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MIL NADU ARCHIVES

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

6th February 1880, No. 284 W.

General.
Establishment

Read the following paper :—

INSPECTION NOTES.

BUCKINGHAM CANAL.

No. 16.

Tour of Inspection lasted from 18th August to 6th September 1879, both days inclusive.

I propose to note in this memorandum the present state of the Buckingham Canal as well as the improvements which I would recommend to be carried out to render it thoroughly efficient. In the first place the surveys of the canal are far from satisfactory. They are in many respects meagre and having been done before the work was commenced or finished they are inaccurate. It is of great importance that a correct and complete survey of the whole line from Madras to the Rompairoo should be available. Careful surveys are required of the various rivers crossed by the canal with soundings, and tide registers must be kept on all the rivers and backwaters which are open to the influence of the tide. Orders have already been given on this point. Until proper information is obtained on both these points (not omitting maximum river floods) it will be impracticable to prepare in detail a scheme for the proper completion of the canal.

Surveys.

Observations by the Chief Engineer

(1) The requisite Survey Estabt. has been sanctioned and the Supt. of Works Captain Awdry is engaged in preparing the Estimate for submission to the Govt. of India. Tide gauges have been established in all backwaters & open estuaries as also at intermediate points along the Canal

2. I will now commence at the Adyar and work up towards the north.

3. *Adyar.*—The lock on the Adyar, at the head of the southern canal, is a temporary structure, formed of stakes, sandbags, &c. It should, in the new scheme, be replaced by a permanent work, and it would be desirable to construct a dam across the Adyar.

3 For sanitary purposes it is most desirable that the level of the water in the Cooum and Adyar rivers should as far as possible be maintained at 3.5 ft. above mean sea level and to do this the lock here proposed would be indispensable as when the Cooum bar open (max. rise of tide 2.92 ft. above and low water 0.70 below M.S.L.) the water would otherwise escape through the Southern Canal. The necessity for constructing a dam here is not sufficiently apparent to warrant the work being included in the estimate & [illegible]

4. On the left bank of the Adyar there should be a landing-place. The Sadras section ends at the Adyar lock and

(4) Under the present arrangements for taking the tolls the proposed landing place would not help traffic but Capt. Crowdy has a proposal for altering the sections so soon as the channel shall be open as far as the Cheyoor back water, which if combined with a proper opening and headway being given to the South Indian Railway bridge would permit and encourage traffic through the Junction Canal

(5) Appended is a detailed statement of the spans and headways of the bridges, the former dimension being generally under 20 ft. and the latter as low as 7.22 ft. at M.S.L. The headway is thus only 5.72 ft. when the level of the water is 3.5 ft. above M.S.L. and is therefore much too low. The expense of altering all these bridges 14 in number would be prohibitory but means should be found by corbelling or otherwise to provide an 18 inch wide board for the towing lines to pass. To prevent water escaping from the Cooum when the Adyar bar is open a lock should be built at south end of the Junction Canal; so long as it can be managed without injury to the channel at the bridges a scour may be provided for in order to remove silt

(7) Observations concurred in

(8) A flood gate which will form no impediment to traffic would answer all purposes

boats coming into the Junction Canal would, under the new rules, be called upon to pay a second toll for merely going perhaps to the Cooum.

5. *Junction Canal.*—The Junction Canal is very narrow, all the bridges have insufficient waterway and of some the headway is too small. They will certainly interfere with the traffic, should it increase. When there is a flood in one of the rivers only (as occurred lately) there is a strong current through the Junction Canal, which causes scour under the bridges. The channel is somewhat filled up, but at the bridges the canal is found to be deeper owing to this scour. Would it not be a good thing to arrange for closing the Junction Canal at pleasure? A channel should be dredged along the bed of the Cooum. The proper channel alignment would pass under Government House Bridge, then under St. Mary's Bridge, about a mile and a quarter in length.

Cooum.

6. *Junction Canal.*—The deposit in the Junction Canal is about an average of 9 inches, varying in depth from 2 feet 4 inches and 2 feet 1 inch near Ice House and Soongavaru street bridges to a few inches. There are 14 bridges across this canal. The headways of these vary greatly, and would appear to have been regulated by the road approaches; when traffic increases some will require alteration.

7. *Cooum.*—The Cooum from Marine Villa to Government House Bridge and thence on to St. Mary's requires to be deepened by 6 or 8 inches, but from St. Mary's to South Indian Railway Bridge and beyond it, the deepening required amounts to 15 or 18 inches. From the General Hospital Bridge to the Madras Rail Girder Bridge slight clearing is required. Some of the bridges, especially the South Indian Railway Bridge and the Salt Cotaur Bridge, require raising, as in their present condition they will greatly interfere with traffic.

8. *Lock at General Hospital Bridge.*—At the General Hospital Bridge it has been proposed, I understand, to build a lock. I presume this is intended to exclude some sewage from the Cooum. The lock will, I venture to think, be a considerable impediment to traffic, and the sewage cut off from the Cooum will be pent up in the canal between the Railway

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(8) The sewage of all the north portion of Black town should unquestionably be diverted from discharging into the canal by an intercepting sewer to be constructed by the Municipality

(9) agreed

(10) Approved but the question will require further study: some of the present lime kilns which occupy the needed ground must be removed

(12) New bridges should be provided, but the removal of the present structures is not a matter of urgency

(13 & 14) This lock has not sufficient height to clear it in maximum floods and is at least half a mile too far north. It will be necessary to remove the lock and take a new isolated channel for the 6 mile 6 furlongs through the ground to the east

Station and the Shadiencoopum Lock. It would be better to get rid off this sewage by some other means and prevent it entering the canal at all.

9. *Canal between Central Station and Basin.*—Between the Central Station and the basin dredging is required, also tow-paths. A narrow strip of land is required on the west bank from People's Park and on the east along the Railway as far as the Elephant Gate Bridge. From the Elephant Gate Bridge nearly up to the bridge near the basin (close to the lime-kilns) both sides of the canal are occupied by the Salt Department; tow-paths are much required here and the Salt Department should be called upon to give up sufficient ground for this purpose.

10. *The Basin.*—The dimensions of the basin are utterly inadequate even for present requirements. When I arrived at Madras on 6th instant the bridge was *completely* blocked with a great number of large firewood boats, &c., and the basin, especially on the east side, was crammed with boats. This basin must be very largely extended, and I would advocate the formation of a basin right up to the rail bridge, a distance of about a quarter of a mile. Some land will have to be bought up on the margin.

11. *Rail Girder Bridge—from Ráyapuram Station.*—The Railway Girder Bridge has fair headway; at the time I passed there was 4½ feet of water and 10½ feet headway, total 15 feet, occasionally the headway is only 8 or 9 feet.

