bridge were widened, would there be sufficient room between Ramsden's paper mills and the Hobson's Bay Railway station for the water to pass down?—No.

181. So that, if they were carried out, would the water still go over the low-lying lands?—I think it would.

182. Not if you took away the falls?—That would have no effect whatever. The heaped-up water in the Bay meets the flood water and throws it over the flats.

183. Then, if Mr. Orkney's scheme of a canal were carried out, it would not relieve the Yarra from storm water?—No.

184. But the storm-water channel would be required?—Yes.

185. And it would at the same time reclaim a portion of land that the canal would not reclaim?—Yes.

186. The water in the Bay has heaped up by the wind?—Yes.

187. Would there be any appreciable difference in the height of the water between the mouth of the lagoon in Prince's Park and the mouth of the Yarra?—No.

188. Then the same cause will operate to prevent the water going off through your channel?—No; I say in my channel the water would force its way without any doubt.

189. Force its way where?—Through the sand, just as it did through the lagoon.

190. But you said just now that taking away the falls, and widening the river there, would not take away the storm water because it is heaped up in the Bay?—Yes.

191. And would not the same thing operate at the mouth of your storm-water channel if the water is heaped up high enough?—Not if the channel be made wide enough to take off the storm water.

192. Width has nothing to do with it; it is the height of the water that is in question?—It is heaped up about 2 feet 6 inches I suppose, and the height of the wharfs in the river is about 9 feet.

193. Taking it that the water at Prince's bridge was 8 feet above the water in the Bay, in a flood, even if the water in the Bay be considerably higher than usual, still in the short course proposed the 8 feet would create a considerable current?—Yes.

194. Up as far as Prince's bridge you would widen the Yarra?—Yes, down to the gasworks, and then leave the Yarra altogether.

195. But if you made a flood channel you have no necessity to widen the river?—If you make a flood channel from the east side of Prince's bridge, by way of the Botanical Gardens and through the Albert Park, there would not be the necessity for widening the channel between the bridges.

196. And it would be very much less expense to do than to widen the river?—Yes.

197. Would not the proposed flood channel, starting from the Yarra about Prince's bridge and passing through the Military Reserve, be a work remunerative and useful, and even tending to ornament the city?—Yes.

198. And could the whole of it be easily done by convict labor?—Yes, it is labor work; no skilled labor would be wanted.

199. I understand you that the most perfect plan would be to have both a storm-water channel and a canal as well?—Yes.

200. Even if the bridges were taken away the floods could not go down the present channel?—No, unless you widen the channel.

201. Is there room to widen it?—No; Ramsden's paper mills and other places are in the way.

The witness withdrew.

Adjourned to Thursday next, at Three o'clock.

THURSDAY, 26TH SEPTEMBER 1872.

Present:

O. FENWICK, Esq., in the chair;

T. McPherson, Esq.,	D. Clark, Esq.,
James Lorimer, Esq.,	S. Amess, Esq.,
S. P. Lord, Esq.,	W. McCrea, Esq., M.B.,
James Patterson, Esq., M.P.,	Capt. Kay, R.N.,
C. Hodgkinson, Esq.,	Samuel Ramsden, Esq.,
J. Reid, Esq.,	John McIlwraith, Esq.

Charles Bradney Payne, Esq., Chief Harbor-master, examined.

C. B. Payne, Esq., 26th Sept. 1872.

202. You are familiar with the River Yarra?—Yes.

203. And with Hobson's Bay and its depth of water and the bottom?—Yes.

204. Have you paid much attention to the prevailing winds and their effect upon the depth of the water in the Bay?—Yes.

205. Does a southerly gale force much sand into the head of the Bay, and if so, where does the sand come from?—I do not think the southerly winds force any sand into the head of the Bay; but the *débris* brought down by the Yarra has a tendency to deposit there under the influence of the southerly winds.

206. That is upon the beach between Sandridge and the mouth of the river?—No, just at the entrance of the river.

207. At the smaller shoal marked upon the map is it produced by that cause?—Yes, and to the north-west of it as well; that chart that I looked at just now is one published by Captain Cox in 1866; since that a great number of soundings have been taken, which I have recorded upon this chart [*producing and handing in the same*]. It is corrected to 1871.

208. Was not there an error in the datum of Captain Cox's survey?—Yes, there is an error in the datum, but it is not certain whether that error in the datum affects the soundings in the Bay; I believe myself, from information that I have received, that in some way it does affect the soundings in the Bay. You will see the difference in the soundings is indicated by different colors—the first survey was taken in 1867, the next in 1869, and the next in 1871.

209. Which is 1871?—The lower one. At the same time the mode of taking these soundings is not that adopted generally by marine surveyors; the soundings recorded there were taken by a pole marked.

210. And were exceedingly accurate in consequence?—Yes, and taken under very good conditions.

211. Soundings are generally taken by the lead?—Yes. The one set of soundings is only taken to feet and the other to inches, and so I should be inclined to put more reliance in the colored soundings than even those taken by the Admiralty surveyor. With regard to the question of southerly winds carrying sand in, I think you will see by the recorded soundings that the depth of water by the Sandridge railway pier, and some considerable distance to the westward, is very little altered—in some cases the water is deeper.

212. In one case an inch deeper than it was two years before?—Yes; at the same time you will observe that at the entrance to the river the depth of water is very considerably decreased.

213. The deposit from the river takes place principally upon the north side?—Yes, principally.

214. Do you think it is possible that the depth of water could have been decreased by sand being blown off the land in northerly gales?—I believe that the shore has extended into the Bay in the vicinity just to the westward of the railway pier.

215. That would look as if it came from the shore?—It would, and I believe, from enquiries that I have made, that the sand has been blown in and the shore is foreshortened just at that particular place. From the surface of the sand being removed, the northerly winds blow a considerable quantity into the Bay.

216. From the metalled streets a good quantity would come?—No, I mean to the westward of the railway pier.

217. That is in consequence of the breaking up and taking away of the sand?—Yes, I believe so.

218. Do you know whether any borings have been taken to ascertain the nature of the strata at the head of the Bay?—I am not certain; I think some have been.

219. How thick do you think the stratum of sand to be just at the head of the Bay between Sandridge and the Yarra?—I can hardly answer that question as to the entrance of the Yarra; but in connection with the removal of the wreck of the *Eliza*, which lays about one-third of the way between the railway pier and the entrance; I found that the sand was immediately below the soft deposit of silt—in fact, I have in my office a portion that I scraped up at the time I was employed removing the wreck, taken at about 1 foot below the surface of the mud, and the greater portion of it is sand.

220. How deep was it down?—It was taken from the surface; it was just what was scraped up from the surface of the mud to place a blast of powder underneath the wreck, and this was taken certainly within 2 feet of the surface—I should say within 1 foot of the surface—and the greater portion of it is sand.

221. What is the character of the best part of the anchorage in Hobson's Bay—is it sand?—No, mud—just mud.

222. Stiff mud?—I do not say stiff mud; it is rather a loose mud—a mixture of mud and sand.

223. It is not sand?—No.

224. Where does the silt brought down by the Yarra deposit itself principally?—I think the chief deposit is from the entrance of the river towards Williamstown.

225. Not upon the north shore?—No; you see by the soundings that very little of it is deposited there; my answers are based upon the facts in the soundings.

226. Supposing it be decided to construct a ship canal, commencing nearly opposite the gasworks and going nearly parallel to the Hobson's Bay Railway, sufficiently deep to admit ships of large draught, would there be any difficulty, in your opinion, in keeping such a canal open at the sea mouth ?—I think not, but it would have to be done by dredging.

227. Do you think there would be a considerable tendency to fill up from the effect of southerly gales ?—The silt and *débris* taken down the canal would necessarily form a bar at the mouth with the wind coming in.

228. But you think that would be easily removed, or kept open by dredging ?—Yes.

229. But dredging would be necessary ?—Yes.

230. Supposing the canal, instead of being made in the direction just mentioned, was made from the gasworks and turned round and debouched into the mouth of the river, would it be easier to keep that opening clear than the other opening ?—I do not think so.

231. You think the former would be much the most easy to keep open ?—I should think so. My reason for saying so is this, that it would not be subject to the same influences: though there is a tide in the River Yarra, there is always a stream running down.

232. Which assists to keep it clear ?—I think so.

233. Do you think the Yarra in ordinary circumstances would assist in scouring such a canal—either of the canals indicated ?—Yes.

234. In either case ?—I should say so.

235. Of course the Yarra would have to be turned into the canal first mentioned as if it came out in the second position ?—Yes.

236. Do you think the Yarra would assist in scouring either of them ?—I should think so; but I should think that answer would be better obtained from a civil engineer than from myself. But I should say it would be so. By collecting certain quantities of water, by proper means a scour could be got there; still a deposit would take place at the mouth of the canal from *débris* brought down.

237. Do you think there would be more difficulty in keeping the one clear than the other—more dredging, for instance, to keep the mouth of the Yarra clear or the canal ?—Would you let the Yarra run down the canal ?

238. In the one scheme it is proposed to run the canal back into the Yarra, and in the other straight into the Bay. Do you think it would be more difficult to keep the mouth of the Yarra clear with the canal running into it, or the mouth of the canal opening right into the Bay ?—If the course of the Yarra is to be changed, it would be easier to keep the mouth of the present river clear, looking at the fact of the training walls being finished there.

239. With the scour of the Yarra diverted into this short canal, would not the tendency of the prevailing winds be to carry the deposit to the bank where it accumulates now ?—I think the southerly winds would cause a bar being formed at the sea entrance—the sea breezes in summer blow directly in—from south-east to east-south-east.

240. Apparently the present tendency is to come up to the mouth of the Yarra, where there is a tremendous bank ?—According to that chart it is, but according to the chart I have just produced it is not so. If you bring a canal straight down to the Bay, the same facts will not be in existence as if you took the canal down to the mouth of the Yarra.

241. Do you think a direct canal could be kept open as easily as the mouth of the Yarra ?—I see no reason why it should not be as easy to keep open the one as the other.

242. Is it not a fact that both sides of the mouth of the Yarra are silting-up ?—More upon the south than upon the north side. You will see by the soundings that there is a slight decrease on the north.

243. Then it is only by the scour of the Yarra that the mouth is kept open ?—And the dredges. The scour of the Yarra will not keep the mouth of the river open without dredging.

244. With the short straight cut, would there not be more scour ?—Yes, only the deposit of silt and *débris* would take place further out. Mr. Wardell would give a very practical illustration of that in reference to the works going on at Belfast. There is a great scour in the River Moyne, from training walls being built; that has actually forced the bar out, and continues doing so as the training walls are built further out into the Bay, until it meets the prevailing winds; then the sand is brought round the end of the walls, where it is deposited upon the shore.

245. It would be the same in this instance, would it not ?—I think so. I lay it down as a principle that, wherever there is an entrance to a river, whatever way it is formed, there must necessarily be a bar, unless it is removed by great tidal influences.

246. The continuation of this wall up the river would tend to scour out the course and keep it clear ?—Yes, it would tend to scour the river; but that will not take away the deposit which comes down the river; that must be deposited somewhere in the Bay; the same quantity of deposit will come down whatever way you build a pier.

247. Then the whole of your experience tends to this point, that, whether the canal runs straight into the Bay or is turned into the mouth of the river, a bar will be formed at its entrance, and that the canal would be just as easily kept open ?—I think so.

248. If the upper part of the canal be built with piles instead of masonry, would the effect of the tide not carry it away ?—I think not.

249. Is it a fact that the silting-up is greater on the Williamstown side than on the Sandridge side ?—Yes.

250. Is it not from the dropping of the silt ?—The quantity that oozes out from the punts is a mere nothing; an alteration has taken place in the course of the river; that is from the piers being built. The current forms an eddy in that particular spot which causes a deposit to take place from its being a quieter water.

251. Do you know whether the silting-up of the mouth of the Yarra is mud or sand ?—I cannot say from personal observance; perhaps Mr. Birnie, the superintendent of the dredge, will be able to tell you exactly what the dredges bring up.

252. The prevalent winds here are southerly ?—In summer the prevalent winds are southerly, in winter northerly.

C. B. Payne, Esq., *continued*, 26th Sept. 1872.

253. But through the year they are southerly ?—Yes ; in summer time a great prevalence of southerly winds. I can forward you the statistical information about the winds.

254. With regard to the sandbanks west of the railway pier, where does that sand come from originally ?—The deposit upon the shore ?

255. Yes ; where do those banks come from originally ?—That I am sure I do not know ; it is a geological question that I can hardly answer with any confidence.

256. Did they come from the sea ?—I should say not, looking at the chart.

257. Where do they come from ?—I really could not say ; it is a question I am not prepared to answer.

258. Is not that sand sea sand ?—I believe so.

259. Do you know ?—I do not know.

260. How does it happen that three steamers and one ship have struck within the last three days between Stony Creek and the junction of the Saltwater River ?—I account for it by Raleigh's bar being silted up ; there is a deposit taking place there from the quantity of stuff brought down the river.

261. What does the silting of the Sandridge lagoon take place from ?—I imagine from the deposit being brought out of the lagoon, and the sea and southerly wind forcing the sand up there.

262. Is the mouth of the lagoon blocked up by mud or sand ?—Sand.

263. That is sea sand ?—Sand from the sea I imagine.

264. Would not the same thing block up the canal ?—No, I understand that the canal will be taken out into the deep water ; that there is a certain force of water running down the canal which would tend to keep the immediate entrance clear ; and, as I said before, any river falling into the sea must necessarily form a bar at its entrance—of course the area of the bar will be affected by the currents and winds.

265. That bar would be formed by the sea sand ?—That I cannot say ; there would be what sailors call a bar—I suppose a mixture of the two—the stuff brought down and a certain quantity of sand from the sea, or sea sand.

266. The present bar at the mouth of the Yarra is formed by what ?—I believe it is formed from deposits from the river entirely.

267. Does the sand which closes up the mouth of the lagoon go up and close the mouth of the river ?—I think Mr. Birnie will be able to tell you whether it is mud or sand. I only look to the fact that that enormous sewer, the River Yarra, bringing down all the *débris* from Melbourne, must deposit there.

268. You say there is an eddy to the right upon the Williamstown bank ?—I say there is an eddy that forms there from the training walls being built.

269. And anything in suspension would settle quicker in that eddy than elsewhere ?—Yes.

270. The bridge that they are agitating for at the present moment is over the Yarra, in a line with Clarendon and Spencer streets, what is your opinion as to the desirability of a bridge there with regard to the navigation of the Yarra ?—I certainly think it would interfere very much with the navigation, for the traffic that would be required to go across the direct road from one large locality, such as Emerald Hill to Melbourne, you would require a very large bridge, which could not be very easily worked so as to meet all the requirements of navigation. I know the one in my own native place, Weymouth, where there is a swing-bridge, and the amount of shipping there is comparatively nothing to what it is in the Yarra, it is considered a nuisance even there.

271. What will be the breadth of the river there when the new improvements are made ?—About 300 feet.

272. Would not the bridge cause the south bank of the river to suffer much more from flood than at present ?—The approaches to it would no doubt.

273. Do you understand exactly where this bridge is proposed to be ?—I understood from Mr. Patterson that it was to be in a direct line from Spencer street across.

274. Above the new dock ?—Yes.

275. Do many sailing vessels come up beyond that, or steamers, generally ?—Generally steamers, but all sailing vessels have to be taken above the spot to swing at the pool before they go down the river.

276. They are taken up under steam ?—Yes.

277. Do you think there would be any difficulty in passing craft if there was a 50-feet opening ?—The difficulty would be in opening the bridge in time to get vessels up ; and you would have to give notice and all that sort of delay, which tends to accidents, as I know.

278. Supposing that the bridge was opened by hydraulic pressure, in a very short time ?—It is a question of convenience and inconvenience where there is a large traffic, as there is there. It has to be borne in mind that, of the trade that comes into this port, two-thirds of it comes up the Yarra ; but Captain Fullarton can give you better information upon this matter.

The witness withdrew.

Robert Fullarton, Esq., examined.

R. Fullarton, Esq., 26th Sept. 1872.

279. You are familiar with the River Yarra ?—Yes.

280. And with Hobson's Bay, and its depth of water, and the character of its bottom ?—Yes.

281. How long have you been employed in connection with the Yarra and Hobson's Bay ?—Over twenty years.

282. Have you paid much attention to the prevailing winds and their effect upon the depth of water in the Bay ?—I have.

283. Does a southerly gale force much sand into the head of the Bay ?—Not very much.

284. Has the depth of the water in the head of the Bay been lessened very much by sand within your experience ?—Not by sand.

285. What by then ?—By silting from the river.

286. Could it be by sand blown off the land in northerly gales ?—A foreshore may have formed in that way along the Sandridge beach ; but I do not think any permanent shoaling of the Bay has been

caused by that, with the exception of the St. Kilda shoal; that I think has been formed by sand that has come from the sea.

287. What wind would have produced that?—Strong southerly and south-south-east winds.

288. But on the beach, between the railway pier and the mouth of the Yarra, you say that there has been no great diminution in the depth for the last twenty years?—Not caused by the sand being washed up by southerly gales, but it has shoaled in that locality by the silt from the Yarra within the last sixteen years, especially since the new mouth was opened to the Yarra.

289. Have any borings been taken to ascertain the character of the stratum there?—I believe the whole of the narrow neck from the gasworks to the Bay has been bored, but I cannot tax my memory to say what they were.

290. That would be in a straight line from the gasworks to the sea?—Yes, about half a mile to the westward of the present Hobson's Bay Railway pier.

291. Where does the silt that is brought down by the Yarra principally deposit itself?—On the west or Williamstown side principally, but it is gradually spreading towards the Sandridge railway pier also.

292. Suppose it was decided to construct a ship canal, commencing nearly opposite the gasworks, from the Yarra nearly parallel to the Hobson's Bay Railway, and of sufficient depth to admit ships of large draught, would there be any difficulty, in your opinion, in keeping such a canal open at the sea mouth?—I think not, especially if the outer retaining walls or piers were made of open pile work, the same as the Sandridge railway pier; for the same cause that would tend to silt up a canal would have silted up the pier.

293. Has the depth of water at the end of the railway pier diminished?—It has in a slight degree, compared with other parts of the Bay.

294. Suppose the canal, instead of being made as described, were made to debouch inside the mouth of the river, would it be more easy to keep it open than in the other case?—I think not, and it would be a great deal longer; therefore I think it would not be advisable to have it there at all.

295. Would there not be an awkward turn to get a large ship into it, if the mouth were within the mouth of the river?—I think so; the same eddy that exists now and causes the silt deposit would still exist, and it would be difficult to get a large ship round the elbow.

296. Would it not be a very awkward thing to turn a large ship to get into the fairway of the canal?—Yes, it is awkward now to get up with steamers of moderate size, and it would be much worse with larger and longer ships.

297. Do you think the Yarra, under ordinary circumstances, in either case would assist in scouring such a canal?—I think it would; but I have an idea that the Yarra should be allowed to take away the greatest part of the silt that comes down the river in floods, and a weir should be placed across the mouth of the canal at the gasworks, so that the canal should only be sluiced when there was no great amount of silt in the river; by that means the silt would go down the river, and deposit as in bygone years.

298. You mean that the canal would be filled with dead water?—With the exception of when there were heavy floods—I would expect when there were such heavy floods that the low-lying lands were in danger of being submerged that then the weir should be opened. I mean that the ordinary sewerage of the city should be taken away by the Yarra as now, but as little as possible of either sewerage or silt should be allowed to go through the canal.

299. That is, the ships would lie in this canal in dead water?—Yes.

300. There would be no stream in it?—No, except what the tide would make—2 or 3 feet of ebb and flow every day.

301. The sand has not accumulated much at the end of the railway pier?—Not very much; there is about 2 feet less water in the last sixteen years; but it is silt I think. I do not put much faith in the different soundings taken, because one was taken by a marine surveyor with a lead, who was not very particular, and the other was taken by an upright pole marked to inches, and therefore is much more correct.

302. You know the remains of an old hulk just west from the Sandridge pier?—There is a boiler of an old steamer there.

303. Has not that shoaled very much?—A foreshore has formed round it; the sand has gradually been blown from the shore, but the water has not actually shoaled out from the pier.

304. Has not the water shoaled round the thing itself?—Yes, it has.

305. From the land?—Yes.

306. The Sandridge lagoon is silted up by the sand?—Yes; that is a different matter. All the foreshore outside the Sandridge lagoon is a large sandbank extending to Brighton. During the flood of 1863 the lagoon was washed out by the flood, and 16 feet water was in the lagoon, and for 600 or 700 fathoms outside of it; in a year, or less, the whole of that sand went back into the lagoon, and you could walk across it at low water.

307. Would not the same cause silt up the canal?—I think not; there is not the same cause to effect it; there is not a large sandbank outside as there is at the lagoon; you have a bottom of blue clay and mud in the proposed position of the mouth of the canal.

308. And is not the lagoon much more exposed?—Yes, much more, as the mouth of the canal would be under the lee of Williamstown.

309. Is not the place where the hulks are anchored sand?—No, it is very stiff blue clay bottom. If an anchor is let go there you can hardly get it up after two months.

310. Would not that point out that the sand would not silt up very rapidly if the canal were constructed?—I do not think the sand is there to do it; it is silt upon the top and stiff blue clay underneath—splendid holding ground—the best in the world.

311. Is it your opinion that the mouth of the canal would be as easily kept open as the present mouth of the river?—I think it would be more easily; there would be less dredging and less injury to the Bay.

312. You would not recommend the closing up of the Yarra?—No, I would not.

313. Do you know anything of the difference in level between the water at the gasworks and the water of Hobson's Bay?—Not of my own knowledge; but I have heard it has a fall of about 4 inches.

R. Fullarton, Esq., *continued*, 26th Sept. 1872.

314. That is, the level of the Yarra opposite the gasworks is 4 inches higher than the water in the Bay?—I have heard so; but Mr. Mosely, of the Public Works department, who took the levels, would be able to give you the information.

315. Did Mr. Mosely do the sounding with the rod?—Yes, he did.

The witness withdrew.

William Elsdon, Esq., examined.

W. Elsdon, Esq., 26th Sept. 1872.

316. What is the nature of the bottom upon which your railway is constructed?—I may tell the Commission at first that I have given little or no attention to this matter at all. I will give you all the information I can, but it is very little. The nature of the bottom is silt, at least 20 feet deep.

317. Is that mud?—A mud deposit.

318. Is it stiff blue mud?—No; about 20 feet of what we call silt; a light deposit.

319. Has the depth of water materially diminished at the outer end of your railway pier since it was first constructed?—No; I think it is about 4 inches.

320. In how long a time?—In eighteen years.

321. It has not varied 4 inches?—Not to my knowledge.

322. According to this chart it is 3 inches more now than it was in 1864?—That wholly depends upon the persons who took the soundings; if you have two different parties, the chances are they do not agree.

323. Do you think there would be any difficulty in keeping the mouth of a canal open through the sandy flat to the west of your railway from the gasworks into Hobson's Bay?—I am afraid that, if you carry any sort of banks out to procure depth, it will silt up.

324. Suppose it was done by piling the same as your railway pier is?—They would have no effect, for the simple reason, piling would be of no service to you.

325. You must have solid work to form a bank?—No. I say if you carry solid work out to get into deep water the set of the tide would silt it up irrespective of winds.

326. Could it be kept open by dredging?—It could be done, but I could not say at what expense. I may explain that our pier is rather peculiarly situated; it is sheltered in reality by the mouth of the Yarra; that is, the stream of the Yarra carries across the end of the Williamstown pier going right past the end of ours, so that we lie in a sort of basin.

327. You have put in several foundations and so on at the station at Sandridge, what sort of a bottom do you get there?—Are you speaking of the Sandridge station?

328. Any of the buildings?—All sand.

329. Nothing but sand?—Nothing but sand.

330. How deep did you go with the foundations?—I think about 9 or 10 feet deep. I may say you will get the borings in the Chamber of Commerce; they were taken by Mr. Christie, and I think he fell in with a quicksand about 18 inches or 2 feet in thickness.

The witness withdrew.

Adjourned to Thursday next, at Three o'clock.

THURSDAY, 3RD OCTOBER 1872.

Present:

O. FENWICK, Esq., in the chair;

T. McPherson, Esq.,
S. Ramsden, Esq.,
D. Clark, Esq.,
T. J. Sturt, Esq., M.D.,
S. P. Lord, Esq.,
G. Gordon, Esq.,
J. Patterson, Esq., M.P.,
W. McCrea, Esq., M.B.,
W. H. Cutts, Esq., M.D.,
James Lorimer, Esq.,
Capt. Kay, R.N.,
J. McIlwraith, Esq.,
J. Reid, Esq.

Captain Hugh MacMeikan examined.

Captain H. MacMeekan, 3rd Oct. 1872.

331. You have been a long time engaged in the steam trade of Melbourne?—Yes, since 1853.

332. In 1860 you gave an opinion, addressed to the Secretary of the Harbor Improvement Commission of that time, expressing your view that a canal would be the best way of connecting Hobson's Bay with the proposed docks: are you still of the same opinion?—Yes.

333. Will you state your reasons for preferring a canal to the present bed of the Yarra?—To begin with, a canal would be much easier kept than the river, and when once it is made there are only 1½ miles to dredge instead of 8 miles, if dredging should be required.

334. Do you think, from your experience of such works, that there would be any difficulty in keeping the mouth of the canal open?—No, I do not.

335. Where do you think would be the best outlet?—Somewhere about the bathing-houses.

336. What width would you propose such a canal should be?—Not less than 500 feet, so that vessels could lie at either side, and turn and swing either way.

337. And what depth?—As deep as the Bay, so that any vessel that comes up the Bay can come up the canal.

338. Twenty-four or 25 feet you mean?—Yes.

339. If the present wharves were continued along the south bank to the Bay, would it be practicable for ships to lie there and discharge all the way along?—Quite.

340. And they would be sufficiently protected in all weathers ?—I think that there could be no danger.

341. Would they be better protected than they are now at the railway pier ?—Much.

342. Can you give us your opinion of the value of the land fronting such a wharf if made ?—£150 a foot I should say along that wharf; I should say it would be quite as valuable as Collins street.

343. That is £270 a foot ?—Yes.

344. For what purposes ?—Warehouses and places of that kind.

345. What scheme would you suggest for providing dock accommodation if you had a canal of that kind ?—[*A plan was produced and examined.*] I approve of this outlet, and here I would make docks—[*referring to the plan*].

346. Would you propose to make docks here from the north bank, what is now known as the West Melbourne swamp ?—Docks would run up to the present railway reserve.

347. In one word, from the railway reserve to a little below the gasworks ?—Yes.

348. You think that, by a well considered plan, there would be sufficient accommodation for all the coasting vessels ?—Yes, but I would still keep the river for them ; there is a deal of room here—[*pointing to the plan*].

349. Can you tell us if in any other ports special accommodation is afforded to steam companies, such as MacMeckan, Blackwood, and Co.'s, and the Australian Steam Navigation Company ?—Yes.

350. If such accommodation were afforded, would it be of much value to the companies ?—Not only to them but to the public too—everybody would know where their goods were put, and where they were to be taken from when a vessel arrived. I have not gone into the question of what the value would be.

351. It is impossible to do that at present ?—No, you never know where your berth is to be—there are continual shiftings.

352. And you are put to great inconvenience in consequence of those shiftings ?—Yes, and expense too.

353. What time would be saved by such a canal as a ship canal instead of coming into the river as now ?—Steamers would come right up, and sailing vessels too could go into their berths at once, whereas now they very often have to lose a day, and lighten sometimes ; that causes expense. I should say, for a steamer, such as one of MacMeckan and Blackwood's boats, very often it causes £50 a day loss.

354. And with a canal they could come up at all hours ?—Yes.

355. Would there be any other saving ?—The saving of pilotages ; but there is more than that : there is the saving of roads, there is the cartage, breakage, and damage to goods by being so often handled, and everything of that sort, to be considered.

356. Do you think it would be practicable to deepen and widen the Yarra to accomplish those advantages without a canal ?—It is practicable, but at an enormous expense, the distance is so much greater.

357. Would there be silting-up between the Sandridge railway pier and the mouth of the Yarra ?—I think not on that shore ; anything here is blown from the land—it is not silting-up, it comes down the river.

358. How do you account for the silting-up of the Sandridge lagoon ?—The sand blowing into it ; there is a large bank off St. Kilda ; a southerly wind drives the sand up, and it is blown along the beach.

359. It is sea-sand ?—Sea-sand.

360. The mouth of the canal would not be liable to that ?—Of course there would be sand blown in there, but not so much.

361. You would have to deepen the mouth of the canal ?—You would have to bring it out to the depth of the Bay.

362. Where the mouth of the canal emerges, would not the sand have a tendency to go in that way ?—Yes, with a strong wind.

363. But not as much as formerly ?—No.

364. But to that extent it would be filled up ?—No doubt in time it would be filled up ; but you must dredge ; but then you would have only 1½ miles instead of 8 miles to dredge.

365. Another plan has been proposed just opposite where your place is ?—I do not think there would be any advantage in that.

366. Would there be any silting-up there ?—The deposit of the river would come down ; you would still have all this to deepen—[*pointing to the plan*]—besides the canal to keep to its depth.

367. Do you propose to do away with the river ?—No, you might still keep the same depth you have now.

368. You would have to dredge for that purpose ?—Now and again you would.

369. You say distinctly you think the canal would not silt up there [*pointing to the plan*]—but would it on the other side ?—That is much more likely ; you see that by the soundings of the Bay.

370. That is on the other side of the railway and town piers of Sandridge ?—It is much more apt to silt up there.

371. Would the canal from the gasworks have a tendency to make the water below shallow ?—I do not think so, the sea level and the level of the river is so little difference.

372. Do you consider it would be a great national advantage to have this canal ?—I do.

373. Would there be a necessity for flood-gates at either end of the canal ?—No, they are not required.

374. Would not the current coming from the Yarra tend to prevent the mouth of the canal from silting-up ?—It would tend to scour it a little, but there would not be much current with the width of 500 feet.

375. If this canal were made 500 feet wide, what necessity would there be for docks on the north side of the Yarra ?—The port of Melbourne will require it some time hence, and in the mean time you would excavate here—[*pointing to the plan*]—and utilize this land.

376. That is with a view of utilizing the land, and utilizing the land in the swamp ?—It would be very valuable land.

377. Do you include taking walls out to the Bay ?—There would have to be a wall such as is here—[*pointing to the plan*]—it would not require a very great amount of wall ; an entrance, or piers at the entrance, would be required ; but in fact you might, for taking vessels up there, drag them up with a horse for that matter.

378. But if you built a wall there, would there not be much more chance of silting-up than by having piers ?—No, a pier and a wall would be the same thing.

Captain H. MacMeikan, *continued*, 3rd Oct. 1872.

379. You would not require the whole to be 500 feet wide all along; a comparatively narrow channel would do from the Bay to the entrance to the canal?—Yes, but sufficient width here is required for swinging a large ship round.

380. But at the outlet?—At the outlet you could have it narrow, with just sufficient room to enable vessels to enter.

381. Would it not be equally good, instead of having 500 feet wide all the way up, to have a series of basins connected in parts?—If you did not want to utilize this land by the stuff taken out that might be so, but then it would cause more labor in moving vessels.

382. Would not the 500 feet be wanted if you are to carry the floods all through?—Five hundred feet would make it pretty certain that you would not be troubled with much flood.

383. But if you contracted the width at the mouth, how then?—If you contracted it at the mouth, it would tend to stop the flood water; I think it would be better to carry it out the whole width.

384. The 500 feet width right out into the Bay?—Yes; I have said 500 feet, because vessels now are pretty long.

385. What length would a vessel be of 1500 or 1600 tons burden?—She would take 300 feet to swing.

386. You think it would answer as a flood channel as well?—Yes; of course I mean, that is, if the upper part of the Yarra, below bridge, is widened (the same as they are carrying on now), and the reefs at Prince's bridge and the falls are removed, it is bringing that wharf further on; in fact carrying it to Sandridge from the left bank going down. There should be also a small canal cut from Flemington bridge to the Lower Yarra or Saltwater River, as I consider that during floods there is as much water comes down Saltwater River and Moonee Ponds Creek as comes down the Yarra. This would escape by the small canal, and the Lower Yarra, instead of inundating all the low-lying lands as it does now, helping to dam back the flood waters of the Yarra. The ship canal would then be certain to take off all the flood waters of the Upper Yarra.

The witness withdrew.

Henry Moseley, Esq., examined.

H. Moseley, Esq., 3rd Oct. 1872.

387. You are a civil engineer?—I am.

388. In the employ of the Government?—Yes, in the Public Works department.

389. You have been of late years engaged in surveying and taking soundings and levels of the Bay and the river?—Yes.

390. How long have you been engaged in this work?—At various times since 1857; about fifteen years.

391. Have you taken soundings about the mouth of the proposed canal at either end?—Yes, I do it every two years.

392. Have you taken soundings all along the river and all along the Bay?—From Williamstown to the falls and from the falls to the bend between Prince's bridge and the Botanical Gardens.

393. Have you plans showing those surveys?—Yes.

394. Would you be willing to lay them before the Commission?—Yes; the plan I now produce shows the soundings.

395. There are three different soundings?—Yes.

396. Will you state the dates of each sounding?—The soundings marked red were taken from the 14th January to the 11th March 1867; the soundings marked blue were taken between the 26th February and the 19th April 1869; the soundings marked brown were taken between the 21st February and the May 1871.

397. As a rule, the brown soundings are the shallower soundings?—Yes.

398. In what part of the Bay is the silting-up, according to each observation, shown?—I will mark it in pencil; that—[*marking the plan*]—is where the Bay is silting-up as now shown on this chart.

399. Will you point out on your chart the mouth of the proposed canal, or near it?—Somewhere near the railway.

400. Will you inform the Commission whether during the last ten years there has been any silting-up in the Bay or in the river; will you show what the level is now, or what is the depth of water now as compared with eight or ten years ago?—There is a little knoll near the baths.—[*The witness described this on the chart.*]

401. But as to the general character of it?—In every other place on this sand-bank it is deepened.

402. How is it at the end of the railway pier?—About the same, as near as possible.

403. It appears to be rather deeper; it was 20 feet 8 inches, now it is 20 feet 11 inches?—Yes.

404. So that, in your opinion, there is no action of the tide or the winds which has caused a silting-up about the mouth of the proposed canal?—No.

405. Have you a chart showing the borings?—No. I have a plan showing the levels.

406. What is the level of the river as compared with the level of the Bay at the proposed ends, and what in the Yarra?—You mean the Lower Yarra of course, not the Yarra above the falls?

407. At the ends of the proposed canal—the two points. What is the level of the river there compared with the level of the Bay?—The difference of level is nothing; it is a mere mill-pond. I have made it 2½ inches, and I have made it nothing. We are going shortly to ascertain the exact level from the different tide gauges which are to be erected on the river bank.

408. You consider the level of the Bay and the level of the river at low water is the same?—At the turn of the ebb; but the tide at Williamstown is two hours earlier than the tide at Melbourne.

409. What, in your opinion, is the cause of the silting-up in the places indicated?—It is, in my opinion, from the opening up of the agricultural districts on the watersheds of the Yarra and the Saltwater River; in times of flood of course it would bring it down in larger quantities than when the land was in its primitive state, and meeting the saltwater near its mouth it would deposit itself.

410. What is the nature of that silting; is it mud or sand?—It is from the banks of the river and from the opening up of the agricultural districts, and the diggings on the watersheds, that comes down in the times of flood.

411. Then you think the silting is caused by the material brought down rather than by any action of the waves—that is, of the water or the winds?—No doubt of it.

412. It is deposit, not silting?—Yes.

413. What, in your opinion, would be the effect of a canal, in regard to the silting at the Bay mouth of the canal ?—It would be precisely the same as at the mouth of the present river.

414. Am I to understand from you that you think that there would be the same amount of silting or deposit at the Bay end of the canal as of the river ?—Not quite so much, because it would have the assistance of the Yarra and the Saltwater River to take a portion of it down.

415. Then the canal would take down a proportion of the deposit which the river now takes down ?—Yes.

416. It would be divided between the mouth of the river and the mouth of the canal ?—Yes.

417. Do you think that that amount of deposit at the mouth of the proposed canal would be such that it would not be easily removed—that it would cause much more expense in keeping it clear ?—You would have, very likely, to use a dredge occasionally, but not always.

418. You do not think the expense would be large in keeping the mouth of the canal clear, notwithstanding any deposit ?—No doubt it would be a considerable expense.

419. Not more than keeping the mouth of the Yarra clear now ?—No.

420. In a space of seven or eight miles must not there be a greater amount of deposit than in a short cut of a mile and three quarters, and must not, therefore, the expense of the dredging be considerably less in the latter case ?—No, the silt comes down on the top water of the Yarra, and when it comes to the saltwater it deposits.

421. You think the silting would be about the same ?—Yes.

422. What effect would a canal have in carrying away the flood water in time of a flood ?—Having a greater water-way, it would carry a considerably greater amount of water away; but I do not think it would be any great advantage in time of flood, with the reef across the Prince's bridge and the falls, which would remain a great barrier.

423. Am I to understand you to say that that reef and those falls are the great cause of the flooding ?—Certainly.

424. Do you think that is the material or principal cause of the floods, the backwater ?—I am almost sure if the falls were removed we would rarely or ever have big floods.

425. You have spoken of a reef at Prince's bridge ?—Yes.

426. Is that a fact ?—Yes, I will show it you on the plan.—[*Sections were produced and explained.*]

427. When were those soundings taken ?—Immediately after the floods; I took the flood lines during the time of the flood; I marked trees all up and down the river.

428. And this chart is the result ?—Yes, this is a section showing that. That is Prince's bridge, as drawn, and that is the reef shown—[*pointing them out on the chart*]. This is the falls reef; if that were taken off a little lower, that would make a difference. That was raised in order to keep the freshwater back for Melbourne.

429. Supposing that these were removed ?—In the course of time Prince's bridge will have to be removed, and it ought to be widened a little bit there. On either side of the reef, at the falls, there is a depth averaging 25 feet.

430. Do the falls extend right across the river ?—Yes.

431. If this reef were removed, and if there is not an absolute necessity for removing the other, do you think, then, a canal would assist largely in carrying off the flood water ?—Certainly it would; that would have the desired effect. In my opinion the chances are that, in times of flood, it might clear your entrance. It would certainly lower the Upper Yarra water but that is nothing, because the Yarra is deep enough.

432. Have you taken the levels of the land between the river and the Bay ?—Yes.

433. Have you got a plan showing them ?—Yes—[*plan produced and explained*]—I have the levels dotted all over here, so that any information required could be got from our department at a moment's notice.

434. Have you taken borings sufficiently to be enabled to indicate at what depth we could get good clay foundations ?—We had borings taken along the Yarra for the purpose of the new wharves, but not across the bend. Borings across the bend have not been taken by the Public Works department.

435. Can you tell what amount of lowering the level of the Upper Yarra would occur if this lower reef were reduced or taken away—that is, looking at the water above Prince's bridge, to what extent would the Yarra be lowered ?—About 2 feet 6 inches.

436. With regard to the opening of the mouth of the canal, would it make any difference with regard to the silting-up ?—I do not exactly understand the question.

437. If the mouth of the canal faced that way, or that way—[*pointing to the map*]—or were straight out ?—My opinion is that it would be far better to have it turned, as the Yarra is. The prevailing south-west winds would have less power.

438. Facing round towards the railway pier ?—Yes.

439. Does not Williamstown afford a great deal of shelter from the south-west winds blowing on that shore ?—Yes.

440. You said that you did not think the proposed canal would make much difference to the level of the river here—[*pointing to the map*]. Have you calculated the quantity of water that the river would take during extreme floods ?—You are speaking of the Yarra; that could not alter the level.

441. Have you ascertained that this portion of the river—[*pointing to the map*]—at present as it is, is sufficient to carry off all the flood water ?—I believe it would be sufficient if the falls were lowered.

442. As it is ?—As it is. No doubt the new channel would be of great advantage.

443. Were you aware of this reef before ?—Yes.

444. What I wish to bring before you is this—if this river is to be very much flooded, in order to carry off a large flood, it must be raised very much more than it is at present—it must be many feet higher than it is at present, because the water comes all over the banks here—[*pointing to the map*]. If this river were very much bigger—in fact if you had the sea higher up, the water would lower itself much more rapidly from this point than it does now ?—Yes.

445. You misunderstood the question ?—I did at first.

446. That proposed new canal would be less liable to silt up than the present mouth of the river, would it not ?—I think, if the falls were taken out, that would be so; but if they are left, it would silt up as it does now.

H. Moseley, Esq., *continued*, 3rd Oct. 1872.

447. You do not understand the question. Would not the wind blowing from the south-west be less likely to block up the mouth of the canal than it would of the river ?—I think not.

448. I understood you to say, in answer to a question put to you, that you did not think that the construction of the new canal would materially lower the level of the river at the upper end of the canal. I thought you misunderstood the question, because it is clear and must be so, according to you when you surveyed it, that this river must be very much higher in a big flood than at the present time; consequently, if this river was very much wider than it is at present, the height it would have to be raised to carry off the flood water would be much greater, and consequently, if you have an additional outlet, that must help to lower the water ?—Yes, that is so.

449. Do you not think this outlet, if the Yarra were turned into it, would have a deposit of the silt that is brought down by the River Yarra, as is the case with all other rivers, which would form a bank at the outlet, whereas the silt would not be deposited here if this canal were made—[*pointing to the plan*] ?—The whole of the watershed of the Yarra would be deposited here, but there would be a large deposit from the Saltwater River, here—[*pointing to the plan*].

450. Your opinion is that there would be a deposit from the Yarra on the Williamstown side, as there is from the Yarra on that side ?—I think it would enter this sort of horse-shoe bend here—[*pointing to the plan*].

451. In the entrances to most harbors you have parallel piers running out into the sea, and there is a bar at the front ?—Yes.

452. Is it not assumed, or rather proved, as a rule, by common experience, that if you make an entrance to a harbor in very heavy gales you get a greater bar than at other times ?—Yes.

453. Do you think in this instance that that would have to be kept clear by dredging ?—I think it would.

454. Do you think the mud that has been dredged out here—[*pointing to the map*]—and carried round to this south side of the point, any of it has been brought back again ?—Very little, if any.

455. Is not it a fact that it is growing up here and here—[*pointing to the map*]—is not that the natural consequence of confining the deep water to a narrow channel ?—Yes, to some extent.

456. Is not it always the case if you dredge a channel and confine the current, by dredging the channel, to a narrow space, that the bottom on each side rises ?—Yes.

457. Do you think that carrying two piers out into deep water would, in course of time, extend the shoal on the south side ?—It would have that effect no doubt.

The witness withdrew.

The Honorable Thomas Loader examined.

Hon. T. Loader, 3rd Oct. 1872.

458. You are an old resident of the western part of Melbourne ?—I am ; I have been there over twenty years.

459. And you have represented West Melbourne in Parliament ?—I have had that honor.

460. I want to ask you a few general questions ; and first, what would be the commercial and practical effect of a canal from Melbourne to the Bay, at the shortest point ?—It would have the effect of bringing the Bay very much nearer to Melbourne, which would be a great convenience for all shipping business, and I think it would be a highly desirable proceeding.

461. Is there anything more than convenience that would be desirable ; would it be a saving of expense in the transport of goods, for instance ?—I inferred that the word "convenience," in the sense that I used it, would carry that with it. I think a ship canal would carry away the flood waters to a very great extent, and reclaim a great quantity of low land that is now comparatively valueless on both banks.

462. Do you know what extent of low lands there is between the river and the Bay ?—With reference to one portion of the low land, commonly called Batman's swamp, I think a great deal might be done of an important character in the way of improving that; the area is estimated to be about 800 acres.

463. By a resolution of the Commission, I think we must confine ourselves to the canal question, so that we cannot go on the north side of the Yarra, because that would involve the question of docks rather than a canal ; the question I intended to ask you was if you knew the quantity of land there was between the river and the Bay ?—I do not.

464. Have you any idea ?—A considerable quantity, over 2000 acres, but I have no exact idea about what the quantity is ; the evidence that I could offer to the Commission that might be of any value would be as to the site of Batman's swamp, in regard to the way that could be reclaimed and made profitable. As to the question of a ship canal, I only feel myself competent to give evidence to the fact that it would be of great commercial advantage.

465. Would it increase, or otherwise, the value of the land on each side of the canal ?—Increase it, unquestionably ; the land is valueless now, and would be valuable if it had a canal frontage.