12. *Canal up to Shadiencoopum Lock.*—Between the Railway Bridge and the Shadiencoopum Lock the channel is in fair order. It is silted up for about a foot or 18 inches with fine mud, which should be removed by dredging. There are two old masonry bridges with very insufficient headway on this part of the canal. They should be removed and replaced by girder bridges with ample water and headway.

13. *Shadiencoopum Lock.*—The Shadiencoopum Lock is at 7 miles 4 furlongs. The lock sills are 6·12 below M.S.L., while the chamber walls are 11½ feet high. The flood of 1872 passed completely over the lock, being 1·86 higher than the walls or 7·24 feet above M.S.L. The cyclone flood of May 1879 was much smaller, 4·66 feet below this level.

as far as the 9 mile 2 furlongs where there should be a flood gate. By these arrangements the canal will be preserved from the effects of the floods of the Kortalayár and of the Red Hill Tank drainage from both of which it now suffers greatly at times

14. *Shadiencoopum Lock to Ennore.*—The channel from Shadiencoopum Lock to Ennore in the 9th, 10th, and 11th miles passes through comparatively narrow parts of the Ennore lake. At 9th mile the Kortalayár falls into the backwater on the west side. On the east of the backwater, opposite mouth of river and for some distance north, there is a deep channel which appears to have been scoured out by the action of the Kortalayár floods. At the 11th mile a long spit runs out from west side of the backwater half way across the lake, this renders the course of the deep channel very tortuous. The lock at Shadiencoopum should be dismantled, a lock being built to replace it at Ennore (a new channel being made along the margin of the backwater) close up to the Catholic Chapel.

Lock proposed at Ennore.

The rise of the tide in the Ennore lake is not great, probably not much more than 1 foot. With the view of being able at pleasure to raise the water in canal reach between Ennore and Madras a sluice weir should be built 50 feet long, so as to take in water at high tide. The crest of the weir being laid at lake mean tide, so as to take in water if required without passing it through the lock as at present.

(15)

From the $11\frac{1}{2}$ mile to the $20\frac{1}{2}$ should be taken in a new isolated channel east of the backwater and have flood gates at either end. The existing deep portion of canal between the 19th and 19th mile might be included in this new line owing to the oozey nature of the bottom in the existing backwater dredging would have no permanent effect.

The opening into the Chintamony backwater will need in any case to be left open for the

15. *Canal beyond Ennore.*—From the 12th to $14\frac{1}{2}$ the channel passes through a wide backwater with salt-pans on both sides. There are no proper tow-paths. The deep channel is very tortuous. This is a great obstruction to traffic, as the trackers have to wade; and with an adverse wind the only means of getting along is by poling. The canal should follow the east margin of the backwater and be completely enclosed, so as to be in no way affected by the floods in the Ennore lake. A lock should be built at about the $11\frac{1}{2}$ miles, with a sluice weir, to give the canal the benefit of the tide at the Ennore bar. Through the 15th and 16th miles the channel is along an arm of the backwater flanked on east side by casuarinas and cultivated fields. The compensation for these fields would be rather high, but no great quantity of ground would be required. The deep channel is tortuous and there is generally speaking only 3 feet depth of water. At 17th mile the banks begin for the first half mile low, but afterwards they become high and irregular, sloping down to the water with much prickly-pear growing on the slopes. Depth of water 3 to $4\frac{1}{2}$ feet. At $19\frac{1}{4}$ mile this cutting ends where the channel enters the Chintamony backwater. At $20\frac{1}{2}$ there is another cut, and at this point we find the bar of the Chintamony backwater which is high and very seldom open. This backwater at present gets the benefit of the Pulicat lake tide, but the water apparently only rises some 6 or 8 inches. I would propose that the channel should be banked across this bar opening. The cut at $20\frac{1}{2}$ mile is much enlarged by action of floods. It has very high banks with the berms quite swept away and no tow-paths. It continues to the end of 21st mile, where it enters the Pulicat backwater. The east border is now planted with casuarinas till end of 22nd mile, where there are high natural sand banks close to the sea. At $25\frac{1}{2}$ we reach Pulicat. I would propose to have a lock at Pulicat on the east side of the backwater, so that there would be an enclosed channel from Ennore to Pulicat $11\frac{1}{2}$ to $25\frac{1}{2}$. The lock would open out into the channel leading to the bar and would be provided (as all others along the line) with a sluice weir to let in sea water when tide was high.

Chintamony Backwater.

Pulicat Backwater.

free passage of flood water. From immediately beyond this point and to the entrance of the lake beyond the town of Pulicat careful study is required. So far as can be judged however a feasible plan would seem to consist in making an isolated channel $4\frac{1}{2}$ miles in length along the west margin of the backwater between the $20\frac{1}{2}$ and 25th miles with flood gates at either end.

I do not approve of the proposal to bank across the opening at the $20\frac{1}{2}$ mile nor to take the canal along the east margin close up to the bar, in flood this would certainly be dangerous

16. In the 26th mile we reach Coromandel. Here there are a number of garden houses built close to the margin of the lake, so that we cannot find a suitable place for a lock at Coromandel till we reach the 27th mile stone; but this is of little consequence as from the bar channel up to this point there is very deep water.

17. *Pulicat Lake.*—From the 27th to the 44th mile the course is through the Pulicat lake. The east shore of the lake is very shallow and the towing of boats was very laborious owing to the indentations of the shore projecting far into the lake. To partially remedy this several cuts were made across these projections which considerably improved the course. The first cut is 7 or 8 miles long, beginning at 27-3 and ending at 34-7. In this cut at present the canal is confined by low flat berms which were much destroyed and breached during the late cyclone in May 1879. The depth of water varies much, from 4 to 6 feet. At the end of the cut a submerged bank extends some little way into the open lake.

(17)

The only apparent means of securing a sufficiently protected line along all this portion will be to take a new isolated line as proposed along the depression which commences a little north of the Pulicat bar. Some palliatives are feasible e.g. altering slightly the end of the South cut so as to carry it into deep water but there is no radical cure apparently to be admitted difficulties of the present line which is throughout exposed to the lake

The only part of the line which can be considered as adequately protected between Pulicat and Kusba is the short portion between the 35 mile 7 furlong and 38 mile and this of course can be taken into the new line

From a peculiarity in the conformation of the Pulicat lake it appears that when the waters of excessive floods begin to subside the canal from a little north of the 36th mile acts as a surplus channel & very beneficial scour is thus found to have been set up throughout the line to its southern debouchure in the lake at the 27th mile This peculiarity should be turned to use for the new isolated line by the construction of a powerful head sluice in the west bank at the 36th mile and a scour produced in the channel down to the bar whenever circumstances favour A sluice with 5 or 6 openings 6 ft. wide each

18. The west bank in this portion is quite exposed to the action of the lake waves, which during heavy west and south-west gales are very high and powerful. Both banks have been seriously damaged, and at the ends where the channel enters the lake the canal is shoaled up to a serious extent. To maintain these ends open is found to be very difficult during the prevalence of the west and south-west winds over the broad surface of the Pulicat lake. A mile of the open lake has to be passed before the next cut is reached. The depth in this open part is 4 to 5 feet. The 2nd cut is nearly 3 miles in length, extending from 36th to near the 39th mile. It is very much shoaled up at both ends, the entrances have to be constantly cleared, yet there was only 3 feet water at the time that we passed. On the east side of this cut is the mainland with a fine berm, turfed slopes, &c. On the west side the canal is bordered in some places by lagoons and in others by extensive foreshores. In fact a part of it is through a neck of land. The depth in the cut varied from 4¾ to 5¼ feet. The north end of this cut runs out a long way into the lake with submerged banks. This part is much silted up, there being only 3 feet of water for nearly a mile.

19. The 3rd cut is entered at 39¼ miles. This is actually in the lake and is hardly a mile long. There was only 3 to 4 feet of water in it while the ends extend far into the lake with submerged banks. In these parts it is much shoaled, there being barely 3 feet of water. On leaving this cut about 2 miles of open lake have to be crossed with depth varying from 3 to 4½ feet; near the 42nd mile the 4th cut is entered. I should have mentioned that on the west side of the 3rd cut there is no bank, but merely stakes with brushwood fencing to break in some measure the force of the waves. The 4th cut extends up to 44¼, where the village of Jonangipolliem is situated. On the east side there is lake water spread and low ground; on the west a low flat berm more or less destroyed, being artificial and exposed to the severe action of the lake. There was about 4 feet of water in this part. I would propose to abandon all these cuts, except No. 2 and part of No. 4, and follow the margin of the lake on the low ground, so as to form a most substantial bank on west side, and have, wherever

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would apparently suffice

Whether a flood gate would be needed at the southern extremity near the Pulicat bar is not as yet clear

(22) From Kusbah 45 mile northwards a strong west bank well clear of flood level is essential and the canal should be isolated up to the × 68th mile where a flood gate may be placed An interval will have to be left for the passage of flood water and the new cut to the west of the backwater as suggested by Major Vibart made up to Dugarazpatnam 69m This last portion will also need to be isolated by flood gates at either end. The proposed basin at Dugarazpatnam should as elsewhere consist of a simple widening of the channel

(24) If on further enquiring the drainage which enters at the 71 Mile 5 furlongs cannot safely be barred from entering the canal a flood gate must be placed a little north - I do not consider a sluice weir as proposed here

practicable, a good foreshore outside the bank. No. 2 cut is a good one and I would retain the whole of it. Parts of No. 4 are also worth preserving.

20. *Canal beyond Jonangipolliem.*—From Jonangipolliem to Cusbah, a distance of 1½ miles, there is a low flat berm on east side with tow-paths well turfed, but bank very slight. On the other side is a berm of 3 feet with bank washed away by cyclone flood; outside of this a wide expanse of lake. From Cusbah at 45-2 to Royadoravoo at 57-5 there is a fair channel, bordered on the west by a wide expanse of shallow water. (Lake.) The berms generally throughout are good, but the banks are more or less damaged and on both sides they need to be thoroughly made up.

21. *Detail observation forwarded with this report.*—I have got details of the whole canal throughout in survey form. These are being put together in a readable shape and when complete will be forwarded for reference.

× 68th

22. *Royadoravoo to Dugarázpatnam.*—From Royadoravoo to entrance of Dugarázpatnam backwater, 57-5 to 65-5 the channel runs through a shallow backwater. Banks, &c., require to be made up on both sides with a few inlets for drainage.

23. *Dugarázpatnam Backwater.*—At 65-5 the present channel enters Dugarázpatnam back water, which it crosses to Dugarázpatnam. The channel across the backwater undefined and difficult. I propose to take a new cut along the west margin of the backwater so as to have the channel completely enclosed, an inlet and outlet being required to dispose of a drainage which now enters the backwater. This cut will extend for 5 miles up to Dugarázpatnam.

Sketch enclosed.

24. *Channel beyond Dugarázpatnam.*—The channel from Dugarázpatnam towards the north now in existence (69th to 73-3) is more or less in connection with the backwater, as only in parts is it provided with a bank on the east side, and those which exist are very weak and low. This it is proposed to thoroughly embank and provide a sluice weir in this bank opposite the bar at Kondoorpolliem, so that the canal may be supplied with water during the rise of the tide. At 73-3 the canal enters a cut through high ground,

to be suitable — Another flood gate will be needed a little south of the Swarnamukhi river. This reach of canal 4 miles in length will thus with the embankments proposed be thoroughly isolated in case of flood

(25) The crossing of the Swarnamukhi river is a complicated matter and calls for further examination. So far as can be judged Major Vibart's proposed deviation from a point near the village of Govindapulli to Mullapulli combined with training the river by means of embankments and strongly constructed cross bunds east and west appears to hold out the best solution

banks rugged and berms damaged. At 74-3 the cut ends and we enter Pamanji backwater.

25. *Swarnamukhi River.*—At 75-4 the Swarnamukhi river joins the canal. This river originally discharged into the sea through a bar to the north, afterwards it changed its direction and discharged through a new mouth to the east. At both these places there are now bars which but seldom or ever open. Shortly after the canal was connected with the Swarnamukhi, the river instead of continuing to discharge through its original bar, possessed itself of the canal, and now discharges at intervals through the Pamanji bar and Dugarázpatnam backwater a long way to the south. From 75-4 to 77th the Swarnamukhi bed is used as the canal. The canal course through the river is difficult to maintain, and in parts the trackers have to wade in the water. At the time I passed there was a depth of 3 to 4½ feet. Of course this part as well as the canal as far as Dugarázpatnam is occasionally subject to somewhat violent floods. At the point where the canal north of the river leaves the river bed the Swarnamukhi has two branches with a high bank between. It is proposed to bank up one of these and so force the river into one channel; close up the two cuts from the Swarnamukhi into the Pamanji; embank the south bank of the Swarnamukhi from these cuts to some high sand dunes near the sea; cut the Pamanji bar and thus force the Swarnamukhi through the above bar to the east. The canal is to be taken in a new cut from 75th to 77th miles. A lock being built on each side of the river to keep out river floods. There will thus be an enclosed reach of canal from Coromandel to Swarnamukhi supplied with sea water at Coromandel, Dugarázpatnam and Swarnamukhi. There might be five sluice weirs to supply the necessary water, placed at average distances of 12 miles apart.

Sketch enclosed.

26. At present the tidal rise in the Swarnamukhi appears to be not more than 8 or 9 inches, which water appears to be received from the Kundalairoo through the canal which is some 12 miles long.

The opening of the Pamanji bar, if it can be kept open, will greatly increase this rise.