466. Assuming a canal a mile and a half long, what would you consider the increased value of the land to be ?—That would depend entirely upon circumstances ; no doubt it would be increased.

467. What would the enhanced value of the land be caused by ?—A larger population would enhance the value of the land ; if you have only a sparse population, and measures be adopted to repress immigration to this colony, the value of the land will not increase in proportion to the cost of the proposed ship canal and other improvements ; but if measures to encourage and facilitate immigration be adopted, or if Melbourne be made a free port, then the value of the reclaimed lands on the banks of the ship canal might be estimated by millions of pounds.

468. What would the land probably be used for on each side of the canal ; would it be for warehouses and other things of that kind ?—It might be used for various purposes appertaining to the extension of the city ; possibly a railway might run down there, or a roadway might be made, and so forth ; the frontage might also be used for manufacturing purposes, and for timber wharves, and establishments requiring water frontages ; but as the ship canal would be essentially a river, it would not be also available as an ordinary canal unless it were made very wide ; indeed it would be inconvenient for ocean ships loading and unloading along the banks of the canal if it were to be only a free passage leading up to an inner harbor or pool and docks.

469. Would not it be a strong inducement for merchants having business relations with China or Calcutta, or any other part of the world, to bring their vessels alongside and discharge right into the warehouses ?—Yes ; but to enable this to be done, and also to secure a good navigable channel at all times, I think the canal should be 500 feet wide.

470. Would not the value of the land be very much enhanced for those purposes ?—Yes, it would.

471. In your opinion, would the increased value of the land pay for the expense of the canal, the land on either side being made available for business purposes ?—If we had a very much larger population here, I have no doubt the value of the land would greatly increase, and pay the cost of making a canal ; but, with the present population, I imagine there would have to be a public credit used to enable that canal to be cut ; at the same time we may remember that the larger the canal is made the greater will be the area of valuable land reclaimed by the excavations available for filling up.

472. What is your idea of the revenue to be derived from this canal ; could it be got from the tonnage from vessels coming up, or how would the Commission, supposing there were one, be repaid their outlay. How would you propose this to be a reproductive work ; or would it, in your opinion, be a reproductive work at all ?—I think it is part of a larger scheme ; the Commission fetter my opinions by making it a question of canal only. If I could enlarge upon other schemes of the same nature, I could put forward the measures that would, in my opinion, enable the Commission to make this a self-supporting work.

473. Supposing we had docks, what would be the advantage or disadvantage ; taking the larger question into consideration of canal and docks, what would be the advantage or disadvantage ?—Supposing docks were excavated below the gasworks, in the West Melbourne swamp, north or south of the river, and the matter excavated deposited on the banks and spread over a considerable area there, that land would be reclaimed, and the large shipping coming to the port would be brought up a ship canal close to the warehouses described to be erected on this site, and that would give great facilities to the trade and commerce of the port, and many incidental benefits facilitating our commerce would arise ; and the river Yarra would become available as an ordinary canal.

474. Would you state, for the benefit of the Commission, your entire scheme ?—If the Commission permit me, I will do so. The area of Batman's swamp may be estimated at about 800 acres of land, which is now practically valueless and useless. I think that the water and the land might be separated by excavations being made, which would divide the water from the land. Thus I think that 150 acres of water might be retained and gathered together in the shape of canals and docks ; 50 acres might be used for roads and streets ; 100 acres might be left as a margin for incidental or unforeseen requirements ; and then we should have 500 acres of land reclaimed. The excavations being fifteen feet deep would enable the 500 acres to be raised a height of four and a half feet, or if eighteen feet deep about five and a half feet high, or they might be made more if desirable. I believe that canals might connect the Saltwater River with the River Yarra or the new ship canal that may be made ; and then the area known as Batman's swamp would cease to be so known, but would become an important division of the city. It would be necessary to construct bridges from Bourke street westerly, from Lonsdale street westerly, and from La Trobe street westerly, over the Victorian Railways, into that area known now as Batman's swamp, so that the streets running from east to west would be produced and carried into the new territory which would thus be reclaimed for the city. The frontages to those streets would be valuable, and bear comparative values to the frontages on the other side of the Victorian Railways in the same street. For instance, at the end of Bourke street west or Lonsdale street west or La Trobe street west the land may be valued at £10 or £20 a foot. I am of opinion that, if the bridges I have suggested were erected, the frontages in the same streets west of the railway would bear relative proportions to the frontages in the same street east of the railway. The 500 acres, divided according to the Government plan of subdivision, would give frontages of 132,000 feet to streets which would be of corresponding width to the streets of the city now. Taking that land at £1 per foot, or £264 per acre, a sum of £132,000 would be produced ; but I am of opinion that the land would be worth a great deal more than £1 per foot ; very much of it would be worth £10 per foot, or £2,640 per acre ; and as this work would be a gradual one, probably before the greater portion of it could be brought into the market it might all be sold at that rate as a minimum, which would produce a sum of £1,320,000 ; but if we simply reckon the half of that, it would still give the very large amount of £660,000 which would be extracted from that swamp, and the land be raised four and a half or five and a half feet ; the 150 acres of water being made then fifteen or eighteen feet in depth. I have heard many schemes for reclaiming that swamp, but I do not know that I have heard any one that appears to be more feasible than this one ; and if a portion of it were undertaken near to the Footscray road, by the cutting of a canal across from river to river, the excavations from the canal being placed upon the land, a valuable frontage both to the river and the roadway would be at once at the disposal of the Government, and the whole work might be conducted by a trust, having authority from the Government, with power to raise money upon debentures, and the money produced could be used in cutting a ship canal, either by free labor or prison labor. And in this manner I think the whole work would be a reproductive one. For by commencing the undertaking upon a public credit granted to a trust having power to collect a toll, and established to make a river canal to reclaim the swamp lands and to carry off the storm waters of the rivers, a loan might first be put upon the local market, in the form of debentures guaranteed by Government. The money thus raised might be expended on the works ; and when a divisional section was reclaimed, the streets being formed and the canals made, the land could be either sold or leased by the trust, and the money be used for the prosecution of the work ; and in this way progressively I believe the whole work would become a reproductive one.

475. Have you made any comparative estimate of the cost of excavating the 150 acres, so as to raise the land with the draining of the land ?—The excavation would of itself drain the land.

476. It would raise the level of the other portions you mean ?—Yes.

477. Have you made any estimate of what it would cost. I have made out, very roughly, that it would cost £400,000 ?—And if it did, it would produce over a million of money.

478. That is simply the excavation, without forming roads or quay walls, or anything of that kind ; just the digging out ?—I imagined it would cost more than that ; I thought it would very likely cost three-quarters of a million of money.

479. Have you compared that cost with what it would cost to drain the land in the ordinary way ?—I imagine that Batman's swamp could hardly be drained except by the land being raised, the level is so low.

Hon. T. Loader, *continued*, 3rd Oct. 1872.

480. It is very little below the highest flood line; it could not be drained without pumping?—That would involve erecting a dyke along the banks of the Saltwater River and along the River Yarra, so that when the water was once pumped out it could be kept out.

481. Have you compared the cost of that?—I have not; I think that scheme not a desirable one.

482. It is only the value of the land in Batman's swamp you allude to?—Just so; but the land south of the river may be similarly treated.

483. Do you think raising of four and a half feet would be sufficient?—Barely sufficient, with the circumstances which I believe would occur when the ship canal was constructed. I believe the greatest height of the flood there is seven feet above high-water mark; and I apprehend when the river is cleared, or a ship canal made, and arrangements made to carry off the storm-water, the floods will scarcely ever rise to that height again; therefore I think that four and a half or five and a half feet would be absolutely necessary; but I am also of opinion that a greater height is highly desirable.

The witness withdrew.

Captain W. H. Smith examined.

Captain W. H. Smith, 3rd Oct. 1872.

484. You are extensively engaged in the intercolonial steam trade?—Yes.

485. In 1860 you gave a strong recommendation in favor of a ship canal, as being the proper mode of improving the harbor accommodation; are you of the same opinion now?—I am.

486. Have you ascertained from experience that the present channel is a very objectionable one?—From my experience and cost.

487. What experience of cost do you refer to?—Damage by collision.

488. Do you think that there is any other way of avoiding the expense arising from the cost of collision and otherwise except by making a canal?—I think a canal would be the most effective.

489. In fact that it would be the only satisfactory channel for an extensive shipping trade?—Just so.

490. Can you give us any evidence as to the probable value of land if a canal and wharves were made extending the present wharf to Hobson's Bay?—I could not; but it would be very valuable, as all waterside premises are where there is much commerce.

491. Would it be worth your while to pay a shilling per ton, or any considerable sum, for the sole use of a wharf?—Yes.

492. Such things are done in other parts of the world?—They are in the colonies.

493. Then water frontages would have a special value for such trades as your own?—Yes.

494. Would a canal be of sufficient value and importance to induce you to pay so much per ton for the use of it?—I think one shilling per ton would be a very large charge.

495. Upon your cargo or upon the tonnage?—If the amount of one shilling per ton were charged for harbor dues, no doubt it would come out of the freight in some way or another.

496. But one shilling per ton would not be an excessive charge for coming up a canal in preference to coming up the Yarra, and being knocked about?—I think not, though it is a large charge.

497. You heard the evidence as to the silting-up of the mouth of the canal; do you think the mouth of the canal would be as easily kept clear as the present mouth of the Yarra?—From what I have observed in other places, I think it would be a very simple matter to keep it clear. I have had a great deal of experience in Holland in my time, and for years I was in the habit of passing up the North Holland Canal, a distance of 52 miles; I passed up it almost every month for several years, and I did not notice much filling up in that canal; that is quiet water. The sea in Hobson's Bay is not of much importance as to silting-up; I have not noticed much silting-up where there is a very strong current. We have not a very heavy sea here, except on rare occasions, in Hobson's Bay.

498. And the bottom of Hobson's Bay is stiff mud?—I think it is stiff mud, with a covering of slime.

499. What width of canal would you propose?—That entirely depends upon the money you have at your command; 200 feet wide would be sufficient for two ships to pass, and I think that would meet all the requirements of the trade of the port at present, leaving a wider place at the bottom and the top for ships to turn round in; but if it were 400, or 500, or 600 feet, it would be better; but in the absence of anything better, it would be very desirable to have one of 200 feet, which I think would answer all the requirements of the trade of the port at present.

500. In a national point of view, do you consider that it would be of great benefit to the country?—Yes, I think it would be a great saving to the port if goods could be brought for two or three shillings to the merchants' stores in Melbourne; it would be so much money saved to the public.

501. The canal you were just now speaking of—are the banks formed by the land excavated?—Just the earth; and certain points, so far as my memory serves me, were protected by brushwood; this canal was made out of a series of small lakes, and some of those lakes still remain; and where there is that washing or dabbling from one of those small lakes, where the canal is 200 feet or 300 feet wide perhaps, I noticed it was protected by brushwood—that is, small saplings tied together and woven, and then brought to the spot and sunk with stone, and another layer on the top of that, and so on.

502. Then is it your opinion that a canal from the gasworks down to the Bay, near to the railway, could be carried out without piling or building the sides?—Yes, if it were only required just for ships to pass. I am judging more particularly from Mr. Sinnott's docks.

503. That is really a dock dug out and not protected; is that still so?—It was for a considerable time, but they have since done it with wood; no doubt it would stand for many years without any protection.

504. But your opinion is that this canal would be required for shipping all the way up?—If ships lay alongside it would require piling.

505. The canal you mentioned just now is a still-water canal?—Still water.

506. And there is no current?—Except at the lower part. I must tell you that this canal is four or five feet above the level of the land; the lakes empty into this canal, and then in the autumn, when there is a very large quantity of rain, at low tide they give notice along the canal that they will stop the navigation, and open it for two hours before and one hour after low water.

507. There is no river running in and no regular current?—As a rule, it is still water.

508. It is a dead-water canal?—Yes, it is a dead-water canal.

509. Even supposing this canal was not used for shipping lying alongside, do you not think if there was a current running through it the banks would need protecting?—Probably they would. I noticed in

Holland four years ago, the entrance to the Texell—that is away out at sea, something like our Heads—it was filling up, and they are now cutting a canal from Amsterdam, and that canal is being formed of small blocks of concrete; the whole canal is formed of concrete.

510. That is out in the sea?—It must be at least two miles from the sea.

511. Is not it the fact that in all commercial cities the water frontages are, generally speaking, amongst the most valuable parts of the city?—Certainly.

512. Do you not believe that the water frontages which a canal would offer would be as valuable as land in Flinders street, or perhaps more so?—I think it would; that is to say, with the limited quantity that a canal would give; those things are regulated, you know, by the supply; those water frontages are a fabulous price in London.

513. And as the city grows they would be worth a fabulous price here?—Yes, and I would be glad to give a good deal for 250 feet at this moment.

514. Your opinion is that a canal 200 feet wide, in the mean time, would be ample?—Yes, a canal 200 feet wide, with plenty of depth, would be a very great improvement on the circuitous river now in use.

515. What value would you put on the water frontage if the Government were to offer you 400 feet frontage to this canal?—I would have to give that consideration.

516. Did you hear Captain MacMeekan's evidence?—I did.

517. Do you concur in what he said generally about the safety of a ship lying along the line of canal?—Yes, she would be as safe as she could possibly be in any place in the world.

518. What depth ought a canal to be for the present shipping coming into the port?—I think 25 feet at low water—25 feet, I should say, at ordinary low tides, so that if a ship of large draught came up, she would come up at high water.

519. That depends to a certain extent upon the winds?—Yes.

520. Ordinary ships of 1200 tons burden, what depth do they draw?—From 25 feet—it depends how deeply they are laden; but 25 feet is an extraordinary draught.

521. Do you think it would be a great expense the dredging of this canal?—Keeping it open?

522. Keeping it open?—I do not; it would require dredging occasionally, but I do not think it would be a great expense.

523. Comparing it with the present bed of the Yarra, which would you consider the most expensive?—I think a canal would be kept open much cheaper than the circuitous outlet of the Yarra.

524. Would gates be required?—I do not think any gates are required.

525. To stop the *débris*?—Gates would not stop it.

526. Referring back to the land question, do you think it is desirable to sell the frontages you spoke of just now or to lease them?—I think it would be better to lease them. I think it would be wrong on the part of the Government to sell them. I would be glad to buy them, but you asked me the question if I wanted one.

527. The saving would be to the mercantile community; but the saving to the population at large would scarcely be appreciable, would it?—I think it would be considerable, looking at the present rates that are charged for bringing cargo from Hobson's Bay. When you take into consideration that the goods would be brought immediately on to the dray, and carried to any part of town, you would save, perhaps, two and sixpence to three shillings per ton.

528. That would be a saving to the community?—Yes.

529. But that would scarcely be perceived by the multitude, would it?—That is going so far into matters of political economy that I would rather not follow it; but it would be a saving to the community, no question about it; moreover, not only that, it would give a better character to the port; because it is not a nice place, if you look at it in bad weather, as you may see ships rubbing alongside, with all the ropes and fenders to keep them from being injured. If a great number of the owners of ships that come here could see their ships sometimes at the pier, they would not consider them so safe as they are represented to be here.

530. Do you think the sea would get up in such a canal?—No.

531. The mouth would be protected?—The waves would be exhausted before they got to the canal.

532. Would the mouth of the canal be protected from the heavy gales?—It is a short turbulent sea, and does not run any distance.

533. Then you consider the mouth of the proposed canal would be sufficiently protected?—Yes; you must have piers or walls—piers I would call them.

534. But if you got 25 feet depth of water, you would have to go a long way out?—Yes; but before the sea got there its force would be exhausted.

535. And you would not propose letting the ships lie out the whole length?—If they lay at the lower end they would not be in a worse position than they are at the present pier.

536. Do you think four miles of wharfage would be enough for the present requirements?—No doubt of it. I do not think we have four miles of wharfage now.

537. You would have then?—Yes; just so.

538. Do you think our present wharves—that is, the Yarra wharves on the south side—and this proposed canal would be sufficient for all the requirements of the port at present?—I think it would be sufficient for the requirements of the port, except under extraordinary pressure.

539. Would you have land reserved in case of docks being required in the future?—I think it would be very undesirable to sell any of this low-lying land—I look upon it that nature has formed this as the most advantageous place for docks in any part of the world.

540. You are speaking of the swamp on the other side of the gasworks?—Of the whole of the low-lying lands. You might have a series of docks, the same as you have at Liverpool—at a comparatively small expense docks could be made.

541. You say you think, if such a canal as this were formed, it ought to be able to admit ships drawing 25 feet water?—Yes, and more at high water.

542. You are aware that that would cause the necessity of erecting piers three quarters of a mile, if not a mile, out in Hobson's Bay?—I dare say it would.

543. Even supposing the passage between such piers could be scoured out, would not it always fill up again immediately?—I think not.

544. Not in the open Bay?—I think not; but that is provided the piers were made solid—no doubt there would be a tendency to silt up at the back.

Captain W. H. Smith, *continued*, 3rd Oct. 1872.

545. The sand would gather there ?—No doubt it would require dredging occasionally.

546. You think, if it were kept that depth, the water running between two parallel lines of walls could be kept clear ?—It would require to be something solid—if it were piled, there would require to be stone thrown in between the piles, or the sand would work in.

547. It would require very solid masonry, would not it ?—It might be piling, and bluestone thrown in.

548. I thought, perhaps, you had not quite recollected how far you would have to go out before you would get 25 feet depth of water ?—I say by the depth as I do by the width ; if you cannot get 25 feet, get what you can—20 feet would, I think, serve most of the ships here.

549. Do you know any ship that draws more than 22 feet ?—I have not much dealing with those large ships ; but that could be easily ascertained from the Pilot office.

The witness withdrew.

Adjourned to Thursday next, at Three o'clock.

THURSDAY, 10TH OCTOBER 1872.

Present :

S. AMESS, Esq., in the chair ;

— Blackwood, Esq.,	W. W. Wardell, Esq.,
Samuel Ramsden, Esq.,	James Lorimer, Esq.,
J. Reid, Esq.,	C. Hodgkinson, Esq.,
G. Gordon, Esq.,	James Patterson, Esq., M.P.,
W. McCrea, Esq., M.B.,	John McIlwraith, Esq.
T. J. Sturt, Esq., M.D.,	

George Birnie, Esq., examined.

G. Birnie, Esq., 10th Oct. 1872.

550. You have charge of the dredging operations ?—I have.

551. It has been stated before this Commission that there is a great deal of silting-up at the mouth of the Yarra, especially on the Williamstown side ; could you inform the Commission what this silting consists of ?—Alluvial deposit brought down by the river itself—soft, earthy matter.

552. Have you ever, in any of your dredging operations, got any sea-sand at the mouth of the river ? —I do not recollect any at all.

553. So that the shallowing at the mouth of the river is altogether owing to what is brought down the river ?—Entirely.

554. Have you ever been dredging in any other places than the river, over on the Sandridge side, for instance ?—We have never dredged on the Sandridge side. We have dredged at the railway pier and at the Williamstown breakwater, and at the entrance of the west channel.

555. You know nothing about the Sandridge shore between the baths and the mouth of the river ? —Except what I have been acquainted with from taking borings.

556. When ?—During the last twelve years, on three or four occasions, I have had directions to take a number of borings throughout the various parts of the Bay, which have been taken and forwarded to the department for its information, and I have of course obtained a general amount of knowledge of the formation of the Bay from those borings, from a recollection of them.

557. Can you state whether the bottom has shoaled on the Sandridge side between the baths and the mouth of the river ?—As you approach the mouth of the river it shoals up; not near the Sandridge baths. I should say at the end of the railway pier and in 18 feet of water there has been no difference in that depth for the last ten or twelve years on the Sandridge side of the Bay.

558. The sand has not drifted on the shore during that time, has it ?—I am not able to speak about that. I know that in the year 1858 we built for the slip the framework for the foundations, 450 feet in length and 30 feet wide, which was built on the Sandridge beach.

559. The foundations of what ?—The foundations for the slipway at Williamstown ; it was built on the Sandridge side of the Bay; and at times I have gone down to inspect that work, and I have not been able to crawl between the sand and the bottom of the frame, and at other times I have walked down and been just able to touch it.

560. Is this from sand drifting in and drifting out ?—Sand drifting in and out.

561. Is there any water on it ; or what is it that drifts the sand in and out ?—The direction of the wind and the action of the sea. If it blows from the southward a certain time, and changes to the northward, there would be a change at high-water mark.

562. Do you know when there is a strong succession of southerly gales whether the ground swell throws up the sand on the Sandridge beach or not ?—It did certainly then ; that was fourteen years ago.

563. This was sea-sand that you are speaking of ?—Sea-sand. I have not had an opportunity of judging since then.

564. Where did that sand come from ?—Washed up from the Bay.

565. Opposite the Sandridge baths what is the bottom—that is, between the railway pier and the mouth of the river ?—Sand, as far as I can remember. I do not recollect what the borings were exactly now, but I think towards Sandridge pier sand chiefly.

566. The railway pier ?—Yes, close in shore there was sand for some depth ; in some places we could not get down any depth, from the water flowing in ; it was like soft quicksand.

567. On which part of the beach did you build the foundations for the slip ?—It stretched along the beach, just above high-water mark, below the present baths.

568. Could you give us any idea of how much annually the river would shoal by the bringing down of the *débris*, if it was not cleared out ?—There is very little silting takes place in the river itself.

569. That is owing to your dredging, is it not ?—No; when we have once dredged and cut a channel, we have very seldom to go over that work again. It has been an exceptional case if we have gone over it again.

570. And this mud that comes down the river, I presume, is deposited after the current flows upon the Williamstown side ?—The whole of the deposit is outside the mouth of the river in the Bay, when the fresh-water coming down and mixing with the salt-water, an eddy is caused on each side at the mouth.

571. Is the current of the river sufficient to keep the river clear for all ordinary purposes ?—It has proved so at present ; but as the stream meets the salt water of the Bay it loses the scour—it loses the force of the current ; it becomes an eddy on each side, and in the still water the mud deposits.

572. Is it on both sides of the mouth of the river ?—On both sides.

573. So that in reality the river keeps itself clear ?—It has always done so as yet.

574. If the mouth of the river were deepened to 20 feet, what would be the effect in regard to the scour then ?—The scour would still have the effect of keeping the river clear. The experience has been that the mouth of the river keeps always extending into the Bay; it is now, I suppose, a thousand feet further into the Bay than it was twelve years ago.

575. That is from this point. Supposing the river were deepened to about 20 feet from there—[*pointing to a plan*]—there would be scarcely any mud ?—It would lose the scour as soon as it came into the open Bay. The entrance to the river some time ago was not further back than half-way between the black buoy and the first light; now it extends out over a thousand feet into the Bay.

576. Is there any rock in the bed of the river ?—There is no rock in the present channel that has been adopted for the river. At the junction of the Saltwater River with the Yarra, for a distance of perhaps 400 feet, there is an ironstone clay, which in some portions is rather hard to remove ; that is the greatest impediment. We have blasted some of that ironstone clay ; there was only four feet water upon a certain portion before that was removed by the department. With that exception, there is no substance in the bed of the river harder than clay.

577. Do you refer to the entire river when you say there are no rocks ?—To the river below the gasworks.

578. When the river is flooded at Melbourne above the gasworks, how is it on the bar ; does it affect the bar ; have you more water on the bar?—I have seen the flood over the banks at the Melbourne basin, and at the junction it has been below the ordinary low-water mark.

579. What has been the result of your nine years' dredging ; what additional depth have you got ?—About 4 ft. 6 in. in the twelve years we have been at it.

580. Would it take the same time to get other four feet ?—If we have no more dredges at work than we have had before, it will certainly. We have only had one dredge at work in the River Yarra for a good portion of that time.

581. I suppose there would be no difficulty in deepening it other four feet ?—None whatever.

582. Does that apply to the whole bed of the river ?—It applies to the whole bed of the River Yarra.

583. Suppose we take about a mile from the mouth of the river upwards ?—It would be of really no use.

584. I want to know if there would be any difficulty ?—There would be no difficulty in the deepening a single mile at the entrance of the river, or any portion of the present channel that may be adopted.

585. Then it would be an easy operation ?—An easy operation.

586. Could it be deepened to 20 feet ?—It could be deepened to 20 feet ; we have taken borings to 20 feet, and found no rock.

587. Could it be easily kept open when once it was deepened ; would it be more liable to silt up at the mouth than now ?—No more. There was always a tendency to silt up where the river enters the Bay.

588. What width have you at this confined channel ?—The walls on both sides do not extend further than about 20 chains in length below the short road.

589. Will there be any difficulty in doubling the width ; you would have to cut away the north bank, I suppose ?—There would be no difficulty ; 300 feet is the width between the banks of the Clyde.

590. Do you think that by cutting a canal through from the gasworks downwards into the Bay, about the baths this side of the railway pier, there would any difficulty in keeping the mouth of it clear ?—I should hardly be able to give an opinion upon the point; there are so many reasons to suppose there would be a difficulty, it would be almost impossible to guess.

591. You stated in the first part of your evidence the water is as deep at that 18 feet line now as it was fourteen years ago ; what reasons are there to suppose it would be difficult to keep it open if the water being as deep now as it was then ?—The same results would follow at the mouth of the canal as follow at the mouth of the present river, namely, that the silt coming from the Saltwater River would be deposited on either side of the entrance from the Bay.

592. Then it would not be any more difficult to keep the mouth of the canal open than the mouth of the river ?—Except that the river would send the drift across the mouth of the canal.

593. Supposing you had a current through the canal the same as there is through the river now ?—There would be always a large amount of silt coming down the present river, which would be directed across the entrance of the canal.

594. Do you know the distance the mouth of the canal would be from the mouth of the river ; would the silt get round there ?—The action of the ebb tide would carry it across the mouth of the canal.

595. Then why has it not been going across there the last fifteen years ?—It has not arrived there yet—it is filling up towards there now ; the silt coming down to the mouth of the river would be one-half of the whole quantity coming down now.

596. Would it be worse coming down the canal than coming down the river ?—It would be sure to deposit on the left-hand side of the canal as well as the right.

597. And it deposits on both sides at the present time at the mouth of the river ?—Yes.

598. Do you think the amount of deposit would be increased by the debris of the water of the Yarra coming down the canal ?—It would leave a larger amount of deposit closer to the railway pier than is the case now.

599. It is not the railway pier I am speaking about; I want to know would there be a greater difficulty in keeping the mouth of the canal open than the mouth of the river ?—Not a greater difficulty.

600. Do you mean by that that you think the canal once opened would remain open without dredging ?—No, the mouth of the canal would always require to be dredged at the entrance.

G. Birnie, Esq., *continued*, 10th Oct. 1872.

601. I understand you to say the river requires it ?—None of the river does; it is the mouth of the river—it is gradually shoaling now. We shall have to extend the opening into the Bay 50 feet next year to what it is this year.

602. Where is the silt taken to ?—Most of it is deposited outside the lighthouse.

603. Do you think any of it comes back again ?—I do not imagine any portion of it does.

604. Can you give any reason why the 18 feet line has kept at the same depth for any length of time ?—In consequence of the action of the flood tide, which, coming round the Bay from St. Kilda, sweeps past the end of this pier and gets into the bed of Hobson's Bay, and the action of the ebb tide strikes off from Williamstown right over to this point.

605. Suppose it carried down by this proposed canal away by the action in the same way ?—As it falls out in this part on the right-hand side of the opening, it would gradually come in front of the canal itself.

606. Does it always run that way ?—The flood was always that way; at the ebb there is very little tide.

607. Then in reality the flood tide would sweep the silt from the mouth of the canal to the mouth of the river ?—Yes, to the mouth of the river.

608. Would not then the mouth of the canal be kept clear more easily than the mouth of the river ?—And that from the Saltwater River flowing into the old mouth of the Yarra.

609. The water would bring the sand up and bank between the two ?—Yes, and gradually extend.

610. Then it is merely a matter of time when Hobson's Bay in reality would be filled up altogether ?—Yes.

611. Would not it tend to keep the canal clear where the steamboats are washing the soil down on each side ?—We have no dredging in the river to clear out the river. The river rather deepens after the dredge has once gone over it.

612. Does the wash from the steamboats wash down the earth, while this canal would be much more easily kept clear ?—I doubt whether there would be any difference; the small portion that is washed away from the banks of the river is a mere bagatelle to the silt that comes down the river; it is not worth speaking of.

613. I suppose there is very little silt except in case of a flood ?—It comes down in very large quantities after every shower of rain, and during the last six months I have taken up no less than three or four buckets of water from opposite the black buoy at the entrance of the river, and taken them on shore at Williamstown, and in twelve hours afterwards there has been a deposit of the eighth of an inch at the bottom of the buckets.

614. Does it deposit along the bed of the river ?—No, the scour of the river scours it out, and there are 13 feet of water now where we have only dredged to 12 feet.

615. Supposing the dredge to be employed all the year round, from the Saltwater River to the Bay, what additional depth could you get in the Yarra ?—It would take a few minutes to calculate that—it is about three miles long—it is super. 3,520,000 yards, and our dredge has never dredged more than 140,000 yards in the year, so that it would take one dredge to work for that quantity, a depth of one foot, upwards of twenty years; but there are many parts that are washed out; we have not dredged the whole of that quantity; we have taken away the hard, and the soft has washed away.

616. I am told it is constantly filling up with soft mud below the bone-mills ?—It is so; but that is the only silting-up in the river of any consequence at all.

617. For what distance is this silting going on ?—About 400 feet in length, and it stretches over, perhaps, about 30 or 40 feet.

618. How much has it silted-up the last two years ?—I do not think it has altered much the last eighteen months; the steamboats passing by keep it from increasing.

619. Would it be possible to deepen the river to 25 feet ?—The borings we have taken only extend to 20 feet, but I have no reason to suppose 25 feet would show any greater obstruction.

620. The deepening of the river to that extent would keep it open ?—Provided the outlet to the Bay be kept clear.

621. That is as deep as the Bay itself ?—Unless at the piers and the breakwater.

622. Would you have a canal or the river itself deepened, looking to merely taking a direct line of canal ?—I think it is a mere matter of pounds, shillings, and pence; and if you can show that the deepening and widening of such portions of the present river is required, it would be cheaper, in my opinion, than the expense of making a canal, and it would not interfere with the navigation of the river.

623. But it would take twenty years to do it ?—With one dredge it would.

624. You think it would meet the rising wants of the trade to deepen the river to 20 feet than to make this proposed new canal ?—I think so, and I think it could be done considerably cheaper.

625. That is, I understand, to deepen the whole of the river up as far as the gasworks from its mouth ?—Make it to the falls. I believe, as a matter of expense, it would be found to cost less money to do that than to cut a canal.

626. What size of a canal ?—300 feet in width.

627. Am I to understand you at the same time you would deepen the Yarra and make it as wide as the proposed canal ?—Yes.

628. And that, in your opinion, would be cheaper ?—Yes.

629. What is the length of the Yarra from the gasworks to the Bay at the mouth of the river ?—Six and a half miles.

630. Do you know what length it would be to take the direct line of the canal ?—I imagine, into the deep water in the Bay, two and a quarter to two and a half miles.

631. You think it would be more expense to lift the material than to widen the river and deepen the river to 20 feet ?—If you limited it to 18 feet in the river it would be cheaper.

632. Then it would be cheaper to do that than to cut a canal 300 feet wide and two and a half miles long ?—Yes, there would be less material to remove.

633. If the river were adopted instead of a canal; that is, if the river were made into a canal, would not it give a great deal more accommodation for wharfage along the edges of it ?—Of course it would.

634. There would be no difficulty in depositing the silt ?—No difficulty at all; it is a mere matter of expense.

635. Why is it not done now?—It is a matter of expense. G. Birnie, Esq., *continued*, 10th Oct. 1872.

636. Not the expense of getting rid of it, but the after expense, I presume, of using it?—No, the expense of lifting it from the pontoons.

637. What increase of expense would it be were that done?—The contract for lifting the silt has averaged about eightpence per yard, in addition to the expense it would have been if we had deposited it at the back of the lighthouse.

638. Would not a canal utilize more land in the immediate vicinity of Melbourne, and therefore pay better than deepening the river and putting the silt on lower down?—I have already stated that cutting a canal would entail the removal of a larger amount of material, and consequently there would be more material to put on the low-lying land, but it would increase the expense of putting it there.

639. Do you think that removing the silt from the bottom of the river, or deepening it by dredging, would cost as much per cubic yard or more than it would do by lifting it out of the canal by digging it out?—If it had all to be lifted out by the dredges, it would be a more expensive way than to lift it with a spade and shovel and a barrow; but during the last half-year at least half the work of removing the silt has been done by the river itself; if we cut one side of a channel, a large proportion is washed away from the part where we leave off cutting; we deepen one side and the other side deepens itself; it carries it away into the Bay; and that is not a twentieth part of what is lodged in the Bay every year.

640. You stated that in times of flood the water at the mouth of the river was lower than at the falls bridge. Is that from the difficulty of the water getting away, or from what?—At the time of the flood the water had overspread the low-lying lands, and it had to drain off the low-lying land to get into the bed of the river; it could not approach the river fast enough till the water at the junction of the Saltwater River was fully an average low-water tide, and within three miles of that, up to the gasworks, it was over the banks of the river.

641. If the river had been banked higher up that low level would not have taken place?—No, certainly not.

The witness withdrew.

Adjourned to to-morrow week at Three o'clock.

FRIDAY, 6TH DECEMBER 1872.

Present:

O. FENWICK, Esq., in the chair;

T. J. Sturt, Esq., M.D.,	C. Hodgkinson, Esq.,
D. Clark, Esq.,	James Lorimer, Esq.,
M. O'Grady, Esq.,	J. Reid, Esq.,
S. P. Lord, Esq.,	W. McCrea, Esq., M.B.,
S. Ramsden, Esq.,	W. H. Cutts, Esq., M.D.

Clement Hodgkinson, Esq., a member of the Commission, examined.

642. Will you be good enough to give us any information you may possess upon the subject of our inquiry?—The information I can give now will be only of a general nature, as the surveys are not yet completed. I would like to make a few remarks upon the improvements of the West Melbourne swamp; for if any expression of opinion is given by the Commission upon the matter, it would be a guidance to me in giving instructions to the surveyor. C. Hodgkinson, Esq., 6th Dec. 1872.

643. Is the canal connected with the improvement of the western swamp?—All proposed improvements for reclaiming low-lying ground are connected. In the first place, with regard to the ship canal, I may mention that some years ago my opinion in regard to the construction of such a work was somewhat different from what it is now. I did not think it would be a good work to carry out; but, from the information we have derived, since the Commission has sat, with reference to the nature and extent of the silting up of the Bay, I have quite altered my opinion. I think now that a ship canal, taken in conjunction with the deepening and widening of the river from Church street, Richmond, to the point from whence such canal should branch off, would be one of the most important means of preventing the damage from floods, which was so great in former years in Melbourne and Richmond. Such deepening and widening of the river would obviously be an expensive work, as it would necessitate considerable alterations in the water way and the approaches to the bridges, and it would also involve a reduction of the width of the roadway now bounding the allotments in Richmond; but such work would prevent the water from making an inroad into South Richmond, as it did some years ago, causing great destruction of property, and driving people out of their houses.

644. In that case would that interfere with the present proclaimed road from Prince's bridge up to the ferry?—Yes, it would interfere very considerably with the width of it.

645. Would it necessitate a fresh proclamation widening the road, taking sufficient width off the park, and off the Friendly Societies' land?—Yes, it would require very considerable alteration in the existing roadway. The extent of such alteration could not be decided till we see the cross sections, on which I presume Mr. Coe is now engaged. When we get the longitudinal and cross sections of the Yarra, we could determine the extent of the work necessary to obtain sufficient capacity in the Yarra to greatly lessen the effect of the floods.

646. Is it your scheme that the river, after widening it above Prince's bridge, is to be conveyed by a canal to the Bay?—The general scheme I propose is deepening and widening the river from Church street, Richmond, to the point where the canal starts, and making the canal itself subservient to carrying away a great portion of the flood water.

647. What outlet would you prefer for the canal?—I think the outlet should be immediately west of the present site of the Sandridge baths.

648. You would not carry it to the present mouth of the Yarra?—No.

649. You would not be afraid of any silting up at the mouth of such a canal?—I think the evidence adduced before the Commission went to show that there is not much fear of silting up with moderate attention.

C. Hodgkinson, Esq., *continued*, 6th Dec. 1872.

650. Would you turn the river into the canal—divert the course of the Yarra in fact?—Not altogether, but a great portion of the water and traffic would be diverted through the canal.

651. What depth would you propose to have the canal?—I would not like to give any opinion about details until I have considered the sections and borings, which I have not had time to look over.

652. But it would be such a canal as could be utilized by the shipping?—Yes, it ought to be very wide and very deep, for every cubic yard of earth taken out would repay the cost of taking it out ten times in the course of time, if used to raise the level of low-lying lands on south side of the Yarra.

653. How would you utilize the West Melbourne swamp?—The first thing to be done there is to provide means for rapidly carrying off the flood waters from the Moonee Ponds. The drainage area of the Moonee Ponds is 35,000 to 40,000 acres, which in flood times sends down an enormous quantity of water. In ordinary weather the water from such area, together with the fetid drainage from West Melbourne, Hotham, and Flemington, stagnates in the shallow lagoon in the swamp, the level of the bed of which lagoon is below that of high water in the Yarra. I propose to cut through such lagoon a broad channel so arranged with regard to the construction of its banks as to convey the waters of the Moonee Ponds creek into the Yarra without ever spreading over the low-lying ground. The soil resulting from the excavation of such channel could be used to fill up the lagoon; and the remainder of the low-lying ground, between the lagoon and West Melbourne, could be raised, partly by soil to be derived from the excavation of a small dock, and partly by bringing down soil and rock from those portions of the railway line intersected by cuttings. The drainage of the low-lying ground on each side of proposed channel would be totally unconnected with such channel, and would be carried off, either by drains connected with the Yarra by tidal valves, or else by drains flowing into low reservoirs, from whence it would be discharged into the Yarra by pumps worked by windmills. The proposed result of such work is the rendering of about one hundred acres adapted for residence purposes in connection with the extension westward of the City of Melbourne; the rendering of a large extent of ground fit for the establishment of manufactories and stores in the vicinity of the Yarra and of the proposed dock; the conversion of the remainder of the low-lying land into sound ground, well adapted for yielding ordinary garden produce, sugar-beet, lucerne, grasses, &c.; and the rendering salubrious and pleasant a disgusting swamp, as repulsive in its present aspect as it is pestilential in its influence.

654. Would it be fit for manufacturing purposes?—A large portion that would not be suitable for residence purposes would be adapted for manufacturing purposes.

655. Would you have the channel of sufficient width to take up barges?—Yes; as I propose that the width should be three hundred feet. It could be used for aquatic sports, or anything else. The portion of the low-lying ground not specially reclaimed for residences, stores, and manufactories, would be very valuable in the hands of dairymen, to get crops for dairy cattle; and a considerable extent of such ground could be reserved for a public park for West Melbourne; it would be the finest piece of grass land in any park in Melbourne; and though the ground is low-lying, and some of the soil is saline, still a great many kinds of umbrageous trees would grow very well in such soil.

656. Have you any doubt that such ground, if reclaimed, would sell for £300 an acre, bringing in a gross sum of £300,000, so that the Government would get the whole of the rest of the ground free?—I have no doubt that the improvements of the swamp, taking it as a whole, would well repay the cost of the improvement, irrespective of the sanitary value of the improvements.

657. Looking at the matter from another point of view, would not the 1100 acres still be somewhat marshy, and therefore a source of ill-health?—I think it could be so reclaimed as not to be a source of ill-health. This broad channel, connecting the Moonee Ponds with the Yarra, and preventiug the waters from stagnating in the lagoon, would have nothing whatever to do with the drainage of the land at the side, and I would protect the channel by broad banks of such a height that the water would not spread over such land, which would be preserved from inundation by the Yarra by levees along it. The drainage of such land would, as already stated, be discharged into the Yarra, either through tidal valves or by means of windmill pumps.

658. Where would the drainage come from then?—Part from North and West Melbourne, and a small portion from the rising ground north of the lagoon

659. You think you could get over that by local arrangements?—You could get over that by local arrangements.

660. So that the mere fact of this lying lower than the rest would not inevitably necessitate its being left a swamp?—By no means; I would intercept as much of the drainage as I could north of the railway and take it into the broad channel.

661. Would it be necessary to fill up the swamp for grazing purposes?—No, nor even for garden purposes nor for ornament; but in the portion of the swamp eastward of the proposed broad channel from the Moonee Ponds I would concentrate the filling up as much as possible; and then the value of the land would be so much enhanced as, in my opinion, to pay for all the work. Besides, the value of the other land would be enhanced; it is fit for nothing at present, whereas, if it were made fit for market-gardeners and dairymen, to grow crops requiring strong soil, it would yield a good return for the outlay on it.

662. Can you say the average amount of filling that that strip would require?—I cannot at present; the surveyor is now taking the levels, upon which only we can form an opinion. There would be some filling required in the lagoon, but a considerable portion of the land could be made sound ground without actually putting any soil upon it.

663. Is it boggy now—the cattle go right through it?—They go in up to their bellies.

664. If a quantity of the drainage were diverted into the canal, would it save it from the backwater?—To a certain extent it might.

665. Do you think it is possible that any of this water could be carried away altogether to some other place instead of the bed of the Yarra?—No, the cost of the work would be so enormous.

666. Supposing we do not have a canal, could this work be carried out now as you recommend it?—Yes; I think if the necessary funds are voted, and if they execute it judiciously, it would repay itself in a very short time. I may mention that the Government railway traverses, at a very short distance from Melbourne, Crown land intersected by considerable lengths of cuttings, the material from which land would form admirable filling-up.

667. It could be brought down at night, so as not to interfere with the traffic upon the railways?—Yes. There are in other countries many saline swamps which, without such facilities for filling up low-lying ground, they have improved with great benefit to the public.

668. Are you aware that in Boston there is about the same amount—nearly half of Boston has been reclaimed in the same way ?—I am aware of that fact.

669. And the most valuable part of the city stands upon reclaimed ground ?—Yes.

670. In carrying through this channel, on which side of the channel would the 100 acres of land be reclaimed ?—On the east side, close to the railway, the gasworks, and some of the manufactories west of the gasworks. A strip of land along the river bank down the river, to junction of proposed channel, could be rendered available for manufactories.

671. There would be but very limited access then ?—Arrangements could be made for sufficient access to the land.

672. Would you be prepared to recommend the carrying out of this at once, before the canal—or is it necessary, to make a perfect thing, to carry out the two together—will the earth from the canal be available to fill up the swamp ?—No ; you want every cubic yard of earth from the canal on the south side of the river, and more if you could get it.

673. You consider the canal an essential thing, in connection with this, to carry away a portion of the flood waters from the Yarra ?—Yes, the reclamation of the low-lying ground round Melbourne and the reduction of floods should be one scheme.

674. Have you ever considered the carrying away of part of the floods above Prince's bridge round by Emerald Hill ?—Yes, I have considered it.

675. Would you clear away Prince's bridge altogether and erect it somewhere else ?—I incline to think that, if the river be widened to 300 feet, correspondingly deepened, and plenty of waterway given at Prince's bridge, such works would render unnecessary the tapping of the Yarra higher up, and taking any line through Albert Park. The scheme for a flood-water channel through Albert Park would seem feasible in the first instance ; but then it must be remembered that such line for flood-water would, first of all, cross a road with great traffic—the St. Kilda road—and then it would cross the Hobson's Bay railway ; there would be consequently a great difficulty in dealing with the company, owing to stopping their traffic for construction of bridge over such channel.

676. Would not the mere fact of laying this ground out in vegetation tend to raise the ground ?—Yes, in course of time. There is a great deal of land near London—in the vicinity of Deptford, for instance, below high-water level, used for gardens.

677. Do you think it would be better for the city to reclaim only the portion you propose, or the whole of it ?—I think the reclamation for residence purposes of only part is safest, for if the whole of the land were raised above the reach of the highest flood, still it would be so generally level, that the street drainage, and drainage of sewers, would be very bad, and it would be a most unhealthy place. I think it would be better to thoroughly improve 100 acres for such purposes.

678. So that the drainage of the reclaimed portion would flow into the unreclaimed portion ?—Yes, into the drains on such portion as is not reclaimed for residence purposes, but only for park and purposes other than residence.