(27) No remark called for further than that at either extremity of these 14 miles of canal flood gates might with advantage be placed. It does not appear essential to make so long a deviation 1 mile in length, as proposed here by Major Vibart. If the present end of the channel as it enters the Kundalairoo river is turned east and north for about 2 furlongs and made to enter the backwater close to the west of the Gungapallem village it will answer all purposes as the backwater is believed to remain permanently deep at this point

(30) The Kistnapatam basin must be extended as proposed

27. *Swarnamukhi to Kundalairoo.*—The channel from the Swarnamukhi to the Kundalairoo, 77th to 89-6, is generally good, with high banks and tow-paths, but the channel is too narrow in parts and sometimes unnecessarily winding. There is not sufficient berm and if the channel is ever considerably widened (which we may look on as certain to be requisite) the widening will be expensive, as one bank will have to be removed. The channel is shallow in parts and must be deepened. With the exception of field drainage from certain wet cultivated lands there is none in this section. Before the present cut joins the Kundalairoo the canal follows the course of an old drainage and is consequently tortuous and formed with many curves.

Entrance to Kundalairoo. Sketch enclosed.

The entrance to the river was well situated for the previously intended north canal, but it does not suit the present canal as the river has to be followed for nearly a mile. The mouth of the cut cannot be maintained deep.

28. I propose to abandon about half a mile of the canal and run a new channel from the point (half a mile away from the river) straight across through low ground nearly opposite to the entrance of the north canal. The canal from the Swarnamukhi will be enclosed with a lock and sluice weir at each end. This reach will be 12½ miles long. The Kundalairoo river is very deep; the bar always open; tide rises fully 3 feet. Large ships of 300 or 400 tons enter this estuary to refit.

29. Mouths of the present cuts have silted up 2 feet. At high tide in the river there is fully 7 feet of water, while at the mouth of the cut there is only 5 feet. Where the north canal leaves the Kundalairoo there will also be a lock. It would be as well perhaps if a "nose" was run out from extremities of canal, some little distance into the river, so as to check this shoaling.

30. *Canal north of Kundalairoo.*—About half a mile from the river we reach Kistnapatam. At 92nd the new cut joins the old channel. The new cut is deep throughout with tow-paths. There are however no banks; backwater and low ground on both sides. There is a basin at this place, but it is far too small, not

A flood gate will be required south of the basin and the canal to the north the banks must be raised and the channel isolated

(31) At Nellatoor it will be necessary to cut a fresh channel for nearly two miles [95-4 to 97-6] a little east of the present line in rather higher ground thus leaving the present channel free for the passage of drainage

) The whole of the drainage here must be collected and passed across the channel at one point

33) Here again of the three openings the central one must be kept clear for the passage of the drainage closing the others

34) The Pennair River 14-3 to 116-6 crossing is robably the most difficult matter deal with in the whole of the nal - Some Rs 11,000 were pent in taking the silt out of the cut here between f 115-4 and 116-3 miles within the first year of ning the canal and in both the cyclones of 1879 t was the same cut again silted up to thin 9 inches of L.W.L. but the several branches

wide or long enough. The present one is also damaged at the ends from boats striking against the laterite masonry.

Through Kistnapatam backwater for about a mile the banks of the canal are destroyed, and the channel much silted up (as much as 2 to 3 feet), all this requires to be embanked.

31. From 93rd mile to 94th also the banks require raising, &c. From 94th to 95½ the channel is in deep cutting, banks high, tow-paths good, &c. From 95-4 to 97-6 the Nellatoor drainage is crossed and recrossed many times. The banks and tow-paths in this section require completion and the drainage must be provided for. It is not however a large one. It is crossed for the last time at Ananthapurum. The depth of water in the canal varies from 3 feet opposite to the Nellatoor bar, where the banks breached; to 6 and even 7 feet in other parts. From 97-6 to 100-6 the channel is in deep cutting with high banks, fairly planted with rabbit wort, tow-paths good.

Nellatoor Drainage.

32. *Kodoor Drainage.*—At 100-6 we reach the Kodoor backwater which continues till 102-4. Banks are generally wanting through this section. At 102-4 to 111 the canal again passes through a deep cutting with good banks well planted, tow-paths on both sides. A few field drainages have alone to be provided for.

33. *Gungapatam Drainage.*—At 111 the Gungapatam backwater is entered. In the next 1¼ miles this backwater is crossed twice. At 112-2 there is a bar where an inlet and outlet would be desirable. After this for the space of a mile the banks are high and good, but only partly turfed.

At 113-2 one of the old Pennér channels is crossed. This old channel might readily be banked out at the point where it leaves the river.

34. *Pennér River.*—At 115 we reach the Pennér river. In this portion the east side banks are all low, while on the west side parts are high. The channel crosses the Pennér right branch to a large island; this is passed by means of a cut a mile long which cannot be properly maintained. At low tide it has scarcely a foot of water and large sums have to be spent yearly (some 8,000 to 10,000 rupees) in maintaining it simply in its present

Sketch enclosed.

of the rivers, five in number, shew such a tendency to change their course that it has become a serious matter for consideration as to how the canal can here be kept open for traffic - Even with steam dredges available the canal would still be closed after each ordinary fresh in the river to all but top boats and others of very light draft taking advantage of high tide and the stoppage would be absolute after a cyclone flood of any intensity - No mere palliatives will therefore answer here and my conviction is that the first and in the end by far the most economical course will be to train the Pennair in such a way from the head of its delta that the discharge shall take place entirely through its southernmost effluent closing all the others. This can be done by training the river from a point near the village of Utakur about three miles west of the canal on the left bank - At the same time groynes should be so constructed on the right bank a little north of Kuditipalem that the present line of river bank and the flood embankment within it shall be preserved from invasion

inefficient condition. In addition to this, in front of the entrance of the southern canal a long shoal has formed, which necessitates a long detour for vessels. It would be better, I think, to cross the river some 1½ or 2 miles higher up in the neighbourhood of Utakoor, where there are no islands and the river runs in one bed. There is a ferry at this village, and it is understood that the tide runs up the river several miles. Survey of the river is required with its islands and shoals, and cross sections should be taken from present crossing point up as high as Utakoor.

35. Between Utakoor and the present canal mouth the river runs in three streams, there being two islands with a shallow stream between. It might perhaps be feasible to close this centre stream, and so help to keep clear the other two and remove shoals which form in them.

36. If the river was to be crossed higher up, as proposed, the ends of the present north and south cuts would be useless, as the north and south channel would have to leave the present channel fully half-a-mile from the river and curve to the west. The new enclosed channels north and south of the Pennér might be supplied with sea water through the present mouths where sluice weirs could be built. The island cut would also be abandoned. In the cyclone flood the Pennér rose 10 feet above true bed of canal, but in 1874 the flood must have been far greater than this.

37. *Canal north of Pennér.*—The canal on the north of the river commences at 117-2. The channel has silted up 1½ to 2 feet owing to the floods of the Pennér. Up to 119-4 the banks of canal are high, but then there is a breach caused by the Ramatheertham drainage. This was banked up and an attempt made to take it into the Pydaru, but the bank across the drainage was swept away during the late cyclone. There is at present a rough bank which has been formed from recent clearings. Banking up the Ramatheertham and running it into the Pydaru I think inadmissible. It would probably not be successful and it would certainly cost a great deal of money as the ground between is high. Moreover, it would increase the difficulties of dealing with the Pydaru, which are not small as it is.

Ramatheertham Drainage.

The left embankment would probably extend from Utakur to the destroyed village of Palipalem - By this means not only would a sufficiently deep channel be always preserved in the southern branch of the river but by closing the canal ends north and south with flood gates these would be preserved from the silting which now causes the difficulty - I do not consider that there should be any serious difficulty in training the Pennair as proposed but further careful study of all the features is necess

(37 and 38) Banking across the Ramatheertham drainage is inadmissible; it will be essential to cut a new line of about 6 furlongs in length to the west of the present line so as to avoid getting dangerously close to the bar

(39 & 40) As with the Ramateertham so with the Pydaru [123-6] and the Escapillay [126 mile] drainages free vent must be allowed across the line of canal but a strong west bank to keep out floods should be constructed. Whether it will be necessary eventually to isolate each of these portions with flood gates (that at the 117 mile is essential) cannot however be decided with certainty

38. The canal at present passes too close to the Ramatheertham bar, it should cross the drainage where cutting ends at 120-1 and join cutting other side, quarter of a mile up. The channel appears to have silted to a depth of about 2 feet. Up to 121-5 canal continues through deep cutting, banks turfed and planted, but more planting required here and there.

39. *Pydaru Backwater.*—From this point the canal follows generally the bed of the Pydaru. On the east side the canal runs along border of high ground, while on the west side it is separated from the backwater by a low and weak bank. At 123-4 we find the Pydaru bar. It would be better to cross the Pydaru close to the bar, and skirt the margin of the high ground to the east. The ends of the canal proper would then be brought much closer together. In the survey the canal is shown as having a fine curve at this point, but as a matter of fact there is an abrupt turn forming about a right angle. A weir should be provided as an outlet from the Pydaru at this point. This will have to be large as the Pydaru appears to drain about 110 square miles of country. After crossing the Pydaru stream the canal continues (till it reaches Eskapally backwater, 126th mile,) with high ground on the east, and broad expanse of water on the west. Banks on both sides are somewhat low, being 10 feet above bed. The channel might, I think, have been taken with considerable advantage somewhat nearer the sea.

Pydaru River crossing.

40. *Eskapally Backwater.*—Across the backwater the banks have been almost washed away by cyclone of May last and they are now but 6 inches above the water. They are chiefly composed of oyster shells. This being so, tracking (especially with a west wind) is rendered very troublesome as the shells cut the feet of the trackers. The deep stream in the backwater is at 126th mile 5½ furlong.

41. At 127-4 we reach the Eskapally bar, the drainage here is banked across. Some parts of the canal are in deep cutting, others through low ground with banks. At 129th there is the Tullipalien bar. In this section there is a cut on the west to take the drainage into the Chippelairoo further on. This, like all the others is not large enough, the waterway is very insufficient.

) The plan suggested of training the river so as to occupy and deepen its central channel, and then to make a new line to the west of about miles long through ground 4 ft above M.S.L. seems essential - Since the cyclone of May 1879 the existing channel through the backwater has changed no less than four times

Flood gates will be required one north of the Chippalairoo at probably the 134 mile and another at the 148-2 mile

The Ramapatham drainage which enters at 148-3 mile might have its outlet to the sea barred permanently and the drainage thus taken into the canal & utilized with a view to bringing a beneficial current to bear on the northern portion towards the Ekalam

42. *Chippelairoo River.*—It is at 130 miles 3½ furlongs that the canal first crosses the Chippelairoo (a branch of which runs almost parallel to the coast), it then enters a cutting for three or four furlongs, emerging whence, it crosses it a second time. The drainages at both these places are banked across. The canal runs in this way close to and occasionally crossing the Chippelairoo till 132-5, where it enters the main Chippelairoo river. Banks good in parts, but sometimes weak.

43. At 132nd the branch of Chippelairoo is again banked across. Where the canal enters the river two "noses" are run out far into the river, too much across the stream. Canal line should, I think, run further inland.* Accurate survey required of this river. The crossing of the Chippelairoo is exceedingly troublesome and lengthy. In the canal some distance before it reaches the river the depth of water is 6, 6½ and even 7 feet, while at and near the mouth it shoals to 3 or 4 feet. The distance to be passed in the river is nearly a mile. Great difficulty is experienced in entering canal on both sides owing to the shoaling up of the entrances. At the mouth of the north canal there is only 3 feet of water, and at 3rd furlong only 4½ feet. Both banks from river to 133-7 require raising to keep out floods. It seems to me that some of the present canal should be abandoned and the canal taken inland, furthest point being about one-fourth of a mile from where it now is. In all this I speak under correction as no trustworthy surveys are available for study.

44. 134th mile passes through low land on east and paddy fields. 135th, banks good, but require raising as they are subject to Chippelairoo floods. The Chippelairoo might perhaps be banked from canal to sand ridges on the west and the local drainage let into the canal or, if necessary, across it. At high tide the depth in canal 6½ to 7 feet.

45. 136th.—Banks, &c., good up to the village of Nadumpally.

From 137th for a distance of 5 miles the canal runs in l[illegible]lying ground, situated between sand ridges parallel to one another, at a distance of a few furlongs. Drainage immaterial, but still needs some small inlets into canal. The banks are fairly good, but want raising in parts. After this the canal enters a deep cutting which is partially filled up with drift sand, &c. At the 3rd furlong (142-4) the cutting is nearly 20 feet deep. High banks turfed and planted with rabbit wort. Tow-paths 3 feet wide, depth of channel varies from 4½ to 6 feet.

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* As shown in Sketch.

46. *Ramapatam River.*—Up to Ramapatam river, at 148-3, high banks, partly turfed and good, tow-paths mostly completed. Drainage channels outside to divert drainage have insufficient waterway. At 147-4 the banks for a short distance are weak, having been washed away partially. At this point the depth is only 4½ to 5 feet, whereas a furlong further each way the depth is 6 feet. Laterite is found in this cutting. The Ramapatam backwater is crossed at 148-3. This was previously banked across up to tow-path level. It is now open. Inlet and outlet required here. The Ramapatam bar is opposite 149-2 where the banks are low for a quarter of a mile and require strengthening. With this exception, past Ramapatam temporary rest-house to 150-7 the banks are good, tow-paths formed and well planted with rabbit wort, but in the channel bed we find a great quantity of muddy slush brought in by the Elikeru drainage crossed about 2 miles further on.