679. You do not think it advisable to turn more than the hundred acres or thereabouts into building sites ?—I think not.

680. The hundred acres can be more thorougly reclaimed if you leave the land as it is ?—No, my meaning is this : that if we are to endeavour to render available for building the whole eleven hundred acres, we should fail ; for, supposing it raised five or ten feet above the present level, still, building upon a level is a very bad thing, for you have no drainage ; and that objection does not apply in the other case, for you start at a high level, and, in filling up, create a surface that will not only be out of the reach of flood, but also have an adequate fall for street and house drainage.

681. So that to leave a large part to remain as it is would very materially improve the smaller portion as a building site ?—Yes, for you would have, contiguous to this land, some other land quite sound and fit to go over, that would be intersected by small drains, the stuff from which would go to fill up the land ; and then I propose, as already stated, to cut a small dock, not so much for the sake of a dock as for the sake of getting stuff for filling up.

682. A timber dock, for instance ?—Yes, and that would remove the timber traffic from the place where it is now interfering with other traffic.

683. Do you happen to know if it would be practicable to divert some of the water that comes down the Gardiner's Creek from the bed of Gardiner's Creek altogether, and take it down to Frankston, at anything like a reasonable expense ?—It could be done, but at an enormous expense, totally disproportionate to the advantage to be derived from such diversion.

684. Do you propose to authorize a surveyor to be put on to get the levels of the swamp ?—I have got a surveyor now taking levels all over the swamp, and some borings upon the line of the channel ; his last report was that it was all a mass of mud as far as he had gone down ; but no doubt there is a good bed of clay underneath the greater portion of the land.

685. That has very much filled up of late years ?—Yes.

686. Would your proposed channel be deep enough to have always water in it ?—Yes. At present the channel is lost a little south of Flemington, before it reaches the railway bridge.

687. Could the canal be made available for large traffic : for instance, to bring bluestone metal down to Melbourne, you could get a source of revenue ?—It is not connected with Footscray.

688. You already have a canal about 10 feet deep running alongside the main road ; why not continue it ?—It is desirable to carry flood waters the shortest way ; besides, much of the land opposite Footscray is good sound ground, valuable in its present state, whereas the line I suggest would go through the very worst part of the ground.

689. But would not you take the proposed canal east of the railway ?—I would confine it to Crown land.

690. Would there not be another drain required to carry off the water from the Moonee Ponds creek ?—You can hardly deal with it further on, for it is private land.

691. In carrying out your scheme of widening the river, is it not necessarily involved to remove the present bridge and to build another ?—To make a thoroughly good scheme of it, there is no doubt that the bridges would all have to be altered.

692. In fact it would be no good widening the Yarra to carry off the water without widening the bridges ?—No.

C. Hodgkinson, Esq., *continued*, 6th Dec. 1872.

693. They would be permanent obstructions ?—Yes. We have retained power to widen the river to 300 feet in letting the land, so we can do so without any expense for compensation. Between Ramsden's mill and the margin of the river, in its ordinary state, there is some low-lying ground, which is covered with water in floods, and that would have to be excavated.

694. It has been already partly excavated ?—Yes.

695. You propose, in any case, to remove the obstruction of the rock to the falls ; or do you propose to leave it as it is ?—In regard to that matter, I should like to see the longitudinal and cross sections first.

696. Have you any further evidence to give ?—No, I think that no more details can be given until the surveys are more advanced.

697. If you were to cut the channel near Melbourne to take off the storm-water, would it have a bad effect upon the Upper Yarra in lowering its level ?—No, I think not ; but I do not like to give any opinion upon that matter till I have seen the sections.

Adjourned.

FRIDAY, 24TH JANUARY 1873.

Present :

O. FENWICK, Esq., in the Chair ;

T. Higinbotham, Esq.,	J. Nimmo, Esq.,
G. Gordon, Esq.,	R. W. Carrick, Esq.,
W. McCrea, Esq., M.B.,	S. P. Lord, Esq.
James Lorimer, Esq.,	

The Hon. George Ward Cole, M.L.C., examined.

Hon. G. W. Cole, M.L.C., 24th Jan. 1873.

698. You have had a long acquaintance with the Yarra ?—Yes.

699. And have paid a good deal of attention to floods ?—Yes.

700. I believe you have put your ideas upon paper as to the improvements you think it is desirable to make ?—Yes.

701. Will you be kind enough to explain to the Commission the improvements in the course of the Yarra you propose, with a view to avoid floods ?—In the first place, I have never learnt from anybody the reason why, when the wharfs are covered by the floods, that point of land (at the junction of the Yarra and Saltwater rivers), which is only a short distance from the wharfs, and about 3 feet above the ordinary level of the river, is not overflowed. Upon examining into the cause of this it appeared to me that the water was confined at the junction, and that as the principal part of the flood-waters came under the Richmond bridge, which is only 150 feet wide, there must be some way of carrying the water off. It will be seen by my pamphlet that if, when a flood came on, the Public Works department were to cut a small channel through here (that is through the neck of land at the junction), below the ordinary tides, the water would run out, but it would not run out till all the land on the north side of the river towards Footscray was flooded. I look upon it that the water is confined at the junction where the Yarra and Saltwater rivers meet at right angles. You may see a similar operation at work at the bottom of Elizabeth street during any heavy rain. The water cannot get away, and Elizabeth street is flooded for a very considerable distance. That is precisely the case at the junction, where the land is only 3 feet above the water-level. At the same time the water at the Queen's wharf would be 8 or 10 feet above the ordinary level ; at Prince's bridge, about 14 or 15 feet ; and at Richmond bridge, under which nearly all the water goes, the level of the river is from 20 to 22 feet above the level of the Bay (as shown by the Government surveys made in 1864). When the water is impeded at the junction it rises gradually up and up as the basin fills, until the flood reaches the wharfs. The old ferryman at the gasworks once told me "There is no fear of the floods coming *down* but of the floods coming *up*," for when the water is running down with the greatest rapidity in the river proper a strong eddy runs *up* on each side of it. I have had timber carried away by the flood which was afterwards found up at Flemington, having been carried there by that eddy instead of being taken out into the Bay.

702. Has the wind anything to do with that ?—No, it has nothing to do with it ; for, in 1844, when I came from Sydney, there was a tremendous flood, *although there was no wind*, the wharfs and low lands being completely covered. Below the junction the river is at least four times as wide as at Richmond bridge, and therefore, if a channel could be cut so as to let the water get into this wide part of the river, the flats never would be flooded.

703. Is that anywhere in a line with the canal upon some of these plans ?—No, below altogether ; it is at the junction.

704. Do you believe that the principal obstruction to the escape of flood-water arises at Fisherman's Bend ?—Yes, decidedly, and at no other place ; there the accumulation begins, and rises upwards. The water never runs over the causeway at Prince's bridge until all the large basin from there to the junction is full. This anomaly seems to me to be due to the curvature of the earth. In consequence of my representations the Board of Works and Mr. Wardell had one or two surveys made respecting this subject ; and I think £30,000 or £50,000 would make the channel across from Humbug Reach clear, and the low lands on both sides of the river would be perfectly drained. This merely refers to my suggestion that the river might be straightened, which was my original idea.

705. Would you confine your proposition solely to relieving floods, or would you also improve the navigation of the river ?—I gave my ideas about that in 1860, in reply to questions submitted for my opinion by the Royal Commission on Harbor Improvements, which will be found in an appendix to my pamphlet, as to what should be done in improving the river. Keep the lower part clear, and the proposed channel would give an additional scour which would keep the river open.

706. Retain the present channel ?—Retain the present channel, except at Fisherman's Bend, and the present outlet of the river. I look upon all the flats as being a kind of estuary, originally sand-banks, and I do so because when digging my dock we came upon mussel shells at the bottom of the excavations ; therefore I have considered it merely an estuary. There may be old channels one way or another, covered

up with sand. In 1860 my idea was to keep the channel from the mouth of the river to the junction open, and to deepen it to at least 14 feet at low water.—[*See* my answer to the 4th query above referred to.]—They have been deepening it. By cutting the proposed channel the circuitous route round Fisherman's Bend would be escaped, a good deal of dredging would be saved, and I look upon it that it would drain Batman's swamp as well as all the other low lands. But one thing I would certainly impress upon the minds of the Commission, that is, that all the water which inundates Melbourne and causes the floods, comes through Richmond bridge, which is only 150 feet wide, and by moving some of the obstacles in the river above Prince's bridge very little would be required to keep that channel open so as to carry off all the water which can go under Richmond bridge. By having a direct course it would make a scour and keep the channel open. I may be wrong in my opinion as to the cause of the water being dammed back, but I cannot find any other explanation to account for the fact that, although the river below the junction is four times as wide as at Richmond bridge, the water is not carried off. The point of obstruction is at the junction. Hon. G. W. Cole, M.L.C., *continued*, 24th Jan. 1873.

707. That is the junction of the Saltwater River with the Yarra?—Yes; they meet at right angles with great velocity, and that is the cause of the water rising. When the river runs down with the greatest velocity the water which floods Melbourne is rising up in a kind of eddy on both sides. Some people think that it is the wind that keeps the water back; but on returning from a visit to Sydney in 1844 I found the whole place flooded, although it was perfectly calm; of course therefore the wind could not have affected it. The wind may affect the high spring tides, but nothing more. But as to the improvements in the Yarra, I do not think the Yarra can ever be improved till there is a harbor commission to look after it, just as the corporation looks after the roads; it is a most important thing; we get all sorts of obstructions and so on in the river, and if we had a harbor trust and proper dredges ships could be brought up to the wharfs, when docks could be made, either on one side or the other as required. I do not know whether it would be of any service to the Commission, but in looking into these matters some time ago I copied out for my own use some short extracts from the Acts in force in England; one providing for loans to harbor trusts in 1861, and the other an Act to facilitate the formation and maintenance of harbors in Great Britain and Ireland, &c. This is the sort of thing which we require. If it be of any service to you I will hand it to you; attached to it is one of my answers to the Commission in 1860, relative to the improvement of the harbor here. I think we should soon want to make docks. I do not say that it is impossible; but I do not think the short canal proposed would be any good; at any rate it would not be so good as the natural course of the river. I speak in that way from having observed what was done with the Clyde, and subsequently from hearing of it. I would mention that some people are under the impression that the river below the junction is overflowed too; but Pilot Lilley informed me that in the flood of 1863, when in charge of the *Dandenong*, Captain Smith, they were obliged to dredge by going down the river stern foremost with an anchor down. When he got past the junction he said to Captain Smith, "There will not be water for us upon the bar," at the same time pointing out that all the mud flats were dry. This shows clearly that there is a basin ready to receive the water if it could only be made to reach it.

708. In your opinion, do you think that a direct canal that has been proposed to the Bay would not remove the flood water, and at the same time be much less expensive and improve the navigation also?—I have studied the surveys of 1864, and the various plans proposed there, and I look upon it that any of them would cost a great deal of money, and I question whether they would be so good or so cheap.

709. You see where the Yarra runs to, and that is direct to that point at once?—You have a natural canal here already with 20 feet of water in many parts, and the only thing you want is just to keep it clear.

710. Yes, but while you are going down there you might get into the Bay if you steer straight across?—There is nothing impossible in engineering, as far as that goes, if you only have money.

711. In 1860, in your letter to the Harbor Commission, you recommended large reservations of land on the south side of the Yarra?—Yes.

712. With a view to the construction of docks and a canal; what canal did you contemplate at that time?—[*The witness referred to a pamphlet*].—I say that when you bring ships up the river you may make docks either on one side or the other, but I look upon the Yarra as the natural canal just the same as the Clyde and other rivers.

713. You did not contemplate the short cut at any time?—No, because the idea was that it would cost too large a sum of money, and my notion has always been to relieve the floods first, and make the other subservient.

714. The evidence we have by contractors is that it would be less cost to cut the canal in dry land than to improve the Yarra which is wet; in fact they would be working in water, underneath the water in fact?—I observed the other day that in the Clyde they had got two new dredges that were imported from France, and found them very serviceable. They took out 300 tons of stuff in no time, and they do away with punts altogether, putting the mud down anywhere you please with very little trouble, and at a very small cost. Seeing these things confirms my opinion. I do not see what the expense would be in the river if they have good dredges, and a proper survey to see what is wanted. I do not know that one has been made in the river since Garrard and Manton took sections all the way down the present channel. I have not the original survey from the Land and Works, but I think it would cost £30,000 or something of that sort, From the entrance there at Humbug Reach upwards there is as good a channel as you could make.

The witness withdrew.

Thomas Higinbotham, Esq., a member of the Commission, examined.

715. Will you kindly give us what information you can upon the subject?—Yes. I received, I believe in common with the other professional members of the Commission, a letter from the secretary, stating that the Commission desired that the professional members should devote their attention mainly to the question of a direct canal from the Yarra, at or about the gasworks, to Hobson's Bay. I may say, at once, that I dissent altogether from the opinion that that work would be at all a desirable one to undertake. I have no hesitation in saying that I believe it would be exceedingly difficult, if not impossible, to keep open the mouth of a canal made directly into the Bay; and that the true principle in improving the Yarra is to adhere as closely as possible to the channel of the river—the present channel of the river—with an improvement at Fishermen's Bend, something similar to what was described by Captain Cole in his pamphlet and evidence. I was a member of the Commission that was appointed in 1863 or 1864, I forget which, upon T. Higinbotham, Esq., 24th Jan. 1873.

T. Higinbotham, Esq., *continued*, 24th Jan, 1873.

the floods in the Yarra, and that Commission produced a scheme which is shown in the plan now upon the table. To a very great extent, I hold the same opinions now which I expressed in 1864, as a member of that Commission; but I believe that the Commission made a mistake to this extent, that it deviated unnecessarily from the natural course of the river, and that it would have done better if, instead of proposing the new cut shown upon this plan, it had proposed a less expensive scheme, cutting off Fisherman's Bend only. It will be observed that the Floods Commissioners did not propose to make a new mouth for the canal; they proposed—and laid it down most distinctly in their report—that the present mouth of the Yarra should be maintained, and to that opinion I still adhere. I believe it would be a great engineering mistake to attempt to open a new channel direct into the Bay.

716. Do you know the evidence we have had continually before us to show that the Bay has not silted up anywhere between the mouth of the Yarra and the railway?—Yes, I am aware of that; but I know also that the sand is continually travelling there; it is impossible to keep open the mouth of the Sandridge lagoon.

717. But I say on the other side?—Yes; but there is a complete ridge across.

718. It is 18 feet, according to the evidence we have, right close up to the edge of the Bay; it is marked upon the plan?—[*Witness referred to the plan.*]—There is 10 feet, 16 feet, 18 feet, 18 feet, 19 feet, 19 feet.

719. That is between the railway and the mouth?—Yes; at the end of the railway pier there is 20 feet 8. Mr. Christie's plan shows the canal brought in close to the railway pier.

720. But they are penned in between the railway pier and the mouth of the Yarra?—Yes.

721. And the whole of the evidence shows that upon the other side of the town pier it is all silting-up?—Yes.

722. But not upon the Williamstown side?—The result of making a new channel with a new opening into the Bay would be that the water which now serves to scour the mouth of the Yarra would be divided into two, or if you turn the whole of the water down the new channel, the present course of the Yarra will inevitably close up.

723. But if we have the new channel very superior it will scarcely matter; beside, would it close up; the difference is really very slight. Would not there be always a quantity of salt water in the Yarra?—If you diverge from the present course of the Yarra, it appears to me inevitable that the Yarra will silt up. You now have a very large reservoir into which the tide flows, and upon its return helps to scour out the mouth; if you make a direct cut you have a very much smaller reservoir for tidal water, and, therefore, diminish the scour; again, we know that the river does keep its mouth open; we have no knowledge that it could do so at a point between the present railway pier and the mouth of the Yarra; on the contrary, we know that the travel of the sand continues—I deny altogether that the travel of the sand ceases at the railway pier.

724. But the very fact of the soundings taken from year to year shows no appreciable diminution of the water?—Not far out; but what are you to do with the ridge of sand? If a channel is made direct into the Bay, between the present mouth of the Yarra and the railway pier, you would have two channels for the water of the Yarra. I do not believe it can be denied that there is a constant travel of sand from east to west, not merely up to the Sandridge railway pier but beyond it; and the result would be, if the piers were thrown out, the sand would accumulate upon the eastern side.

725. Are you aware that the evidence shows there is muddy clay upon the bottom there, while on the other side it is sand according to the evidence, that is from actual experiment in boring?—But, as a matter of fact, the sand does extend, not perhaps out into the Bay at present, but it extends upon the west side of the railway pier. If you put an obstacle there, in my opinion the result will be that the sand, being stopped in its travel, will accumulate upon the eastern side of the obstacle, till it reaches the mouth, which it will fill up. I am not prepared to say that it could not be kept open by constant dredging, but that would be a great expense.

726. Would you recommend a fresh cut into the present mouth of the Yarra?—Under any circumstances I should retain the present mouth; and it is really a question of what length you would make the new cut, whether you would make it as long as was proposed by the Commission of 1864 or confiine it to something like the scheme proposed by Captain Cole. The scheme proposed in 1864 was a very large one, and the fact that it has been allowed to remain without being acted upon in any way for ten years leads me to the conclusion that it was too large. A much more practicable scheme would be the one cutting off Fisherman's Bend, combined with the widening and deepening of the channel of the river.

727. Then you do not propose any plan that would be a material advantage to the trade of the port or to the improvement of the navigation of the river?—I believe that to cut off Fisherman's Bend would be in itself a great improvement.

728. But the difference of a mile or one and a half miles towage would not be of much consequence. Do you think there are engineering difficulties in the way of making the canal; irrespective of floods altogether, would it be possible to cut the canal up to the Yarra?—Quite possible to cut it, but it could only be kept open at a very great expense—an altogether unjustifiable expense when you have already the open mouth of the Yarra.

729. The outlet could not be kept open, no matter whether the Yarra got through it or not?—I think not.

730. Owing to the drift of the sand?—Yes.

731. Would not the drift of the sand, if it is all a western one, have the same effect upon the mouth at present—where does the drift stop?—As a matter of fact it does stop before it gets there, for it does not stop up the mouth.

732. Does the current of the river carry it away?—It may help to do so.

733. The soundings taken for several years show that there is no silting-up there—[*pointing to the plan*]—may not the travel stop before it gets there?—There is no silting-up, but there is the travel of sand, as any one can see.

734. Is the travel of the sand from east to west in Sandridge Bend?—Yes.

735. Sandridge and the railway cutting right up through Sandridge; how can there be any drift which does not come over the railway?—It travels along the beach.

736. It is washed up upon the beach?—Yes.

737. How much longer would the canal be supposing it started from the point generally proposed, that is near the gasworks, and run between the two points, how much longer would it be?—About a mile longer; I cannot say exactly, but roughly it would be about that.

738. Was that proposed cut upon the plan a canal or simply a flood channel?—Simply a flood channel.

739. Why not make that the line for a canal?—The expense would be so enormous.

740. It is not proposed to turn the Yarra into that new course?—No, except in floods; there is a weir along this upper mouth, and in floods the surplus water would go over it.

741. That is a canal at once, it is 300 feet wide and 12 feet below low water; if the course of the sand is, as you suggest, from east to west, the same difficulty or no greater difficulty would exist in the case of a canal than now exists in the case of the river. Assume that the whole of the ground were built over, as it would be, where would the sand come from?—From Brighton, and lower down still.

742. Sandridge stops it, it cannot come across it?—If you have ever been down there in a gale of wind, you might observe the sand travelling.

743. But would not the same obstruction from sand exist in the case of the mouth of the river, and does not it exist now, as you anticipate, from the drifting of the sand in the mouth of the canal?—I have not the least doubt that the sand has gradually driven the mouth of the river to its present position; very probably the outlet for the Yarra originally was here—[*pointing to the plan*]—but the travel of the sand has kept gradually closing up the mouth of the river towards its present point, where it has the power to keep itself open.

744. But the experience of the last eighteen years shows that the ground has not silted up outside?—No, not outside; but there is the ridge, you have to get through the ridge; what you propose to do would be to carry out piers, and I believe the result would be that the sand would ultimately choke the mouth.

745. But the traffic in and out would affect it. One captain said that in some of the Indian rivers the steamers had a rake that they dropped over and kept the mouths perfectly clear?—There would be no scour at all in the direct channel proposed; there is now a large area in which the flood tide accumulates, and on the ebb it scours the channel; but if a direct channel were made, you limit the scour.

746. But, to some extent, there would be scour?—Just to the extent of the area.

747. In flood times there would be a tremendous scour, cutting all before it right into the Bay?—(No answer.)

748. But your idea is that the danger of silting-up arises from the canal having too small a capacity for storing water?—Yes; I know that, as a matter of fact, the river does keep its mouth open, and I have no such fact in the case of the canal.

749. And you have the reverse of that you think?—Yes, I think so.

750. You think that the river did formerly empty itself at the mouth of the Sandridge lagoon?—Probably.

751. Might you not fairly deduce from that that the Saltwater River, which must always have run out in this place, was sufficient to keep open the mouth of the Yarra?—Yes; that is a very important point. If you make a direct cut, the water of the Saltwater River is lost as a scour for the mouth of the Yarra.

752. And the history of this therefore shows that if we repeat the experiment of letting the Yarra go out there instead of where it does it is sure to close up?—I think so. The result of the operations of nature show that this is the point for the outlet of the river, and it would be a mistake of the very gravest kind to try to alter the mouth.

753. Yes, if that was the original outlet; but there may have been a natural difficulty to the water getting out that way—there is some solid land there—that drives the water to the present position; but, since there is no evidence that it silts up between the lagoon and the present mouth, what evidence is there to the contrary?—I do not think you have any contrary evidence; there is a ridge of sand right along; the evidence would be to the contrary if there was any break in the ridge of sand.

754. But is it not much more important that the Bay does not silt up except just close in shore—it would save your running piers out—the bank might be kept clear—we have evidence, for instance, that the railway is not flooded with sand?—There is constant difficulty with the railway, which is often covered with sand.

755. It has been stated by you, and it has been proved, that the Sandridge lagoon has silted up, but at the same time have you not observed from the soundings that the water of the Bay has not shallowed more opposite the Sandridge lagoon than it has up here—[*pointing to the plan*]—and therefore the same causes are still in operation?—It is just what I have said; it is the ridge of sand you have to consider, not the water outside.

756. The argument is, that though the lagoon has filled up, therefore the water would not shallow; but the fact is, that the water has not shallowed anywhere?—Just so.

757. Looking solely at one of the points submitted to the Commission, and that is, the navigation of the river, I would like to ask, what is your opinion of the relative expense of keeping dredges at the mouth of the proposed canal and that of keeping the river the whole distance open?——

758. Not for carrying away flood-waters, but merely improving the navigation of the port?—I am not prepared to say what would be the relative expense, but I have no doubt the actual expense of keeping the canal clear would be much greater than that of keeping the river clear; a portion of the river, it must be borne in mind, requires no clearing, at least not much; where the river shallows is just in Fisherman's Bend; there is nearly enough water in other parts of the river, and therefore I say to abandon that, and to make a canal, which you cannot be sure could be kept open, would be a great mistake.

759. Could no way be devised, by engineering ingenuity, to keep it open by erecting piers and piles?—The object should be to spend money in the most useful way.

760. Has no case been tried where it has succeeded, in any part of the world?—I know of none.

761. It would pay a company to expend thousands per annum to dredge a canal and keep it open, if we could bring our ships up?—There is this to be borne in mind, that two-thirds of the tonnage that comes to the Port Phillip Heads does already come up to Melbourne.

762. If this canal was taken from Fisherman's Bend to the mouth of the river, might it not be carried up and the Yarra be widened so as to form the same port accommodation as the canal scheme gives?—Yes, a greater amount of accommodation, on account of the length.

T. Higinbotham, Esq., *continued*, 24th Jan. 1873.

763. If you carried this canal out into 24 feet of water by two piers, the only feasible way, would not the expense of erecting those piers and keeping the channel clear, be enormous?—Enormous, and there is no end to it.

764. Now, supposing you want to bring ships of a certain draught of water—20 feet say—might not that be obtained in a better way by coming in at the mouth of the Yarra and coming up the river—would you not have more port accommodation?—I believe in the one way you obtain it with certainty; I believe in the other way it is doubtful whether you could get it at all.

765. Could a large vessel not be brought up at less expense by this mode than by the proposed canal?—I believe by adhering to the present channel as nearly as possible, making improvements at Fisherman's Bend, the communication between the Bay and the wharfs at Melbourne may be vastly improved; the improvement would go on gradually, and ultimately vessels of the largest class could come up to the wharfs. I believe the attempt to cut a canal from the gasworks to the railway pier at Sandridge would probably end in failure after a very large amount of money had been spent.

766. Then you are of opinion that this would be a more feasible method of attaining all the objects proposed to be attained in the canal?—I believe it to be the only feasible way.

767. You stated that two-thirds of the tonnage came up to Melbourne already?—Yes.

768. I would like to call your attention to the returns?—I have understood so. I do not wish to speak positively about it.

769. The returns show that 644,000 tons came to Melbourne and 1,321,000 tons came through the Heads?—Yes, I see that I was mistaken there. May I ask do those returns extend over a number of years?

770. The last two years—1871-72—to June last. Is your sole reason for thinking that a direct canal from the city to the Bay is impracticable under any circumstances that silting proceeds from east to west, and that the mouth of the canal would be silted up by the sand?—I believe that the mouth of the canal would be silted up by the sand, and that the silting would be greatly facilitated, and the difficulty of keeping the mouth open would be greatly increased by the small capacity of the direct channel for holding tidal water and the withdrawal of the water of the Saltwater River from the mouth.

771. Yes; but are we to understand that what you state as to tidal water would not carry away the silt; is that the only reason why you think the canal is impracticable?—The silting and the expense.

772. They are the only reasons for thinking it impracticable?—Yes.

773. I believe you would think it important, if there was no silting, if the canal was cut?—The shortest channel is the best, other things being equal. I would ask leave to say one word about a matter that has struck me. I see that advertisements are called for tenders for excavating the bed of the lagoon near Prince's bridge—to be four feet below the railway level in the lagoon—and for depositing the earth upon the south side of the river. I would suggest that the Commission should call attention to that, because the earth may be deposited in a place where it ought not to be. The advertisement is from the Department of Land and Agriculture.

Adjourned.

MONDAY, 3RD FEBRUARY 1873.

Present:

O. FENWICK, Esq., in the chair;

W. McCrea, Esq., M.B.,	J. Reid, Esq.,
T. J. Sturt, Esq., M.D.,	G. Gordon, Esq.,
Capt. Kay, R.N.,	J. Nimmo, Esq.,
C. Hodgkinson, Esq.,	T. Higinbotham, Esq.,
James Lorimer, Esq.,	D. Clark, Esq.,
S. P. Lord, Esq.,	R. W. Carrick, Esq.

George Gordon, Esq., C.E., a member of the Commission, examined.

G. Gordon, Esq., C.E., 3rd Feb. 1873.

I put in Mr. Coe's surveys. This is the general plan simply showing the position of the cross sections—[*producing the same*]. It begins at Dight's falls and goes down as far as the gasworks. This plan did not extend any further, but they are taken at half-mile distances right to the mouth. These are the cross sections—[*producing the same*]. I have not a copy of them, and I should like the calculations to be left. They show that about Prince's bridge the river has silted up somewhat since the last survey in 1864. The others I do not think I need refer to at present, they will be useful if it is decided to widen the river between Prince's bridge and Church-street bridge; they will be available to show on which side it will be best to take it.

774. You are aware, from having discussed the matter from time to time, that a straight cut is proposed?—Yes.

775. I do not see anything in the shape of a weir proposed on the top of it?—No, it is mentioned at one of the first meetings—a pier was mentioned, but the plans I have seen do not show whether there is proposed to be a pier or not.

776. There was a weir in the first plan proposed by the professional board that sat some time ago?—Yes, the long cut.

777. Would you be good enough to tell us what would be the actual effect of cutting this wide canal from the Yarra to the sea upon the river, without a weir?—In my opinion the effect would be that, without a weir, the river would be taken out of its present course and deflected into the Bay to a point to the west of the railway—that would become the regular course of the river; the remaining portion between the gasworks and the present mouth of the river I think would silt up on account of being deprived of the current and the tide up and down.

778. Do you know the difference of level between the Bay and the top of the canal?—In extreme flood or the ordinary level?

779. The ordinary level?—It is nearly the same; in fact it is given in evidence that high-water is a little lower at the gasworks than it is in the Bay.

780. Then if this canal were carried out as it is proposed here, at a depth of 22 feet, the effect would be that the Yarra below that would be completely useless?—In course of time completely useless; the regular flow of the river would be down the canal, and bring the sediment down the canal instead of its present course. The sediment must of necessity be deposited outside the pier heads as soon as it gets into the still water in the Bay, but it would be deposited more quickly and more in one place, for there would be no ebb and flow of the tide to keep it in suspension—the ebb and flow of the tide do not do so much in scouring as in keeping the particles from settling, they keep the mouth open; in that way this cut, being so short as compared with the long course of the Yarra, and being so very wide, the tidal current would be reduced to one-third of a foot a minute, which is not perceptible at all.

781. If there were a weir instead of an open mouth; would it be practicable to have a weir there?—According to my calculations it would not, because you must calculate that the same kind of flood will happen under the same conditions as in 1863, or at least as bad conditions. At that time the water in the Bay was 6 feet above datum, and if you suppose it possible to reduce the flood-level at the gasworks to $8\frac{1}{4}$ feet above datum, a good part of it would go down the channel; there would not be height enough left for fall over the weir, the weir would have to be more than 2000 feet long to discharge the flood-water with that slight fall over it left, if you lower the flood-level to $8\frac{1}{4}$ feet at this end.

782. If there were either a movable or a permanent weir it would of course prevent ships coming into the canal making use of the Melbourne wharfs at all?—Yes, unless you had a lock, and a lock would be expensive—of course it could be put in, but the length of the weir would interfere with the ships making use of the wharf, it would extend half a mile.

783. And the difficulty of getting ships up through a lock of that kind would be considerable?—No difficulty at ordinary tides, it would be awkward—there would be delay, and so on, but no great difficulty.

784. Could the river be deepened to the same extent that is proposed in the plan of Mr. Higinbotham, and could it be made available for the wharfs of the city with this canal as in the other one?—You could not keep it deep—it is deep enough north of the proposed entrance to the straight canal.

785. If the river below that silted up, this would have to be the river for all purposes?—It would.

786. You do not think that weir is practicable?—No, I think not, taking into account the reduction of the level.

787. And the expense would be very great we may suppose?—Yes.

788. And even if there were a weir, there would not be much tidal action in the canal?—No; it would be one-third of a foot in a minute, according to my calculation; you could hardly see it.

789. Then the formation of an expensive weir would be the only thing that would preserve the river in its present state below the canal?—I think so.

790. If it were an open cut the river below the canal would be practically useless?—Yes, it would be so in a very short time.

791. When you got into the Bay, how far would the piers require to go out to get into deep water?—I cannot say, for they vary on the different charts.

792. Would it be a little further out than the railway pier?—Yes, a little further; according to the scale it is 3300 feet.

793. That would be more than half a mile?—Yes.

794. Would those piers require to be solid?—Yes.

795. Quite a different thing from the present railway piers?—Yes; you could not have that deep channel between two open piers.

796. Of course it would be very expensive to make this weir?—Yes.

797. And cutting down the channel between the piers so as to deepen the Bay from the mouth of the canal 22 feet, would be also a very expensive proceeding?—Yes, but not exceedingly so. I think you could dredge a great deal of it.

798. All of it would have to be dredged?—All below low-water mark.

799. Now if this mouth of the canal going into the Bay is much deeper than the Bay all round it, would the tendency of the drift of the sand which is at present washed up upon Sandridge beach be to fill up the mouth of the canal?—I think the sand would drift and collect at the east side of the easternmost pier, as it has done, according to Mr. Elsdon's evidence, I think it is; and you can see it at St. Kilda where the high-water mark at the weather side of the pier is 50 yards further out than at the lee side; of course if it begins to gather it must go on, and in time would extend out to the end of the pier.

800. What would be the cure for it; to extend the pier?—That would do for a time, but it would simply hasten the closing up of the upper end of the Bay altogether; if you extend the pier I think the upper end of the Bay is certain to silt up in course of time.

801. What effect would this canal have upon the combined mouths of the Yarra and Saltwater River?—So far a bad effect I think; the Saltwater River of course would bring down a lot of stuff in the present course, and there being less tidal current up and down, it would have less depth than at present and would be less easy to keep open.

802. Would the sand from the river have any tendency to close up the mouth of the canal?—In course of time it would spread towards the mouth of the canal, especially as the silt brought down by the new canal would be deposited at the new mouth of the river, and would tend to meet it; and another reason is that these long piers would cause perfectly still water behind them during a great part of the tide, and in still water a deposit takes place.

803. And altogether, what with the silt from the mud of the Yarra and the Saltwater River, and the silt from the mouth of the canal, and the sanding-up of the Bay, it would be very difficult to keep the mouth of this canal clear?—Yes; it would take constant dredging, and I think the head of the Bay would silt up more quickly if these were constructed than it will without them.

804. The river at the head of the canal would require the same deepening and widening under both sets of circumstances as regards floods?—Yes; above the canal it would be the same in both cases.

805. The other proposed cut?—I think the river ought to be brought down to 22 feet deep to bring the level of the river from the flood-level in 1863 to the red line shown upon the section.

806. What would you do to prevent the floods?—I would remove the Falls reefs and the Prince's-bridge rocks to 22 feet below Melbourne datum, and I would dredge the river to a minimum depth of 22 feet up as far as Church-street bridge; a great part of the river is deep enough already and is wide enough to carry off the flood; if you get a greater slope to the surface of the flood it would need to be

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regulated and widened a little so as to have a bottom width of 46 feet at Richmond bridge, down to 77 feet at Prince's bridge, and slopes of two to one. There is plenty of room for that without interfering with much existing property or the reclamation of the Government House reserve.

807. The principal obstructions which cause the floods lie between Richmond Bridge and the Falls bridge?—Yes; there are great obstructions above Richmond I believe, but I see no way of removing them; the river flows between high banks.

808. I mean the floods which flood the city?—The great obstructions are the Falls-bridge reef and the Prince's-bridge reef; if they are not removed you may as well do nothing at all.

809. And you propose to embank some part of them?—Yes, between Church street and Prince's bridge.

810. And if those improvements were carried out would it carry away all the storm water that we are likely to have?—Yes, to the Falls bridge, provided the river were deepened and widened below to carry it off. It would have to be deepened if it goes in the new cut I propose down to the end of that cut, after that the sectional area of the river is great enough to carry off the floods, but it would not be deep enough for navigation; if that cut was to be used for navigation the mouth of the river would have to be deepened too, but it is deep enough for floods at present.

811. That deepening of the river of course would afford an immense wharfage extent?—Yes; you could have wharfs both sides of the river down to the gasworks, or lower if you like.

812. For vessels drawing 21 feet?—Yes. The depth is 22 feet at low-water. I believe, if the river were deepened to the depth proposed, the tide would go right up to Church-street bridge, and probably above it.

813. Would it keep the place sweeter and scour it?—Yes, it would keep it clearer with the sweep of the tide up and down.

814. Now, as to the new cut, this—[*producing a plan*]—is what you propose?—Yes.

815. This is a cut simply into the river without any weir, or anything?—Yes, altering the course of the river is shown there. This part, with those cross, lines is to be deepened and widened.

816. In fact the whole river, not only the cut and pier as far as Melbourne, might be as available for wharfs?—Yes.

817. And would give at least as much wharfage as the proposed canal?—It would give as much, because it is rather longer.

818. It would give more?—It would give more if necessary, more than would ever be needed, if you have it down to the gasworks on both sides. I think that is as much accommodation as will be wanted for a long time.

819. But all vessels instead of remaining in the canal could be brought up close to Melbourne?—They could be brought up to Prince's bridge, for the Falls bridge ought to be removed at any rate.

820. In fact this plan would allow vessels as well to come up to Prince's bridge as the proposed canal would bring them up to the canal head?—Yes.

821. Would that plan reclaim the whole of the land south of the river?—There is a great portion of this—this part that is shaded, which is, I think, under the highest flood-level.

822. But the land south of the railway—there is a large block of land that would be available for so many purposes?—There are a lot of heights along the banks of the river for a considerable distance from it where the land is under the level of the highest flood in the Bay near the mouth. I do not think that ought to be banked, for the sooner the flood-water gets a broad spread the quicker it gets away from Melbourne, but a large expanse of land a good way from Melbourne might be raised to a good width—the river at present has about one-third the sectional area that it ought to have, so that there is a considerable quantity of material.

823. You do not see any difficulty in making the river what you think it ought to be, except the expense?—No difficulty at all; and I think it would cost less than the other canal.

824. Upon the whole, if you want a weir for the canal and piers in the Bay, and the silting-up and so on, would not this other be the less expensive plan?—The quantity of excavation or dredging in both cases would be very little different. I took it out very roughly, because of course you would have to have a proper survey of it to get it out exactly; but approximately there would be by the river—the new cut—there would be $4\frac{3}{4}$ millions of cubic yards of excavation required; and the proposed straight canal, there would be $4\frac{1}{2}$ millions—and then to that you must add to the straight canal the piers in the Bay; they extend 22 feet into the Bay. That includes the dredging to 22 feet; but if you dredge it to 16 feet or 14 feet it would still be sufficient for the floods; the wharfs at the upper end, to Prince's bridge and the gasworks, would be a common expense to both schemes; but the piers in the Bay should only be added on to the straight cut.

825. In the $4\frac{3}{4}$ millions have you simply compared the quantities from the point where the proposed direct cut leaves the river with the quantities below that point in the river, or does the $4\frac{3}{4}$ millions include the whole widening of the river?—No, only from the common point of starting both canals; this work above the Falls bridge is common to both schemes, and would have to be done in either case.

826. This cut would have an effect upon the tidal action of the river; what would it be?—I think it would improve it very much, for the more regular and even the depth of the channel is, the better swing the tidal action has up and down.

827. Would less dredging be required?—I think so; and after the depth was once got very little dredging would be wanted compared with what otherwise would be.

828. It would be an important difference between the two schemes?—Yes, I think so; there would be no regular current up and down the canal; the canal is so wide and so deep that the tide would be almost imperceptible.

829. Do you calculate the same depth in the river as in the proposed canal?—Yes, the same depth; 22 feet below low-water.

830. Do you think there is any more danger of silting in one than in the other?—Less, I think, in the river than in the Bay; there would be always some current in a straight canal. I do not fear much deposition in the canal, but it would be simply deposited in the Bay when it got outside the piers.

831. What would be the comparative facilities for reclaiming the land between your proposed deepening of the river and the canal plan?—The amount of stuff available would be nearly the same in both, for I should not think the dredge stuff out of the mouth is fit for making land at all; it ought to be

carried away and not put upon the banks ; but, in the other part, the amount of stuff would be nearly the same ; the excavation in one case is $4\frac{3}{4}$ millions, and in the other four and a half. In the former case there would be an amount of one million.

832. Taking these two things, with the weir before us now—taking the whole thing into consideration, are we to understand you that, with greater facilities for keeping the river open, and with likewise greater facilities to the mercantile community to get their goods by getting their ships up to the wharf, instead of a canal your plan is the best?—I think the position of the wharf in the river would be quite as good as that in the canal would be.

833. Would it be closer to the city?—Closer to the railway station, and to the city somewhat—there is no great difference.

834. It would be a more circuitous route?—It would be longer ; from that point in the Bay where the vessels generally bring up to Spencer street, by the river, is $6\frac{1}{8}$ miles ; by Mr. Christie's line of canal it is $3\frac{1}{8}$, so it is 3 miles further by the river than the straight line.

835. Then this distance would involve the services of a steam-tug for half an hour or more to any ship?—It would be just the difference of 3 miles instead of 6. I do not know the time they take to come up ; the difference would be about half an hour probably.

836. Of course if the river were widened and made easier they could come more quickly?—Yes.

837. Then if a weir were made at the top of the proposed canal would it or would it not take more time to take a ship up to Melbourne than by the other scheme?—Then I think it would take longer, for you would have to lock through the weir.

838. So that altogether your evidence is decidedly favorable, both as to the expense of keeping the canal open afterwards, and as to giving the merchants of Melbourne facilities for getting their goods, to the adoption of your proposed plan?—I think so.

839. Rather than the straight canal with a weir?—With or without a weir.

840. If there be the same tendency to silt up the mouth of the proposed canal, supposing a sectional area of the river were enlarged from the fourth bridge up?—I do not quite understand.

841. Supposing the sectional area of the river were made larger, as you suggest, from this bridge at Dight's falls, the tidal action would flow up?—Yes.

842. And I understand you to say that that sand and silt was kept by the tidal action from sinking?—Yes.

843. Would there be the same tendency to silt up the mouth of the canal, supposing the mouth of the river were reformed as you suggest?—You mean a straight canal?

844. Yes?—It would make a very little difference, for the tidal capacity above Prince's bridge is very small compared with the tidal capacity of the canal itself ; it is not so much the actual quantity that goes in and out as the length of time it is in action and the longer space it has to fill up ; and where the tide is flowing up and down on a short cut it would be high-water almost at the same time as it is in the Bay, for the canal is so wide and so deep.

845. Then you think the proposed canal, viewed from all points, is impracticable?—Not impracticable, I think it is very objectionable.

846. Undesirable?—Undesirable, yes.

847. Do you think, in the meantime, supposing one of the suggestions of yours have been carried out, nor has the canal, and a great deal of valuable property has been erected there along the south bank of the river from Prince's bridge towards Sandridge, and with a view of saving the property as much as possible from floods, would it not be advisable to cut a channel from Prince's bridge, running through finishing into the Bay behind the barracks, finishing near the battery?—I think, if you wish to dispose of the flood-water only, without any reference at all to the navigation, you might carry it down that way, but it would be very expensive.

848. This canal then would relieve the river, would it, cut from a point east of Prince's bridge and run along the flat land behind the barracks skirting Emerald Hill?—That would depend upon the size it was.

849. If it was made of sufficient capacity?—Yes, if you brought the Bay, in fact, up to Prince's bridge it would.

850. The existence of such a canal would not have a tendency to make the river silt up more at its mouth would it?—It would if always open, but if only used for flood discharges it would have no effect upon the river below in its ordinary state, but then you have the difficulty of a weir ; again, you could not get a fall at the point to relieve the flood sufficiently to save Melbourne ; you cannot get sufficient fall over the weir into the sea to take off the flood.

851. In order to preserve the water for the scour of the river you must have a weir of course at the mouth of the cut Mr. Nimmo has just described?—I think so, at least up to ordinary high-water.

852. And if you have a weir across it, from the want of fall, the level of the water being lowered sufficiently to save Melbourne from floods, the discharge over the weir would be practically so small as not to save it from floods?—Just so.

853. Then practically, if you preserve the water for the scour of the river, such a cut as Mr. Nimmo has just described would be of very little value?—It would be of very little value.

854. In what respect would it be of very little value, for scouring?—No, for saving the town from floods, for it would require a weir, and the weir would raise the water behind it nearly, but not quite, to the level of the last flood.

855. Supposing the only object was to avoid floods, which scheme would you recommend?—I should still recommend widening the river.

856. You speak of the piers running out into the Bay as adding to the expense?—Yes.

857. Would not those piers be available as wharfs?—If you have two miles of wharfs at the other end you would not want them.

858. You say it would silt up all in one place ; would it not be less expensive then to dredge than if it were spread over a large surface?—No ; more expensive, for the river brings down the same amount of stuff, and you have to get it out of the way, and there would be less tidal action to prevent its settling.

859. The evidence we have is that the tidal motion does keep it moving at St. Kilda?—I think there is a mistake about that ; it is not the silting-up I speak of at St. Kilda, it is the sand gathering, moving along the coast.

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860. But the evidence does not show that, for the evidence shows that the water is kept at a uniform depth at the neighborhood of this pier ?—There are no piers at present.

861. I speak of our railway piers ?—They are open, the sand can travel through them ; if you put a solid pier down it stops the travelling sand.

862. But the evidence states that in this particular neighborhood it is not sand, it is mud ?—But there is a sand upon the coast.

863. Round St. Kilda the bottom of the Bay is sand, showing there is a different action in the neighborhood of the piers and at St. Kilda ?—That varies very much ; in the chart you find sand and mud dotted irregularly all over the Bay ; it just happens to be in patches where they got the soundings, but you have only to look at all the district near Sandridge to see that the sand does gather there along the beach ; in fact near St. Kilda there is a distinct high-water mark a long way in from the present one.

864. In calculating the expense, the great expense is the weir, which it seems might be done away with—it is not absolutely necessary ?—It is not, so long as the piers are into the Bay, they would be the greatest expense.