47. *Elikeru Drainage.*—The Elikeru was also banked across, but it was breached during the cyclone of May 1879. There are two branches of the Elikeru: one might be substantially banked while the other should be provided with outlet to discharge the whole drainage through the bar. Up to 152nd mile the ground continues low, but at that point a sand ridge running from the west joins the canal. From 152nd up to the Manneru (160 miles 2·3 furlong) it runs through this sand ridge in a deep cutting of fine sand. Rabbit wort has been planted all along, but has not thriven equally well. Tow-paths have been formed. One to two feet of sand has formed in the bed. It is, I fancy, chiefly drift from the banks. All this should be removed.

(47) As regards this drainage it will be best to embank across the northern outlet placing a flood gate at the 151st mile leaving the present southern opening [150-6 to 150-7] free to discharge by the open bar

48. It would be well, I think, if palmyra trees were planted all along the banks in these sections. Two grasses grow well on the slopes of this canal, Toonga and Woolsa.

Sketch enclosed.

The line of canal might be altered as shown in sketch. This can be considered when the surveys are ready.

Manneru.—From 159-4 to 160-3 the Manneru runs parallel to the channel; as the channel approaches the Manneru it is found to be very much silted. The proper depth of water at high tide should be 7 feet—

while at 159-6 it is only 5 feet.
159-7 4½ "
160 4 "
160-2 4 "

and at junction 2½ to 3 feet. On the other side of the river at entrance to canal it is 3½ to 4 feet, and this depth is continued all the way to the Pakala backwater, 166th. In the 161st mile the banks are low. The Manneru left bank might, it is thought, be embanked with advantage from the canal up to ridge near Binganapalle to prevent the spill of the river. The Manneru drainage basin is 1,245 square miles, the river is however not much more than a furlong in width. Although the Manneru is crossed by canal at 160-⅔ the bar is found to be opposite 161-6/7 a mile and-a-half further north, the Manneru working considerably to the north. At 162-3 another drainage crosses the canal. This might be diverted to 161-6½ and outlet provided so as to discharge it through the bar. Banks good in parts, but washed away in places. A salt creeper grows well here, it is somewhat similar to the rabbit wort. The natives called it merely "Oopu Tega," or salt creeper. Owing to the floods of the Manneru the banks require raising to the extent of perhaps 3 feet.

8

To prevent the silting of the channel south of the Manneru a flood gate will be necessary at about the 160 mile

The spill of the Manneru floods over the left bank of the river must be stopped by an embankment but the most essential work here and one which there should be no delay in carrying out is the deviation of the present channel for about 3 furlongs in length as suggested by Major Vibart

Without any cyclone flood in 1878 some three miles of channel were silted up to a depth of over 2 feet with ordinary freshets and there can be no question that flood gates are essential at both the Manneru and Palar ends of this reach of the canal

49. In 163rd mile the banks, &c., are good, but more planting and turfing is required.

Pakala Drainage.—164-4½ there is a bar of the Pakala drainage very close to the canal. Cross banks require strengthening.

At 166th to 166-2 there is a second Pakala bar; bank here very weak and almost destroyed. There is a large swamp on the west side of the canal. The bar is very low and close to the canal east bank of canal is much exposed and must be remade very strong.

The Paleru spill water now falls into the Pakala swamp. The Paleru should be embanked from canal bank to Pakala tank bank, and then there will be only a small quantity of drainage to be disposed of into or through the canal.

50. In 167th mile the banks are good. The whole country above the canal on the west is occasionally flooded from the Paleru and the Manneru so that the west bank is required high and strong. It is sufficiently so nearly every where. It should be 15 feet above bed of channel. The cyclone flood which was not particularly severe rose to 10 feet. In this section "Eela," a salt shrub, grows on the berms.

51. *Paleru River.*—The river Paleru (drainage area about 767 square miles) is met at 168th mile ½ furlong. This river a few years ago, before the canal was made, was 8 or 9 feet deep at low-tide, it now has barely 2 feet at the same period; since it was connected by the canal with the Moosee it has shoaled up from the Moosee water entering the Paleru by means of the canal, the Moosee being more frequently in flood than the Paleru.

The drainage area of the two rivers is approximately—

	SQ. M.
Moosee	1,011
Paleru	767
	1,778

52. *Cut between Paleru and Moosee.*—The cut between the Paleru and Moosee cannot, I fear, be avoided. It silts up terribly and will be a constant source of trouble and expense. Depth at low tide 2½, 2¾, and 3 feet; banks and towpaths are good, but the slopes are affected by the floods.

Sketch enclosed.

53. *Moosee River.*—At 169th mile we reach the Moosee. Crossing is difficult. The Moosee has a very winding course. It would perhaps be advisable and feasible to straighten the river by a new cut as shown in sketch attached. The river crossing is about 3 furlongs in length. At the entrance of the south canal the depth at low tide is 2½, 3, 3½ feet. In the river there is 5 feet while at the north entrance into canal the depth is 4 feet.

54. The Moosee spills over the country and comes down on banks. The banks

(49 and (50) agreed. It is essential that the spill of the Paleru floods over its right bank should be barred by a strong embankment from the north end of the present Pakala bank to the canal

(51) The short portion of canal 6 furlongs in length between the Moosee and Paleru rivers having silted up in both the May and November cyclones of 1879 barring navigation some early & effective means must be found for curing the present defects. Hand dredging alone had not sufficed to allow of a passage being opened for any but boats of very light draft at high tide within two months after the last flood, and even then cargo boats drawing over 1' 9" have had to unload and have the goods carried by hand 3/4 of a mile. For a short time after the November cyclone there was a passage to the east close to the united bars of the two rivers but this did not last long. Had powerful steam dredgers been available and at once set to work a passage might no doubt have been opened at an earlier date but at the [illegible] it may be assumed that subsequent to each

(52) The [illegible] of the stretch of canal from [illegible] mile north of the Moosee bar (about the 170th mile) to the Gundlakamma river depends on the treatment of the spill of the former river during flood over its left bank. Whether it be feasible to train the river by means of a left embankment ~~starting~~ from a point near the village of Zirupee Nayadipalem and thus force the whole flood through the present bar is not clear, but the subject should receive attention

For the present immediate relief will be given by cutting away entirely the banks which were injudiciously thrown across the Zandavaros creek at 177-2 miles and again at 177-6 miles. The effect of any further flood will be to bring a beneficial scour to bear on the whole length of the channel northward towards the Gundlakamma

Should however the training bank for the left bank of the Moosee river as suggested prove feasible it would in that case probably be desirable to cut a fresh channel for the canal in the 4 furlongs a little to the east so as to keep clear of the Zandavaros creek as proposed by Major Vibart. There should be a flood gate at the end of the canal as it enters the Moosee river of the cyclones of last year this portion of the Canal must have been closed to traffic for five or six weeks; it is thus clear that exceptional measures are called for to prevent as far as possible the recurrence of such delays which if allowed to continue must affect very injuriously the traffic on the Canal.

Were it feasible to divert one or other river so as to discharge by a single channel into the sea the difficulty now experienced would vanish but as this means cannot ever be adopted it appears that the only effective and economical means left will be to excavate a second channel parallel to and a little west of the present cut 6 furlongs long — This channel measuring 15 ft. in breadth at bottom and carried to 2½ ft. below M.S.L. should be ~~[illegible]~~ excavated as soon as possible — When opened to traffic the existing channel should be closed, cleared and deepened, opened to traffic and the new subsidiary canal closed and prepared to receive the traffic after the next flood — By thus working alternately on two channels alongside of each

are good, but the cut between the rivers is greatly silted.

55. From 170th to 175th the banks are high, good and turfed. The tow-paths are all right. The course of the Moosee for nearly 2 miles above the canal crossing is generally parallel to the north canal, no where 3 furlongs distant and at two points hardly a furlong away.

Thondairoo Drainage.

From 175th to 177th banks are good, fairly turfed, tow-paths complete; depth of water 6 feet, shallowing to 5 feet near the Thondairoo at 177·1. The west bank is exposed to great floods from the spill waters of the Moosee. At 177-1½ we enter the Thondairoo. On east side there is no bank, and the channel is very shallow for 5 or 6 furlongs. Our boat went aground here although drawing less than 2 feet. Depths of water 3 feet, 2 feet 3 inches, 2 feet, 1 foot 10 inches, 2½ feet from 177-1½ to 177th 3 feet. From 177-3 to 177-6 3 feet and at 177-6½ 2½ feet. There is a side drainage channel here, its capacity is quite inadequate.

56. The spill waters of the Moosee, I understand, stretch from the canal westward to near the trunk road, a distance of 4 miles, and cannot be relieved by so small a channel flanked by high ground.

Kottapatam Bridge and Basin.

57. The Thondairoo (Kottapatam creek) could and should have been avoided or, at any rate, the canal taken along its east border. At 178-½ we reach the wooden bridge of Kottapatam. It is very shaky and unsafe. It is of insufficient span; should be removed at once and replaced by an iron girder bridge. The site of basin close to the bridge. It is proposed to have the basin enclosed with a narrow entrance at right angles to the canal. It would, I think, be preferable to have the basin simply an enlargement of canal. No fresh water is to be obtained at this important station. The water supply is distant 1½ to 2 miles. Provision for water-supply on the spot is highly desirable. On east side of the canal there is low ground with a drainage side channel which leads north connecting the low ground with next swamp. Banks here small. The west bank is high with tow-paths. Kottapatam swamp being behind. The

other the best palliative for the existing difficulties here will have been provided. No west bank will be needed for the new channel all spoil going to form a wide strong bank for the existing cut so as to insure its isolation. Flood gates at each extremity of the latter will also be needed

(57) & 58) The basin at Kottapatam may as suggested consist of nothing more than an enlargement of the channel to the east and north of the present bridge. The latter though shaken by the November cyclone is now sufficiently secure to last for some years and the boats in passing it have to lower their masts there is no serious inconvenience as they invariably halt at the place

The road dam immediately west of the bridge must be removed (as being much too close to the Canal) to a point on the Ongole road 300 yards further west and be there re-constructed 100 yards in length lowest point of crest being 1 foot above H W L. The materials of the present dam will nearly suffice for the new and the same style of tail apron should be employed. The western embankment of the Canal (south of the bridge) should be much strengthened and the road well raised over the site of the present dam so as effectually to prevent any future irruption by flood waters. The laterite bridge which with its 9 elliptical arches of 18 ft. span carries off all the residue of the Zondairoo drainage not vented by the canal should be thoroughly repaired as its flooring is still sound. The unworkmanlike additions made on either side of the arches to raise the parapets and which were much injured by the November flood must be removed and the roadway reduced to about 9½ ft in width

but it may be assumed that

rise of the tide appears to about 2 feet in this reach.

58. 179th mile.—There is no bank along east side for three-fourths of a mile, but merely an artificial tow-path 3 feet above water. East swamp behind requires inlet into canal. It was banked across, but the cyclone made several openings. Tow-paths eroded in rear. West bank high, but unfinished. Kottapatam swamp behind the floods in this, I am told, rise high.

59. 180 to 182.—East bank low, unfinished and unturfed; high ground beyond. West bank, high, but unfinished and unturfed also. Kottapatam swamps behind; also Beerangoonta salt-pans on west side, on borders of swamp.

60. *Mootoomala Creek.*—At 183-2 we reach Moodegonda or Mootoomala creek bar. The drainage area of this creek is estimated approximately at 136 square miles. In addition it receives spill water of Moosee and Kottapatam swamp; a large inlet and outlet required here. Near the Moodegonda on west side ground, for half a mile to the north, low and swampy; banks and tow-paths are good on both sides; turfed, but the turf has got covered with drift soil from inland.

61. At 184 we reach another branch of Moodegonda drainage. It is banked across. This also will require an inlet and outlet unless it is carried by a cut to the one proposed at 183-2. The banks are high, partially turfed; tow-path 3 feet above water; swamp to the west and drainage not relieved up to 185. When Moosee is in flood it spills over. In fact the Moosee requires a more extended channel. It is believed that since the construction of the canal the Moosee has improved, as the bar now keeps continually open and this was not the case before. The improvement of this river—indeed all the rivers between the Pennér and the Gundlakamma—must be taken in hand and every exertion made to improve their channels and bars.

62. *Gundlakamma River.*—The Gundlakamma river is at 187th mile. This has a drainage area of about 4,500 or 5,000 square miles. A lock will have to be built on either bank in connection with sluice weirs. The bar is always open and the floods are considerable. The river runs to the sea in only one channel.

(59, 60, 61) Northward from Kottapatam (179 to 187th mile) the banks originally low have suffered severely during the November cyclone, first by the action of the storm wave from the east, there being no protecting "dunes" here, and second from the land flood which supervened. But notwithstanding this destruction of the banks the canal channel has been if anything improved owing to the fact that the surplus of the Moosee river flood vented itself through the Zondairoo creek and finding its way into the canal scoured it thoroughly and cleared it of silt. Practically therefore little work is required in this reach. In a few places a strong well planted east bank will be needed to counteract the action of a storm wave, but on the ~~east~~ west the less obstruction presented to the land flood the better unless at some future time the expense of a sufficiently high and strong isolating ~~east~~ west bank be considered essential. As matters stand levelling down the bank as much as possible and bringing the tow path into order is all that need be thought of. No vegetation seems to thrive here owing to the salt dust carried by the west winds which smothers & kills even the "woolsa" rush and the salt plant "eela" both of which thrive elsewhere. So long as the channel is not isolated no flood site is necessary at the southern

on the west a well planted east

63. I may mention here that I propose to have a lock on each side of the Manneru, one on south bank of the Paleru and one on north bank of Moosee. Two will be required on the Gundlakamma, and one where the channel enters Rompairoo. Thus, including the Adyar, I propose 18 locks. About a mile from the Gundlakamma we reach an old branch of the river which has been banked across. It is much silted and will probably shortly get silted up altogether. At present there is a drainage cut on west side of canal, connecting old channel with the river; this should be closed. A mile beyond this old channel a sluice is required to supply salt-pans.