865. Greater than the weir ?—Yes, each is 561 yards long. I have no data for it, but I daresay Mr. Wardell would be able to give you some idea of what they would cost ; but without piers, I mentioned that I thought the effect of the straight cut would be still worse than if you had a weir, even if that were to cost nothing.

866. It is the silting-up of the Bay, not of the canal, that you dread ?—Of the mouth of the canal.

867. What would be the difference in the length of the river as tinted red by you there—[*pointing to the plan*]—and the present river ?—I do not know exactly, I shall have to measure it.—[*The witness did so.*]

868. I mean from A to B, and from A to B by the present line of the river ?—It is very nearly half—this is a mile and a quarter ; that is two and a half miles ; the difference is one and a quarter miles.

869. Are we to understand that your reasons for thinking the canal impracticable, compared with the proposed river scheme are that, in the first place the deepening of the river will cost the same as the construction of the canal ?—Somewhere about, a little more possibly for the river scheme.

870. In what proportion do you think ?—Four and three-fourths to four and a half millions of yards of excavation.

871. Your second reason is, that the cutting from the river—the excavation from the raising—will fill in and reclaim the same amount of land as the canal would do ?—Not quite, because a great part of the excavation of the four and three-fourth millions is mud, and it would not be handy to reclaim land with that.

872. What proportion do you think ?—About three to two ; I should think you might reclaim probably half as much again by the straight cut, or a third more than by the other.

873. Then the other would reclaim one-third to one-half more than the deepening of the river ?—Of course, that is supposing that the stuff is needed to reclaim land ; then it would be—[*making a calculation*]—more correctly as four and one-third to three and three-fourths ; the straight cut would reclaim four and one-third while the river would reclaim three and three-quarters.

874. Would not the land reclaimed from the river be in a less available position for use ?—That I am not prepared to say.

875. Are we to understand you to say that there would be a saving of the expense of the weir, which you consider necessary ?—I object to the weir altogether, and I object to the canal without the weir still more.

876. Then if a canal were cut, you would think a weir was necessary ?—If a straight canal was cut, it is a choice of evils—you raise the flood level at Melbourne or you ruin the river at its mouth.

877. Are we to understand that if the canal is cut a weir is necessary ?—It is necessary for the river below, but it is likely rather to increase the floods in Melbourne.

878. The weir is only necessary to save the river ?—Yes, and the tidal action.

879. Then the deepening of the river, we are to understand, will save the cost of the piers ?—Yes, the cost of the piers is to go to a direct cut on that side of the comparison ; you do not want them in the other case.

880. If there is a cross-cut the piers are necessary ?—Yes.

881. Would that be entirely saved ?—I should say it would be entirely saved.

882. That would entirely save the cost of the piers by deepening the river ?—Yes.

883. Then are we to understand you further to say, that the deepening of the river in the way you propose will have the same or a greater effect in doing away with floods ?—A greater effect than the short cut.

884. Your proposal involves the removal of the Falls bridge ?—Yes.

885. Would there be any practical difficulty in erecting another bridge in its place to keep up the communication between the two sides of the river ?—There would be no difficulty, but there is always an objection to erecting bridges across navigation ; there would have to be a swing bridge.

886. Any other kind would be an obstacle ?—Yes.

887. Unless you go up higher than the falls ?—Yes.

888. The Falls bridge, just now, is necessary to keep up the communication between the two sides of the river ?—It is there. I do not know that it is necessary. I think a swing bridge would be more useful at Spencer street than the other at the falls.

889. Why ?—Because the Falls bridge is so near Prince's bridge.

890. Prince's bridge would have to be very much enlarged ?—Yes, the reef would have to be removed to 22 feet, and the sectional area should not be less than 3500 square feet below datum ; that is rather smaller than the one proposed by the Board in 1864.

891. Do you believe that the deepening of the river as proposed by you, and widening it, will reduce the liability to silting to less than the canal would be subject to ?—Yes.

892. We gather from you also that there would be less liability to floods from the scheme suggested by you ?—It would carry off the floods better than the straight canal would.

893. Why do you think it would do so ?—Because having a weir at the top of this straight canal you raise the flood level so much, in order to get the two or three millions of feet per minute over it ; but you do not diminish the level of the flood here, you must have a certain fall down there to produce a current to carry off the water.

894. To get a fall in the river that you do not get at the canal?—You get the same level at the Bay; I assume that at the flood-tide level of 1863, 6 feet above datum; but to get that you must have not only the same surface fall down the canal, but a fall to give an initial velocity coming straight out from the river like that; it comes to very nearly the same fall as from here down the straight cut; I have shown it upon the longitudinal section—[*producing the same*]. The black dotted line is the flood of 1863; that red line—[*pointing out the same*]—is the flood level to which I think the proposed work should reduce the 1863 flood.

895. Supposing such a flood as that of 1863 were again to happen?—Yes, under the same circumstances; of course with a less high flood in the Bay it would be correspondingly reduced all through from about Prince's bridge downwards.

896. Then with the same height of tide in the Bay and the same flood in the river, with the proposed deepening and widening, it would make the red line indicate the height of the flood compared with what it was in 1863?—Yes.

897. Do you consider it quite impracticable to have the canal without a weir?—You could make it.

898. But would it answer the purpose?—I do not think it would, it would increase the silting of the river below and the head of the Bay very much.

899. The fact of the Yarra silting-up below is of very little consequence if you have a better river to bring the ships up?—That is not the only consideration to be thought of.

900. Would the non-formation of the weir affect the river below the junction of the Saltwater River?—Yes, I should say it would, for the tide would flow up the canal and meet the high water roundthe other way.

901. That would be an advantage to the canal, the tide rapidly running up?—It would be imperceptible, for the canal is so wide.

902. Then again if you have no weir the water takes a straight course down the canal instead of going down the river?—Yes.

903. Then would not the only effect be to render useless the part of the river between the departure of the canal and the Salwater River?—No, the principal effect would be that all the silt, sand, and mud brought down by the Yarra now would be deposited at the pier head.

904. Would not the portion of the Bay near Williamstown be greatly relieved?—No, not to any great extent, for there is a good deal of tidal action that keeps it clear.

905. Is not there a great deal of tidal action up the Salwater River?—Yes, but you take off so much, that of the Yarra.

906. Would not the scour of the Salwater River keep open the river below?—It would do as much as it does at present, but now you have two rivers keeping the mouth open, and then you would have one.

907. Your answers just now about the position of the swing bridge were to the effect that you think the best position for a swing bridge is where?—I do not wish to give an opinion upon that; I merely wanted to say that the Falls bridge is unnecessarily near to Prince's bridge; I think the Falls bridge ought to be removed altogether, for the wharves could extend up to Prince's bridge.

908. But with reference to the site of a swing bridge, we were under the impression that you hold the opinion that Spencer street is the best site for it?—No, I merely mentioned that that was the position shown upon this plan; I do not give an opinion upon it.

909. You have been reminded that the great bulk of the ships lie above Spencer street; but the question could be qualified that that is caused by there being no turning room other than the present basin: but if the river be widened according to the present plan so that all vessels might turn, all vessels would not need to go up to the basin to turn?—That is merely a matter of convenience that I cannot give an opinion upon.

910. If the falls are removed, how much will it lower the present level of the water above the falls?—The present low-water level would be lowered about 2 feet, but the mean level would remain much about the same—the flood-tide would then go up to Church-street bridge—the low water would be lower, and the mean level might be lowered a little too; but it is of no consequence, for there would be 22 feet all the way up.

911. With that it is only the bridges that would obstruct vessels going up any distance?—Vessels might go up to Church-street bridge, there or even further, for there is 12 feet low water up at Hawthorn Railway bridge—the existing bridges do not offer much obstruction—except Prince's bridge and the Falls bridge—the bridges above Prince's bridge, if their foundations are deep enough, need not be altered at all.

912. But you include in your scheme the doing away with the present Prince's bridge?—Yes, and the Falls bridge and the Hobson's Bay Railway bridge below Prince's bridge.

913. Would it not be desirable to confine the widening of the river above Prince's bridge entirely to the north side so as to avoid interference with the Botanical Gardens and private property?—I think it is entirely immaterial which side you take so long as you get the sectional area and a good curve—a decently regular curve; there is plenty of room for the improvement.

914. On the northern side there are no private interests at all involved?—It does not need any widening except at the places shown upon the section.—[*The witness pointed out the same.*] The amount of widening and deepening is not very great above the bridge.

915. Could you give us any idea as to the comparative cost of the two schemes?—I cannot give that; I have not had time to go into it.

916. To give anything like a reliable estimate would take some considerable time?—It would; we should require detailed estimates.

917. Would you require borings to be taken along the line of the proposed canal?—There have been a considerable number of borings taken. I wish to make one remark; it is, that I do not think any scheme will lower the water more than to 8 ft. 3 in. above datum at the Australian wharf; it needs the remaining available slope to get down to the Bay in time of high flood, that is above the level of the intersection of Flinders and Spencer streets, so that the local rain could not be carried off with any works you make, in any case like that of 1863; in ordinary cases, of course it would be different.

918. In any case then the flood would rise?—The wharf could be raised, and the waters of the river could be prevented from coming into Spencer street by a trap. I believe that flood of 1863 is the only extreme flood we have to go by at all, and I have to take the same circumstances as in that case.

919. How would your scheme affect the natural drainage of the city, supposing your scheme is carried out?—I do not think it would affect it at all, for I do not think you can ever drain the city into the Yarra—you would make simply a sewer of it, if you drain the city into it.

G. Gordon, Esq., C.E., *continued*, 3rd Feb. 1873.

920. You would not approve of draining the city into the river, even if it were practicable ?—No.

921. By drainage do you mean merely the surface drainage or the sewage ?—At present the sewage is not divided from the drainage.

922. The question referred merely to the surface drainage as it exists at present ?—It would not affect it, but would slightly lower the river; but it would not have any practical effect upon the drainage—there would be a slightly greater fall than at present; but it is enough now, I think.

923. Would that not silt it up, the rubbish going down from a great city like this ?—It does silt it up now; it would not affect that.

924. You do not include the drainage and sewage ?—I would not let it go into the Yarra, it would become like one of the canals of Venice or Amsterdam—a cesspool.

925. Do we understand you to say that if the present system of drainage is continued it will become a cesspool like a canal in Venice or Amsterdam ?—It is upon the road to become that now.

926. An analogy has been drawn here several times between the Yarra and the Clyde—is there any real analogy ?—None, rather a contrast.

927. So that no argument drawn from the Clyde would apply ?—No, the Clyde has a very high range of tide and a strong tide.

928. There is one point of analogy—you are aware that neither the drainage nor the sewage of the city is allowed to go into the Clyde, but is allowed to go away down the side of the river ?—Yes.

929. Have you any further statements to make ?—No.

930. What would be the width of the river opposite Spencer street, if widened according to your plan ?—It would be 405 feet.

931. There is room to turn ships ?—Yes.

932. That would require a gigantic bridge, would it not ?—No.

933. What would be the width at Swanston-street bridge ?—There would have to be about 180 feet between the abutments of the bridge ; there is a much more rapid current there than lower down.

934. Are you aware of the recommendation of the Board that were appointed to improve the Government grounds—that they have recommended certain works near the new Government House, which, if carried out, would interfere with the proposed widening of the river ?—I have not seen the plans of the proposed works, so I do not know how much they would interfere, or whether they would interfere ; but I think they ought not to go on with them till it is settled, since they might possibly interfere.

Hugh R. Reed, Esq., examined.

H. R. Reed, Esq., 3rd Feb. 1873.

935. You are a steam-tug proprietor ?—Yes.

936. Can you give us any idea as to the relative cost as to towing a vessel up a straight canal : the cost of towing up the river at present, and the cost of towing up the river as proposed to be altered by Mr. Gordon ?—The river at present is between seven and eight miles I think ; the towage is a sliding scale, as the vessel gets bigger we reduce the rate ; the average rate is 1s. 6d. a ton, up and down ; of course the shorter the distance the cheaper it would be, though there would not be such a difference as might be supposed, for the time of the tug is principally taken up in getting the ship under weigh ; between $7\frac{1}{2}$ and $3\frac{1}{2}$ is suggested ; one might be inclined to say one-half at first, but the difference, I should say, would be practically one-third; the present towage of the river, last year, was something like £10,000, that is within £100 one way or the other. I should imagine there would be a saving of say £3000 a year.

937. Would it not be as quick or as cheap to tow a vessel right up a short canal as it is to Sandridge pier or Williamstown, considering that the one is in still water and the other may be stormy ?—In the first place, the Williamstown ships generally go right alongside.

938. Could they not do the same right up the canal ?—The Williamstown pier takes ships at all times ; the canal would have to wait for high water.

939. Twenty-two feet at low water ?—Then they could go up and down at all times.

940. Which would be more costly, to tow a vessel to the Hobson's Bay pier or tow it up the canal ?—At least double by the canal ; in the first place the stoppages, two ships meeting would cause delay.

941. But it is 300 feet wide ?—But two large ships meeting would never keep up full speed for fear of a collision, if ships did happen to meet they would have to ease just as the Harbor Regulations require now. Then when they got up amongst the shipping they would have to go dead slow ; then as to turning, I would presume they would turn, so that the two cases do not apply at all ; the Government pay twopence a ton in and twopence a ton out, so I think it would cost about half the present rate.

942. The relative cost between towing to Hobson's Bay and towing to this canal ?—About two to one.

943. Twice as much ?—Quite that.

944. What would be the relative cost between towing up the proposed canal and towing up the river widened and deepened, as you have heard Mr. Gordon suggest ?—The difference would be very little, certainly not more than 20 per cent ; getting the ship under weigh is the same in both cases, swinging is the same, and fastening to piers is the same ; it is certainly a little longer, but the difference would be very little ; one of the great expenses in towing now is that vessels stick so often, and that would be prevented.

945. If the river were the length and width proposed by Mr. Gordon, the difference between that and the canal would be very slight ?—Very slight, about 20 per cent.

946. What would be the difference of time between going up the canal and going up the river ?—The average time at present is an hour and a quarter ; in the other case it would be perhaps less than an hour ; but as the traffic increases the time would increase.

947. What would be the difference in rate between the straight canal and the mproved river ?—Not quite half, because the traffic would come closer, and so would be slower ; but the difference might be a quarter of an hour.

948. Could vessels sail right up, and so save towing altogether ?—We have no experience, but the tugs at home invariably tow a ship ; sailing in or out of a dock is out of the question ; they have to bend the sails, and weigh the anchor, and the crew get drunk, and so on.

949. The saving to steamers would be very much larger in proportion than to sailing ships ?—Yes, there would be no making fast, they could go right out to sea.

The witness withdrew.

Thomas Higinbotham, Esq., further examined.

950. You have heard Mr. Gordon's evidence, will you favor the Commission with an expression of your opinion upon it?—I have heard almost all that Mr. Gordon said, and I quite agree with it; I coincide in his opinions. T. Higinbotham, Esq., 3rd Feb. 1873.

Adjourned.

FRIDAY, 14TH FEBRUARY 1873.

Present:

O. FENWICK, Esq., in the chair;

W. McCrea, Esq., M.B.,	Capt. Smith,
D. G. Clark, Esq.,	J. Reid, Esq.,
Dr. Cutts,	R. W. Carrick, Esq.,
J. Lorimer, Esq.,	W. W. Wardell, Esq.,
G. Gordon, Esq.,	J. McIlwraith, Esq.

Charles Phillips, Esq., examined.

951. Will you make any statement to the Commission you may have to make?—My intention in attending here is not to give evidence, for that I could not possibly do. It is a subject that has too long engaged my attention and involves too much to be explained *vivâ voce* in this way. I may say that, nearly sixteen years ago, the subject of your enquiries prompted me to stay in the colony, although it was not my intention to remain—what I had read about the obstructions to making a dock and ship canal in Melbourne induced me to stay, though the prospects for such works have been very much changed since that time. I have incurred during that period a very heavy expenditure both in time, money, and labor. My main object in coming is to ask you, after all the expenses I have incurred, if you will favor me by putting what I have to communicate in print. I have it here, but it is too voluminous to be read to-day. I have also a plan of my scheme, which I shall be happy to explain. C. Phillips, Esq., 14th Feb. 1873.

952. You do not ask the Commission to put anything you have into print unless they have first seen and approved of it?—No, I only desire to leave in your hands my statement, and to ask you to consider it, and, if you think it worthy of attention, to print it.—(*See Appendix.*)

953. Have you your model here?—Yes. I shall be happy to explain it if the Commission will hear me.

954. The Commission will be glad to hear anything you may have to say in explanation of it?—[*The witness produced a model and a plan.*]—This is what it is I propose in the first place as a main object to avoid the immense amount of dredging that would be incidental to maintain the navigation of the Yarra. You will get from the Yarra a greater amount of dredging in one year than you would by this means in a hundred years. You would have nothing but clear sea water in the dock. None of the silt that is brought down by the river, during freshes, would ever get into the dock, and but little get into the canal, not sufficient to reach half way up it. Originally the docks were all that concerned me—the floods were a matter that turned up afterwards. That involved modification of the plans. I propose a dock of 40 acres. At first it was 60, but that is altogether too large, and the military reserve between Melbourne and the grounds of the Agricultural Association affords ample room for a 40-acre dock. I propose to take the canal from the dock out to the beach at a point about 36 chains from the Sandridge town pier. There, by Commander Cox's chart, I found that to get out into 22 feet of water I should have to go 60 chains into the Bay; then, by way of extending the canal thereto, I construct two piers, which I propose to be of jarrah timber, the spaces between the timber filled in with excavated soil, one of those piers extending to the distance of 60 chains, but the other not so far, on account of the groin, which I will describe after the description of a storm-water channel which I will next give; this need be only a timber groin, instead of being filled in as the others are, because it is so much in the lee of the land on all sides. To prevent floods, and also to provide scour at the entrance to the ship canal, I propose to make a storm-water channel from the south side of the Yarra, as far above the St. Kilda road as the banks of the river will allow, which taking its course through the lowest of the land which lies between Emerald Hill and the Yarra, and between Emerald Hill and Sandridge, I design to have its outfall into the Bay at the present outfall of the Sandridge lagoon, with the east side of its outfall about 2 chains to the west of the shore end of the pier, by which the west side of the extension of the ship canal into the Bay is flanked. This storm-water channel I propose to be of a mean width of 11 chains, 7 chains wide at its departure from the river and 15 chains wide at the beach end of it. My original design was a mean width of $7\frac{1}{2}$ chains, 5 chains at the river and 10 at the beach, but I have since had reason to consider that the latter width would not at all times be sufficient. Across the head of this storm-water channel, within 2 or 3 chains of the river, there must be a weir of well fitted sluices to prevent the waters of the Yarra getting down it except in times of flood. The depth of this channel need not be more than a foot below low-water level, but the dock and canal must go to the depth required for the shipping. That part of the ship canal which leads straight into the Bay, having its course parallel to the north-east and south-west streets of Emerald Hill, its centre line will cut the shore line at a point 36 chains distant easterly from the shore end of the Sandridge town pier; 5 chains nearer to that end of the pier will be the east side of the mouth of the storm-water channel, and 20 chains nearer thereto, or 15 chains from the last-named point, will be the west side of the mouth of that channel; then 2 chains further west, or 14 chains easterly from the shore end of the Sandridge town pier, will be the point from which I propose to extend the timber groin before mentioned. This groin will go out to the same depth of water as the longer of the two piers; and I propose that, for the passage of shipping, there should be but the space of a chain between its end and the end of the pier. Its length will be 49 chains, and the first 5 chains from its seaward end must be made solid in the same way as the piers are so made; this will be necessary to fit it to sustain shocks from passing shipping. Immediately from this 5 chains length of solid end will commence a series of openings, forty-five in number, for sluices, each opening 22 feet wide,

C. Phillips, Esq., *continued*, 14th Feb. 1873.

with three sluices in each, and each sluice 7 feet 4 inches wide. The distance between these openings will depend on the distance which the farthest of them may extend towards the shore, but I advise that they go into no shallower water than 16 feet at low-water level, and that the height from the bottom to the sluice sills and the height from the sluice sills to low-water level be equal; and according to the soundings shown on Commander Cox's chart this depth will be at 25 chains from the groin head, and at this distance there will be a length of 7 feet between the openings. The sluices are designed to turn on a vertical axis in the middle of each, by which means whatever resistance the water may offer to the motion of one half will be exactly balanced by its aiding action on the other half, and a man would easily open or close a 100 or more of such sluices in less time than he could open a single sluice of the same dimensions which had to be raised by rack and pinion. The sluices in each opening are to be so geared together that all three will move similarly and simultaneously, and by the motion of a lever through a quarter of a circle they will either be closed or opened. They are all to be kept open during times of flood, and also at all other times except when the scour is required at the shipping entrance, which I do not believe will be more frequently than one tide on alternate days; and the area of artificially enclosed tide water being 370 acres, the quantity that will fill that area to the depth of the rise of tide will flow in through 16 chains width of openings (the 15 chains of openings through the groin and the 1 chain for the passage of shipping), then by closing all the sluices at high water the whole 370 acres will have to pass out during the ebb through the single chain opening between the head of the groin and the head of the longer pier.

955. Where do you propose to make your entrance into the Bay?—On the St. Kilda side of Sandridge.

956. Are you aware that there is evidence that it is always silting up there with sand, whereas upon the other side of the pier it is not so—you have no sand at all—nothing but silt?—I know that; but that is a point upon which I shall have to give my written evidence. Part of my expenses consisted of this. I went down once from Melbourne to Sandridge to ascertain the force of those tide currents; twice expressly from Dandenong to Sandridge for no other purpose; and once to Mordialloc. Sand will fill up the angle, which is formed by the pier with the coast line, and will then drift round the end of the pier; but it will be cut there as often as you like to cut it by the scour. Many persons think that if they ran groins out beyond the present extent of sand they will stop the spaces between them from being silted. The sand will get round as sure as can be; but it will be cut by that scour whenever you like to cut it, of course not oftener than once in every tide.

957. The evidence is that the Bay does not silt up on the other side of Sandridge as it does on the St. Kilda side?—I know, from the investigations I have made, that sand will drift round and fill up the angle, and work round this or any other groin you may put there.

958. Will you put in your evidence now in writing, or do you think that is sufficient explanation as regards the model?—[*The witness produced a paper.*]—You have about half as much as this already before you, and I desire to add to this about a third more. I do not now pretend to give evidence upon the subject, but only to give an outline of the scheme.

959. What depth is the storm-water channel to be?—I propose it to be only one foot below low-water level.

960. What is the width of the ship canal?—Some seem to think it is of great importance to allow ships to pass in that canal. I cannot think it myself. In a canal of that short length they know when a ship is coming in and when one is going out. I have made it here 150 feet wide, but in another plan it is only 80 feet wide. Of course the Harbor Trust, or Government, or whoever determines upon the details, will determine that.

961. You would not connect this with the Yarra at all?—No; you would have nothing but sea water in that canel. During heavy freshes a small quantity would run in, but nothing that would ever run in would give rise to dredging.

962. Would the rise and fall of tide scour the place?—You would have 370 acres area of tide-water, which rises and falls, according to Commander Cox's statement, 2 feet 8 inches in every tide, making a very considerable volume of water running out at a mouth of one chain in width. I would not make that wider than for a ship to enter. You do not require ships to pass at the mouth of a canal. It might be a chain and 5 feet or 6 feet perhaps.

The witness withdrew.

William Wilkinson Wardell, Esq., Inspector-General of Public Works, Member of the Commission, examined.

W. W. Wardell, Esq., 14th Feb. 1873.

963. Will you favor the Commission with whatever evidence you may be prepared to give?—I may condense the whole by saying that I examined this scheme of Mr. Gordon's as well as I could in the short time I have had since my return, and I think that upon the whole it is a better one than that proposed by myself and my brother Commissioners in the year 1864, for this reason, that it is cheaper, and that it complies with all that I think necessary.

964. It is equally good and less expensive?—I think so, and I do not believe that any direct channel from the Yarra to the sea could ever be kept open. I have a very strong opinion on that.

965. As to the silting-up of the Bay, it does not seem to involve the depth—the sand is known to travel along the beach?—Yes.

966. Is there any difference between the deposit of silt in the bed of the Bay and the travelling of the sand along the beach?—Yes, decidedly.

967. As to the gathering of the sand at Sandridge, is there any reason for it to gather, the piers being open?—No.

968. It would not be possible to make the channel even with a solid pier?—No.

969. Have you ever seen in your experience a river without a bar at right-angles?—As a general rule there must be a bar, and as you project the piers the bars will follow.

970. But where the bar has been there has been considerably more surf?—There is a very great sea there at times, but there is always a little drift, and if it is intercepted it must fall along the sides.

971. Have you ever seen a harbor constructed as proposed where the ships lie in the open sea alongside the pier as quietly as they do at the Hobson's Bay Railway pier?—I do not know any harbor exactly like this, but this has almost all the disadvantages of an open roadstead.

W. W. Wardell, Esq., *continued*, 14th Feb. 1873.

972. When you made your former plan did you make any investigations as to the manner in which the sand silted up to the west of Sandridge pier?—I hardly understand.

973. As to the way the sand drifted; you have seen the sand coming over there—[*pointing to the plan*]?—Yes.

974. Was that an important element in your calculations as to the silting-up?—No doubt it would have been.

975. Are you aware that the outlet of your Commission's proposed canal is below the rocks pointed out by Captain Smith in conversation just now?—It is all rock on that side.

976. But the river is wider there?—Yes.

977. That might be an important consideration in the expense as compared with Mr. Gordon's statement?—I do not think you would come upon any rock there.

978. Could you give the Commission an estimate of the respective cost of the two canals?—I forget our estimate, but the whole thing, I believe, was £670,000; including straightening Swanston street approach and putting a bridge across, and so on.

The witness withdrew.

Adjourned to Friday next at three o'clock.

FRIDAY, 21st FEBRUARY 1873.

Present:

O. Fenwick, Esq., in the chair;

W. H. Smith, Esq.,	J. McIlwraith, Esq.,
W. McCrea, Esq., M.B.,	C. Hodgkinson, Esq.,
J. Nimmo, Esq.,	T. Higinbotham, Esq.,
James Lorimer, Esq.,	G. Gordon, Esq.,
J. Reid, Esq.,	R. W. Carrick, Esq.,
W. W. Wardell, Esq.,	T. J. Sturt, Esq., M.D.
S. P. Lord, Esq.,	

C. Hodgkinson, Esq., a Member of the Commission, examined.

C. Hodgkinson, Esq., 21st Feb. 1873.

979. Can you give us any further evidence as to the improvement of the West Melbourne swamp?—Yes; I have written a memorandum, which I will read with the permission of the Commission.—[*The witness read the same, which is as follows:*—]

"The carrying out of this design for rendering available for building purposes part of West Melbourne swamp, and utilizing the whole of it for various purposes, would not be feasible unless under the following conditions:—1. That the present maximum height of the flood-level in the swamp be considerably reduced by the deepening and widening of the Yarra, or by other works. 2. That facilities be afforded by the Railway department for obtaining stuff from portions of railway reserve near Melbourne, traversed by cuttings, to assist in the raising of the low ground denoted by letters *a b c* on drawing, and for transport of such stuff by rail at small cost to such ground. The area of this ground is 126 acres, of which, after allowance for streets, 74 acres would be available for sale in building lots if the design were carried out. To raise such ground to an average height of 12 feet above the level of ordinary low water at the Queen's wharf would require 1,667,000 cubic yards of stuff, part of which would have to be supplied by railway, and part derived from the excavation near gasworks of docks, denoted by blue tint on drawing. Before the filling up of such ground be completed, it would be expedient to construct across it a culvert, so arranged as to admit of being ultimately used for sewerage purposes. This ground would be connected with the city eastward of railway by the street shown on drawing on prolongation of Flinders street. It would not, in my opinion, be practicable, unless at enormous cost, totally incommensurate with the advantages to be thereby derived, to obtain direct access from western part of the city to the ground across the railway. The low land near the gasworks, denoted by brown tint on drawing, would be raised by some of the stuff from excavation of adjacent docks and the low-lying Crown land between. Adderley street and the railway would be gradually raised by stuff derived from excavations from time to time made in different portions of the city, pending which filling-up provisional arrangements could be made for carrying off the water now stagnating at foot of railway embankment. The proposed channel for conveying the flood-water of the Moonee Ponds creek into the Yarra, without spreading over the swamp, would have a width of 200 feet, and a depth of 10 feet below the level of ordinary low water. The construction of such channel would involve the excavation of 506,000 cubic yards of earth, which would be used for forming raised banks on both sides of the channel, and rendering a portion of the surface on the east side of it available for sites for factories. In the portion of ground denoted by green tint on drawing, and intended for a public park for West Melbourne, part of the existing lagoon would be deepened, so as to create a small permanent lake, and the earth derived therefrom would be used for raising the adjacent swampy surface. The portion of swamp westward of the proposed channel for flood-water of Moonee Ponds creek would be rendered sound pasture land by means of a catchwater drain and cross drains connected with one main drain having a tidal valve. This work would involve the formation, with the aid of stuff derived from the widening and deepening of the Yarra, of a level along the bank of that river and the Saltwater River, so as to prevent the inroad of flood-water. If, instead of carrying out the costly works indicated in this design, it be deemed expedient to restrict the improvement of the West Melbourne swamp to its drainage, and the conversion of its present boggy surface into sound grassy sward, such requirements might be obtained by making a smaller cut for connecting the Moonee Ponds creek with the Yarra, and a series of carefully-arranged catchwater drains and cross drains. The whole of the swamp would then have to be enclosed, so as to keep all cattle off it pending the consolidation of the drained land, which could be subsequently sown with artificial grasses, and let for grazing purposes only during the summer months, subject to the stringent conditions relative to maintenance of drains in proper order."

980. I believe you say the whole quantity of filling required will be 1,677,000 cubic yards?—Yes.

981. That would weigh about two tons to the yard?—Not so much.

982. That is the whole quantity, supposing it were brought down by rail. I believe you propose to obtain part from the docks?—I do.

983. Have you separated the quantities at all?—I have not gone into such detail.

984. I suppose the quantity to be obtained from the docks would be very small compared with that to be got from the railway?—No, it would be a considerable portion of the total quantity required.

985. In making the calculation of raising these 12 feet, did you include the quantity above the present surface only?—Above the present surface.

986. Did you allow for any subsidence?—Yes.

987. How much?—I forget now, but I did make some allowance.

C. Hodgkinson, Esq., *continued*, 21st Feb. 1873.

988. This ground is very soft ?—Yes.

989. And I believe the subsidence in raising it 12 feet will be at least a couple of yards, from what I know of the character of the ground ?—I cannot concur in the opinion that it would subside to such an enormous extent as that.

990. The whole quantity of filling would, according to my calculation, weigh 3,354,000 tons; do you know the tonnage at present conveyed upon the Government railways annually ?—No, I do not.

991. It is something under 500,000 tons; to convey which employs the whole of the rolling-stock upon the Government lines; so that it would take six years, employing the whole of the rolling-stock of the Government railways and all their resources, to carry the quantity of stuff required to fill that portion, and that is without assuming any subsidence below the surface at all ?—Perhaps my memorandum has been misunderstood; what I meant to convey by the words "that facilities be afforded by the Railway department" was, that contractors for the work should be allowed to get the material from sides of railway cuttings, and transport it at minimum rate of cost to the low lying ground.

992. Perhaps you scarcely realize the extent to which the railways must be devoted to carrying out the scheme in order to make it effectual. As the thing stands now, if the material for filling it up is to be carried by railways, it would require the whole resources of the Victorian railways for six years to do it ?—Yes, but only a part would be brought by railway.

993. Where do you propose to get the material from that is to be carried by railway ?—A portion of it would be obtained between the railway station and Footscray bridge, and more beyond.

994. Did you estimate what may be got in the cuttings near the North Melbourne station ?—No, I did not.

995. Are you aware that the whole of the material there will be required for filling in connection with the widening of the railway embankments ?—No.

996. Assuming that no part of the earth which is now to be obtained at and near North Melbourne station can be utilized for filling up the swamp, where would you go to get filling-up material ?—Do you mean that all the stuff between the railway station and the bridge will be required for the railway ?

997. Up to the junction of the Essendon line certainly, and beyond that the Railway department has not much quantity ?—If one had to go much further for the stuff, it would be certainly fatal to the scheme; that is, it could not be carried out except at a cost incommensurable with the advantages to be obtained.

998. How would you propose to provide for the drainage of the swamp after it is filled up ?—I mentioned in my memorandum, that a culvert would have to be constructed; the position and direction of such culvert is a matter not so material as to be worth entering upon till it is decided to carry out the scheme.

999. That would provide for the drainage coming from the high ground ?—Yes.

1000. And the drainage falling upon the raised ground would fall into that culvert ?—Yes.

1001. Did you make any estimate of the cost of the culvert ?—No, I did not.

1002. Nor any borings to ascertain what the foundation would be ?—The borings generally were unsatisfactory.

1003. Have you made any borings ?—We have made some, but they are unsatisfactory as far as taken.

1004. To what depth did they extend ?—About 18 feet.

1005. And thus it would be a very costly work ?—A very costly work.

1006. Do you propose to give any slope to this land towards the river ?—It could be so arranged as to give sufficient slope for street formation.

1007. About what rate of slope would it be ?—Estimating 12 feet above low-water mark, there would be sufficient margin for the requisite slope.

1008. To get any slope from the river to the railway would involve a very much greater rate of falling than 12 feet to the railway ?—That is, assuming one uniform slope; but the surface would have to be arranged in a succession of short slopes.

1009. And drain into a culvert ?—Yes.

1010. To what purpose do you think the land, when improved in the way proposed, would be appropriate ?—It would be ultimately sold.

1011. As building land ?—Yes.

1012. Would not the value of it be very much decreased by the fact that, at least, 18 feet would have to be gone through to get a good foundation to build upon ?—Yes, it would.

1013. Would it not also be an unhealthy site under any circumstances ?—No; I do not think it would specially, as the scheme would provide for the reclamation of the adjacent land.

1014. Has it not been always a matter of regret that the Government has sold low-lying land in other places, such as Ballarat East and Sandhurst ?—Yes.

1015. And the Government has been involved in much difficulty and expense in the drainage of such lands ?—Yes; because that is land within the reach of flood.

1016. In your opinion, is the area still remaining unoccupied in West Melbourne, Flemington, Footscray, Hotham, and North Melbourne, so confined that it is necessary to adopt a scheme of this sort to raise land for the purpose of accommodating population ?—I do not think that there is any present necessity for more building land in that neighborhood.

1017. With very considerable unoccupied land on high ground, where there is no difficulty as to drainage and foundations, and no expense in making ground, is it worth while to bring forward, or to urge a scheme of this kind, do you think, to reclaim ground in Batman's swamp ?—I should mention that it can hardly be considered my scheme; is was mainly prepared in accordance with the representations made by a large number of gentlemen who wished to have the city extended westward of railway.

1018. Am I to understand that you advocate the scheme ?—The memorandum I gave with it shows that I do not warmly advocate it. In such memorandum I stated that the scheme would be practicable only subject to certain conditions, and if such conditions cannot be had, of course it will fall through. I ought, perhaps, to mention that, since I gave my evidence, I have found out many unfavorable circumstances, of which I was not before aware, in connection with the raising of the land. I was not then aware that we should have to go so far down without meeting any sound bottom. I certainly expected that we should have met the bottom of the mud at a moderate depth, from some observations made by parties who I thought knew.

1019. Have you formed anything like an estimate for carrying out the whole of the scheme which is shown there upon paper?—No, I have not; I had not got sufficient data so to do without consulting the Railway department.

1020. And then, considering whether the material could be brought down by railway, you have not, if I understand rightly, taken into consideration the amount of tonnage carried by the department?—No, I have not consulted the department upon the subject.

1021. At present, do you think the scheme you put forward upon this plan is in such a practical shape that it could be dealt with in any way by a Commission?—Yes, I think it might be, if it be found that the stuff to be brought by railway can be delivered on the ground at a moderate cost.

1022. But taking this fact into consideration: that the tonnage to be carried will be about 3,000,000 tons; that the tonnage at present carried by the Victorian railways is half a million annually?—The best way of putting it is this: that unless the cost of the stuff put upon the land, partly from the dock and partly from the railway, would be considerably less than 2s. per cubic yard, it would not be expedient, in my opinion, to endeavour to raise this land in the manner shown on drawing .

1023. And you have not formed any opinion whether it could be deposited for 2s. a yard?—No, because I have not been in communication with the Railway department.

1024. In fact, no one could say what this scheme would cost?—Not at present. I submit this drawing, not as a matured scheme, but simply as a design for discussion, especially as a large section of the community have strongly urged the conversion of the whole of that swamp, from one end to the other, into land for building purposes.

1025. Did I understand you to say that a cubic yard of this stuff would weigh two tons?—No, that is a misunderstanding. The statement was made by Mr. Higinbotham.

1026. What kind of earth is it?—The earth from the docks would be argillaceous mud; the stuff that would be brought down by railway would be boulders of basalt rock, and a lot of detritus and earth connected therewith.

1027. I understand that a cubic foot weighs about 84 lbs.; if so, that would reduce the whole weight to one ton and a fraction per yard instead of two?—The estimate was Mr. Higinbotham's, and he is more conversant with the nature of the cuttings on the railway under his charge than I am.

1028. The whole stress of the obstacle just pointed out is the enormous weight of the material to be conveyed. How much of the stuff to be excavated in carrying out the design would be available for filling up the land?—I have not made any distinction between the amount that would be brought by railway and the amount derived from excavation. It would be premature to go into such minutiæ.

1029. But you made an estimate?—From a mere inspection of the plan, I considered that a large amount of the earth required would be got from the docks, and the rest would be got from the railway.

1030. You propose to raise the area 12 feet?—It would have to be raised about 8¼ feet, and then there would be subsidence.

1031. There are seventy acres eligible for building purposes you think?—Seventy-four.

1032. That would bring £800 an acre?—I think more than that. All the adjacent land would be improved. It ought to be worth considerably more than that, otherwise the cost of the work would be very much greater than the amount that would be received from sale of the land.

1033. Assuming that Mr. Gordon's plan for widening and deepening the river were carried out, would there not be a large quantity of stuff available from that work for filling up this one?—Some. Probably the better way of obtaining more stuff from excavations to make up for such material as could not be obtained from the railway cuttings would be by increasing the size of the docks, as they would be so contiguous to the land to be raised.

1034. Do you think, with a view to executing the work shown upon Mr. Gordon's plan, you would be justified in concluding that all this stuff would have to be brought by railway?—I have not assumed that in any case the whole of the stuff would have to be brought by railway; only a portion of it. I ought, however, still to mention my opinion, that, unless a certain portion of that stuff could be brought down by railway, it would be inexpedient to carry out the project of raising the ground, for if only the stuff derived from the swamp itself, and the banks of the Yarra, be placed upon the land, the raised ground would not be adapted for purposes of residence.

1035. You seem to contemplate stone to some extent in filling this?—Such stone as would be derived from those cuttings which traverse a friable basalt of the old formations, and also some of the newer basaltic beds wherein there are boulders.

1036. The first of those cuttings of any size upon the railway is a little beyond Sunbury; the cost of excavating that, and converting it into bank close at hand, was 4s. 3d. a cubic yard, and the contractors lost money by it?—I cannot understand that, for I am at present being supplied with good bluestone metal from a considerable distance, and deposited in Melbourne Parks, at 5s. 9d. a cubic yard; and I pay for the deposit in the public reserves of soil brought from a distance of two miles 2s. a cubic yard.

1037. This material would have to be conveyed something like twenty-six or twenty-seven miles; and, as a matter of fact, the contractor lost money by excavating it, and putting it into an adjoining bank, at 4s. 3d.; it would cost at least a half-penny a ton a mile to bring it down—that is another 13d. a yard?—I cannot understand why the cost should be so great.

1038. Could not the area be filled up to the extent of 2 feet 6 inches above the present level with the stuff got from Mr. Gordon's plan of dredging the river?—Yes, it might be raised to that altitude at a low rate; but it would not be expedient to sell such land for commercial or residence purposes.

1039. Would that work, if the whole flat were raised, remove the present nuisance?—Not unless the proper drains were constructed throughout the whole area, and more especially unless the whole of it be enclosed, and cattle kept off the land for a time, till the drain got consolidated.

1040. You remember that it was stated by Mr. Gordon, in his evidence, that low water would be reduced a little; that is, the river would be lower when once it was deepened and widened than the present banks, than it does now above the bridge?—Yes.

1041. You made some observations showing that low-water mark had sunk 6½ inches since 1851 or 1852?—Mr. O'Connor, C.E., who made some observations, reported that he found the low-water datum 6½ inches higher than mine; but then another gentleman, who has made some observations since, finds it lower. Mr. O'Connor's observations were taken just after some heavy rains, and, therefore, are valueless. My datum was based on a series of observations on a tide gauge set up in 1851 at Queen's Wharf.

C. Hodgkinson, Esq., *continued*, 21st Feb. 1873.

1042. The present level of the swamp is pretty near the same as the park behind the barracks ?—Yes, with regard to that portion near the railway.

1043. You are aware that during all ordinary seasons of the year, since an embankment of about 3 feet 6 inches was put down for drainage purposes, that piece stands high and dry ?—Yes.

1044. Would it be necessary for this work to be carried out at once, or could it be spread over, say, five or ten years ?—My opinion is that whatever action is taken with regard to the swamp should be taken at once ; there should be no further delay in relieving Melbourne from the repulsive aspect of that place.

1045. What is the area of the proposed dock ?—Twenty-three acres.

1046. Can you give us any idea of the cost of excavating an acre of the dock as compared with the cost of raising an acre of this land ?—The excavation of a dock in that locality would be a cheap work ; I cannot reply to the question at present.

1047. Do you consider that those docks would give sufficient accommodation to the shipping in the port ?—No, those docks were only intended as timber docks, and were placed there principally with a view of getting some stuff to raise the low-lying land.

1048. Have you ever given any consideration to the idea of constructing docks in this land instead of converting it into building allotments ?—Yes, I have ; but, if a ship canal be carried out, it would be unnecessary to construct large docks upon the north side of the Yarra.

1049. What would be the effect of a system of docks, in a sanitary point of view, all round the gasworks say—would it be as beneficial as the present scheme suggested ?—Yes ; I think any scheme which tends to do away with the present bad undrained surface would do good.

1050. Do you say that the soil taken out by widening and deepening the Yarra would raise the whole of the swamp two feet ?—I have not gone into the details of Mr. Gordon's scheme. I do not know the amount of earth that would result from it. It would, in my opinion, be a waste of money to raise the whole of the swamp between Melbourne and Footscray, as a portion of it could be reclaimed and made salubrious as grazing ground, by a system of drains.

1051. Where would the drainage of this go ?—Into the Yarra.

1052. And the drainage of the whole of West Melbourne would go into the Yarra ?—Yes ; I do not see any satisfactory way of diverting it. You might make a deep receptacle for it, deodorize it therein, and then pump it into the Yarra.

1053. With regard to the other scheme, you say, "If, instead of carrying out the costly works indicated in this design, it be deemed expedient to restrict the improvement of the West Melbourne swamp to its drainage, and the conversion of its present boggy surface into sound grassy sward "—— Have you any idea of what this drainage would cost ?—Not much ; but I have not prepared any estimate. The cost of rendering the swamp salubrious, and good sound grazing ground, would not be more than would be well met by the rent from letting the land for grazing purposes, especially if, before the land was let, the Government, or the body having charge of the swamp, were to see that it was well covered with grasses and lucerne.

1054. Do you think a great part of it could be let to market gardeners ?—A part of it could be ; but I think the better plan would be to enclose it, and let it for grazing only in dry weather ; whatever is done to it, it would not be advisable to let cattle get into it in winter—they would destroy the drains, and very much injure the surface, even if they did not make it as bad as at present.

1055. Do you think this scheme would be remunerative ?—I think it would be. I had more favorable views with regard to the scheme for rendering the eastern portion of the swamp adapted for building ground when I last gave evidence than I have at present, as the borings and levels subsequently taken have considerably modified my views.

1056. Do you think that if the Government were to offer this to a contractor, giving him a lease for a certain number of years, he would do the work ?—Yes. But I do not approve of such action.

1057. It would be summer time before it would return remuneration ?—Occupation should be restricted to the summer months. It would not be expedient to allow cattle to be in till grass or lucerne had been sown at least in portions of it, and the whole consolidated.

1058. How long would it take ?—Eighteen months ; at least one summer and winter should elapse between the formation and throwing it open. The first step should be its enclosure.

1059. Then it would be let for grazing land ?—Yes, and I think it would give a great revenue.

1060. Then, upon the whole, you consider this scheme of merely draining the swamp a preferable scheme to the other one ?—I do certainly. I think the main object is to rapidly cure the present evils.

1061. Assuming this to be the question which has been submitted to us to give an opinion upon, and that the Government asked us to submit a plan by which this work could be carried out best, is this a plan you would recommend ?—The plan Dr. McCrea just alluded to ?

1062. Yes ; what is called your scheme, upon the plan here ?—I do not wish anything to be called my scheme, but I prepared those plans and got information mainly for discussion by the Commission.

1063. The only plans we have are these two. Now, if the Commission is bound to report to the Government as to the most advisable means of carrying out improvements and draining the swamps, is this the plan that you would recommend ?—No, I would not recommend that any extensive portion of ground be reclaimed for building purposes, from the information I have derived since I last gave evidence.

1064. Is there any plan before the Commission that you would recommend ?—No ; but I have indicated in the conclusion of my memo. what I think should be done. The portion of the memo. alluded to is as follows :—"If, instead of carrying out the costly works indicated in this design, it be deemed expedient to restrict the improvement of the West Melbourne swamp to its drainage, and the conversion of its present boggy surface into sound grassy sward, such requirements might be obtained by making a smaller cut for connecting the Moonee Ponds creek with the Yarra, and a series of carefully-arranged catchwater drains and cross drains. The whole of the swamp would then have to be enclosed, so as to keep all cattle off it pending the consolidation of the drained land, which could be subsequently sown with artificial grasses, and let for grazing purposes only during the summer months, subject to the stringent conditions relative to maintenance of drains in proper order."

1065. That is the other scheme ?—Yes ; with regard to the scheme indicated upon the plan, I commenced by saying—"The carrying out of this design for rendering available for building purposes part of West Melbourne swamp, and utilizing the whole of it for various purposes, would not be feasible unless under the following conditions:—1. That the present maximum height of the flood-level in the swamp be considerably reduced by the deepening and widening of the Yarra, or by other works." With regard to

such first condition, Mr. Gordon has remarked that the deepening and widening of the river contemplated in his scheme will lower the level considerably in the higher part of the Yarra, but not materially reduce the height of the flood level at the swamp, so that one of the conditions which I consider essential is not attainable. "2. That facilities be afforded by the Railway department for obtaining stuff from portions of railway reserve near Melbourne, traversed by cuttings, to assist in the raising of the low ground denoted by letters *a b c* on drawing, and for transport of such stuff by rail at small cost." The remarks made by Mr. Higinbotham show also that this condition cannot be met.

1066. Then, are we to understand that the alternative that you would recommend, with the present light we have, would be the alternative you suggest?—Yes; as those conditions cannot be fulfilled, then I would say that the swamp should be reclaimed in the cheapest and most expeditious manner possible, as suggested in the latter part of my memo.

1067. Would that effectually do away with the nuisance so much complained of; would it drain the swamp and render it salubrious?—Yes, I think it would have such effect on that portion of it between Melbourne and Footscray.

1068. You think that in time, if it was carried out, it might be remunerative?—Yes; and there are proofs that it could be made salubrious by paddocks belonging to private individuals enclosing some of the boggy ground; such paddocks present a totally different appearance from the swamp just outside.

1069. Would it not also be advisable to plant a belt of gum trees, selecting gum trees from the essential oil in the leaves, so that if they fall they would not rot; would not that filter and purify the swamp?—I do not think any kind of Eucalyptus would thrive in such a swamp, especially the Eucalyptus globulus to which you allude.

1070. According to these levels, it appears they are 3 feet and a little over above low-water datum?—About 3½ feet.

1071. Assuming the whole surface to be covered a depth of 4 feet, it would be about the height of Sandridge road, which is 7 feet now?—Yes.

1072. Are you aware that it often happens that Sandridge road is covered with water?—Yes.

1073. But the surface of it may be said to be in a state free from nuisance, in as far as drains are concerned, from year's end to year's end?—I do not think it would be expedient for this Commission to recommend for private residence unless——

1074. But speaking simply for drainage purposes, to remove the present nuisance, if you were to raise it to the present height of Sandridge road, would it not be enough?—Yes, with some drains. Fascines laid upon the subsoil would prevent a good deal of subsidence; but the laying of fascines would be a costly matter.

1075. But would not that only delay the sinking; would not the fascines sink through the subsoil if it is only soft enough?—Not to any appreciable extent if the adjacent ground be drained.

1076. Do you think it would be any use, if you are going to drain for sanitary purposes, to fill up 1 foot 6 inches or 2 feet over it?—I think, if the land is to be merely drained and made into good pasture land, it would be unnecessary to do more than construct well-arranged drains, and fence the land, and sow grass and lucerne.

1077. If you conduct the water of the Moonee Ponds by an embanked channel into the Yarra, you could always keep the other part as dry as you please by artificial means?—Yes; but, as I mention in the memorandum, it would not be necessary to make a cut from Moonee Ponds of anything like that size shown in the plan.

1078. Could you not run a drain through it to catch the Yarra similar to the one Emerald Hill has put behind the barracks, through the Emerald Hill swamp—would not that effect the drainage of it just now?—Yes, it might; but, the land being so flat, it is not a matter of very material importance how the cross drains are arranged, but it is desirable there should be catchwater drains.

1079. That drain has drained the Emerald Hill swamp in all seasons?—I do not think such a drain would drain this swamp without catchwater drains.

1080. And have the roads across that swamp subsided much?—I have not any information upon the extent of subsidence that has taken place. I may say that I did not allow so much for anything like the extent of subsidence Mr. Higinbotham has mentioned; no other professional man has had so much experience as Mr. Higinbotham has had in constructions in the West Melbourne swamp.

1081. Is not the lower part of Flinders street very much in the same position?—The ground there is not so bad as where we took our borings.

1082. Would a subsidence of 6 feet in 12 arise merely from pressing water as if out of a sponge and the consolidation of the earth; or, if it were an ordinary subsidence, by weight put upon the softer soil, would not that spread out at other parts—of course the subsidence of a rood would be a material loss, but the subsidence of an acre, if the soil were pressed out sideways, that would be no loss again?—The adjacent surface would rise. Such subsidence would not involve absolute loss of material.

1083. What would be the effect upon the swamp of the Moonee Ponds being confined to a channel, instead of being spread, as now, over a surface?—It would not of itself consolidate the swamp, but with the catchwater drains and cross drains I propose it would have such effect. It is an absolute necessity to take the Moonee Ponds into a channel.

1084. You have no scheme to make it into docks?—No.

1085. Was there a scheme some years ago by the Chinese to utilize some portions of this lagoon?—I am not aware of it.

1086. Was there ever a company formed with a view of draining it?—There has been a scheme for making a canal between Footscray and North Melbourne, which is shown in pencil; in fact, the Governor in Council approved of the issue of a lease to an individual, Mr. Brown; but, as he did not pay the rent that was due, the lease was forfeited. Since the Commission has been sitting he has applied to have the forfeiture revoked, and says he is prepared to carry out his scheme.

1087. In the present state of things, do you think it would be advisable to let him carry out his scheme?—I think not at present, till the Commission have decided upon some plan.

1088. Would it not be possible to form a catchwater drain of such dimensions as would divert the water from Moonee Ponds from lodging now; in fact, to protect this from the surface drainage of surrounding

C. Hodgkinson Esq., *continued*, 21st Feb. 1873.

lands ?—It might be done. If the persons who proposed to carry out this canal would amend their scheme, so as to relieve the swamp from the waters of the Moonee Ponds creek, it would be advisable to give them a lease I think.

1089. Did this Commission on which you were some years ago see reasons to advise the Government not to alienate this land for private purposes ?—Yes.

1090. Do those reasons still exist ?—Yes. I think it would be very inexpedient to let this swamp pass into the hands of private parties ; it would be far better to reclaim it as I propose, merely to be ultimately used as grazing paddocks when reclaimed ; such paddocks should then be let upon such conditions as would prevent the surface from being broken up again, and keep the drains in good order. The aspect of Melbourne would be sightly enough when this bog is converted into sound pasture land, for, from the nature of the soil, it would be green even in the hottest weather.

1091. Do you think it could be reclaimed, without any filling, by fencing ?—Yes, by fencing and drains, as specified in my memorandum.

1092. Would it be wise to allow one party to hold a monopoly of a canal along the swamp, right into the Yarra, while there is a general scheme under way for the reclamation of the whole ; because there is a party named Brown now applying for that monopoly ?—I ought to explain that Mr. Brown made application for a lease of land for this canal several years ago. The application was recommended by the late Surveyor-General, Mr. Ligar, after inspection of the ground, and the lease was granted ; but it was recently forfeited for non-payment of rent. Quite recently he has applied for the forfeiture to be revoked ; but the Board of Land and Works has declined to accede to the request, pending the report of this Commission.

1093. Would it be advisable for this lease to be submitted to us, to see the conditions, or can you give us the information ?—I cannot at present, but I shall be most happy to send all the papers to the Commission.

1094. *To Mr. Higinbotham.*—I understood you to say that the plan that was made for the Government, several years ago, on which you were one of the advisers to the Government, recommended that that land should not now be alienated ; previously you made the remark that that was the plan you would now recommend to be carried out ?—No plan was made for the Government.

1095. Do you think it should be done by the Government or by an individual ?—I think it ought to be done by the Government, and that the increased value should go into the pocket of the public.

1096. Whose scheme was that ?—I forget at this distance of time, but the particulars are all either in the Crown Lands or in the Public Works office. Such scheme did not go into any details, such as levels —it was merely a preliminary application. The construction of docks upon such a soil as is found in that swamp would be difficult and expensive.

1097. Would it not be far better to put them upon the other side of the river ?—Yes, if the construction of a ship canal did not render unnecessary any docks on south side of the Yarra.

Adjourned to Friday next at two o'clock.

FRIDAY, 7TH MARCH 1873.

Present :

O. FENWICK, Esq., in the Chair ;

W. H. Smith, Esq.,	S. Ramsden, Esq.,
Capt. Kay, R.N.,	J. Nimmo, Esq.,
W. McCrea, Esq., M.B.,	J. McIlwraith, Esq.,
W. H. Cutts, Esq., M.D.,	J. Reid, Esq.
T. J. Sturt, Esq., M.D.,	

Peter Edwin Henderson, Esq., C.E. F.R.S., examined.

P. E. Henderson, Esq., C.E., F.R.S., 7th March 1873.

1098. Will you state your views to the Commission on the subject under their consideration ?—From the experience I have had I think that the proper way to do would be to move the three bridges and give more water-way—the two last bridges more particularly, and put them into one. After that I would go down to near the gasworks and make a canal, 500 feet wide, in a straight line to within a very little of the present pier of the railway. I think at the same time that there should be given great consideration as to a general railway station and the railway attached to the different parts of the dock.

1099. Have you any plan with you ?—I have.—[*A plan was produced.*] I may state that I know pretty well the different rivers in Europe, but I think this is nearer to the River Tees than any other I have seen. I remember when I was a pupil, Stockton-on-Tees was the port. The Darlington railway came down, as a matter of course, to Stockton ; but when a proprietary, called the Quaker proprietary, bought Middlesborough, they made a branch railway from about a mile from Stockton, and made a railway four miles to Middlesborough, the river being at that time about eight miles. I remember Middlesborough when there was one house in it, and, when I was a pupil, I assisted in setting out the town ; there are now 45,000 inhabitants in Middlesborough, and Stockton has been so far neglected. I think that, if this canal was made from, say, near the gasworks, it would take the whole of the traffic and make a dock similar to what has been made on the Tees ; then again this is a very circuitous route, and whatever may be done to the river, it would be money thrown away. It must come to this eventually, and I think it will be seen very clearly that, whereas this canal which I propose is only about two miles, the river will be six miles and a half, and the cost will be considerably less, and the facilities for shipping will be a great deal more ; the canal itself, for many many years, will accommodate the whole of the shipping coming here, and if not, lock-gates could be

made across the river, and any sized port could be made in Batman's Swamp; besides that it would give great facilities to different railways coming down here for shipping and unshipping goods into the railway cars immediately, or to any other trade or traffic that might require accommodation. I think with this that there ought to be a consideration about the railways—railways being the national property, there ought to be one station. A few years ago in Glasgow I was engaged in making an amalgamation of the railways coming into Glasgow, in conjunction with Mr. Miller, and there we went through a great portion of the most valuable portion of Glasgow, and took a whole block of Glasgow for station purposes.

1100. Are you aware that it is stated by civil engineers and others that, in order to run a straight canal out into the Bay at this point, there would have to be two piers constructed at an enormous expense, and they state that those piers would make a back-water for the sand, which would silt up to the pier, and gradually silt across the entrance?—I do not believe in that. I will show you a plan of piers along the French coast and the Belgian coast.—[*The plans were produced.*] They are very inexpensive, and I think would suit this place. I produce a plan of the breakwater at Calais, which is made of brushwood and timber, and is a very inexpensive affair, and to my knowledge it has lasted thirty years.

1101. Do you think a pailed pier would do, sheeted with red-gum, and basket at the back to catch the sand?—I have no doubt about it. I am quite sure it would. Here is a plan of Dunkirk. This is a pier made of timber and stone.

1102. What depth do you propose to go?—Twenty-four feet at the Yarra end, and 21 in the Bay.

1103. It is generally said there would not be scour enough in that short space to keep it clear?—I think that is a great mistake. In the docks of Cardiff we go through the mud flats, and there is no trouble about the scourage there. This water will be always in motion, and the silt which comes down I believe will be very much reduced, because the silt is evidently from the cultivation, and the parties who cultivate their land will take care in a few years that they do not lose their good land. Melbourne, again, has a good deal of silt from it, but in a few years they will not allow a single stone to be washed away from the Melbourne streets; and then, again, there is the flood channel. I am perfectly satisfied that, if this ship canal is made, there will never be any floods again. By widening the Yarra from Prince's Bridge, and taking away the Railway and Falls bridges, and connecting them as one centre into one bridge you will improve the fair-way of the water channel. No doubt you may take the American plan here with one large bridge, and the railway underneath that, or *vice versa*, the same as the high-level bridge at Newcastle-upon-Tyne.

1104. Are you aware that the whole of the engineers, or the greater part of them, have been afraid to open a direct canal into the Bay, and that they all recommend about this proposed line, which the Commission some ten years ago recommended as a storm-water channel?—I may mention a case of a new cut on the River Tees, between Stockton and Middlesborough. I remember seeing a place called Yarm flooded with water, and it was often flooded; but we made a new cut below Stockton, which is eight miles distant, to take off the flood water, and there has never been a flood in that place called Yarm since.

1105. Are you of opinion that if the Yarra was widened from Richmond Bridge and Prince's Bridge, and the reef at the Falls, and the reef at Prince's Bridge removed, and this canal of 500 feet wide, 24 feet deep at one end, and 21 feet deep the other, were made, that that would totally relieve Melbourne from floods?—I am quite sure of it; it is a matter of calculation—I am sure it would discharge it.

1106. If those obstructions were removed?—Yes. With regard to the silting-up, there is no silt except this sand, which can be easily done away with. If you take the simple plan they have in Holland: they take the poor people there and set them to work, and take withes and drive them into the ground and make basketwork of it; the result of that is, that they save an immense quantity of land, and they have very nice plantations there.

1107. They have a sort of broom stuff they plant?—Yes; I can instance a case of the kind in my practice. From a place called Watchet to Dunster Abbey I built a very heavy sea wall, and the first heavy sea that came washed it all away. I afterwards went to Holland, and was witness of the way they made the basketwork there; I returned to Watchet and taught the men there how to do it, and there has never been anything washed away; on the contrary, a large quantity of land has been reclaimed.

1108. The engineers all admit that the water does not silt up here, but they say that a sand-bank forms, and that it will entirely silt up to the edge of the canal and at the edge of the Bay. We have got practical evidence of ten years to prove that it banks up at the back of the piers—what effect would that have upon that canal?—I do not think it will silt up there at all; there is less silt in this bay than in any place I have seen—it has been greatly magnified.

1109. Have you noticed the great bulk of sand that has buried the cottages nearly near the baths at Sandridge?—It would not do that when the water is in motion, it would never do that in that canal, because the water is always in motion, and the flood water will clean it out, while in the case of the Bute docks it was said that it would be always silting-up because they are made on the Cardiff flats; but they are found to be quite the contrary, it is easily washed out. The Cardiff are now becoming the largest docks in the world, and Lord Bute (I heard it given in evidence, before leaving England, twelve years ago), cleared £37,000 a year; he is now enlarging them and putting dock-gates 80 feet wide.

1110. Are not the Liverpool docks larger?—No, they are making Cardiff docks larger now.

1111. Is it your opinion decidedly that it would be less expensive to keep those two miles clear by a dredge than the Yarra with the natural mode and the aid of the Saltwater River, the Yarra being improved?—The canal would be less cost, and be in every way a great deal better than the Yarra—there is no comparison. Improve the river as you like, it will never be a good job.

1112. Would it be practicable to make a channel as deep as the one you propose at the old mouth of the Yarra without piers?—Yes.

1113. Would not the old mouth of the river be as liable to silt up as the new cut you propose?—I think more so, because you have always that natural dam, the Saltwater River.

1114. Could you make an opening without piers at the old outlet as easily as you could at the new outlet?—No.

1115. You would require piers at one as well as the other?—Yes.

1116. Would it be practicable to find a substantial contractor who would undertake to do the whole of that canal and piers?—Yes.

P. E. Henderson, Esq., C.E., F.R.S., *continued*, 7th March 1873.

1117. On the other hand, would it be practicable, or do you think you could find a contractor who would undertake to give the same facilities for going into the Bay from the Yarra and take a contract for doing it?—They can both be done; but there is no comparison between making a new canal and going about six miles by the river.

1118. The expense would not be more than one-third?—I do not think it would cost a million of money.

1119. There is less engineering difficulty in making the proposed canal than in improving the old river?—Yes.

1120. If it were 500 feet wide it would serve for dock accommodation as long as the traffic was not so large that it was not sufficient to accommodate it?—It will practically serve for ever; for instance, when I went to Cardiff, in 1836, there was not a single building near those docks at Cardiff, now all the commerce of Cardiff is down there—and remember it is upon flats.

1121. It is swampy ground similar to this?—Exactly, and there are the finest shipping staiths there in the world now.

1122. Do you think that the force of the water now tends to keep the mouth of the present river clear from the sand?—I do not think the sand is very serious there.

1123. Are you aware that the current is from St. Kilda towards Emerald Hill and Sandridge?—No doubt; but I have just been explaining that I think you could stop all that.

1124. You are aware of the fact?—Yes.

1125. You are aware that within the last twelve years there have been sand heaps raised 16 feet high across at the batteries?—Yes.

1126. Was that blown out of the sea on to the bank?—No doubt of it. I would accumulate sand at different places along the coast as in Holland.

1127. You think the strength of the river at the mouth, taking its present capacity, is sufficient to keep the sand out?—Yes, no doubt of it.

1128. Suppose that that strength were divided by cutting a straight canal 500 feet wide, would not that lessen the force that is now excited against the sand at both places, both at the mouth of the present river and at the canal?—I think not perceptibly so, because the water will always be in motion, and the sand here is very light.

1129. This 500 feet cutting would be all you require in capacity to equal the current of water now going down the river?—Yes.

1130. But that would divide the force?—No doubt of it; but the water being always in motion, and there being so little silting-up here, I do not think there would be a perceptible difference; besides that, the shipping, particularly the steamers coming up and down, would keep the sand in motion.

1131. Would you see any reason in favor of a canal being cut on any other grounds, such as a fact the tide rising, and having to travel before it reach the gasworks eight miles up the present river, whereas it would reach the same point by travelling only two miles by this canal, or would any objection arise out of that?—It would travel quicker the two miles. It would rise quicker, and discharge itself in the two miles quicker than it would over the six, and you would have mechanically a greater motion.

1132. Then assuming a given pressure here—say two miles back—would not that pressure expend a greater force at the end of the two miles here than it would do if it had to travel round eight miles?—No doubt it would eke it out quicker.

1133. What is your opinion as to the floods which occur at Melbourne—are they from the rain that falls or from the south-east winds?—I do not think the wind has anything to do with it; it is the flood from the different sources of the river.

1134. What effect upon the courses of the Yarra would the completion of this canal have—that is, what effect would it have upon the bottom—would it cause the river to silt up?—No, it would not do the least harm to the river.

1135. Mr. Gordon is of opinion that, if a canal was made like this, there would require to be a very long and expensive pier at the end—do you think that necessary?—Not at all. I would rather put three 80-feet locks.

1136. Supposing this is the Bay here—[*pointing to the plan*]—assuming that this is the River Yarra coming down, and these are the gasworks at this spot; suppose we cut a canal running straight to the Bay, and the river to silt up and become practically useless as a river, do you think it would be a disadvantage equal to the advantage that would accrue to the whole of the population lying south, such as Emerald Hill and Sandridge; assuming this canal 500 feet wide to become the river in future?—I would not care if the river was filled up to-morrow.

1137. Supposing that this canal was cut, would the river become practically useless for shipping?—No ship would come up it.

1138. There could then be no objection to making the river a proper common sewer for the drainage from Moonee Ponds and all adjacent lands, if it were properly built in and constructed in a proper way?—Not the least; I may add in conclusion, I have visited every one of those harbors in France and Belgium, and I have never seen one of them that has so little silting as I have seen in this harbor.

1139. Were you to be understood to say that it was merely a question of time as to the silting-up of that part of the Bay where the Yarra opens into it?—No, I did not say so, for I do not think it will silt up, and what silting you have may be very much reduced upon that simple plan I have spoken of in Holland; I do not say exactly the same, but the same in principle.

The witness withdrew.

Adjourned.

APPENDICES.

No. 1.

RETURN showing the Number and Tonnage of Vessels arrived at the Port of Melbourne during the Years 1860–1871 respectively, and the first Six Months of 1872.

Year.	From United Kingdom.		From British Possessions.		From United States.		From Foreign States.		Total.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
1860	193	200,756	1,189	250,603	55	38,054	80	38,726	1,517	528,139
1861	159	164,540	1,235	281,277	45	31,190	72	29,794	1,511	506 801
1862	145	152,647	1,214	307,916	34	22,413	96	39,856	1,489	522,832
1863	180	182,365	1,198	314,781	38	29,038	102	48,434	1,518	574,618
1864	150	163,124	1.289	337,895	42	26,278	91	39,019	1,572	566,316
1865	128	146,629	1,288	344,011	35	22,975	106	43,549	1,557	557,164
1866	127	146,045	1,377	367,241	72*	45,032	123	52,120	1.699	610,438
1867	128	142,442	1,259	344,094	39	25,515	83	41,270	1,509	553,321
1868	133	137,074	1,366	393,451	37	22,760	99	43,187	1,635	596,472
1869	155	165,305	1,489	418,422	35	25,852	99	45,231	1,778	654,810
1870	134	153,853	1,365	388,167	30	19,203	107	46,120	1,636	607,343
1871	114	134,989	1,396	408,044	30	20,978	79	33,880	1,619	597,891
1872 (Jan.–June)	52	62,696	672	201,254	13	10,482	35	14,860	772	289,292

* In 1866 there were 47 vessels (23,553 tons) entered inwards from San Francisco, many of which were laden with grain, flour, &c.; cargoes valued at £323,028.

J. CHATFIELD TYLER,
Assistant Commissioner of Trade and Customs.

Accounts Branch, Department of Trade and Customs,
Melbourne, December 1872.

No. 2.

RETURN of the Number of Vessels entered at the Port of Melbourne from 1st July 1870 to the 30th June 1872.

Whence.	Where Discharged.															
	Ballast.		Tide Inspector, Hobson's Bay.		Hobson's Bay into Lighters.		Williamstown.		Sandridge Old Pier.		Melbourne and Hobson's Bay Railway Pier.		Melbourne.		Total.	
	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage.	No. of Vessels.	Tonnage	No. of Vessels.	Tonnage
Foreign Ports, from 1st July 1870 to 30th June 1871 ..	..	..	5	2,755 *	18	19,077	76	77,172	67	40,666	105	84,245	61	17,293	332	241,208
Foreign Ports, from 1st July 1871 to 30th June 1872	1	52	3	937	18	21,047	62	61,111	74	47,371	114	95,042	52	16,383	324	241,943
Intermediate Ports, from 1st July 1870 to 30th June 1871	11	1,144	75	25,047	85	32,537	3	222	16	5,310	101	49,869	1,029	238,501	1,320	352,630
Intermediate Ports, from 1st July 1871 to 30th June 1872	10	1,527	145	37,996	11	11,704	..	..	13	6,109	97	52,792	982	244,849	1,258	354,707
Coastwise, from 1st July 1870 to 30th June 1871 ..	..	..	..	..	13	1,096	1	103	3	553	..	..	603	65,992	620	67,749
Coastwise, from 1st July 1871 to 30th June 1872 ..	..	..	..	..	18	1,488	7	235	..	..	..	..	510	61,468	530	63,191
Total	22	2,453	228	66,735	158	86,949	149	138,848	173	100,009	417	281,948	3,237	644,486	4,384	1,321,428
Average for one year	11	1,226	114	33,367	79	43,474	74	69,424	86	50,004	208	140,974	1,618	322,243	2,192	660,714

* These cargoes are chiefly transhipment cargoes consisting principally of Colonial produce from other colonies.

J. CHATFIELD TYLER,
Collector.

Port of Melbourne, 7th December 1872.

No. 3.

RETURN showing the Number and Tonnage of Vessels arrived at the Port of Melbourne from 1st July 1870 to 30th June 1872.

Year.	From United Kingdom.		From British Possessions.		From United States.		From Foreign States.		Coastwise.				Total.	
	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.		No.		Tons.	No.	Tons.
From 1st July 1870 to 30th June 1871 ..	115	136,499	1,416	399,718	29	18,965	92	38,656	Steamers ..	228	620	43,148	2,272	661,887
									Sailing Vessels	392		24,401		
												67,549		
From 1st July 1871 to 30th June 1872 ..	111	133,475	1,361	406,127	29	21,707	81	35,341	Steamers ..	216	530	45,485	2,112	659,841
									Sailing Vessels	314		17,706		
												63,191		
Total	226	269,974	2,777	805,845	58	40,672	173	73,997	..		1,150	130,740	4,384	1,321,228

J. CHATFIELD TYLER,
Collector.

Port of Melbourne, 7th December 1872.

No. 4.

RETURN of the Number of Vessels entering the Yarra each Year from 30th June 1870 to 30th June 1872, classifying the sea-going vessels for each 200 tons above 300 tons; also sea-going steamers without classification.

Year.	Total Number of Vessels and Tonnage.		Sea-going Sailing Vessels.				Sea-going Steamers.	
			Between 300 and 500 tons.		Between 500 and 700 tons.			
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
1870–1	2,787	406,057	77	27,625	1	675	557	177,299
1871–2	2,628	411,502	61	21,791	1	537	584	203,406
Total ...	5,415	817,559	138	49,416	2	1,212	1,141	380,705

CHARLES B. PAYNE,
Chief Harbor Master.

No. 5.

RETURN showing Amount of Tonnage Dues received under Act 17 Victoria No. 18, and Pilotage Rates received under Act 17 Victoria No. 28, at the Ports of Melbourne and Geelong, during the Years from 1st July 1860 to 30th June 1872 inclusive.

Years.	Tonnage Dues Collected.									Pilotage Collected.								
	Melbourne.			Geelong.			Total.			Melbourne.			Geelong.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1860 (July to December)	8,935	4	0	606	6	0	9,541	10	0	9,270	15	8	471	6	9	9,742	2	5
1861	16,128	9	0	699	18	0	16,828	7	0	17,626	2	6	628	18	4	18,255	0	10
1862	17,605	14	0	475	17	0	18,081	11	0	21,572	10	2	371	9	9	21,943	19	11
1863	19,315	12	0	534	13	0	19,850	5	0	23,668	6	7	737	0	5	24,405	7	0
1864	17,817	2	0	794	14	0	18,611	16	0	21,547	14	5	902	14	4	22,450	8	9
1865	16,689	0	0	413	11	0	17,102	11	0	17,567	2	6	292	9	7	17,859	12	1
1866	18,281	15	0	320	2	0	18,601	17	0	19,596	2	3	371	17	8	19,967	19	11
1867	15,694	17	0	288	10	0	15,983	7	0	15,990	18	11	321	4	5	16,312	3	4
1868	16,344	1	0	392	15	0	16,736	16	0	16,357	7	0	604	14	8	16,962	1	8
1869	17,913	5	0	490	6	0	18,403	11	0	19,111	0	8	463	2	5	19,574	3	1
1870	17,096	17	0	405	1	0	17,501	18	0	17,483	9	9	545	6	2	18,028	15	11
1871	15,586	14	0	374	19	0	15,961	13	0	16,910	4	7	370	15	11	17,281	0	6
1872 (January to June)	7,154	10	0	160	19	0	7,315	9	0	7,819	1	2	81	15	9	7,900	16	11
Total in 12 years...	204,563	0	0	5,957	11	0	210,520	11	0	224,520	16	2	6,162	16	2	230,683	12	4

J. CHATFIELD TYLER,
Assistant Commissioner of Trade and Customs.

Department of Trade and Customs,
Melbourne, December 1872.

No. 6.

STATEMENT showing Expenditure for each Year from 1st January 1860 to 30th June 1872 on Wharves and their approaches, Melbourne, Williamstown, and Sandridge.

Year, &c.	Melbourne.	Williamstown.	Sandridge.
	£ s. d.	£ s. d.	£ s. d.
1860	4,530 18 0	Nil	2,988 10 9
1861	5,663 10 5	Nil	940 18 9
1862	1,642 4 10	Nil	3,487 10 0
1863	2,107 9 5	98 7 6	1,183 10 0
1864	5,022 2 10	785 3 0	978 17 6
1865	2,426 6 6	59 13 4	577 16 5
1866	2,365 19 3	917 19 0	2,167 0 0
1867	353 6 2	33 0 0	422 13 11
1868*	1,327 8 8	Nil	1,928 11 7
1869	2,988 4 6	595 15 8	4,522 2 10
1870	6,503 0 6	138 11 6	2,525 8 7
„ (south side of Yarra)	4,972 18 6	...	...
1871 (first six months)	1,946 13 2	38 19 10	Nil
„ „ „ (south side of Yarra) ...	2,964 7 2	...	...
1871–2	8,272 18 5	19 14 3	1,978 11 6
„ (south side of Yarra)	4,704 1 7	...	...
	57,791 9 11	2,687 4 1	23,701 11 10

* Site of Cole's and Raleigh's wharves purchased in 1868 for £35,000.

A. G.

No. 7.

ABSTRACT of Dredging Operations.

——	River Yarra.	Cost.	Wharves.	Cost.
	Cubic yds.	£ s. d.	Cubic yds.	£ s. d.
1862	141,595	13,734 7 7	...	...
1863	115,542	9,409 16 9	14,590	4,607 8 6
1864	126,290	11,749 5 8	7,260	1,412 18 1
1865	113,917	12,399 16 8	14,705	3,050 18 10
1866	59,613	10,245 1 4	...	...
1867	34,855	6,208 14 11	4,155	660 10 0
1868	25,466	4,084 9 3	15,903	2,153 14 11
1869	137,792	13,259 15 7	2,010	356 10 6
1870	122,702	10,036 1 9	...	...
1871 (first six months) ...	43,088	5,534 9 7	4,737	715 13 0
1871–72	111,934	9,530 0 0	5,714	1,023 1 8
	1,032,794	106,191 19 1	69,074	13,980 15 6

Total removed from River, from January 1862 to June 1872, 1,032,794 cubic yds., at a cost of £106,191 19*s.* 1*d.*= 2*s.* 0·67*d.* per cubic yard.

Total removed from Wharves, from January 1862 to June 1872, 69,074 cubic yds., at a cost of £13,980 15*s.* 6*d.*= 4*s.* 0·57*d.* per cubic yard.

GEORGE BIRNIE,
Superintendent of Dredging Operations.

23 | 1 | 73.

No. 8.

ABSTRACT of Dredging Operations.—Quantities of Silt Landed.

——	Cubic yards.	Cost.	Average per yard.
		£ s. d.	s. d.
1863	11,600	559 15 6	0 11·6
1864	33,382	1,293 17 6	0 8·6
1865	28,530	1,090 10 3	0 9·1
1866	20,970	785 6 6	0 9·0
1867	34,395	1,077 14 0	0 7·5
1868	3,693	266 10 9	1 5·8
1869	31,580	1,091 17 3	0 8·3
1870	7,110	177 15 0	0 8·6

GEORGE BIRNIE,
Superintendent of Dredging Operations.

23 | 1 | 73.

No. 9.

STATEMENT showing Expenditure upon Port of Melbourne, including Sandridge, from 1855 to 30th June 1872.

	£ s. d.	£ s. d.	£ s. d.
Expenditure upon Wharves and other approaches, including repairs, as per Appendix F to report of Royal Commission on Harbor Improvements, &c., 1860	296,147 6 0		
Expenditure as per return from the Public Works department to this Commission—Appendix No. 6	57,791 9 11		
		353,938 15 11	
Purchase of Cole's and Raleigh's Wharves	...	35,000 0 0	
			388,938 15 11
Cost of Dredging from 1862 to 30th June 1872—			
At Wharves at Melbourne, as per Appendix No. 7	...	13,980 15 6	
River Yarra, as per Appendix No. 7	...	106,191 19 1	
			120,172 14 7
Total Melbourne Wharves and Yarra ...	...	...	509,111 10 6
Sandridge—			
Expenditure as per Appendix F to report of Royal Commisson 1860—			
Sandridge Jetty	19,224 11 3		
North Beach Jetty	13,005 2 10		
		32,229 14 1	
Expenditure as per return from the Public Works department to this Commission—Appendix No. 6	...	23,701 11 10	
			55,931 5 11
Total Expenditure from 1865	...	...	565,042 16 5

GEORGE A. MOURITZ,
Secretary.

No. 10.

WINDS, Hobson's Bay.—Average of Six Years.

Mean hourly velocity, 10·7 miles. Greatest velocity, 58 miles, on 8th March 1866, from West.

Seasons.	Winds blow per cent.		More Northerly than Southerly.	More Southerly than Northerly.	Calms.
	Northerly.	Southerly.			
SPRING—					
September to November	52·7	46·3	6·4	...	1·0
SUMMER—					
December to February	28·5	70·6	...	42·1	0·9
AUTUMN—					
March to May	45·9	52·7	...	6·8	1·4
WINTER—					
June to August	76·9	22·1	54·8	...	1·0
The Year	51·1	47·8	3·3	...	1·1

N.B.—N., N.W., N.E., and W. = Northerly winds. S., S.W., S.E., and E. = Southerly winds.

No. 11.

STATEMENT showing the Amount of Wharfage Rates collected at the Port of Melbourne in each Year since the present Rates were imposed.

Wharfage and Harbors Rate Act, passed 11th May 1864.

Period.	Amount Collected.
	£ s. d.
12th May to 31st December 1864	50,261 5 10
1st January to 31st December 1865	81,434 19 5
" " 1866	90,384 5 9
" " 1867	75,214 9 9
" " 1868	88,943 17 7
" " 1869	99,219 12 3
" " 1870	86,810 11 11
" " 1871	85,200 1 2
1st January to 30th June 1872	39,929 5 6
Total	£697,398 9 2

J. CHATFIELD TYLER,
Assistant Commissioner of Trade and Customs.

Department of Trade and Customs,
4th March 1873.

No. 12.

Sir, Melbourne, 1st May 1873.

I beg to forward you herewith a longitudinal section of the proposed canal for the diversion of the River Yarra from the gasworks to the sea. I took no cross sections, as the ground being level in a transverse direction, they were unnecessary.

I append underneath the result of the borings. From them you will perceive that sand exists for about thirteen (13) feet from the surface at either end, to about twenty-two (22) feet in the centre. Then comes blue clay, until arriving at a depth of twenty-nine (29) feet from the surface in the centre a stratum of stiff yellow brick clay is reached.

On Mr. Gordon's line sand exists for about nine (9) feet from the surface, when the blue clay is reached, and continues for about twenty-five feet from the surface, which is as far as I thought it necessary to bore.

In none of the borings did I find any indication of rock.

Borings on proposed Line of Canal, or Flood Board Scheme.

No. 1 *Boring.*—Surface.

Black loam	1′ 4″	31′ 6″	
Soft loam and sand	2′ 6″		
Quicksand	12′ 0″		
Tenacious blue clay, soft in water, sand absent	15′ 8″		

Total depth, 31 feet 6 inches.

No. 2 *Boring.*—Surface.

Black sandy loam	3′ 0″	31′ 0″	
Sharp grey sand mixed with quartz	2′ 6″		
Fine beach sand	8′ 6″		
Black sand and some blue clay	7′ 6″		
Blue clay	7′ 6″		
Stiff yellow clay	2′ 0″		

Total depth, 31 feet.

No. 3 *Boring.*—Surface.

Black sandy loam	1′ 6″	30′ 6″	
Black coarse sand	1′ 6″		
Very fine beach sand	18′ 9″		
Hard cement	1′ 9″		
Blue clay	7′ 0″		

Total depth, 30 feet 6 inches.

No. 4 *Boring.*—Surface.

Sand and loam	2′ 0″	30′ 0″	
Coarse sand and shells	4′ 6″		
Soft blue mud, with some sand	6′ 6″		
Blue clay	17′ 0″		

Total depth, 30 feet.

Borings on Mr. Gordon's Line, or River Scheme.

No. 1 *Boring.*—Surface.

Sandy loam	1′ 0″	25′ 6″	
Blue clay	1′ 0″		
Coarse quartz sand	9′ 6″		
Blue clay	11′ 0″		
Stiff yellow clay	3′ 0″		

Total depth, 25 feet 6 inches.

No. 2 *Boring.*—Surface.

Sandy loam	1′ 0″	0′ 0″	
Coarse gravelly sand	5′ 0″		
Sand and blue clay	3′ 0″		
Stiff clay and shells (blue)	11′ 0″		

Total depth, 20 feet.

The accompanying longitudinal section will show the level from which each boring was taken.

The level of the surface of the ground for the borings on Mr. Gordon's line may be taken at 4′ 0″ (four feet) above datum.

I have the honor to be, Sir,
Your very obedient servant,
RICHD. HALL COE, C.E.

G. A. Mouritz, Esq.,
Secretary Royal Commission.

No. 13.

Report on Borings made under direction of F. C. Christy, Esq., C.E., for a Ship Canal and Docks, copied from "Argus" of 3rd June 1854.

A set of eleven borings has been taken round Batman's Hill, with the view of ascertaining the position of the stone below. The results are satisfactory. A mass of bluestone (basalt) is found at varying depths, in some places within a few feet of the surface, while at others, following the slope, it is lost at a depth of 30 feet. The following is a statement of one of the latter borings, taken six chains from the hill :—

2 feet sandy loam.
6 „ back river mud.
To 10 „ ditto, tending to clay, mixed with quartz.
To 16 feet, clay with quartz (grit).
18 to 25 „ firm tenacious clay.
27 to 30 „ looser clay with iron, as usually found over the stone.

A set of thirteen borings has been taken on the line of the canal, and a solid bottom has been found throughout nearly the entire length. The bottom is of clay, and its surface ranges at from 5 to 30 feet from the surface. The clay strata are in thickness from 20 to 30 feet, as far as examined.

By the courtesy of Mr. Christy our reporter has had access to the whole of the borings, and has compiled the following notes, which afford the best evidence of the soundness of the ground that could be desired. Thirteen borings were taken along the projected course of the canal, and beyond the required depth. The only places which appeared to be discouraging were two faults which appear to have been washways or watercourses, in connection with the Yarra, at an early period in the geological history of the country. They are connected at the surface with the St. Kilda lagoons, and the small section which they will form with the canal has been ascertained by check borings made at the side of them. In both these cases there is good bottom. It is probable that these places may have been taken for quicksands in the former surveys, but they do not seem to be so. The following is an abstract of the borings with their positions, indicated by their distance in chains from the proposed junction with the Yarra, the whole length of the canal being 138 chains :—

Boring 1—2 *chains.*

Surface, river mud
To 5 feet, peat and vegetable earth.
6 „ sand conglomerate.
7 „ loamy sand to clay.
8 „ tenacious clay, red and yellow mottled.
10 „ do., with pipeclay.
To 50 „ clay, various colors, bottom very stiff.

Boring 2—22 *chains.*

Surface, flat, with grass.
1 foot, peat.
2 feet, sand,
9 „ vegetable loam.
10 „ loamy clay.
To 13 „ shells.
14 „ hard quartzose conglomerate.
18 „ do., with clay.
19 „ hardened sandy loam.
21 „ hard mottled clay, with a little sand.
27 „ stiff clay.
35 „ clay, with yellow ochre.
38 „ red and yellow clay, with sand.

Boring 3—42 *chains.*

Surface, grassy flat.
1 foot, peat.
2 feet, sand.
To 18 „ sand and shells, to loam.
19 „ loam.
20 „ compacted loam.
23 „ clay.
To 29 „ clay, with some sand.
30 „ clay (good).
To 45 „ clay, with some sand.
50 „ sound clay.

Boring 4—53 *chains.*

Surface, swamp.
1 foot, peat.
2 feet, sand, with vegetable earth compacted.
6 „ clay, with sand.
14 „ black river mud.
15 „ do., with coarse sand.
16 „ do., do., verging on quartz conglomerate.
17 „ wet sand.
20 „ stiff, black, clayey river deposit.
To 50 „ do., stiffer, with wood and shells.
(This is the largest of the two washways.)

Boring 5—57 *chains.*

Beyond the Swamp—A check on the last to ascertain the extent of the washway.

1 foot, peat.
2 feet, loam, quartz, conglomerate.
5 „ soft red sandstone.
(Water is here found for several feet.)
14 feet, sand.
18 „ pipeclay.
19 „ alluvial deposit, vegetables and shells.
22 „ compact clay.
33 „ hard clay.
To 50 „ mottled clay.

Boring 6, 7.

Taken to ascertain if a ridge 18 chains beyond the last station was stony.

To 15 feet, sand, &c. ; no stone.

Boring 8—85 *chains.*

Surface, swampy ; the second washway.
To 20 feet, sand.
26 „ sandy loam.
30 „ sand and shells.
38 „ very coarse sand.
40 „ loamy river deposit.
44 , black do., firm.
60 „ solid black deposit.

Boring 8*—87 *chains.*

A check on the last, beyond the washway ; surface, sand and vegetable matter.

4 feet, sand.
6 „ coarse red sand.
8 „ coarse sand and shells.
10 „ fine do., do.
To 20 „ wet sand.
22 „ wet sand and shells.
24 „ wet grit.
28 „ compacted coarse sand.
29 „ clay, stiff grey brown.
40 „ do., do., mottled.

Boring 9—117 *chains.*

Surface, sand with ferns.
6 feet, colored sand.
To 18 „ do., and shells.
19 „ loamy sand.
20 „ loose sand.
24 „ loam.
28 „ brown clay and shells.
To 34 „ compact brown clay.
36 „ soft sandstone.
40 „ red do.
42 „ sandstone grit.
To 48 „ coarse conglomerate.
50 „ do., hard and red.

Boring 10—133 *chains.*

Surface, tea-tree scrub (*fabricia lavigata.*)
To 6 feet, fine sharp sand.
12 „ sand and shells.
16 „ wet sand.
To 26 „ do., firm.
30 „ sandy loam.
32 „ loam.
38 „ alluvial deposit.
42 „ do., black and stiffer.
45 „ do., compact.

Boring 11—138 *chains.*

Surface, ridge above high-water mark.
To 8 feet, sand.
— „ blue-black clay.
28 „ loam.
To 40 „ do.
45 „ clay.
79 „ do.
79 „ black clay, with nodules of ochre, &c.

All these measurements are taken from the surface of the ground. It must therefore be observed that some of these stations must have an elevation considerably above high-water mark, so that an allowance must be made which will remove much of the apparent disadvantages from even the most unfavorable borings, Thus the second washway (boring 8) commences 5 feet above high-water mark, therefore, in practice, the bottom will be found so much earlier than appears by the above measurements.

At the beach a hard blue clay underlies the surface sand, and is bared at a distance of 700 feet from the shore. At 100 feet further, there is 18 feet of water, and at a distance of 1000 feet there is a depth of 21 feet at low water. The canal will be slightly contracted at its mouth to give a greater force to the current, and to ensure the passage being kept clear.

[TRUE COPY.] ROBERT BOWDEN,
Secretary to the Harbor Improvement Commission.

The above, if a copy of my report, is a true statement of the ground specified.

F. H. CHRISTY, Loco. Superintendent Victorian Railways.

No. 14.

SIR, Melbourne, 2nd May 1873.

I beg to forward you herewith the estimate of quantities contained in the three designs for channels and river improvements, as directed in your letter of 26th ultimo. The estimate has in each case been based on a width at bottom of 300 feet, depth at low water 22 feet, and side slopes 2 to 1.

I have also included, as desired, an estimate of approximate quantities and cost of the necessary piers or walls in the bay for the scheme of Mr. Christy's (No. 2), in timber, rubble, and in masonry. These walls do not extend more than 1100 feet into the bay from high-water mark.

I have the honor to be, Sir,
Your most obedient servant,
SAM. H. MERRETT, C.E.

G. A. Mouritz, Esq.,
Secretary Low-lying Lands Commission.

QUANTITIES in excavation for the works as proposed by Mr. Gordon in widening and deepening the River Yarra from the line of Spencer street and Clarendon street, and in forming a new cut across Humbug Reach; also in dredging the river from the end of the proposed cut and the entrance channel in the bay to a depth of 22 feet at low water.

4,202,964 cube yards excavation (river and new cut).
1,765,000 do. do. dredging river and channel.

5,967,964 total cubic yards.

Length of new cut and river widened to Spencer street, 2 miles 70 chains.
Do. dredging, 3 miles 67 chains.
Total length from Spencer street to end of dredged channel in the bay, 6 miles 57 chains.

QUANTITIES in excavation of the direct channel to the bay from a point on the River Yarra opposite the gasworks, as proposed by Mr. Christy, including the widening of the Yarra from this point to the line of Spencer street; also in dredging an entrance to the channel to a depth of 22 feet at low water.

4,012,395 cubic yards excavation (new channel and river).
230,000 do. dredging entrance to channel 65 chains in length.

4,242,395 total cubic yards.

Length of channel from Spencer street to high-water mark on the beach, 1 mile 76 chains.
Do., do., dredging, 65 chains.
Total length from Spencer street to end of dredged entrance channel in the bay, 2 miles 61 chains.

APPROXIMATE cost of pier walls to entrance of direct channel:—

Timber.—Width on top, 15 feet, 1100 feet long, and 10 feet high above low water.

		£	s.	d.
81,450	feet run. in jarrah piles, @ 6s.	24,435	0	0
194,839	cube feet sheeting piles, walings, &c., @ 3s.	29,225	17	0
16,500	cube yards clay filling, @ 3s.	2,473	4	0
163,342	lbs. wrought iron, @ 4d.	2,041	16	0
		£58,175	17	0

Stone (*"pierre perdue"*).—Walls 8 feet wide on top, 1100 feet long, height above low water 6 feet, side slopes 1 to 1.

		£	s.	d.
20,049	cube yards excavation, or dredging for foundations, @ 3s. 6d.	3,508	11	0
188,557	do. stone, @ 4s.	37,711	8	0
		£41,219	19	0

Masonry.—Walls 8 feet wide on top, 1100 feet long, height above low water 6 feet, battering sides.

		£	s.	d.
12,400	cube yards excavation, as before, @ 4s.	2,480	0	0
6,200	do. cement concrete, @ 40s.	12,400	0	0
444,725	cube feet ashlar, @ 4s.	88,945	0	0
14,606	cube yards hearting of walls, @ £3 7s. 6d.	49,295	5	0
		£153,120	5	0

Memo.—To the cost of the masonry in these piers must be added that of a coffer-dam to execute the work of each pier, in two lengths, say £24,000.

QUANTITIES in excavation of a new channel from the gasworks to a point in the Yarra near the mouth, as proposed by the Board in 1864, including the widening of the river from Spencer street to the new channel, and dredging into the bay a channel 22 feet deep at low water.

6,984,453 cube yards excavation (new channel and river).
1,120,556 do. dredging river and entrance channel.

8,105,009 total cubic yards.

Length of new channel and river widened to Spencer street, 3 miles 40 chains.
Do. dredging, 2 miles 32 chains.
Total length from Spencer street to end of dredged channel in the bay, 5 miles 72 chains.

SUMMARY OF QUANTITIES.

No. 1.—"Gordon."—Excavation	4,202,964			
Dredging	1,765,000			
		5,967,964	cubic yards.	
No. 2.—"Christy."—Excavation	4,012,395			
Dredging	230,000			
		4,242,395	„	
Pier walls—				
Timber		... ...	£58,175	17 0
Pierre perdue		... ...	41,219	19 0
Masonry }		... ... {	153,120	5 0
Coffer-dam }		... ... }	24,000	0 0
No. 3.—"Board."—Excavation	6,984,453			
Dredging	1,120,556			
		8,105,009	cubic yards.	

No. 1.—Gordon.—Length, 6 miles 57 chains.
No. 2.—Christy.—Length, 2 miles 61 chains.
No. 3.—Board.—Length, 5 miles 72 chains.

S. H. MERRETT, C.E.

No. 15.

SIR, 18 Market street, Melbourne, 9th May 1873.

At your suggestion I beg to forward, for the information of the Royal Commissioners on Low Lands, the revised rates of towages for this port, which came into operation on the 1st instant.

As the whole of my evidence before the Commission is not so clear as I could wish, I may be allowed to explain a portion of that evidence by the following further remarks on the probable cost of towage between Hobson's Bay and Melbourne by the direct canal and improved river.

Taking a vessel of 200 tons register as a basis, her towage up and down the present river is £15 17s. net. For this remuneration she is towed an average of 18 miles; for although the actual distance between Hobson's Bay and Australian Wharf, and *vice versâ*, is not more than 14 miles, yet, as nearly every river vessel receives a remove in Bay on the outward voyage, free of charge, and as a number of coasters are towed some distance into the Bay to secure their river work, I estimate that, on an average, every vessel discharging in Melbourne is towed 4 miles more than the actual distance paid for.

If a direct canal is cut, the distance will be shortened by say one-half, and, arguing from this fact, you might reasonably assume that the towage should be reduced in proportion, but when it is remembered that a considerable portion of the tug's time is taken up in assisting the vessel to get her anchor, conveying orders from consignee to the captain, and attending upon master, pilot, &c., it is evident that the saving to the tug proprietor is more apparent than real. Taking everything into consideration, and allowing for the risk of vessels "sticking" being considerably reduced, I am inclined to think that the reduction in towage by the direct canal to the class of ships *now using* the river would be about one-third, *i.e.* a vessel now paying £15 17s. would then pay £10 11s.

If the scheme proposed by Mr. Gordon, C.E., was carried out, the reduction in towage might be estimated at one-fifth, so that the cost of towing a 200-ton vessel might be calculated as follows:—

	£	s.	d.
1. By present river	15	17	0
2. By Mr. Gordon's scheme	12	15	0
3. By direct canal	10	11	0

I would rather be excused from offering any definite opinion as to the towage which would require to be charged the large ships which may be expected to use either the canal or improved river; of course the larger the vessel the less rate per ton will prove remunerative.

The ships of the "Loch" line of Glasgow clippers (averaging 1200 tons each) now pay £18 net for towage to and from the Government or Sandridge Railway piers, the distance towed being usually about 2 miles in all; but although that is only one-third of the distance by the direct canal (up and down), it does not follow, from the reason already mentioned, that the increase would be in proportion to the distance.

As regards the question mooted, whether ships would be likely to sail direct from sea to Melbourne through the canal, I have made some further inquiries in the matter, and I am informed that all large vessels, without exception, require a tug to go into the London Docks. My own decided opinion is, that as no vessels from foreign ports sail alongside the piers in Hobson's Bay (a much easier operation than sailing up a canal), no shipmaster or pilot would attempt to enter the canal with a square-rigged vessel, under canvas, if the services of a steamer could be obtained on reasonable terms.

I have the honor to be, Sir,
Your obedient servant,
HUGH R. REID.

G. A. Mouritz, Esq.,
Secretary Royal Commission on Low Lands.

RATES OF TOWAGE.

RIVER TOWAGE.

All Vessels.

200 tons and under	1s. 8d. per ton up and down
And for every ton above 200	1s. 2d. per ton up and down

Sailing Vessels only.

To and from docks or slips	half full rates

Vessels ballasting in Hobson's Bay, after discharging cargo at Melbourne, are entitled to one remove free of charge.

BAY TOWAGE.

Coasters.

250 tons and under	£2 2s. each removal
Over 250 tons	2d. per ton each removal

Foreign Vessels.

500 tons and under	£4 4s. each removal
Over 500 tons	2d. per ton each removal

Steamers.

200 tons and under	£3 3s. each removal
And for every ton over 200	2d. per ton
Lighters	£1 11s. 6d. each removal
Bulks	As per agreement.

Vessels going alongside a pier, and only towing one way, will be charged 3d. per ton; minimum rate being—for Coasters, £3 3s., for Foreign Vessels, £6 6s.

Vessels removing from Sandridge or Williamstown Railway piers to any other pier will be charged an additional half-rate.

REID, POOLE, AND CO.,
18 Market street, Melbourne.

Royal Commission on Low Lands,
56 Queen street, 12th May 1873.

SIR,

I am instructed to acknowledge receipt of your letter of the 9th instant, and to thank you for the explanation therein of your evidence given to the Commission on the 3rd February last; also for the revised rates of towage for this port which came into operation on the 1st instant.

I am also instructed to ask you to make a similar estimate of the cost of towage as that given in the above letter for a line of channel from Yarra, at the gasworks, to a point in the Yarra near its mouth, and known as the Board of 1864 Scheme, the distance being 5 miles 72 chains, Mr. Gordon's line being 6 miles 57 chains, the direct canal 2 miles 61 chains.

When I receive your reply I am instructed to have the information given printed, so that it will appear as part of the evidence collected by the Commission.

I have the honor to be, Sir,
Your most obedient servant,
G. A. MOURITZ, Secretary.

Hugh R. Reid, Esq., Melbourne.

SIR,

18 Market street, Melbourne, 13th May, 1873.

I have the honor to acknowledge the receipt of your letter of the 12th instant, and in reply thereto beg to state that, in my opinion, the difference in towage in favor of the scheme proposed by the Board of 1864, as against the one now suggested by Mr. Gordon, C.E., would be so trifling that it would not be advisable for the Royal Commission to take the question of towage into consideration at all when deciding between the *two* proposals.

I have the honor to be, Sir,
Your obedient servant,
HUGH R. REID.

G. A. Mouritz, Esq., Secretary Royal Commission, &c.

No. 16.

LETTER SHOWING PRESENT STATE OF FORESHORE AT ST. KILDA PIER.

SIR,

Melbourne, 19th June 1873.

In order to ascertain whether it would be desirable to have a survey made of the St. Kilda pier and the shore adjacent thereto, so that the alterations (if any) which had taken place in the locality since the pier was built might be noted for the information of the Commission, we yesterday visited the spot, and, having the original drawings with us—which were supplied to the Commission by the Public Works Department—we found the condition to be as described below, and submit the same for the consideration of the Commission, leaving to its judgment whether a survey will be required or not.

On drawing dated 31st May 1859 there are three cross sections of the pier laid down, viz.:—A B, about 30 feet distant from the shore end of the straight parapet wall; C D, about 112 feet distant from the same point; and E F, about 167 feet distant from the same point.

The cross section A B shows on plan a depth of 10 feet 6 inches from the top of the parapet. We found the sand blown up to be 5 feet from the top of the parapet; thus showing a deposit of 5 feet 6 inches in fourteen years.

The cross section C D shows on plan a depth of 11 feet 9 inches from top of wooden rail. We found the present depth to be 10 feet 7 inches; thus showing a deposit of 1 foot 2 inches in the same time.

The cross section E F shows on plan a depth of 11 feet 9 inches from top of wooden rail. We found the present depth to be 11 feet 6 inches; thus showing a deposit of 3 inches in the same time.

The above are taken on the eastern or weather side of the pier; on the western or lee side there is no alteration.

We have the honor to be, Sir,
Your most obedient servants,
JOHN McILWRAITH,
SAMUEL AMESS,
Members of the Royal Commission on Low Lands.

To the Chairman Royal Commission Low Lands, Melbourne.

No. 17.

ESTIMATES OF COST OF THE SEVERAL CANAL SCHEMES CONSIDERED BY THE COMMISSION.

SIR,

Melbourne, 9th May 1873.

At the request of the Commission, as made at last meeting, I submit statement of the cost of each of the three schemes for improving the approach to Melbourne from Hobson's Bay which have been under consideration, and for each of which Mr. Merrett has taken out the quantities. For the sum which I place opposite each scheme I am willing to undertake and complete each work respectively:—

	£	s.	d.
Mr. Gordon's scheme	465,797	18	0
Mr. Christy's scheme, including timber piers	320,982	4	6
Board scheme	547,495	18	6

I have the honor to be, Sir,
Your most obedient servant,
THOMAS O'GRADY.

To the Chairman of the Royal Commission on Low Lands.

SIR,

Melbourne, 9th May 1873.

As requested at the last meeting of the Commission, I now submit a statement of the cost of each of the three schemes which have been under consideration, and for which Mr. Merrett has taken out the quantities. For the sum opposite each scheme I am willing to undertake and complete that scheme:—

	£	s.	d.
Mr. Gordon's scheme	492,410	17	0
Mr. Christy's scheme, including timber piers	310,013	18	3
Board scheme	546,407	18	7

I have the honor to be, Sir,
Your most obedient servant,
SAMUEL AMESS.

To the Chairman of the Royal Commission on Low Lands.

No. 18.

LETTER FROM GEORGE GORDON, ESQ., C.E., ENGINEER-IN-CHIEF, VICTORIAN WATER SUPPLY, OBJECTING TO MR. AMESS' ESTIMATE FOR DREDGING.

SIR,

Sandhurst, 18th June 1873.

As I shall be unable to attend the meeting on Friday next, I wish to express in writing my dissent from the opinion of Mr. Amess as to the relative cost of dredging and excavation, which he put at 3s. and 1s. 1d. per cubic yard respectively. I think this may be calculated to mislead some of the members in their choice of a line for the canal, and I beg to submit for their information the following notes of rates at which dredging has been done in Europe and America:—

1. On the Hudson River, the cost of raising mud 20 to 25 feet, by a small machine, was from 4d. to 7½d. per cubic yard. A larger machine was expected to do it for less.

2. In the case of the River Tyne improvement, where immense quantities of dredging have been done, the cost, including labor and materials and all repairs, but exclusive of depreciation of plant, has been 3½d. to 4d. per ton.

3. At the Grand Canal works, Amsterdam, the dredgers have raised sand, gravel, &c., at the rate of 2000 tons per day, at a cost for labor, fuel, &c., not exceeding 1½d. per ton.

4. On the River Witham, a 16-horse power non-condensing engine raised soft mud from 15 feet below water at the rate of 1½ tons per minute, and the wages amounted to only £4 3s. per week.

5. On the Clyde, the cost of dredging and carrying the mud, sand, &c., 27 miles to Loch Long, including wages, coals, repairs, and 5 per cent. on capital, is 6·36d. per cube yard.

6. At Port St. Nazaire, in France, a very careful analysis of the cost of dredging mud gives the cost at from 2·2d. to 5·7d., according to the machine employed, or an average of 3·9d. per cubic yard, including *all* expenses—the *ascertained* depreciation of plant and interest. The stuff was carried one mile, and the conditions are similar to those of the port of Melbourne. The work was done by Government: no profit of contractors is included. Taking labor at two and a half times, and machinery at twice the European cost, and coals at 50s. per ton, and reducing the cost of the French work to these terms, it becomes 8½d. per cubic yard. The Clyde work would be at the rate of about 10d. reduced to Melbourne prices.

I have the honor to be, Sir,
Your most obedient servant,
G. GORDON.

The Secretary of the L.L. Commission.

MR. AMESS' REPLY.

To the Chairman Royal Commission, Low Lands.

Sir, William street, Melbourne, 23rd June 1873.

Mr. Gordon, in his letter of the 18th instant, which was read to the Commission at last meeting and ordered to be printed, having impugned the correctness of my estimate for the item of dredging in the three schemes for the improvement of the port which I submitted to the Commission on the 9th May last, and as the Commission at its last meeting finally decided to adopt the most expensive line for a canal, I request that, in fairness, I should be permitted to defend my estimate, and have this letter printed as an answer to Mr. Gordon's strictures.

1st. I submit that, for obvious reasons, the cost of dredging in Europe is scarcely a fair ground of comparison by which to judge of the cost here, even if Mr. Gordon's statements were thoroughly reliable. I am not in a position to test any of the statements he has made, except in the case of the Clyde. In this case the report of the accounts of the Clyde Trust, 1868–1869, are before the Commission as a matter of evidence supplied by the Government of Victoria. In that document I find the cost of dredging for that year was 9·52d., and did not include any charge for interest on plant. The Trust has been dredging since 1844, and would therefore have the plant in thorough working order and suitably adapted to the work by long experience. Therefore, as I cannot accept Mr. Gordon's statement as to the Clyde, neither am I disposed to receive the other instances he cites, or admit the correctness of his deductions as to what the Melbourne prices ought to be.

2nd. But I consider what has been done in the colony itself is the best criterion. In the return supplied to the Commission by the Public Works Department (*see* Appendix No. 7) I find the cost to the Government has been, for the ten years ending June 1872, for dredging in the river, 2s. 0·67d. per cubic yard, and at the wharf, 4s. 0·57d. per cubic yard. The whole of the stuff lifted—1,101,868 cubic yards—was deposited in the Bay outside Williamstown, except 171,260 cubic yards, which was landed on the banks of the Yarra. My estimate was made upon the supposition that the whole of the stuff lifted would be landed and used on shore in raising the level of the adjacent lands. This item of landing, the Government estimates, for the year 1870, at 8·6d. per cubic yard. Further, in the Government cost there is no interest on plant, nor is there any evidence that the cost of repairs is included.

I maintain, therefore, that my estimate is a correct and fair one; and the stern fact must remain, to the discomfiture of engineers and others, that the direct scheme is the cheapest in point of construction, as compared with the selected scheme, by £250,000, and is the best beyond comparison in point of utility to all others.

I have the honor to be, Sir,
Yours, &c.,
SAMUEL AMESS.

No. 19.

ST. KILDA LADIES' SEA-BATHING COMPANY (LIMITED).

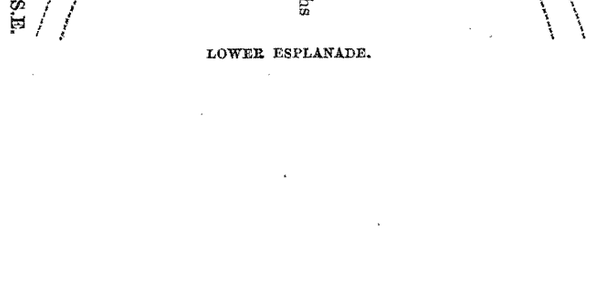
Dear Sir, Grey street, St. Kilda, June 19th 1873.

As requested by you, I herewith forward soundings taken at dates given of Hobson's Bay opposite the above baths,
And remain,
Your obedient servant,
HENRY TULLETT, Secretary.

S. P. Lord, Esq.

LOW WATER OF SPRING TIDES.

	1873.		1873.		1873.	
	February 4.	June 17.	February 4.	June 17.	February 4.	June 17.
500 feet	...	...	11 ft. 0 in.	...	...	...
350 „	...	...	...	9 ft. 2 in.	...	...
300 „	...	8 ft. 8 in.	10 „ 0 „	9 „ 8 „	...	9 ft. 6 in.
250 „	...	8 „ 0 „	10 „ 0 „	9 „ 2 „	...	9 „ 6 „
200 „	7 ft. 6 in.	7 „ 1 „	9 „ 0 „	7 „ 2 „	10 ft. 0 in.	8 „ 10 „
150 „	...	6 „ 7 „	7 „ 6 „	6 „ 2 „	...	7 „ 6 „
100 „	...	5 „ 6 „	6 „ 3 „	6 „ 4 „	...	6 „ 2 „
50 „	...	4 „ 0 „	5 „ 0 „	4 „ 8 „	...	4 „ 11 „
		3 „ 2 „	4 „ 3 „	4 „ 2 „	...	3 „ 8 „



No. 20.

SUMMARY OF ENGINEERING AND NAUTICAL EVIDENCE.

Taken at various times, on the formation of a direct channel from Melbourne to Hobson's Bay, and also the improvement of the River.

Evidence in favor of the practicability of making direct canal to Hobson's Bay, and the maintenance of an entrance there at little or no annual expense:—

Evidence, while admitting the practicability of making, is against the construction of a direct canal to Hobson's Bay, because the entrance in the Bay could only be kept clear (if at all) at an enormous annual expense:—

From Report of Evidence, Select Committee, 1852.

Engineers.

Henry Ginn, Esq., Colonial Architect.
James Blackburn, Esq., City Surveyor.
David Lennox, Esq., Superintendent of Bridges.

Nautical.

Captain Ferguson, Chief Harbor Master.

Engineers.

None.

Nautical.

Captain George Gilmore.

From Report of Evidence, Select Committee, 1858.

Engineers.

Captain Charles Pasley, R.E.
Francis Bell, Esq., C.E.
Frederick C. Christy, Esq., C.E.

Nautical.

Captain Ferguson, Chief Harbor Master.
Captain Currie.
Captain Cole.

From Report of Evidence, Royal Commission, 1860.

Engineers.

M. Bullock Jackson, Esq., C.E.
Jno. Nimmo, Esq., Surveyor, Emerald Hill Municipality.
A. K. Smith, Esq., C.E.
Jno. Reilly, Esq., City Surveyor.
G. C. Darbyshire, Esq., C.E.
Francis Bell, Esq., C.E.
Thomas E. Rawlinson, Esq., C.E.
F. C. Christy, Esq., C.E.
Thomas Oldham, Esq., C.E.
John Millar, Esq., C.E.
W. A. Zeal, Esq., C.E.
Mungo Park Smith, Esq., C.E.

Nautical.

Captain James McMechan.
Captain Ferguson, Chief Harbor Master.

Engineers.

William Elsdon, Esq., C.E.
George Birnie, Esq., Superintendent of Dredges.
Robert Adams, Esq., C.E.
Thomas Higinbotham, Esq., C.E., Engineer-in-Chief Victorian Railways.

Nautical.

Captain John McLean.

From Report of Evidence, Royal Commission Low-lying Lands.

Engineers.

Henry Mosely, Esq., C.E.
Clement Hodgkinson, Esq., Assistant Commissioner Lands and Survey.
Edwin P. Henderson, Esq., C.E.

Nautical.

Captain Payne, R.N., Chief Harbor Master.
Captain Fullarton, Harbor Master, Melbourne.
Captain Hugh Macmeikan.
Captain W. H. Smith.

Engineers.

Robt. Adams, Esq., C.E., City Surveyor.
William Elsdon, Esq., C.E., Engineer Melbourne and Hobson's Bay Railway.
George Birnie, Esq., Superintendent of Dredges.
Thomas Higinbotham, Esq., C.E., Engineer-in-Chief Victorian Railways.
George Gordon, Esq., C.E., Engineer-in-Chief Victorian Water Supply.
W. W. Wardell, Esq., C.E., Inspector-General Public Works.

Nautical.

Honorable George Ward Cole, R.N.

GEORGE A. MOURITZ,
Secretary Royal Commission Low Lands.

GENERAL SUMMARY.

The figures refer to paragraphs in the reports of evidence.

From Report of Select Committee of Legislative Council, 1852.

HENRY GINN, Esq., Colonial Architect—

In favor of direct canal, 31. Apprehends no difficulty of importance in keeping mouth open, 34. There are no great engineering difficulties to overcome, 38. The formation of docks should be left to private enterprise, 71; they should be on the north side of the river, 72. *See* also report in Appendix.

JAMES BLACKBURN, Esq., City Surveyor—

Proposed a line of canal or cutting from Melbourne to beach, 87. The Falls breakwater must be removed to allow of greater and longer tidal action in the river above Melbourne, and so provide a scour, 96; this is needful for either the river or canal; would divert the river into the new cut; the remaining portion of the river might fill up but it would be a slow process, 98, Even with the proposed improvements (as above, 96), added to the present river, would still advocate the new cut as the best and cheapest method of improving the port, 99. *See* also report in Appendix.

DAVID LENNOX, Esq., Superintendent of Bridges—

In favor of canal, and apprehends no difficulty of importance if mouth of canal was further west than Mr. Blackburn's proposal, so as to be under the lee of Williamstown, 186, 187.

CHARLES FERGUSON, Esq., Harbor Master—

The canal should enter the Bay west of Liardet's, 224, 234. No difficulty in working the canal at the mouth, 241. Vessels are at present detained unloading because the lighters have taken the ground in the river, having become unmanageable in the freshes, and therefore unable to discharge and return, 255. The winding nature of the river makes it difficult to navigate; when freshes are coming down vessels become unmanageable, 256. If the river was deepened it would afford more facilities than a narrow canal, 257. Is unable to estimate the probable expense of either, 258.

Captain GEORGE GILMORE—

Opposed to a canal; the mouth could not be kept open because of southerly gales, and being on a lee shore, 322. If jetties were made on the north (Sandridge) beach, even with the benefit of a breakwater at Williamstown, permanent traffic could not be carried on there, 339.

In 1854 a Commission of three Royal Engineers—Captain Clarke, Captain Pasley, and Captain Ross—was appointed to consider the relative merits of communicating with Sandridge and Williamstown, by means of a road, a canal, or the River Yarra; but it does not appear that this Commission ever reported, as no record can be found in the office of the Chief Secretary, or in the office of the Private Secretary, that such a report was ever made.

Captain CHARLES PASLEY, R.E., in report on various plans for the improvement of the Port of Melbourne, 1855—

Is opposed to Christy's plan of a direct canal (the only one submitted, though he had heard of others), on account of the heavy expenditure it would entail, and this objection is common to all such plans. All the money that the colony could then raise was required, in his opinion, for railways. Concurs with Messrs. Oldham and Rawlinson in the opinions they expressed, viz.:—that Hobson's Bay was comparatively free from silt (sand); that the chief source from which the head of the Bay is filling is the Yarra and Saltwater River; that owing to the small rise and fall in Hobson's Bay, and to the nature of the Bay, it being a gulf with a small entrance at the Heads, they contend that to expect a scour of more than 3 feet in depth below low-water is simple nonsense; and to think of running groins out to confine the entrance of the river, and use that as a scour, is little better. A general plan showing Christy's scheme accompanied the report.

From Report of Select Committee, 1858.

Captain C. PASLEY, R.E., 19th November 1858—

Opposed to the canal chiefly on financial grounds, 482. If it could be shown on reliable grounds that a large sum (say £800,000) could be obtained for the adjacent lands, let the work be undertaken by a company, or a trust, granting to such a body the land, but it would be impolitic for the Government to undertake it, 483, 564. Docks will be a necessity for Melbourne, and access to them must be by deepening the river or by a canal; the latter is to be preferred; there are objections

to it, but they can be overcome; they are chiefly matters of expense; one is the difficulty of keeping the mouth open, 484. Before the piers at Sandridge were built the witness anticipated some difficulty in ships lying there, but since the piers have been erected it is demonstrated that ships can lie there 493. Did not make an estimate of the cost of the canal, not having a complete set of borings, 506. Considers the mouth of the canal might be kept clear by running out walls into the sea until you get beyond the action of the waves; but it would most likely occur that the sand, having a motion from east to west, would gradually silt-up outside the most easterly of those walls, and would then turn the corner, 517. There would be but little scour; the dredge would be in constant use, 518. The expense would not be heavy, 519. The effect of building solid walls into the Bay would be to spoil Hobson's Bay railway pier, 520; to turn a portion of the land now covered with water into dry land, but is unable to say to what extent, 521; but would not speak with certainty, for although it is apparent that there is a movement of the sand from east to west, the movement is constantly changing, so that it is impossible to say what the effect would be, 524. Would prefer the river if the tortuosity could be remedied, 525, 526; because the river has arrived at its proper course, and cannot go further to the westward, and the water coming down will always keep the mouth open. If the shallows now existing were removed the river would have no tendency to silt-up again, 527. If Humbug Reach were cut through to the mouth of the river it would be in some respects a better scheme than the canal, but the difficulties of towage would be great, 528. A narrow canal of sufficient width to allow vessels to pass each other, and docks on the north side of the river opposite Batman's hill, would be more advantageous than a wide canal the whole way, 536, 565, 566, 567. The land near the foot of Batman's hill affords extraordinary facilities for docks, 538. Never heard of springs being in the swamp below Batman's hill, but has heard that water is always found at Sandridge when an excavation is made to the level of high-water. This would be a difficulty in making the canal, 543. Mud or silt coming down the river in floods is not deposited at the mouth to any extent, and could be kept under by dredging, 578. Has not seen any reports upon improving the river rather than making a canal, 579. The difference in expense would be doubtless very large, 580. If the river is merely to be a canal, it would not be required to be widened, only deepened, 581.

CHARLES FERGUSON, Esq., Chief Harbor Master, 19th November 1858—

The sand in the Bay does not shift, 716. Since the construction of the town and railway piers at Sandridge there has been a steady accumulation going on on the south-eastern sides of these piers from the boat channel, 717; partly caused by silt from the river, and partly from sand stirred up by vessels, 718. It is on both sides, 720. And from northerly winds there is a deposit from the shore, but that is a deposit over the whole Bay, 721. The deposit in the Bay is clearly traceable to the silt in the river, 722. The deposit of sand between the railway pier and Sandridge pier is about 18 inches after a southerly gale, 724. This is not a great evil, and could be overcome by dredging, 726. In six years the river has been deepened 2 feet by dredging, 728; or an average of 18 inches in five years, 730. The action of heavy vessels dragging through the mud loosened it, and the steamers passing up and down and the current assisted to produce this result as well as dredging, 732, 733. It is practicable to deepen the river much more, 735. Is not aware of any solid rock along the course of the river; and there is a continuous stream from Humbug Reach to Raleigh's wharf of 17 feet of water, 738. If boulders exist they could not be removed by dredging, but by a diving machine, 740. This would be an expensive process; but if the river is deepened with the view of bringing large ships up, it must be widened as well; it is now so very narrow in the deep portion that two large ships could scarcely pass; it would be dangerous, 741. If the river was deepened to 22 or 23 feet, it would be below the average level of Hobson's Bay, and could not be kept clear; bars would form at the mouth; 16 feet would be the greatest depth at which it would keep clear. This, however, is an engineering question, 743. Would consider a canal a great boon to the port if the difficulty of keeping the mouth open was got over, 744. There would not be so much difficulty with the canal as the river, for the mouth of the canal could be constructed so as to promote scour, 745. Running piers out into 22 feet of water would to some extent obviate the difficulty, 746. In an age or so solid land would be formed outside the piers, but a bar would form across the mouth, which must be kept clear by dredging, 747. This would be no practical difficulty, 748. Dredging would be a necessity, but this is of no great moment; there is not a harbor in the world in which artificial means are not used to keep the depth of water they have obtained, 750.

FRANCIS BELL, Esq., C.E., 26th November 1858—

Was engaged professionally as engineer on several works in Great Britain, 773; Belfast Waterworks, the Firth of Clyde canal, &c., 774. Submitted plan for diverting the river from the Falls to the Bay to a committee of merchants, who advertised for plans, and received a prize, 783. The cutting would be about 2 miles in length, 797. The rise and fall of tide is 2 feet or 2 feet 9 inches, but with southerly winds it will rise 4 feet, 803. There would be a sufficient scour down the cut, as it would be perfectly straight; the water would flow more rapidly down the cut than the river, 809. A difference of fall is not necessary, as, in fact, the water would be nearly always at a level, 810. The cut would not silt-up to any extent, and this could be easily removed by dredging; this cut would be very similar to that at Belfast, called "Dargan's cut," 811. The river there is about the same size as the Yarra, 812. The rise and fall is about 14 feet, 813. Would rely upon the natural current, the rise and fall of tide, and flood waters for scour, 815. The velocity of the current in the Yarra varies much; in summer there is sometimes no current at all, 823. The difference of level between Hobson's Bay and the basin is about 1 foot, 825. Proposes to use timber where needed at the wharves, and the rest slopes 3 to 1, 831, 832. Does not anticipate that the sides, even if sandy, would be affected by the current, 833; and it is too narrow (400 feet wide) for the winds to affect it, 834. Steamers might slightly, 835. If so, rough pitching with stone would protect it, 836. Proposes to keep the mouth open by piling out to sea, on one side only, similar to that at the wharf, 847; on the St. Kilda side, 848. One on the north or west side is not necessary, as the tide comes round from St. Kilda, 849. The length of pier would be about 750 feet, 850. Does not propose to go out to the extent of

the depth of the canal, as it is thought the scour will clear the remainder, 851. Would excavate the depth of the cut into 22 feet water, 852. Would give the mouth a good width, making it bell-shaped, 854. There would be 3,270,000 cubic yards of excavation, 875. The cut would be 2 miles long, 25 feet deep, and 375 feet wide on the average, 876. In considering the improvement of the river, the distance round, its narrowness, and the greater cost over the cut, are great objections, 881. Did not give much consideration to the improvement of the river, as having learned there was rock at the outlet of the river to the Bay, considered that, sufficient ground to set it aside, 882. The river could be deepened as a passage simply from the Bay to docks formed near Melbourne, but the expense would be very great, and would not be a good job after all, 883. The expense would be greater than making the canal or cut, 884, 885. Had made no calculation for improving the river, 886. Has considered the improvement of the lagoon by widening it; it could be made available for shipping, but not for vessels of as deep a draught of water as the canal; it would require to go a long way out into the Bay at a very great cost, 888, 889, 890. The reason for a great depth not being attainable in the lagoon is that the water in the Bay is the same depth for a long way out, about 3500 feet to 20 feet water, 897. The estimate of cost of canal, without docks, by the scheme proposed by witness, £660,000, including wharves and iron lattice-girder bridge over Yarra, &c., 838, 839. The extent of wharves would be nearly half the canal, 901. Considers there is a great deal too much stress laid by people generally upon keeping the mouth of the canal open; it might easily be done; is quite sure that one dredge-boat could keep it clear without much expense, 902. Included in the above estimate is £12,000 for a wrought-iron bridge over the Yarra at the Falls, with timber piles; £20,000 for two patent slips; £5000 for drawbridge, &c.; and £5000 for cranes and mooring posts, 909. *See* also full report in Appendix.

FREDK. C. CHRISTY, Esq., C.E., 7th December 1858—

Some time ago had made survey and plans for canal and docks as a scheme for the improvement of the Port of Melbourne, 1338. Still retains the same opinions; is more convinced now than then that that is the proper method, 1342. Since then has had good opportunity of observing Williamstown during the last six months. In a former report stated that a set or south-westerly current across Gellibrand's Point would always cause an eddy, and cause a filling in on Williamstown side; that filling in was not expected to be extensive, because there is very little *debris* at the bottom of the Bay that is shifting; it is merely the breaking away of the Brighton beach and all that part of the coast; the fact remains that the sheltered or northern side of Gellibrand's Point is filling in, and will fill in gradually. Gellibrand's Point projects and forms a groin, technically speaking, and the eddy thus formed by the southern current collects any floating material or *debris* and deposits it under that projection, so that Gellibrand's Point causes a settlement of mud and other material to take place there, and consequently Sandridge will always be the deepest point, 1343. When the above report was written there was a general impression that ships could not lie with safety at any pier constructed at Sandridge, 1344. Such was not my opinion, for there would not be the slightest difficulty in a vessel lying at any point in the Bay, because the Bay is so thoroughly protected that the wind could never cause sea enough to injure a vessel, 1345. The difficulty apprehended by me, and which still exists, that width enough could not be obtained at a pier to allow goods to remain and go into shed, so as to allow of their being reshipped, 1346. Considers now that the canal should be 500 feet wide, because the tonnage of ships is continually increasing, and they should be able to swing clear of any ships lying alongside the wharves. It was intended to wharf both sides with stone the whole length, thus affording accommodation for 200 ships. The length of canal would be 1⅝ miles, 1349. The estimate was £2,300,000; it could now be done for £2,000,000, 1350. There would be no difficulty with the strata, 1367. The bottom of the canal would be in blue clay, 1370; a similar clay is all through the sandy districts of Prahran and St. Kilda at a depth of about 2 or 3 feet; it is peculiar in one respect; it is of such a hard nature that you can hardly get the pick into it, and it is mottled with blue all through, 1372. There were ten borings taken through the whole distance of the proposed canal, 1373. There were also thirteen borings taken by me under Batman's hill, to try the soil there, and it was found to be pretty good, 1374. It would be impossible for the work of cutting this canal to be stopped by water from below, 1377. There might be some trouble from the water coming through the sides, and a 40 horse-power engine might be required to pump the water clear, but perhaps a 20 horse-power engine would do. The difficulty with these works in England arises from the upper stratum lying upon a bed of peat, and that this, being lighter than water, as soon as the water is taken out below, the pressure from the outside forces the whole body up, and it rises in the same way as the saltwater swamp did under the railway embankment; but this is hard clay, and therefore there is no chance of such a difficulty, 1378. The piers of the canal would run into the Bay, one at each side, of peculiar construction, of either vacuum or screw piles—a double row for each pier, 15 feet apart at the top and 25 feet at the bottom, and filling in between each of these piles with cast-iron sheeting, and between that sheeting clay puddle or loose stone work; merely filling up that portion that was proposed to be piled and sheeted, 1380. There would not be the slightest tendency for the mouth to fill up, because no sand has been found in the bottom of the Bay at the distance proposed to go out with the piers, and a wave has only effect on the water 6 or 8 feet deep. That is the greatest effect produced by the heaviest wave, 1381. There would be a tendency to fill up just at the angles, 1382. There would be no tendency for the sand to extend into the water, because the beat of the sea is from Gellibrand's Point, 1383. The piers would not injuriously affect the railway pier at the outer portion. Close in shore it might be affected, 1384; certainly not in any way over 10 feet; it might interfere close in shore, 1385. Does not think that the use of wood instead of stone would be a great saving in the estimate, only some £100,000 or £200,000, 1386. No wood that could be put in would last more than ten years, and it might be destroyed in three or four, 1387. If the mouth of the canal were decreased, an increase of scour would be effected; the Yarra flowing through the canal would keep the mouth open; it would not cause the other portion of the river to silt-up in any way; the mouth of the Yarra might silt-up a little more, but it could be dredged, 1389. There is no silt in the Bay moving towards that point, (*the mouth of the canal*), 1391. The current would keep it perfectly clear; there would be no silt inward from the Bay, 1405. The Yarra should be blocked off, either permanently or by lock,

to facilitate the scour; but a great scour is not needed, because, before any great effect could be produced, there must be silt coming in from the bottom of the Bay, 1409. Is of opinion that there is no very large quantity of mud coming down by the Yarra now, 1410; has frequently examined the water coming down in times of flood, and has not found it so; has never evaporated the water to test the quantity, 1414; if there was a large amount of material coming down, the mouth of the river would silt-up, 1416; an eddy being formed by Gellibrand's Point, also the current of the canal, together with the tide, would form an eddy towards the mouth of the Yarra; thus whatever deposit took place, would take place there; but is of opinion that the amount of silt coming down by the Yarra is inconsiderable; also that there is very little matter floating in the Bay, the bottom being blue clay and not sand, 1417, 1418, 1419. The accumulation of sand on the shore is more the effect of winds than from deposits in the Bay, 1422. Believes that the mouth of the canal would require but little if any dredging, 1423. Is of opinion that there is no difference in the depth of water in the Bay over 15 feet; it may be shallower within that margin, but not beyond it, 1425. If it could be proved that the water had receded in the last four years 30 or 40 feet, this opinion would be altered; but, having made a survey of the coast five or six years back, does not believe that the sand has altered its position from the bench mark on the town boundary post then made, just on the western side of the railway pier, 1426, 1427; but even if the water had receded 30 feet, it would be of no importance in a work of this kind; the pier could be extended or a dredge could be applied, 1428. Does not think it possible to improve the river so as to avoid the necessity for a canal, 1430 to 1434.

ARCHIBALD CURRIE, Esq., Master Mariner, 14th December 1858—

That it is the opinion of master mariners generally that vessels could lie with safety at the piers at Sandridge when the wind is from the northward, but not when the wind is southward and blowing a strong breeze, 1482, 1483. Considers that the river is too crooked, and too narrow, to be useful for the larger class of ships drawing over 15 feet water, 1495, 1496, 1497. Is in favor of canal and docks, 1498. Is of opinion that, notwithstanding the little rise and fall of tide, if the mouth was well to the westward, opposite to where the prison hulks are, the canal would not be difficult to make and keep clear, 1504.

G. W. COLE, Esq., R.N., 21st January 1859—

In favor of canal and docks, 1582. The entrance was the chief difficulty in the way of adopting this opinion until seeing the entrance to Sunderland harbor opening into the German Ocean, also the harbor of Seaham in Durham. Considers from what he had seen in England that it is within the power of engineers to make any part of this harbor available for docks or canals, 1584.

From the Report of Royal Commission on Harbor Improvements and on River and Harbor Trust, 1860.

WILLIAM ELSDON, Esq., Engineer, 3rd August 1860—

There has been no silting-up at the end of the Hobson's Bay Railway pier from southerly gales, 250. It silts closer to the shore; it does not interfere with the depth of water, only extending about 40 feet out, 251. Does not believe that the water has shoaled at No. 1 berth (that nearest the shore), 258. There is a deposit of about 6 inches of sand every year on the shore, extending out 40 to 50 feet from low-water mark, 261. There would be deposit at the sides of the pier if it was close piled, 266. As the pier is lengthened expects the sea to have less effect upon it, the distance being shortened towards Williamstown, 276. Is of opinion that the bottom of the Bay, from railway pier to where the hulks lie, is blue clay, 310. Considers it practicable to make the mouth of canal into the Bay, but that the expense of keeping it open would be very great, 300 and 309.

JAMES MCMECHAN, Esq., Master Mariner and Shipowner, 8th August 1860—

Thinks it possible to make the river so as to bring up ships drawing 17 feet, 503. The expense would not be very great, 504. Considers the old boat channel should have been made the mouth of the river, 511. A canal and docks will be ultimately necessary for Melbourne, 521, 522. Could not say what the cost would be to maintain the improvements suggested in the river, but supposes it would not be much; the river has not had fair play, 523; the expense has been great, but the benefit small from mismanagement, 525. The river could not be kept clear without dredging, 526.

M. B. JACKSON, Esq., C.E., 8th August 1860—

The tide, except under the influence of strong winds, never rises so high at the Queen's wharf as it is in the Bay; the tide falls in the Bay before it can travel to the wharf by the long course of the river; this is the result of actual measurements in 1853, 613. A canal, therefore, being direct, would allow the tide to rise to a greater extent at the wharf than the river does, 614. The difference, speaking from memory, was 1 foot 10 inches; this was again tested in 1855. If a canal is made all risk of flood is taken away, the old channel of the river still being kept as an additional escape valve, therefore it is desirable that a canal or cut should be made, 617. There are no engineering difficulties in the way of making a canal through the Sandridge lagoon, 618. There are but two ways, cutting a canal or straightening the river by cutting across Humbug Reach; if the river is continued to be dredged, every foot in depth is so much gained; no part of it would be of service until the whole was completed. As a permanent work, and looking to what is natural to consider the colony will be at some future time, the best course will be a canal, 622. There would be more water in the canal, and in the old channel of the river too, as it would be fed by two mouths instead of one, 632. The flow of water would keep both the canal and river clear, for the canal would allow a greater body of tidal water to go up; that is, the tide would rise higher, go further up, and be of greater volume than it is now; there would be a greater difference of rise and fall of tide than there is now in the Yarra, 638. The canal would have no injurious effect upon the Sandridge piers, 639. Groins, piers, and breakwaters can be made at the entrance of the canal into the Bay, as at the mouth of the Wear at Sunderland, and as they are now being constructed at the mouth of the Tyne, near

the Hird Sand, 640. Skeleton groins might be constructed, as at Sunderland, which fill themselves by the action of the tides, and become banks, 641. The silt brought down the canal would be carried out into deep water, and very little dredging would be required; there is but little dredging required at the mouth of the Wear, at the mouth of Grimsby docks, or at the mouth of the Hartlepool, 643. The best line for the canal would be from the head of the Sandridge lagoon, across the railway, to the foot of Spencer street; it would be the cheapest, 644. There is no practical objection to the shorter cut from the Bay to the river; and taking into consideration that in the lagoon scheme the purchase of, the Hobson's Bay Railway is a necessity, the direct cut is perhaps preferable, 648–664.

JNO. NIMMO, Esq., Surveyor, Emerald Hill, 10th August 1860—

Does not consider there would be any difficulty in making an entrance to a canal in the Bay 908. It could be easily kept clear by dredging, but the work might be so laid out as to send the sand past by tidal action, 910; by a breakwater, 911; of open piles, 912. The sea would soon form a bank for itself inside the piles, 913. Some injury would be done to the railway pier by the deposit of silt, 914. It would improve the entrance to the river; it would create a current in places where it is now very sluggish, 916. A canal would so lessen the chances of floods that it would be one of the greatest boons that could be conferred on Emerald Hill; the reduced length that the flood would have to travel—a mile and a-half instead of eight miles—would naturally relieve the river and improve it, 917. It is a fact that the difference of tide between Hobson's Bay and the basin in the river is 18 or 20 inches, 919. It is not desirable to make a canal of the same depth as the Bay, 924.

Captain FERGUSON, Chief Harbor Master, 15th August 1860—

Does not consider it advisable that the river should be deepened beyond 16 feet, 996. There would always be a difficulty in turning Humbug Reach with a large ship, 997. Of these schemes submitted—namely, the construction of a canal and docks, the deepening of the river, or providing additional wharfage accommodation in Hobson's Bay—the river should be deepened, and more accommodation at the existing wharves be provided; but the time will come when you will have a canal and docks, 999. A canal and docks are only a question of time, 1000.

GEO. BIRNIE, Esq., Superintendent of Dredges, 15th August 1860—

Considers that making the entrance to the canal would be a work of great difficulty, 1117. Has known the sand to be washed up 3 feet in twenty-four hours on the Sandridge side of the Bay, 1117; after heavy gales of wind, 1120. This could easily be removed by dredging, 1121. The sand might wash away and come again; it is continually shifting, 1122. When boring on the Sandridge side found nothing but sand for a depth of 15 feet, 1123.

A. K. SMITH, Esq., C.E., 15th August 1860—

Was engaged in reporting on the rival schemes of Christy and Bremner in 1854, 1187; that is for cutting a canal from Hobson's Bay to Spencer street, 1188. The cost of cutting such a canal—360 feet wide at bottom, slopes two to one, and 25 feet deep—would be £250,000 for the earthwork only, 1190, 1192. Does not include any piers in the Bay; only the excavations, 1205. Would have a lock in the Yarra where the canal intersects the river, and also one at the outlet to the Bay, and thus have the means of scour at all times at disposal; a fall of 3 feet would be secured to make a scour at the entrance, 1206. Would place the docks to the east of the Gasworks, on the north side of the river; the ground is there hard, yet easily excavated, and would stand without much slope or support, 1211. Instead of docks of large areas would have projecting piers, so that vessels could run up between them, the said piers to be formed by the present ground strengthened by masonry, 1215. Considers there would be no difficulty with the entrance at the Bay, especially if the latest and best mode were adopted, by putting a lock upon the entrance, and keeping the water up to the greatest height allowable, and by that means have a fall in the Bay at high or low water from 2 to 4 feet, 1228. Between a canal 25 feet deep and the river deepened to 15 feet, the former would be cheapest in the end by a long way, and the river would not remedy one of the present evils, namely, distance from the city, 1238; the first cost of the canal might be the greatest, but there would be other things as offsets, 1239.

JNO. REILLY, Esq., City Surveyor, 17th August 1860—

Assisted Mr. Blackburn, late city surveyor, to lay out his line for canal from Hobson's Bay to Melbourne in 1851; made borings along the line, also took soundings of the Bay for half a mile, 1242. The borings were satisfactory, and the ground was tried every 10 chains, 1251. One boring was made in the Bay; rock was found after going down 40 feet, 1260. It was about half a mile out, about 40 chains west of the city boundary post, 1261. Is of opinion that there would be no difficulty in keeping the mouth clear; is of opinion that there is not 3 inches difference in the depth of the Bay in ten years, 1265. This opinion is based upon observations and soundings, 1273, 1274. There would be a slight accumulation of deposit at the mouth, 1278. Would not apprehend any accumulation of sand from the Bay itself, 1282. Considers the plan submitted by Mr. Bowden as the best of those then before the Commission, 1327. Was engaged upon the improvements of the Belfast Harbor, 1335; as an assistant-engineer, 1341. Those works are satisfactory; the mouth of the new cut has to be dredged occasionally, 1345. The rise of tide there is 9 feet, 1347. Is of opinion that the velocity of the water is about 4 knots an hour, 1349. The sea at Belfast is very stormy, 1352. The distance from Belfast to the sea is about 4 miles, 1355.

G. C. DARBYSHIRE, Esq., C.E., 17th August 1860—

Considers a canal an ultimate necessity for Melbourne, 1434. There would be no difficulty in forming an entrance for a canal into Hobson's Bay; the difficulty would be in keeping it open afterwards, 1461. It would require to be dredged, 1463. Is of opinion that the current coming down the Yarra after it leaves the river sets to the westward, 1465. A canal is only a question of time, 1475. All the works now projected should be done with this object in view, 1486, 1503, 1504.

FRANCIS BELL, Esq., C.E., 22nd August 1860—

Adheres to the evidence given before the Select Committee, 1858, except in a few particulars, 1560. Considers that, as the Government terminus has been opened at Spencer street since that time, the canal should leave the Yarra lower down, nearly opposite Batman's hill, 1565, 1567. Would place one dock close under Batman's hill and one dock on the south side of the river, to be connected by a drawbridge across the present course of the Yarra, 1568. The Gasworks interfere very much with having all the docks on the north side of the river, 1571. The sides of the river should be excavated into piers with wharves on each side, 1573, 1574. The term "dock" is improper; they would be more basins than docks. In Great Britain the rise and fall is so great, gates are required; here none are required; the whole harbor would be a large basin, with jetties or piers, 1576. The cost of basins or docks or piers, or by whatever name they are called, would be the same for the canal as for the improvement of the river, 1582.

THOMAS E. RAWLINSON, Esq., C.E., 22nd August 1860—

Considers a canal a very costly and unsuitable undertaking, and therefore has not given it much consideration, 1605. Prepared, in conjunction with Mr. Thomas Oldham, a scheme for enclosing Hobson's Bay, by means of an iron pier, for a harbor, and connecting it with the main trunk lines of railway, 1606. This scheme was submitted to various public bodies in 1855, and considers it the best scheme still, 1609. The harbor proposed to be formed was by an iron pier stretching across Hobson's Bay railway pier to Gellibrand's Point, with 85-feet entrances in deep water; the communication across these entrances was by swing bridges, tubular in character; total cost, £800,000, 1610. There are no engineering difficulties in the proposed canal; the only difficulty is the commercial one, how to find the money, 1636. Gives estimate for pier and railway, £1,000,000, and for the canal, £1,100,000, 1638. Without docks canal running out three-quarters of a mile into the Bay, with wharf-wall on each side 30 feet deep, and 5 chains wide in the clear, with quay-room on each side 30 feet wide; the cost of wharfage is made for the whole length of the canal, 1640. If the wharfage was not made all at once, would slope the banks so that they would not wash away, 1646. The current down the canal would not be greater, if so great, as down the Yarra at present, 1648. Should not be afraid of leaving the banks of the canal with a natural slope in the material through which it would pass, 1660.

Captain JNO. MCLEAN, 29th August 1860—

Considers a canal would be an improvement upon the present river, but sees no occasion to leave the river; it can be made all that is necessary to any depth, 1885, 1886. There would be no difficulty in towing up any ship if there was plenty of water, 1892; even without widening for ships of 1200 or 1500 tons to pass, 1893. The most natural place for docks is on the north side below the Australian wharf, 1897. The river could be cut to any depth by going through the boat channel, 1899. There should be four or five dredges in the river, 1900; not to keep it clear, but to make it available for large ships to come up, 1901.

F. C. CHRISTY, Esq., C.E., 5th September 1860—

Gave evidence before Select Committee in 1858, and is of the same opinion now as then, 1954. Went on this morning to the Bay to find the bench mark cut in 1853 or 1854 on the boundary post; the post was removed, but on comparing the sections made at the time with the present state of the Bay is, as far as he could observe, precisely what it was then, six years ago. The general features of the Bay are the same; there is no difference, 1955. Made the borings then submitted, 1956. The section produced is an exact and true section of the ground between Chessell's slip on the Yarra and the Bay, 1959. There was no quicksand anywhere, 1961. Mr. Selwyn, Government Geologist, compared this section with the material brought up in the borings, and was satisfied with the result, 1966. Did not take the shortest distance for the canal, as it was desirable not to come upon the Yarra too abruptly, that the flow of the river might go through the canal, and thus scour it and keep it clear of sand, 1979. Considers that the cost now of making the canal would be about £1,500,000, 1984; in stone, 1985. Does not think the banks of the canal would stand without stone coursing or sheet piling, 1987. Timber would last about fifteen years, judging from the timber piles drawn at the pier at Williamstown, 1994.

ROBT. ADAMS, Esq., C.E., 7th September 1860—

Advocated a line of canal from the Gasworks towards the mouth of the Yarra, making the entrance different from the present mouth of the river; stopping the Yarra, so as to cause it to flow through the new channel, leaving the Saltwater River to come through its present mouth; thus obtaining the shelter of Williamstown for the mouth of the canal; the mouth of the canal to be dredged through the mud flats, and protected by timber wharves, 2054 to 2067. Had made no estimate of the cost, but considers that nothing can be done for the port effectively under a million of money, 2070. Has adopted the longer distance for the canal to obtain the protection of Point Gellibrand, so that the entrance might be in still water, 2081; the short cut is exposed to the full fetch of the Bay from the south and south-east, 2082. There is an absolute certainty of silting if the entrance be made near the Hobson's Bay railway pier, when the water of the Yarra is coming down through the entrance, and the wash of the Bay setting with the Sandridge shore, with the southerly and south-easterly winds driving the sand and shingles in a westerly direction along the shore; the water coming out of the canal from the Yarra meeting the sand coming along the shore will check its course, and cause the sand and silt to deposit on the east side of the entrance, and this deposit, after commencing to form, will accumulate towards the west side until it forms a very serious obstacle. When a cut is once made from the Yarra having its *embouchure* at Sandridge, a new element is introduced in the shape of an outflowing current, so that the probable effects cannot be judged by the mere examination of the shore under present circumstances, 2083. The water running out from the river would check the shingles passing along, and cause them to deposit along the edge of the current whenever there

was any sand or detritus in motion; but the entrance proposed by me would be protected by Gellibrand's Point, 2084; from the effects of the wash of the sea coming in when the southerly and south-easterly winds are blowing, 2085; it would be protected from every point, 2086. The entrance at Sandridge would be beyond the shelter of Gellibrand's Point, and would be dangerous to use unless protected by a large wharf on the west side, for ships to bring up against. Considers it would be difficult for any vessel to enter with a strong southerly gale blowing, 2088. The silting would be very great indeed, particularly during certain winds combined with floods, 2089; decidedly more so than at the railway pier, for there is not the cause for silting there now that there would be when the entrance was made; it could be made, and it could be kept open, but it would be expensive, 2090. Could not make an estimate of the cost of the works proposed that would be reliable in the absence of correct detailed survey and borings, 2093. There would always be a slight amount of dredging required from the entrance of the canal proposed by me, 2115.

THOMAS HIGINBOTHAM, Esq., C.E., 14th September 1860—

Having read the engineering evidence given before the Commission, I cannot agree in the views that are expressed in that evidence as to there being no difficulty in forming and maintaining the canal and docks; there would be considerable difficulty in keeping the mouth of the canal open, 2124. Has not seen any of the borings that have been taken, 2125. Allusion is only made to keeping the mouth open, more especially with reference to the plan that would make the mouth of the canal a little to the west of the present railway pier at Sandridge, 2126. Believes that there would be the greatest difficulty in keeping the mouth of the canal open to the depth required for the largest class of vessels; but if the attempt be made at all, the right course for the canal is that shown on Mr. Adams's plan, where the mouth of the canal is placed at the mouth of the present river. The small rise of tide in Hobson's Bay is a great obstacle to any project for bringing large ships up to Melbourne, 2127. Is of opinion that the force of water rushing down the canal would not keep the mouth of the river clear without constant and expensive dredging. At Belfast, where the rise of tide is something like 12 feet at springs and 8 feet at neaps, where very considerable difficulties have been overcome, the annual expense for dredging is very large, while here the extreme rise is something like 4 feet only. An objection also to the canal is, that if made, the present river must be sacrificed to it, and it will become useless; but the river enables a very large number of the smaller class of vessels to reach Melbourne at little or no cost; whereas if a canal be made, heavy dues to cover the interest on the cost of construction and the cost of maintenance must be levied, and these dues will fall on all classes of ships using the canal; thus the smaller class of ships will have to pay for what is little or no benefit to them, 2128. The value of the land would presumably be very considerably increased, 2129. Is doubtful if the slopes of the canal would stand without pitching or other protection; with the passing of tugs up and down there would be a good deal of wear, 2139. Had a pile taken up at Williamstown about ten days ago which had been standing in the water for five years; had it cut across to show the section; it is pierced in the sap-wood by the worm, but nowhere else; the strength of the pile is not materially decreased, 2140. It was of what is called blue gum, Van Dieman's Land timber, 2141. Iron piles would be the most advantageous to use if the consideration of expense was left out, 2143. Has not made an estimate of the cost of a canal the shortest distance to Hobson's Bay from the river; could not make a reliable estimate without borings and going into the whole question carefully, 2146. Does not think the entrance could be kept open, 2149; not even with dredging. The mouth of the Yarra is kept open now by the united action of the waters of the Yarra, of the Saltwater River, and of Stony Creek; and it is for this reason, among others, that, supposing the canal to be attempted, the plan of Mr. Adams, which places the mouth of the canal at the mouth of the river, appears most feasible. The circuitous course of the Yarra has this very important advantage, that it forms a reservoir for a large body of tidal water, which on its return must have an important effect in keeping the mouth of the river open. Engineers have always attached great importance to the free admission of tidal waters into rivers, and anything that diminishes the capacity of the river for receiving the tidal water will act prejudicially upon its mouth, 2150. Is of opinion that the right course will be to improve the river as far as possible for the class of vessels that use it, and the largest vessels that come into the port must be kept down in the Bay, and communicate with Melbourne by railway, 2153. More jetties and more accommodation on those jetties will be required, 2154; and a terminus for goods, to sort them, either at the jetty or in town, 2156. Is unable to say how many dredges would be sufficient to keep open the mouth of the canal 250 feet wide and 28 feet deep, there is so little assistance from scour; if there was a rising tide of 10 or 12 feet, then a good scour could be obtained; but as it is, there would be but little scour, 2170. I apprehend that with a south-east wind the sand would close the entrance. If the pier was placed here—[*pointing to the map*]—the sand would accumulate first in the inner angle and extend out and close the entrance, 2171. Silt would be a difficult material to go through in making a canal; it would require a very flat slope, and to have the slopes protected by pitching or piling, 2178. There is, no doubt, a great deal of wash going on from the banks of the river from the passage of steamers, 2179; and it may be supposed that an increased deposit goes on from this cause, 2180. The soil taken from deepening the river by dredging could be used to raise the adjacent lands, 2181; the expenses would not be great; of course it would depend upon how far it had to be run, 2182; the mud would harden after being placed upon the land; at first it would be in a liquid state, 2183. If the river were deepened, dredging would be necessary to keep the mouth open, 2184. The expense of dredging the mouth of the river, if deepened, would not be so great as dredging the mouth of the canal, supposing such a work to be practicable. If a canal capable of bringing up the largest class of vessels to Melbourne be attempted, it will be necessary to have a depth of water of about 25 feet, and to maintain this depth a very large amount of dredging will be required, and it must extend over a larger distance than it will be necessary if the river be deepened, 2185. The mouth of the river could be kept open with less expense, because in the case of the river it is not contemplated to attempt such a depth as will be necessary if the canal scheme is to be carried out, 2186. The scour will be greater in the river than in the canal, because there is a larger reservoir for the rise of tide, and there is the Saltwater River and Stony Creek to assist, 2187. Taking the river in its present state, with all the advantages it obtains from a large quantity of tidal water, and also from its tributaries—the

Saltwater River and Stony Creek—it can maintain a depth at its mouth of 7 or 8 feet only, 2188. There will be no more scouring power in the new cut, and therefore it is not apparent how a depth of 25 feet is to be maintained, 2189. There would be no difficulty in widening the river ; a very great improvement might be made in taking off part of the bend at the Saltwater River. Considers that the canal works can only be carried out at so very large an expense that the charges on goods would probably exceed those now made, 2190. It is practicable to deepen the river to 14 feet only, and that can only be maintained by a very considerable amount of dredging, 2191. Greater depth is not practicable, as there is little or no assistance from the tide, 2193. A perfectly reliable estimate can be made of the cost of making a canal of a defined width and depth, but the cost of keeping the mouth open after it is dug is a separate matter, of which I could offer no opinion, as it is a matter of the greatest doubt to me if it would be possible to do it without an enormous expense in dredging, 2197. Does not consider that a breakwater outside the pier would have the effect of keeping the mouth open, 2197. It would be possible to protect the mouth by a pier for a time; ultimately the sand would reach the mouth, 2199; no doubt this would depend upon the nature of the bottom of the Bay and of peculiar currents, but, as far as my observations have gone, in south-east winds the sand moves westerly in this direction—[*pointing to chart*]—the mouth of this lagoon has been shut up during a single stormy night, 2200 ; after a time it goes away again, 2201. The making of the canal would no doubt lessen the risk of floods ; it would be a very great outlet for them, 2203.

THOMAS OLDHAM, Esq., C.E., 19th September 1860—

Abandoned the plan proposed by Mr. Rawlinson and himself (*for reasons stated*), 2209. Would construct docks near Batman's hill, and reach the docks by a canal ; has gone through the cost by the present river and by a canal, and is quite satisfied that the river Yarra can never be made navigable for vessels requiring 20 feet of water at anything like a reasonable cost ; prepared a rough estimate for vessels drawing 16 feet, and is of opinion it would cost £607,000, 2211 ; 16 feet at high-water, 2212 ; the cost of canal plan now submitted, with 24 feet water, with lock at Hobson's Bay, and dock of 48 acres, £703,000, 2215. Believes the mouth would be clear for many years without dredging at all. The natural currents are from the Brighton side, flowing down by the Hobson's Bay railway pier, and past the mouth of this canal ; the only place where silting or filling up would take place would be where the natural current of the tide meets the flow of the river passing into the Bay, which causes a rotary motion, in which the silt settles, 2232. Believes that all this talk about silting and currents is altogether nonsense ; is of opinion that no scour of any description can be created in streams. The natural tendency of their waters is to flow away at that angle that offers the least resistance to it, and that angle is towards the surface. Is also of opinion, if there is any silting-up here, it could be dredged ; there will be no silting for years to come ; of this he is certain ; for there can be no action upon the mud or bottom of Hobson's Bay, or any other Bay of equal depth, either by the tide or by the waves, at a depth of 24 feet, that could possibly cause silting-up, 2233.

JNO. MILLAR, Esq., C.E.—

Proposes an open tidal cut about 2 miles long, and an average depth of water of 25½ feet, as the best mode of improvement to be resorted to for the river and port of Melbourne ; would allow the tide to flow into the Yarra by new cut as well as by its own mouth.—[*Accompanying plan shows that the river is locked where the canal leaves it.*]—The cut to be a uniform width of 400 feet. Regards the question of deepening the Yarra to be at best but a patched-up method of attempting an improvement, and if accomplished to its fullest practicable extent, would not even then meet the requirements of the port. The mouth of the proposed canal should be at a point formed by extending a line north from 36 chains east of Williamstown Lighthouse until it touches the northern shore exactly where the current of the flood-tide seems to have made a considerable impression on the outline of the shore. As respects the "bar" formation theory, is decidedly of opinion that no bar will form here, inasmuch as by having an expansive cut there will be (including the adjunct of the river-level, east and west) upwards of thirty-five million cubic feet of water ascending the canal and river every tide, increasing the velocity of the ebb or downward current in its return. The level of the bottom too being of such slight ascent above the Bay channel, the transmission of the tidal wave will be quickened in its course, turn early, and attain a head to overcome the ebb, having the river's stream a concurrent quantity, so that the interval of ebb and flow will be short. For further arguments and details *see* letter in Appendix to Report.

W. A. ZEAL, Esq., C.E.—

Considers the formation of the canal a settled question. *See* letter.

MUNGO PARK SMITH, Esq., C.E.—

Submitted plan for canal in connection with Captain T. Robertson.

From Evidence taken by Royal Commission on Low-lying Lands, 1872-73.

ROBERT ADAMS, Esq., C.E., 24th September 1872—

Advocates the line of the Flood Board of 1864, or a similar one, it being the second scheme he proposed, and the one he suggested to that Board, 39. His reasons for considering this position better than that selected by Mr. Christy and Mr. Bell are that this place was protected at the mouth, and therefore would not silt-up, and the outlet provided by nature for the Yarra would not be interfered with, 44. Opposed to direct channel, as the mouth would be unprotected, 45. Selected it at first, but abandoned it altogether ; the waves beat upon the rocks down at the Red Bluff and disintegrate the stone into sand, and that causes silting, 45. The cost of dredging at the mouth of such channel would be very serious, 46. Considers it impossible to keep the mouth open on account of the travelling sand, 48. Recommends a wide channel, say 15 chains, for a flood channel, and, either in the centre or at one side, a channel 300 feet wide for navigation, 159. Considers the making of a storm-water channel, as above described, would be a cheaper operation than widening the river, 172.

Captain PAYNE, R.N., Chief Harbor Master, 26th September 1872—

Does not think that the southerly gales force any sand into the Bay, but they have an effect upon the *debris* brought down by the Yarra, causing it to deposit at the head of the Bay, 205; not on the Sandridge beach, but at the mouth of the Yarra, 206. Produced chart showing soundings taken in the Bay by Captain Cox, R.N., 1866, and soundings taken by the Public Works department in 1867, 1869, and 1871, 208. From this chart it was pointed out that the southerly gales did not bring sand into the Bay at Sandridge beach, 211. The northerly winds blow a considerable quantity of sand off the land, which has formed or increased the foreshore at Sandridge beach, west of the railway, 214, 215. The bottom of Hobson's Bay is mud, 221; mud and sand, 222. The mouth of a canal into Hobson's Bay, west of railway pier, would have to be kept clear by dredging, 226; it could be easily done, 228. Does not think that a canal opening into the mouth of the river could be so easily kept clear, 230; the mouth of the direct canal into the Bay could be as easily kept clear as the mouth of the river, 241. The training walls at the mouth of the river would be required to assist the scour. But they will not take away the silt that will be deposited somewhere in the Bay, 238, 246. The scour of the Yarra will not keep the mouth clear without dredging, 243. The prevailing winds are southerly in summer and northerly in winter, 252. Throughout the year there are more northerly than southerly winds. *See* Appendix. The silting of the Sandridge lagoon arises from deposit brought out of the lagoon and the sand forced up by the sea and southerly winds, 261. The same thing would not happen at the mouth of the canal, for there would be a certain force of water running down that would tend to keep the immediate entrance clear; a bar is formed at the mouth of all rivers entering the sea; the area of the bar is affected by winds and currents, 264.

Captain FULLARTON, Harbor Master, Melbourne, 26th September 1872—

Knows the Bay for twenty years, 281. Has paid much attention to the prevailing winds and their effects upon the depth of water in the Bay, 282. Southerly gales do not force much sand into the Bay, 283. The depth of water in the Bay is lessened by silting from the river, not by sand, 284, 285. The St. Kilda shoal has been formed by sand from the sea, 286; produced by strong southerly and south-south-east winds, 287. Does not think the mouth of canal into the Bay, west of railway, would silt-up, especially if the piers were open piling, like the railway pier, 292. Does not think it would be advisable to have the mouth of the canal to debouch into the river, 294. It would be awkward to get large ships into such a canal, 295, 296. Considers that the Yarra should be still allowed to carry its own silt by having a weir at the end of the canal, which could be open at the time of floods; the Yarra should still take the sewage and silt, none of which should be allowed into the canal, 297, 298. A foreshore has formed round the old boiler lying west of railway, by sand blown off shore, 303, 305. The shoaling of the Sandridge lagoon is no criterion to judge by, as there is a large sandbank commencing there and extending to Brighton, 306. The same cause does not exist to affect the canal, 307. The mouth of the canal would be under the lee of Williamstown, 308. It is a stiff blue clay bottom opposite where the mouth of the proposed canal would come, 309. Is of opinion that the mouth of such canal would be more easily kept clear than the mouth of the river, 311. Would not recommend the closing up of the Yarra, 312.

WILLIAM ELSDON, Esq., Engineer to Hobson's Bay Railway Company, 26th September 1872—

The railway pier is constructed on a bottom of about 20 feet deep of silt, 316. The depth of water has not materially diminished since the pier was constructed; it is about 4 inches less in depth, 319. The pier is peculiarly situated; it is protected by the mouth of the Yarra, which sends its stream across the end of the Williamstown pier, and past this, so that it lies in a sort of basin. The mouth of a canal could be kept open by dredging; but could not say at what expense, 326.

Captain HUGH MACMEIKAN, 3rd October 1872—

Is of opinion that a direct canal is the best means of improving the port; it being shorter than the river, it could be the easier kept if dredging was required—the canal being 1½ miles, the river 8 miles, 332, 333. Does not consider that there would be any difficulty in keeping the mouth of a canal clear, 334. Considers that to widen and deepen the river would be an enormous expense, the distance being so much greater, 356. There would not be much sea-sand blown into the mouth of the canal by southerly gales, 360. The river might still and ought to be kept open, 366, 367, 368. The soundings in the Bay indicate that the mouth of the canal should not be eastward of the Sandridge town pier, 370. The canal would be a great national benefit, 372. Considers the width of the canal should be 500 feet, 382. It should be 500 feet wide, as vessels now are built pretty long; a vessel of 1500 or 1600 tons burthen would require 300 feet to swing, 385.

HENRY MOSELEY, Esq., C.E., 3rd October 1872—

Has taken soundings at either end of the proposed canal, and does so every two years since 1867, 390, 391. Except a little knoll near the baths, the sandbank at this part has deepened, 401. The depth of water is the same at the end of the railway pier as it was ten years ago, 402. Is of opinion that no action of the tide and winds has caused any silting near the site of the mouth of the proposed canal, 404. The level of the Bay and the level of the river below the Falls is the same at the turn of the ebb, but the tide at Williamstown is two hours earlier than the tide at Melbourne, 408. The silting in the Bay is not caused by the action of the waves, but by the deposit brought down the river, 411. The effect at the mouth of the canal and the mouth of the river would be the same, but not to the same extent at the former as the latter, 413, 414. To keep the mouth of the canal clear a dredge would have to be used occasionally, 417. No doubt it would be a considerable expense, 418. The length, eight miles as against one and three-quarter miles, would make no difference in the deposit, as it comes down on the top of the water, and is deposited when it comes to the saltwater, 420. The silting would be the same at the mouth of the canal as at the mouth of the river, 421. A canal, if the obstruction in the river at the Falls and Prince's bridge was removed, would largely assist in taking off the flood waters, 431.

Captain W. H. SMITH, 3rd October 1872—

Is strongly in favor of a ship canal, now as in 1860, 485. Knows from experience and cost that the present channel is very objectionable, 486. From experience and observation in other places, considers that to keep the mouth of the canal clear would be a very simple matter. Was in the habit of passing up the North Holland Canal, 52 miles, almost monthly, for several years; did not notice much filling up there, it was quiet water. The sea (or waves) in Hobson's Bay is not of much importance as to silting-up. When there is a strong current there is not much silting; except on rare occasions there is no heavy sea in Hobson's Bay, 497. Considers a canal 200 feet wide would do at present, but 600 feet would be better, 499; and should be, if possible, 25 feet deep at low-water, 518. The sea (that is, waves) would not come a long distance up the canal; they would soon be spent; it is a short turbulent sea, and does not run any distance, 530, 532. The mouth would not immediately fill up again after being cleared, 542. It would require dredging occasionally, but this would not be a great expense, 522, 545.

GEORGE BIRNIE, Esq., Superintendent of Dredges, 10th October 1872—

Has charge of the dredging operations, 550. Silting-up at the mouth of the Yarra consists of alluvial deposit brought down by the river, 551. Has never dredged on the Sandridge side, 554. There has been no difference in the 18 feet depth of water this last ten or twelve years on the Sandridge side, 557. The sand on the beach at Sandridge drifts in and out with different gales of wind; if it blows from the southward for a time, and then from the northward, there would be a change in the high-water mark, 560, 561. But little silting takes place in the river itself, 568. The river if once dredged it is seldom necessary to do it again, 569. The deposit is outside the mouth, in the Bay, 570. The river at present keeps itself clear; but as its stream meets the saltwater in the Bay it loses its scour, and deposits its silt on either side, 571, 572. The mouth of the river is always extending itself into the Bay—about 1000 feet in twelve years, 574. There is no rock in the bed of the present channel of the river; it could be deepened to 20 feet, 576. There is always a tendency to silt at the mouth, 587. The same results would follow at the mouth of the canal as at the mouth of the river, 591. It would not be more difficult to keep the mouth of the canal open than the mouth of the river, except that the river would send the drift across its mouth, 592. There would be no greater difficulty in keeping the mouth of the canal open than there would be in keeping the mouth of the river clear, 599. The flood-tide would sweep the silt from the mouth of the canal to the mouth of the river, 607. The river silts opposite the bone-mills, about 400 feet in length, 616, 617. The river could be widened and deepened cheaper than to construct the canal, 625, 628.

CLEMENT HODGKINSON, Esq., 6th December 1872—

From the information obtained since the sitting of the Commission with reference to nature and extent of the silting-up in the Bay, is now in favor of the direct canal; was not so formerly; is of opinion that a ship canal in conjunction with the improvements in the river from Church-street bridge, Richmond, downwards, would be one of the most important means of preventing floods, 643. The outlet should be the site of the present baths, 647; not the mouth of the river, 648. Considers from the evidence adduced that there is not much fear of silting-up, 649. Would not altogether divert the course of the Yarra, 650.

Honorable Captain COLE, R.N., 24th January 1873—

Does not think the direct channel would be so good as straightening the river by cutting through Fisherman's Bend, 707. Does not think the former would be so cheap as the latter, 708. The question of cost is the great difficulty, 710, 713.

THOMAS HIGINBOTHAM, Esq., C.E., 24th January 1873—

I dissent altogether from the opinion that that work—(*a direct canal from the Gasworks to the Bay*)—would be at all a desirable one to undertake. I have no hesitation in saying that I believe it would be exceedingly difficult, if not impossible, to keep open the mouth of a canal made directly into the Bay; and that the true principle in improving the Yarra is to adhere as closely as possible to the channel of the river—the present channel of the river—with an improvement at Fisherman's Bend, something similar to what was described by Captain Cole in his pamphlet and evidence. I was a member of the Commission that was appointed in 1863 or 1864, I forget which, upon the floods in the Yarra, and that Commission produced a scheme which is shown in the plan now upon the table. To a very great extent, I hold the same opinions now which I expressed in 1864, as a member of that Commission; but I believe that the Commission made a mistake to this extent, that it deviated unnecessarily from the natural course of the river, and that it would have done better if, instead of proposing the new cut shown upon this plan, it had proposed a less expensive scheme, cutting off Fisherman's Bend only. It will be observed that the Floods Commissioners did not propose to make a new mouth for the canal; they proposed—and laid it down most distinctly in their report—that the present mouth of the Yarra should be maintained, and to that opinion I still adhere. I believe it would be a great engineering mistake to attempt to open a new channel direct into the Bay, 715. The result of making a new channel with a new opening into the Bay would be that the water which now serves to scour the mouth of the Yarra would be divided into two, for, if you turn the whole of the water down the new channel, the present course of the Yarra will inevitably close up, 722. If you diverge from the present course of the Yarra, it appears to me inevitable that the Yarra will silt-up. You now have a very large reservoir into which the tide flows, and upon its return helps to scour out the mouth; if you make a direct cut you have a very much smaller reservoir for tidal water, and,

therefore, diminish the scour; again, we know that the river does keep its mouth open; we have no knowledge that it could do so at a point between the present railway pier and the mouth of the Yarra; on the contrary, we know that the travel of the sand continues—I deny altogether that the travel of the sand ceases at the railway pier, 723. The fact of the soundings taken from year to year shows no appreciable diminution of the water far out; but what are you to do with the ridge of sand?—If a channel is made direct into the Bay, between the present mouth of the Yarra and the railway pier, you would have two channels for the water of the Yarra. I do not believe it can be denied that there is a constant travel of sand from east to west, not merely up to the Sandridge railway pier but beyond it; and the result would be, if the piers were thrown out, the sand would accumulate upon the eastern side, 724. Under any circumstances I should retain the present mouth; and it is really a question of what length you would make the new cut; whether you would make it as long as was proposed by the Commission of 1864, or confine it to something like the scheme proposed by Captain Cole. The scheme proposed in 1864 was a very large one, and the fact that it has been allowed to remain without being acted upon in any way for ten years leads me to the conclusion that it was too large. A much more practicable scheme would be the one cutting off Fisherman's Bend, combined with the widening and deepening of the channel of the river, 726. It would be quite possible to cut the canal, but it could only be kept open at an unjustifiable expense when the mouth of the Yarra is already open, 728. The outlet of the canal could not be kept open owing to the travelling sand or drift, 729, 730. The sand has gradually driven the mouth of the river to its present position, where it has the power to keep itself open, 743. The Saltwater River and the Yarra combined form a scour to keep the mouth of the river open; in the case of the canal the scour of the Saltwater River is lost, 751. Has no doubt that the actual expense of keeping the mouth of the canal clear would be much greater than that of keeping the river clear, but is unable to say what the difference would be, 758. The cost of erecting the piers necessary to protect the mouth of the canal would be enormous, 763. The mouth of the canal would be silted-up by the sand, and that the silting would be greatly facilitated, and the difficulty of keeping the mouth open would be greatly increased, by the small capacity of the direct channel for holding tidal water, and the withdrawal of the water of the Saltwater River from the mouth, 770. The silting and the expense are the reasons for thinking the canal impracticable, 771, 772. Other things being equal, the shortest channel is the best, 773.

GEORGE GORDON, Esq., C.E., 3rd February 1873—

A canal would deflect the course of the river into the Bay, the remaining portion of the river between the Gasworks and the present mouth would silt-up on account of being deprived of the tidal current up and down, 777; the sediment of the river being brought down the canal would be deposited outside the pier heads; the ebb and flow of the tide prevent the particles from settling and keep the mouth of the stream open; but this cut being so short, as compared with the long course of the Yarra, and being so very wide, the tidal current would be reduced to one-third of a foot a minute, which would not be perceptible at all, 780. The piers at the mouth of the canal should extend into the Bay about 3000 feet, or more than half-a-mile, 792, 793; the piers must be solid, 794. Thinks the sand would drift and collect at the side of the easternmost pier; this effect can be seen at the St. Kilda pier, where the high-water mark at the weather side of the pier is 50 yards further out than at the lee side; if the sand begins to gather, it must go on until in time it would extend out to the end of the pier, 799; these piers would ultimately cause the head of the Bay to silt-up, 800, 802. The river should be brought down to 22 feet deep, 805. All obstructions above the basin removed, such as the reefs in the river, and the bridges, and the line of river regulated and widened from Richmond bridge down; but this would be common to any of the schemes, 804, 806; if these improvements were effected, and the river widened from the basin downwards, with a cut across Fisherman's Bend, the tide would go up as high as Richmond bridge, 810, 812; the river thus improved would give more wharfage room than the canal, 816, 817, 818. The river at present has but one-third of the sectional area it ought to have, and a large expanse of land could be raised above floods by the excavation, 822. To improve the river as indicated would cost less than to make the canal and piers, 823, 824; the quantity of excavation and dredging in both cases would be very little different; to get this exactly a proper survey would be required; but approximately there would be by the river, including the new cut, $4\frac{3}{4}$ millions cubic yards of excavation required—and by the proposed plan there would be $4\frac{1}{2}$ millions; that includes dredging to 22 feet; the piers into the Bay are a charge against the straight channel only, 824; the above calculations are from a common starting point—the improvements above that are common to both schemes, 825; the cut across Fisherman's Bend would improve the tidal action in the river very much, giving a more regular and better bearing up and down, 826; therefore less dredging would be required, 827; not so in the canal, it being so wide and deep, the tidal action would be imperceptible, 828; the river would be the same depth as the canal, 22 feet at low-water, 829. There would be not much deposition in the canal; it would be simply deposited in the Bay outside the piers, 830; the amount of stuff available for reclaiming land would be about the same in both cases, 831. The distance by the improved river, from a point in the Bay where vessels usually bring up to Spencer street, is $6\frac{1}{8}$ miles; from the same point to Spencer street, by Christy's scheme, is $3\frac{1}{8}$ miles, 834. Looking at both schemes in their entirety, the river scheme is the best, 838. If the section of the river was made larger at the Falls bridge, the tidal action would flow up, 841; but this would make very little difference to the canal, for the tidal capacity of the river above Prince's bridge is very small as compared with the capacity of the canal—it is not so much the actual quantity that goes in and out as the length of time it is in action, and the longer space it has to fill up; and when the tide is flowing up and down in a short cut, it would be high-water almost at the same time at the head of the canal as it is in the Bay, for the canal would be so wide and so deep, 844. The canal is not impracticable, but it is very objectionable, very undesirable, 845, 846. A flood channel only, would require a weir; and here a difficulty would occur; a sufficient fall could not be obtained over a weir to save Melbourne from flood, 850. A weir would be necessary to prevent the ordinary flow of the river from going down the flood channel, otherwise the flood channel would have the same effect as the canal in its action on the river, 850, 854. If even the object of the Commission was only to prevent floods, the widening of the river would be the best remedy, 855; the proposed improvement of the

river would have a greater effect in doing away with floods than the canal or short cut, 883; and the liability to silting in the river would be less than in the canal, 891; the river would carry off the floods better than the canal, because of the weir at the top of the canal, 892, 893. The canal could be made without a weir, 897; but without a weir the silting in the river and in the head of the Bay would be very much increased, 898; and, the river running down the canal, the silt brought down thereby would be deposited at the pier head, 903. Only the tidal action of the Saltwater River would be left to keep the mouth of the river clear, 905, 906. To give the comparative cost of the two schemes would require detailed estimates, 915, 916. There is no analogy, but a strong contrast, between the Clyde and the Yarra; the Clyde has a high range of and a strong tide, 926, 927.

W. W. WARDELL, Esq., C.E., Inspector-General of Public Works, 14th February 1873—

Considers the scheme proposed by Mr. Gordon (the widening and deepening the river) a better scheme than that proposed by the Flood Board of 1864, because it is cheaper and fulfils all the requirements, 963. A direct channel from the Yarra to the sea could not be kept open, 964; even with solid piers, 968. As a general rule, a bar must exist in all cases, 969. Hobson's Bay has also almost all the disadvantages of an open roadstead; there is a very great sea at times, but there is always a little drift, which if intercepted must fall along the sides, 970, 971.

EDWIN PETER HENDERSON, Esq., C.E., F.R.S., 7th March 1873—

Would remove the bridges to give more water-way, and make a canal 500 feet wide in a straight line from the Gasworks to Hobson's Bay, a little to the west of the railway pier, 1098. The cost of piers in the Bay need not be expensive, 1100. The depth proposed is 21 feet at the Bay end, 24 feet at the Yarra end, 1102. There would be sufficient scour to keep the mouth clear, as in time the quantity of silt will be much reduced by the corporation taking more care that the streets are not washed away, 1103. Is sure the straight cut would do away with floods, 1104, 1105. The travelling sand on the shore of the Bay can be easily done away with by a plan in use in Holland, by driving withes into the ground and make basket work of it, which stops the sand, 1106. There is less silt in this Bay than in any place within witness's knowledge; the silt has been greatly magnified, 1108. It was stated that the Bute docks at Cardiff would be always silting-up because the were made on the Cardiff flats—there would be no scour—but the contrary is the fact; the silt is easily washed out; so with this canal, the flood water and tidal action will always clean it out, 1109. The canal will cost less and be in every way a great deal better than the Yarra; there is no comparison; improve the river as you like, it will never be a good job, 1111. It would be practicable to make the mouth of the river as deep as that of the canal, and without piers, 1112. The mouth of the river would be much more liable to silt-up than the mouth of the canal, because the waters of the Saltwater River form a natural dam to the waters of the Yarra, and thereby promote deposit in the more sluggish action of the combined rivers, 1113. The opening at the mouth of the river could not be improved so easily without piers as making the mouth of the canal, 1114. Piers would be required at both, 1115. A substantial contractor could be found to undertake the whole of either works; but there would be no comparison between making a new canal and going six miles by the river, 1116, 1117; the latter would cost a million of money, 1118. There is less engineering difficulty in making the canal than in improving the river, 1119.

GEORGE A. MOURITZ,
Secretary.

No. 21.

To the President and Members of the Royal Commission on Low-lying Lands South and West of Melbourne.

GENTLEMEN, Dandenong, 23rd October 1872.

It was my wish and intention to trouble you with no further communication till I was prepared to lay before you everything which I have to suggest with reference to Melbourne as a port, with reference to the floods of the Yarra, with reference to the effect on the sanitary condition of Melbourne of what may be done, and with reference to the disposal of the railways in the neighborhood of Melbourne; for, although the last of these four subjects has not in express terms been submitted for your investigation, it is so essentially mixed up with the others, that without due consideration of it much might be done that would afterwards be seen to be better to have been done differently; but as a decision was arrived at at your last meeting that it was desirable that a canal should be made from the gasworks to Hobson's Bay, and that the professional members of the Commission should be requested to give evidence on the feasibility of carrying out the approaches of the canal into deep water in the Bay, and as I am the author of a new arrangement of mechanical details whereby one of the *only two* essential means for keeping open such navigations may be made available at Melbourne, it appears to me that I ought, at the present time, to point out more explicitly than I have yet done what that arrangement is, and how the causes operate which will give occasion for its use, the latter of the two being the matter for prior consideration; for, if the means which I propose be not needed, it will be but a mere waste of your time and mine to describe them.

The original Yarra Flood Commission, in their report to the Minister of Public Works, say, "We do not believe that it would be possible to keep open the mouth of a channel at any point on the beach between the mouth of the Yarra and St. Kilda in the face of southerly and south-westerly gales." And they were perfectly right so far as the idea which they intended to convey is concerned, namely, that no then known means, except the altogether too costly one of constant dredging, would keep open the mouth of such a channel. Dredging and scour (what is called flushing being but a variation of the latter) are, fundamentally, the only two means by which the purpose can be accomplished. Other means, which are auxiliary thereto, are constantly to be met with in combination with both, but one or the other of these must always be present; and the latter is preferable because much the less costly. But no efficient scour has ever yet been produced by means of tides so small as three feet, nor can such tides be made available in any other way than making a large area of tidal water perform that function which is performed by hydrostatic pressure where high tides prevail; and the cost of providing this area of tidal water vanishes from estimates of the cost of canals and docks at Melbourne, because it is indispensable for flood prevention, and for this reason neither subject ought to be separately dealt with.

The first point to be further considered is, what are the materials that will become obstructions to the entrance to the canal from the Bay, and by what agency they will be brought into a position to become an obstruction ; and this, although not the only point for consideration, is the only one which affects the matter on which it is intimated that the professional members of the Commission will be requested to give evidence. The waters of the Yarra should not be allowed to flow freely through the canal, for, if they be, continual dredging of the silt which would be deposited in it will be required through its whole length ; but this will be easily prevented by a single pair of gates similar to lock gates placed at the river end of the canal, and opening towards the river.

The only materials that can become obstructions to the entrance to a canal from Hobson's Bay are, silt from the mouth of the Yarra, and the sands of the Bay ; and I think the professional members of the Commission will agree with me that the former would be ages before it became deposited eastward from the mouth of the Yarra so far as the point at which it is proposed that the canal should open into the Bay, and that it never would be enough in quantity to involve either much trouble or expense in keeping the entrance to the canal sufficiently free from it. But the sands of the Bay are a matter of much greater magnitude ; and for the purpose of this enquiry it becomes important to ascertain with some degree of precision by what means they will become the obstruction which has to be prevented.

The tides at Port Phillip Heads rise and fall about fourteen feet, whilst at the head of the Bay, or in other words at the beach at Sandridge, the rise and fall is but three feet, from which it follows that for a considerable time in every tide there is a fall of the surface of the Bay from south to north of more than two inches in each mile ; and as it is a rapid-flowing river which has a fall of six inches to the mile, where no part of its flow is by rapids over shallows, it further follows that for a considerable time in each flow of tide there is a considerable tidal current from the south to the north end of the Bay, dependent on the difference of the respective levels of the water of the two parts ; and looking at the configuration of the Bay, and the direction in which tidal water enters at Port Phillip Heads, it appears certain from this alone that the greatest force exerted by this current, except for a short distance from its entrance at the Heads, will be up the east side of the Bay from south to north, and round the north end from east to west, when, meeting with the current from the Yarra, the two currents become blended ; and it would be foreign to present purposes further to trace the course of either. But, if the plans of the Crown Lands Office are correct, which I believe them to be, there is still further evidence of the tidal current which I have just described, and a more important evidence too, inasmuch as it affords a means of estimating what its force is.

On the east side of the mouth of the Yarra is a promontory of silt, which has been brought down by the river and has subsided there, and according to the plans of the Crown Lands Office, it is (with the exception of its apex not being a perfect angle, and neither of its sides perfectly straight) a well-defined isosceles triangle, the base of which is the coast line, whilst its two equal sides abut, one on the current of the Yarra, the other on the before described tidal current ; and the equality of the two sides is a plain indication that the mean action of these two currents is about equal. The greatest force of the tidal current bears no comparison with the greatest force of the current of the river, but the former is constantly recurring with every tide, whilst the latter is absent for months in some dry summers, though excessive during the continuance of heavy freshes. But the object of these remarks is less to draw a comparison between the forces of these two currents than to show the adequacy of the tidal one to produce the obstructions which have to be prevented, and if its force were not sufficient to cause this evil it would have been insufficient to prevent the drifting of the silt from the Yarra far beyond Sandridge, and instead of the beach there being as it is, clean and sandy, it would be muddy there as it now is for a short distance from the mouth of the river. There can be no plainer proof of the existence of this tidal current than that which is afforded by the cleanness of the beach at Sandridge.

I need make no remarks on the certainty that a heavy amount of dredging would be immediately and constantly required to keep open the entrance to any ship canal which opened directly at the beach ; indeed the resolution arrived at implies that this is an admitted fact. But there are amateur engineers and others who believe that, if the entrance were flanked on both sides with piers or groins extending into the Bay beyond the bounds to which the sands of the beach now extend, this is all that would be required to keep a permanently free entrance to the canal. By means of the tidal current which I have described the sands of Hobson's Bay are continually drifting from east to west till they are met by the current of the river, and whether they perform a circuit or increase on the west side of Port Phillip Bay and decrease on the east side, is a point on which I could not form an opinion without better means for observation than any which I have had. But this is a question which does not affect the present enquiry, all that is concerned therein being the fact that it does drift from east to west in Hobson's Bay in a course about parallel with the beach.

The piers or groins just referred to are an essential part of any scheme for dealing economically with this matter ; but they alone would be found altogether inadequate to keeping the navigation open for more than a year or two at most, and very soon either dredging or scour must be brought to do that for which they would be found to be altogether insufficient. Were they made as is contemplated, and as will have to be done whenever the canal is made, the following will be the result :—The sand which now drifts into the current from the river would be intercepted in its course by the eastern pier or groin, and the first apparent effect, which will be visible almost immediately, will be a bank of it accumulating in the angle formed by the pier or groin with the beach, and this bank will increase in both directions till very soon it will extend along the whole length of the pier or groin, when it will next drift across and much of it into the space between the ends of the two piers or groins ; and that this will result from the tidal current is as certain as it is certain that that current now causes silt to drift away from the south-east side of the promontory at the mouth of the Yarra instead of extending along the shore of Hobson's Bay. Then the flow of tide, which always acts with greater force than the ebb, owing to the impulse of the mass of water from behind, would begin to exert some little influence in driving in the sand, and a bar would begin to be formed between the piers or groins ; but the main cause of progressive increase of this bar and its extension for a long distance inwards would be the heavy seas which are produced by all gales blowing from a southerly direction, and very soon vessels of but light draft of water would be unable to enter the canal till a way was cleared for them either by dredging or by scour.

But the flood question has to be considered in conjunction with the construction of this canal, for although it offers no objection to the site of the canal being where it is proposed to be, it offers a very great objection to the canal being separately dealt with, and it indefinitely delayed, or even delayed at all, for a greater flood than that of 1863 may come at any time and therefore may come immediately the canal is finished, and what will be the result is a matter of great importance to a large section of the population of the district. The Sandridge people will be anything but pleased with the port of Melbourne being removed from them, though to this they must submit at some future time ; but they will have a double cause for displeasure in the means by which it is done becoming a means of flooding them doubly deep ; and the people of Richmond will have just cause for interference with anything which will have the effect of increasing their floods.

To make the navigation of the canal safe and commodious at all times, both its sides through its whole length must be embanked to above flood level, and this will add another to the already too many artificial obstructions to the escape of flood-water. I have never had an opportunity of ascertaining where any other of the points for flood escape are, except the mouth of the Yarra and the Sandridge lagoon ; but I believe there are others between Sandridge and the mouth of the river ; but whatever may be the outlets to the west of Sandridge, making the canal where it is proposed to be done, and not simultaneously therewith increasing the facilities for flood escape on the east side of it, to an extent at least equal to those which are by it cut off on its west side, would be to inflict an injury on those who suffer by the floods on the east side of the canal to which they can scarcely be expected willingly to submit.

As the decision which has been arrived at is to make a canal reaching from the beach on the west side of Sandridge to the Yarra, I send herewith a plan which four or five years ago was, together with another plan, laid before a Committee of the Chamber of Commerce, a member of the Royal Commission (Mr. J. H. Blackwood) being then on that committee. This plan represents a canal leading from the beach on the west side of Sandridge to a dock in the angle between the Hobson's Bay Railway and the Yarra ; but it will serve all present purposes just as well as if it represented the canal connecting the Bay with the river, seeing that whatever may be done to keep the mouth of it open would be equally suitable in either case. It will be seen that, bringing the storm-water channel out on the east side of the canal, I have shown a groin designed to protect the pier in which are the sluices, from the drift of sand from the east, whilst nothing of the kind will be required on account of the silt from the west ; moreover, something of the kind will be required as a breakwater to protect the sluices from the heavy seas that would sometimes break on to them from the south-east ; but this will not be required on the west side, the lee of the west shore of Hobson's Bay being sufficient protection against the effect of all gales from that side. But unless great value be attached to the stuff excavated from the canal as a means for raising the surface of adjoining land, I should consider a pier made with walls of jarrah-wood planks, supported by waling pieces, and the opposite waling pieces braced together by means of tie-rods passing through the pier, and the space between the timber walls filled in with the excavated stuff, far preferable to a timber groin, both for efficiency for the purposes designed, as well as economy in construction of the works.

Together with the plan just mentioned, I send a drawing in which are shown a plan and elevation of a part of the pier in which are to be the sluices described in the plan which has been sent to you from the Crown Lands Office ; and by means of the

latter this drawing will be readily understood. The part of the pier therein shown is that which extends from the pier-head to past the second set of sluices, the first set (that nearest to the pier-head) being shown standing open, whilst the other set are shown closed. The manner in which the sluices are actuated will be better understood from the plan (the upper part of the drawing), where the lever by which the open sluices are moved is seen at an angle of forty-five degrees from a transverse line across the pier, and in the direction of that angle away from the pier-head, whilst that by which the closed sluices are moved is seen at the same angle from a transverse line, but in the direction towards the pier-head, the difference in the direction making the quarter of a rotation by which the sluices are to be opened and closed. This drawing, which was not made to any exact scale, was not designed to show the pier just as it will be required at Melbourne, the height of the elevation not representing half the height that will be required there; and in fact the height that will be required there was not ascertained when the drawing was made.

I have the honor to be, gentlemen,
Your most obedient servant,
CHAS. PHILLIPS.

To the President and Members of the Royal Commission on Low-lying Lands South and West of Melbourne.

GENTLEMEN, Dandenong, 11th February 1873.

In laying before you the results of my investigations of the subjects which have been submitted for your consideration and report, I purpose first to consider the floods of the Yarra, their causes, and what will be the best means for their prevention or diminution. I shall next show what I consider to be best to be done for the port of Melbourne in the way of making docks, ship canals, &c. I shall then endeavor to show how the sanitary condition of Melbourne may be best promoted in dealing with these matters; and lastly I shall point out what I consider to be a desirable re-arrangement of the railways, especially if the Melbourne railways become State property. The last of these subjects has not, in express terms, been submitted for your consideration, but I believe it to be impossible to deal properly with the others without making it a part of the whole.

In considering the causes of the floods of the Yarra, I feel sure that the effect of what has been called the heaping-up of the waters in Hobson's Bay has been excessively overrated as to its influence on floods of such magnitude as those of 1863 and 1866, and that the influence of the floods of the Saltwater River, both in backing up the floods of the Yarra and occupying a large portion of the natural openings for flood escape, has been altogether too much overlooked, so far as that influence affects the depth of floods in the low parts of Melbourne proper; and I feel sure that, by adopting the means which a correct appreciation of these two facts would suggest, the south-west parts of Melbourne would never afterwards be seriously flooded, and the flooding parts of Richmond would be very much relieved. That the latter of these causes has a large share of influence in causing the high floods at Melbourne, and that the former has but little effect, except on very small and almost harmless floods, I shall next proceed to show.

Looking at the map of the county of Bourke, published at the Crown Lands Office, and tracing the various streams that are shown thereon, I find that the western boundary of the watershed, which gets its outfall by the Saltwater River, commencing on the promontory on which Williamstown stands, takes a course about north-west to the west side of Gisborne, and also to the west side of all the streams that run southerly from the Mount Macedon ranges, the creek at Gisborne and all those from the south side of the ranges being tributaries of the Saltwater River, and by this boundary is the watershed just mentioned divided from the watershed of the Kororoit Creek, the latter getting its outfall south of the Williamstown promontory. Then the eastern boundary of this watershed, commencing on the high land which lies between the Merri Creek and a creek which crosses the Mount Alexander road at Flemington (the name of which is not on the map), takes a course about due north till, passing through the parish of Kilmore, it extends at least about six miles into the county of Dalhousie, the parish of Kilmore and the county of Dalhousie both furnishing at least one tributary of the Saltwater River, that furnished by Dalhousie being the west boundary of Rutledge's special survey. Now, this is a large triangular tract of country, the flood waters of which, by backing up those of the Yarra, and occupying no very small portion of the small natural outlets for floods, must very considerably increase the floods at Melbourne, though its effects would extend but a very small distance up the Yarra.

To show how little influence the heaping-up of the waters in Hobson's Bay has on any of the largest of the Yarra floods, the height of those floods at various parts of their downward course is one important means, and the height to which those waters are heaped up another. There are other important matters concerned in determining this point; but these two are the first for consideration.

From the manner in which the St. Kilda road was torn up by the flood of 1863, and the approaches to the bridge at the Botanical Gardens were washed away by the same flood, I always felt sure that the rapidity of the current from Richmond to Melbourne must at that time have been very great, and the downward fall of the surface of the flood waters great accordingly; but it is only lately that I have acquired any accurate information respecting these facts. On the 13th of last December I went to the point of the Yarra where the Punt road crosses it, and there ascertained, with sufficient accuracy for my purpose (within two or three inches), that the flood of 1863 rose to the height of sixteen feet higher than the river was on the day when I was there, it being then slowly trickling over the falls at Melbourne; and a few days before I was informed by a surveyor of the Government Survey Department that the Upper Yarra, when at that level, was five feet higher than the high-water level of the Lower Yarra, which made the height of the flood at the Punt road twenty-one feet higher than high-water level. I intended then to ascertain for myself to what height that flood rose in Flinders street, but the Hon. G. W. Cole (as reported in the *Argus*) has saved me from the necessity for doing this, his observations agreeing so well with those which I had made as to leave no doubt on my mind of the correctness of his. He states that the flood of 1863 rose to twenty-three feet higher than high water level at the upper railway bridge, and to twelve feet higher at the Melbourne wharves. This was a fall of eleven feet from the upper to the lower point, and, viewed in conjunction with my own observation at the Punt road, the fall was proportional to distance throughout. A fall so great must have caused a current of very great velocity, and its effects on the bridge at the Botanical Gardens, on the St. Kilda road, and at other places, all support the correctness of Captain Cole's statements. Our joint observations give a fall of two feet over the thirty-one chains from the railway bridge to the Punt road, and nine feet over the 147 chains from the latter point to the Melbourne wharves. To be in exact proportion to distance, the latter fall should be six inches greater than our joint showing, but the diminution of current, caused by its running on to a broad open flat as soon as it had crossed the St. Kilda road, that flat occupied by the united floods of the Yarra and Saltwater River, and the outlet to the sea being altogether incommensurate with the water-carrying capacity of the valleys of the two rivers, very accurately explains this slight departure from the proportion of fall to distance.

For accurate information respecting the heaping-up of the waters of Hobson's Bay, and all the variations of tide levels, I have found no single source sufficient, but by the help of a paper read by Mr. Rawlinson at a meeting of the Royal Society, on the 31st of October 1864, which, with a diagram, is published in the sixth volume of the Transactions of that society, and by the further help of Commander Cox's chart of Hobson's Bay and the River Yarra. I am enabled to ascertain that the greatest heaping-up of the waters above spring-tide high-water level is but two feet and eleven inches; and that the greatest depression of the waters of the Bay below spring-tide low-water level is but one foot and five inches. From the diagram, the tidal heights of which were compiled from Mr. Ellery's tide registers, and therefore undoubtedly correct, I find that the greatest variation of height from highest known flow to lowest known ebb is seven feet; and referring to the 163rd page of the volume of Transactions already referred to, I find it stated by Mr. Rawlinson that, on the 14th of December 1863, the tide rose two feet and a half higher than the ordinary range of flood tide; then, referring again to the diagram, I find that the height of that tide was, as near as can be ascertained by the small scale of the diagram (about three-sixteenths of an inch to the foot), six feet and seven inches higher than the lowest known ebb, and five inches lower than the highest known flow; then, substracting this two feet and a half of excessive rise of tide from its height of six feet and seven inches above the lowest known ebb, I get four feet and one inch as the height of the ordinary high-water level above the lowest known ebb; and beyond this I get no information that concerns me from Mr. Rawlinson; but referring to Commander Cox's chart, I find that the rise and fall of tide is two feet and eight inches, which, subtracted from the four feet and one inch high-water level just named, gives one foot and five inches as the height of ordinary low-water level above the lowest known ebb. Here then we have the following figures derived from very high and

reliable authorities:—One foot and five inches from the lowest known ebb to ordinary low-water level, two feet and eight inches rise and fall of tide, two feet and six inches rise of tide on the 14th of December 1863 above ordinary high-water level, and another five inches makes up the whole height to the highest known flow. But these two last quantities, the two feet and six inches and the five inches, make up the whole amount of the heaping-up of the waters of the Bay; and, taking the figures exactly as they have been given, taking the height of the flood of 1863 as twenty feet and one inch higher at the upper railway bridge than the highest heaping-up of the waters, taking the height at the Punt road as eighteen feet and one inch higher, and the height at Melbourne as nine feet and one inch higher, considering that all these variations of height occur within a distance of four miles, and considering also the amount of mischief done by the very rapid flood current consequent on so great a fall within so short a distance. I think any one who gives due consideration to all these facts will find it very difficult to believe that this heaping-up of the waters of the Bay can have any appreciable influence on any but very small and comparatively almost harmless floods.

There is a cause for the height of the floods at Melbourne which, to my surprise, has always been overlooked, and it may with truth be said to be the sole cause, for, were it removed, the united waters of the Yarra and the Saltwater River would never flood any part of Melbourne, though the valleys of both rivers would still be flooded to within a very short distance of that city. This is a ridge of blown sand, such as is almost always met with on such shores as that of Hobson's Bay, and which there extends along the whole length of the shore to the mouth of the river. It is higher than flood level, steep on the side towards the sea, has a very gradual descent on its land side, and, as far as I can discover without the aid of surveying instruments, is nowhere low enough to be topped by the highest floods except at the Sandridge lagoon. I do not mean that no one but myself has ever noticed this ridge as the cause of floods at Melbourne, for no doubt Captain Cole alludes to it in what he says to the effect that the floods at Melbourne are caused by the flood waters of the Yarra falling into a basin at Melbourne; but his allusion to it is the first that has ever appeared in print, notwithstanding the fact that its operation as a cause is to the exclusion of the heaping-up of the waters of the Bay, even if the latter were adequate to the production of the effects ascribed to it. If by any process of magic (and it will never be done in any other way) the mile and a half length of this ridge lying between Sandridge and the mouth of the Yarra could be lowered to near the level of the lowest lying of the land south of the Yarra, no flood would ever after be seen at Melbourne. I think no one will deny that this mile and a half breadth of opening would carry off, and with but a slow and sluggish current too, all the water that can find its way under Richmond Church-street bridge, together with the addition of that from the Saltwater River, and the whole of any Yarra flood does pass under that bridge.

That the capacity of the Yarra is altogether insufficient for the discharge of its flood-waters is a most indisputable fact, but it by no means follows that increasing that capacity is the proper remedy. The brim of what Captain Cole calls the basin is, I feel as sure as I can feel, without having taken the levels, several feet higher than any part of the banks of the Lower Yarra, and, if so, whoever attempts the remedy by increasing the capacity of that part of the river will be very disappointed by the results.

In making the last remark I, for the moment, quite forgot that the floods themselves afford all the evidence that can be gained by taking the levels. No flood ever yet crossed that ridge at any point except at the Sandridge lagoon, whilst there is no part of the banks of the Lower Yarra that has not been submerged, and I believe to a greater depth than six feet.

With the exception of the impracticable, or at least extremely inexpedient, means mentioned in the latter part of the paragraph immediately preceding the last, or some other more inexpedient, there is no other means of preventing floods in the south-west parts of Melbourne than by the construction of a storm-water channel from some part of the south bank of the Yarra to the sea, and the higher up this channel taps the Yarra and the shorter its course to the sea may be, the greater will be its effect. The original Yarra Flood Commission gave it as their opinion that such a channel could not be kept open to the sea, and they were quite right so far as any means then known were concerned, except that it could be done by constant dredging, which they must have known to be practicable, but also knew it to be altogether too expensive, but I have devised a very simple means of accomplishing that purpose, the effectiveness of which I believe no one doubts. A description of what this means is will be better to be given when I come to the question of a dock and ship canal, and for the present it will suffice to say that such a channel may, without any current expense, be always kept open to the sea.

I believe every competent engineer will admit that tapping the river at any point will do more for flood prevention there than tapping it at any point below; that tapping it higher up will do still more, and that the higher it is tapped the farther up the river will the benefit of doing it extend; and I believe it will also be admitted that the shorter the distance through any water-course of given dimensions, whether enclosed or open, may be, the freer and more rapid will be the flow of the water through it, and the difference between a long and a short course will be still greater if both lead from and to the same levels. Now I propose to tap the south side of the river as far up as its banks will allow, which will not be much more than a quarter of a mile above the St. Kilda road, with a storm-water channel seven chains wide at that part, which I propose shall enter the Bay by the shortest possible route, namely, round the north side of Emerald Hill and over what is now the Sandridge lagoon, that lagoon being filled up to the level of the bottom of the other parts of the channel with stuff taken from the excavated parts; I also propose that this channel shall expand, at a uniform rate through its whole length, to fifteen chains at its outfall at the beach. My original design was a width of five chains at its river end and ten chains at the beach, but recent investigations have convinced me that these latter dimensions will be too small. The depth below low-water level need not be more than a foot, unless required to be deeper for navigation by lighters and other small craft. Depth below low-water level will do little or nothing for flood prevention, the water there having no tendency of itself to flow, and what current there is in it is no more than the result of impulse from the water above, which loses the same amount of its own momentum and velocity as that which it imparts to the water below. A weir of sluices must be erected across the head of this channel, as shown in the plan herewith sent, and the waters of the river must flow down it only in times of flood. At all other times there must be sea-water only in it. By these means I have no doubt that all mischief by floods will be prevented at Melbourne, at least on the north side of the Yarra; and I have also no doubt that the height of floods at Richmond will be reduced several feet, but I do not expect their effects to be felt far above the Church-street bridge. If they be put in execution, I mean dock, canal, and all, no part of Emerald Hill will ever again be flooded.

I now come to the question of a dock and ship canal; and the first remark I have to make is that a notion appears to prevail popularly that rivers are most desirable harbors for mercantile shipping. They are frequently matters for inevitable submission, of which London, Bristol, Glasgow, Hull, and many other ports are examples, but never are desiderata; and a river never ought to be the place for a ship that can find a berth through a short canal in a dock where no water but clear sea-water ever enters. The water may be a matter of no moment to the ship or to her owners, but it is a matter of considerable moment to those who have to keep the dock in a state fit for her accommodation, and the muddy estuaries of rivers, especially the middle of the tidal parts of them, are just the places where the trouble and expense of doing this are greatest. Even as harbors rivers are always abandoned for docks as soon as a port rises to sufficient importance to pay for the construction of the latter; but always some current expense has to be incurred to keep the dock clean, and I know that in some cases that expense is something considerable, and nowhere that I know is it greater than it would be at Melbourne, or indeed so great anywhere else.

What I have to suggest is to make a dock of forty acres extent, and twenty-two feet below low-water level deep, in the flat on the Melbourne side of the National Agricultural Society's reserve, and a ship canal of the same depth leading from it, first in the direction towards St. Kilda, for a distance of twenty-five chains, thence by a curve of a quarter of a circle of twenty-nine chains radius round from the north-east side of Emerald Hill to the south-east side, and thence in a direction at a right angle with its first course from the dock, and in a course parallel to the north-east and south-west streets of Emerald Hill, to the Sandridge beach, at a point about thirty-six chains distant from the Sandridge town pier on the St. Kilda side of it; thence I propose to extend it in the same direction as that last described between two jarrah-wood piers into the Bay, and if extended to a depth of twenty-two feet, and also, if Commander Cox's chart shows the soundings correctly, the pier on the side of the canal towards St. Kilda will have to extend sixty chains into the Bay, but that on the Sandridge side of it need not extend farther than about forty-four chains, and indeed must not extend much farther on account of the jarrah-wood groin next to be described. From a point on the beach fourteen chains to the east of the Sandridge town pier I propose to extend a jarrah-wood groin out to a point at which the end of it, and the end of the longer pier, will leave about a chain opening for shipping to enter and leave the canal, or a few feet more if that will be at all dangerously narrow; and in this groin I propose to make forty-five openings, each twenty-two feet wide, amounting altogether to a width of fifteen chains, and in each opening will be three sluices, each seven feet and four inches wide, the width required for closing the opening. The three sluices in each opening will all be geared together, in the same way as are the axles of locomotive engines for heavy draught, so that all three will move together; they will turn on a vertical axis in the middle of each sluice, whereby any pressure of the water will aid on one-half of each as much as it resists on the other, and thus constructed, the sluices will open and close so easily that a man may either open or close the whole fifteen chains width of them in less than an hour. The sluices will all be open during the prevalence of floods, and also open at all other times, except when required to be closed to scour the entrance for the shipping; but when so required they will all be open during the flow of tide, and thereby two feet and eight inches depth of tide water will be admitted, by sixteen chains width

of openings, into an enclosed space of three hundred and seventy acres, the whole of which must pass out through the ship entrance by the sluices being closed at high water, and by this means, small as the tides at Melbourne are, a scour will be produced more than sufficient for keeping the canal open to the sea.

Some of the peculiarities of the Yarra are either overlooked in the consideration of this matter or they are deemed irremediable evils that have to be submitted to. The Yarra in its normal condition is not a navigable river; to that condition will it return, unless by the constant use of means it be kept in any state to which it may be brought, and the greater be any departure from its normal state, the greater will be the labor and cost of preventing its return thereto. When the Hon. J. P. Fawkner and Batman first sailed up it, the mean quantity of silt carried by its current into the Bay during a revolution of the seasons was identical with the quantity brought down during the same time from the country above; but as soon as the deepening of it was commenced, less was carried into the Bay by the mere current of the river than was brought down to the tidal part of it, and the excess of one quantity over the other has ever since had to be removed by dredging; and if the river be deepened for the largest ships to come up it, the quantity of dredging and the cost of doing it will be something very great.

Another important matter for consideration is eligibility of dock site; and it is not at all uncommon to hear persons say that nature designed the flat to the west of Melbourne for one. If nature did anything of the kind she made a very great mistake, and showed herself to be no engineer; for, for ill consequences, to make a dock there would, out of all that has been suggested on this subject, be second only in the way of mistake to that of making a canal from the Bay to the river to the west of Sandridge. The objections to the latter are almost legion; to the other they are but few, but the few are cogent. If a dock were made there, of course it would be tidal, and would get its supply of water from the muddiest part of the river. As soon as the water had entered, it would, even during the heaviest freshes, become immediately stagnant, the mud would subside rapidly, and much less would be carried out by every ebb than had entered by the preceding flow. This, it may be said, may be prevented by keeping the dock always at high-water level by means of locks. So it may, but then the dock would soon resemble a great open cesspool, and before the end of a hot summer its surface would be covered with a dingy looking iridescent film of decomposing animal and vegetable matter, which would certainly add something to the insalubrious conditions by which all dense masses of population are surrounded.

A tidal dock getting its water from the Bay would always be as clear as crystal, and any light-colored object would be seen on its bottom as plainly as if no water were in it. I may be asked—Would none of the mud of freshes get into it? My reply to this is—Certainly not, the quantity would be too small, and it would subside too readily after it had left the Bay ever to reach the whole length of the canal; and the river deepened for the navigation of all shipping would furnish more work for a dredger in one year than the dock and canal would do in a hundred years. Whoever doubts this, let him dip a tumbler of water from the Bay during the heaviest fresh and compare it with the water of the Lower Yarra when in its most limpid state, and then consider how large a portion of the year the Bay is perfectly clear, whilst during about half the year the Lower Yarra is as much like mortar as water, and I think he will no longer doubt the correctness of my representations, or that the need for dredging will entirely cease as soon as my proposals are put into execution.

On any part of the low lands on the south side of the Yarra a dock may be made that may be supplied with sea-water only; but only where I propose can it be made with the sluices in the Bay facing to the west, and at the same time the storm-water channel tap the river as high as it should do, and to the west the sluices must face; besides there is no place to be compared with what remains of the military reserve for convenience to the whole metropolitan district.

My time is gone, and I have not been able to give the result of my investigations respecting the tidal currents of the Bay, nor have I been able even to touch on sanitary matters and the railways; but if I may be favored with time for another letter, a very small compass will suffice for dealing with them.

I have the honor to be, gentlemen,
Your most obedient servant,
CHAS. PHILLIPS.

To the President and Members of the Royal Commission on Low-lying Lands South and West of Melbourne.

GENTLEMEN, Dandenong, 17th February 1873.

In accordance with your courteous permission that I might complete what was left incomplete in my letter of the 11th instant, I now proceed to the execution thereof, which, if done according to the intimation expressed at the end of that letter, will consist only of a small amount of further matter on the subjects of a dock and ship canal, and what I have to say on sanitary matters, and on the re-arrangement of the Melbourne railways. But so strongly do many persons urge the construction of a canal from the beach on the west side of Sandridge to the river, that I must resume the consideration of some part of the flood question, to show the impracticability of that undertaking, and the mischief and waste of money that would result from it. Were it a practicability, no one would be more disposed than I should be to urge it forward, my only personal interest in anything that may be done being in the adoption of the means that I have devised for making the small tides of Hobson's Bay available as a scour for keeping open the mouth of any channel at the beach, and the first flood that came would prove the necessity for adding it to this project.

The objections to this undertaking will, some of them, vanish if the banks of the canal can be left at the same level as the level of the flat across which it is proposed to make the canal, and the floods, to whatever height they may rise, allowed to flow freely across it to their outfall at the mouth of the Yarra, the course of the navigation being marked by posts up both sides of the canal, the tops of which must stand a few feet at least above the level of the highest flood. To deal thus with the matter would totally preclude the erection of warehouses along the banks of the canal, for independent of the obstructions which they would present to the flow of floods, who, let me ask, would erect any at a place where every little flood would cover their floors? But I have a question to ask on another part of this matter, and I ask it purely for information, for shipowners, tug proprietors, mariners, &c., are much more competent than I am to give the answer. Could a tug, with its hundred, hundred and fifty, or two hundred horse-power on board, take such ships as the *Great Britain*, the *Donald McKay*, or even much smaller vessels, at all safely up such a navigation, considering the variations of the direction and force of the cross currents that would be caused by the various erections near which the canal would pass? I think not, but I freely confess my comparative unfitness to answer the question.

If what I have just described be not a practicability, the only other thing to be done is to embank the sides of the canal, and the top of the embankments must be higher than the brim of the Honorable Captain Cole's basin, or the first great flood will overflow them and flow into the warehouses and into the canal, and that which would flow round through the river and over the flat on the north side of the river, backed up as it will be by the floods from the Saltwater River, will do a mere nothing in preventing this result, as anyone may feel assured who only considers the character of the torrent from Cremorne to the St. Kilda road, falling as it there does eleven feet in less than two miles. But what will be the consequence on the low lands is but the smaller consideration; Melbourne becomes the most important object of concern in considering this matter. No flood has ever yet topped the brim of the basin, but a much smaller one than that of 1863 will do so if ever the canal from the beach to the river be made, and made with such embankments as those which I have described; and then such a flood as that of 1863, instead of reaching only to Flinders lane, would not be very far from reaching the corridors of the General Post Office. Where it would rise to is easily ascertained. Level across from the brim of the basin to Melbourne, and take about two feet higher than the level thus shown, as an allowance for the fall of the surface of the water, consequent on the starting point being in the direction of the flow of the water, and that line from east to west through Melbourne will be about the line of flood level.

It is perfectly natural that the shipowners and merchants of Melbourne should be anxious to bring their vessels by a direct cut up to the wharves, and no one would be more ready than I should be to contribute what I could to their proposed mode of doing it, did I not know it to be, if expediency is to have any weight at all in the matter, an utter impossibility. If all considerations of present and future cost, and of all mischief and damage in other directions, are to be thrown to the winds, why then the thing is quite possible; but I think few of those who now advocate it would do so regardless of these considerations.

The questions put by the writer in the *Argus* of the 12th instant, under the *nom de plume* of "West Melbourne," are all of them in the slightest possible degree relevant to the subject; the engineering questions in this particular matter are paramount to all others; and if the one which I have already explained be not sufficient to condemn it, I can give several others nearly as

cogent, all condemnatory of it. The same writer much more reasonably asks, if floods can be prevented on the mighty Mississippi, cannot they be prevented on a stream so insignificant as the Yarra, and I say most unhesitatingly that they may be entirely prevented at Melbourne, even to the extent of doing it on the lowest of the land on the south side of the Yarra.

Whether the floods at Melbourne could be wholly prevented is a subject to which I have given no attention till within the last week, for I have been so annoyed with seeing building after building going up on land so much required for these purposes, that I have felt a sort of misanthropic pleasure in anticipating what their owners would suffer when floods came, and this prevented my giving any thought to their prevention; but various incidents of the last week have led me to give more attentive consideration to this matter, and the following is the result of that consideration.

There will be so much excavated stuff to be disposed of, that it will scarcely be possible to dispose of it advantageously, without embanking the storm-water channel which I propose to be made from the Upper Yarra to the beach at Sandridge altogether above flood level throughout its whole length; and to send the whole of the waters of the Yarra down it in times of flood, which I propose to do, it will merely be necessary that the timber by which its banks are retained should be carried a few feet higher than I at first designed; and if jarrah wood be very expensive, that timber need only reach a foot or two above the highest flow of tide; then a sort of terrace eight or ten feet wide may be formed on each side from the top of the jarrah wood; and from the back of this terrace the red-gum of this colony may be used to the top of the highest flood level; then by erecting a weir of sluices across the Yarra, a short distance below the part where the storm-water channel leaves, and embanking above flood level from this weir to the embankment of the storm-water channel on one side, and to the high land below Flinders street east on the other, the whole waters of the Yarra may at any time be sent down the storm-water channel by opening the weir of sluices across the head of it, and closing those which cross the Yarra. But it may be asked—Will this channel carry so large a volume of water as that which constitutes the largest floods of the Yarra? Certainly it will. Its mean width will be 726 feet, and the width of its narrowest part 462 feet, whilst in proportion to its length it will have a greater fall to the sea, and also a greater actual fall than the fall from Cremorne down to it, and it will have to carry merely the extra quantity of water that comes off East Melbourne into the Yarra beyond that which flows through Church-street bridge. These facts are most conclusive proof that its capacity will be more than will ever be required. But the next question that will be asked is, how will I prevent the flooding from the Saltwater River. In just the same way: embank the south bank of the river from its mouth up to the gasworks, which will not need to be done to the height of many feet; and from the upper end of this embankment construct another weir of sluices across the river, and thence extend the embankment across the flat below the gasworks to the rising ground at the back of them; then carry as much of the surface water of Melbourne as possible into the Upper Yarra above the weir, and as much as possible of what cannot be carried thither into the Lower Yarra below the other weir; and what cannot be carried to either of these points, which will not be much, must go into the Lower Yarra above the lower weir. When all these works are carried out, and whenever floods are threatened, both weirs across the river may be closed, and the weir across the head of the storm-water channel opened, and all the flooding land at Melbourne, to the extent of several thousand acres, will be as securely dyked in from floods as Holland is dyked in from the Zuyder Zee; and when the flood is over, or should it be threatened and not happen, the position of all the weirs may be reversed, and no harm will have been done. This done, what an extent of land would be made valuable, much of which is now quite valueless?

I may still be asked what I propose to do with the rainfall on the several thousand acres of land thus dyked in, which cannot escape till the flood has subsided, and which, flowing to the lowest part (that where most of the factories are), must cause some little flooding there. This I would keep entirely cleared away by wind-power, of which there is always plenty in times of flood; and I undertake to construct windmills which will bear any amount of the gusty and shifting winds of this country which no mills yet made will do. But I still expect another class of questioners, namely, those whose vessels now come up to the wharves of the Yarra, and these will ask how are they to get up at *any time* if a weir be erected below the wharves. This weir will consist partly of sluices and partly of a pair of sea-gates for the passage of shipping, all of which will be open, except during the continuance of floods; but should the lower part of the river prove to be navigable during the continuance of floods, which I expect it will be when the waters of the Saltwater River only flow into it, a complete lock, instead of sea-gates, may form part of the weir, and then ships may go to and fro at *any time*, which they cannot do *now*.

I have not been able to go into a calculation of what these works will cost, but judging from the calculations which I made a few years ago of what their cost would be if executed as I then proposed, I feel sure that, without these additions for the entire prevention of floods, all else that I propose being done may be done for about £800,000, and that it will cost less than another £100,000 to entirely prevent all floods at Melbourne.

In treating of this matter I consider it impossible to overrate the importance of separating as much as possible the port of Melbourne from the River Yarra; for, independent of the circuitousness of the navigation, a necessity for a large amount of constant dredging must result from making a river navigable by such vessels as the *Great Britain* and the *Donald McKay*, which, in its normal condition, was scarcely navigable by cockle-shells; whilst a dock which gets its supply of water from the open sea will be ages before it will require so much as a month's dredging; and if drawing off the waters of a river from their natural channel be the most expedient means of preventing floods, and it is so at Melbourne, the higher up it is done the greater will be the benefit to parts below, and the higher up the river will the benefit extend.

In the first letter which I had the honor of addressing to you, a part of the object of that letter required reference to be made to tidal currents in Port Phillip Bay, which I was sure must exist there, but the effects of which and the evidences of their existence I had then had no means of observing. I need now only state the facts which I have since observed, their bearing on the matters under consideration being fully set forth in the letter now referred to. The currents to which I am referring are caused by the greater height to which the tide rises at Port Phillip Heads than in Hobson's Bay, and its earlier rise at the former point than at the latter, and from the configuration of the Bay, and the direction which tide takes in entering at the Heads, I consider that at any distance into Port Phillip Bay the current from this cause must be strongest up the east side of the Bay and round the north side of Hobson's Bay, running from south to north in the former, and from east to west in the latter. The first step I took to assure myself of the facts of this matter was going to Mordialloc, where, taking with me three empty bottles, I went out at about high water at Port Phillip Heads to the head of the jetty (about four hundred yards long), where, standing about the middle of the head I dropped one of the bottles into the water, where, instead of its floating away northerly as I expected, it went rapidly under the jetty and did not appear at all on its north side till it had traversed more than a chain of the jetty's length, which showed that the current of the rising tide running directly into the shore far exceeded in strength the current which I was seeking to investigate. Losing sight of the first bottle, I immediately dropped the second into the water at the north corner of the head of the jetty, and it floated away rapidly towards the shore, making so little northing that it had not got more than half the width of the jetty away from its side when it was more than a chain's length along it, and just as it had got into this position the first bottle reappeared from under the jetty, the slight distance in advance of the second that was due to the few seconds earlier dropping it into the water. I walked along the jetty at the same pace that the bottles floated along its side, but when I got about half way along it, a very considerable decrease of the motion towards the shore was perceptible, with an increase of the northing, so there I dropped the third bottle, which floated away from the jetty at about the same speed that it floated towards the shore, showing that there the force of the two currents was about equal. Throughout the whole course the current shoreward decreased, whilst the other, that which I was seeking to investigate, increased, and every indication of the former was altogether lost at about a hundred yards from the shore, from which point the bottles kept a course parallel to the shore as far as I could see them. This trial showed me that at that time and place this current was not perceptible till very close to the shore. I do not consider the trial to have been of much value, nevertheless it was not altogether without significance, with reference to the subjects referred to in my letter of the 23rd of last October.

On the 13th of last November I went to Melbourne, mainly for the purpose of going to Sandridge on the following morning to ascertain all I could about these tidal currents. I reached Sandridge at a little before 10 a.m. on the 14th, 11.46 a.m. on that day being the time of high water at Port Philip Heads. I went up the beach towards the mouth of the Yarra close to the water's edge, perceiving no indications of much current; but I had not gone very far beyond the baths when I noticed a small promontory of sand reaching out five or six yards into the water, having a side towards Sandridge at least a chain long, and forming a very obtuse angle with the coast line in the easterly direction, whilst its westerly side was but about the same length as the five or six yards which it extended into the water. This, if there were many such and all alike, was an unquestionable proof of the regular occurrence of the currents to which I am alluding, though there might be one such without their being the cause of it. I passed several of them before the idea of counting them occurred to me, but there were not less than ten or a dozen of them up the whole length of the beach, and all very exactly resembling each other in the particulars which I have just described; the easterly side was always long, forming a very obtuse angle with the easterly coast line, whilst the westerly side was always short and sometimes at a less angle than a right angle with the westerly coast line. When I reached the promontory of silt on the east side of the mouth of the Yarra, I found that it exactly corresponded with what is shown on the Crown Lands Office plans, its easterly margin well defined, and no gradual running of it out on the sands of the beach. Returning, I set off

along the highest part of the ridge of blown sand for the purpose of noticing its slope both landwards and seawards, and also for the purpose of discovering any opening there might be through it, but none could I discover; in fact so closely did I look for this, that I am sure there is not one, nor do I believe there is one anywhere except at the Sandridge lagoon. Finding time going so fast that I might lose the opportunity of ascertaining the velocity of the tidal current, I returned again to the water's edge after going about half the length of my return by the top of the ridge, and when I reached the water, which was about 11.15 a.m., great quantities of small black seaweed were drifting along towards the west at a very equal speed, but for a long time I had great difficulty in noticing the speed of any one piece, and at the same time noting the time by my watch, but after many trials my eye fell on a piece sufficiently distinguishable from all the rest for me to have no difficulty, and I found that it drifted along at the bottom of the water, not floated on its top, at a speed of about forty-three feet in a minute of time. When I got about midway between the baths and the railway pier I had an excellent opportunity for seeing how the pier, when thronged with shipping, obstructed this current. Vessels of one kind or another occupied the whole of the Melbourne end of the pier, and a piece of paper was floating on the water about three or four feet from its edge which I found drifted along no more than fifteen feet in a minute. Having made these observations I then went to the Sandridge town pier, which I intended to reach by 11.30 a.m., but did not reach it till within a few minutes of noon. I went about a third of its length along it, and there, on the west side of it, I dropped a piece of wood into the water, which floated direct off to the west at the rate of fully a hundred feet per minute. I did the same at a point about two-thirds along the pier, and again at its head, with the same result at both places as at the other.

I went to Sandridge again on the 20th November, when a heavy fresh was coming down from the river. I reached the town pier at 3.19 p m., high water at Port Phillip Heads being then at 3.39 p m. I went about one-third of its length along the pier, when I dropped a piece of wood into the water on its west side, which floated off to the west at a very slow speed, not making a greater distance than about fifteen feet in a minute; I then went to the pier-head where there was no current at all. I stayed there so long that I did not reach the place of my first trial till 4.11 p.m., when I again dropped a piece of wood into the water on the west side of the pier, which floated slowly under the pier, so I went across to the east side, where I dropped another piece of wood, which floated off to the east at the rate of about fifteen feet per minute, showing that between 3.19 p.m. and 4.11 p.m. the state of the current had become exactly reversed. At this time an elderly Scotchman was near me, coiling up some hose, from which I infer that he was an employé on the pier; and to him I remarked that the heavy fresh from the river nearly stopped the tidal current in the other direction, to which he replied, that the current that way was sometimes as much as two knots an hour, but that it never lasted long.

All this information respecting the tidal currents relates to the subjects of my letter of the 23rd of last October; but as I could not give it then, not having gained it myself, I have added it to this letter.

On sanitary matters, I must remark that I am sure the whole of Melbourne sewage cannot be utilized, and that, with all that is practicable for that purpose, some of it must pass away by its own gravitation, and to the river and thence to the sea must this part of it go; but a year or two ago, I saw in one of our newspapers a statement to the effect that the sea would not allow itself to be the receptacle for sewage, but would cast all matter of that kind back on the land. Now, I do not believe there is the smallest show of reason in the world for believing anything of this kind, and the universality of the fact that animal excrement is vegetable nutriment is altogether repugnant to any such notion, and nowhere can I see any evidence of it. That sewage is pernicious and pestilential to animal life and health is an indisputable fact, and therefore it is an important matter for enquiry to what point that portion of it which cannot be utilized can be carried where it will cease to be nocuous, and what will be the best means for getting it there. The waters of Port Phillip Bay are such a mass that if it were a lake the sewage of Melbourne would not appreciately pollute it for years, and I believe, not for ages, but the rapid interchange of its waters with those of the outward ocean is such that a hundred Melbournes would never appreciably pollute it. Take its mean rise and fall of tide at four feet (and it is more than that), and its mean depth at forty feet (which is much more than the reality), and it discharges through the Heads and also receives through the same channel a quantity of water equal to its own capacity in eleven tides, or in about six days; and whoever considers this fact, I think, will arrive at the conclusion that we need trouble ourselves no more about our sewage when once we have got it into the Bay; and how then is it to be got there? I will take Emerald Hill as the first example. Its sewage, if my scheme be adopted, must flow into the storm-water channel, and if none of it passed away, the waters would be a long time in becoming much polluted; but for the sake of avoiding fractional quantities, let the rise and fall of tide be considered to be three feet and the depth of the channel a foot below low-water level, and at this rate, three-fourths of all that flows into the channel would be taken out into the Bay by every tide. Having thus considered the Bay and Emerald Hill, how does the same reasoning apply to Melbourne and the Yarra? Were the bottom of the Lower Yarra throughout its length exactly at low-water level, every tide would carry the whole of the sewage out into the Bay; but with little more than two feet rise and fall of tide and twenty-two feet depth, the exchange of its polluted waters for the fresh waters of the Bay will be so slow, that its condition will always be that of a filthy open sewer. Sanitary considerations are as antagonistic to the deepening of the Yarra as are those which relate to the port of Melbourne

I must say but few words about the railways. Breaking up the St. Kilda line and the Bay line, and extending the Suburban line from Greville street to the Junction at St. Kilda, and making a line as shown on the plan by Emerald Hill to Sandridge, will shorten the railways by nearly four miles, will save a large amount of rolling-stock, will in the aggregate give a larger amount of public accommodation at less working expenses, and will furnish three or four times the quantity of railway material that will be required to connect the railway at Spencer street with that at Flinders street.

I have the honor to be, gentlemen,
Your most obedient servant,
CHAS. PHILLIPS.

By Authority: JOHN FERRES, Government Printer Melbourne.