64. From 188 to 190-6 banks, &c., are good; at this latter point we enter the Kanuparti backwater, at the mouth of which there is a long, low bar. The channel follows this creek for about a mile and, as a consequence, twists about very considerably. The channel should here be rectified. It should, I think, run from 190-4 more to left, cross the creek at 191-4 near the ferry and join the other channel at 192-1. The channel would be much improved, awkward curves got rid of and one-fourth mile in length saved.

Kanuparti Backwater.

65. In 192nd to 194th miles the banks are not quite completed or completely turfed. Side drainages are also obstructed. Sand ridges on both sides. Tow-paths complete. Depth of water in—

192nd	...	6 and $5\frac{3}{4}$ feet.
193rd	...	$5\frac{1}{2}$ and 5 feet.

66. *Creek at Chinna Ganjam.*—At 195th the canal crosses Chinna Ganjam creek. An inlet or outlet is proposed for this drainage 500 feet in length (proposed by Kistna Engineer).

67. *Junction with Commamoor Canal, Kistna.*—At 195-1 is the point where the Buckingham Canal will join the Commamoor Channel a short distance below the lock now in course of erection.

68. *Rompairoo.*—At 196-3½ the Buckingham Canal joins the Rompairoo; banks incomplete, but fairly good. They extend, I think, too far into the waterway of the Rompairoo. From this point up to the temporary lock into the Commamoor Canal near Feringy Dibba is about 2 miles. There is already a considerable traffic along the Rompairoo to Vetapolliem on the

The removal & reconstruction of the road dam above adverted to must be charged to the Canal but the alterations of the bridge ought to devolve on the Local Fund Board who may also fairly undertake the construction of the proposed Moosafir Khana at Vetapalem

(62) The crossing of the Gundlakamma river calls for no special remark

(63) As regards the proposals in this paragraph I have seen reason for the present at least to prefer flood gates everywhere to Locks the grounds for which will be found elsewhere

(64) For 5 miles north of the Gundlakamma river the canal is exposed to serious wash particularly at two places where bars opened in the November cyclone and which must therefore be left free of any obstruction. To all appearances however the spill water from the Gundlakamma might as suggested by Sub-Engineer Ottmann be effectually checked by constructing a strong training bank along the left bank of the river 2 or 3 miles in length & divert the drainage from the Kanuparti Swamps - The alternative to this plan would be to construct a strong west bank all along the canal - In addition to protection on the west a well planted east bank is also needed at two places but only for short lengths. Mr Vibart has suggested an entirely new channel between the 190½ and 191½ miles but as the object here must be to get sufficiently inland from the Kanuparti bay to which the present line is dangerously near it will suffice to make the new cut to the westward only 3 furlongs in length 200 yds from the existing channel

(66, 67, 68) Little remark called for. — It may be doubted whether the position of the new Lock at Feringy dibba has been judiciously selected and whether looking to the great drainage which sweeps over the whole country South of Nantaravoor it would not have been safer to have given another flight to the latter lock and dropped the canal thus direct into the Rompairoo drainage. It is now however too late to suggest any alteration of the arrangements here

(69) The reasoning here employed by Major Vibart in favour of isolating the different reaches of the canal which intervene between drainages that cannot be safely particularly during flood be barred in their passage to the sea derives additional force from the effects of the November cyclone which followed on that regarding which ~~[illegible]~~ is the subject of his report. But there is such a strong and it must be admitted well founded objection to the delays inseparable from locks added to the great expense of first construction and subsequent working a regular establishment being necessary for each all the year round that I have proposed to employ only flood gates at the end of each reach — these would only be closed on extreme occasions to exclude silt & flood from the channel. They would be comparatively

sand ridge beyond Chinna Ganjam. Lock necessary where Buckingham Canal joins the Rompairoo, and it would be well to have a channel to the Chinna Ganjam salt-pans.

69. At present no attempt has been made to control the rivers crossed by the canal so as to prevent their floods entering it. These floods cause enormous quantities of silt and sand to be deposited on the bed of channel. Such attempts as have been made to deal with the minor drainages have usually been ineffectual and may be considered as a general rule failures. The channels to lead them in other directions have usually proved insufficient and the result has been that the banks raised across the drainages have been swept away causing great damage to the canal. It should not be forgotten that the damages now mentioned are those caused by a cyclone certainly, but it was as regards rainfall not a very severe storm other cyclones have been much worse so in future we may expect to experience far more serious storms and far heavier falls of rain and the damage to the canal if left as it is, will be proportionately greater. I propose to entirely exclude the larger rivers from the canal by the construction of a lock on each bank. I would arrange to keep the water in the canal up to high tide by providing at or near each lock a sluice weir of same width as canal, say 50 feet with its sill on M.S.L. At each tide sea water could be let into the canal to bring it up to high tide level and replace the water which had in the interval been expended either by lockage, leakage or evaporation. If 4½ feet were taken as the maximum depth required at present the canal need only be excavated to 4½ feet below ordinary high tide or say 5 feet and a foot or 18 inches of expensive deepening could be dispensed with. This would allow of boats drawing 3½ to 4 feet passing the canal. As it is possible when the canal is extended to Calcutta (which I take for granted is a certainty in the future), a greater depth of canal will be required (perhaps up to 6 or 6½ feet). I would build the sill of the locks 1½ feet lower than the present proposed bed of canal, so that when it is found necessary to deepen the canal, no alteration would be required to the locks. The locks and sluice weirs must be so arranged as to completely exclude floods of river as well as to retain level in the canal at spring

cheap in construction, would be made portions of Locks at any future time should such be needed, requisite, would in no way interfere with or delay traffic, and need only have a small Establishment to look after them in the cyclone or flood periods. — Inlet or weir I also see no immediate necessity for but the depth of the canal and very its section may now with advantage be much diminished to meet actual requirements. These and other subjects will however be discussed in a separate paper

(70) The training of the several large drainages and the necessity for a special study of each case has been sufficiently pointed out in the above remarks, but then as elsewhere Major Vibart seems to favour the use of inlets and outlets of masonry for the disposal of minor drainages — I very much question the applicability of works of this character to the canals as in hardly any case is there means of securing a proper outfall for the water on the down or eastern side of the channel. There may however be a few cases in which the principle might be applied, and where this is the case the plan might be tried, adding however a capacious silt trap on the upper or west side of the canal. This should be kept always clear. It seems to me that all drainages which cannot be effectually shut out and diverted into other lines must of necessity be allowed free vent at a level across the canal and that everything in the shape of an obstruction would be a mistake

tides, and with this object the locks must be provided with a double set of gates. Of course these gates will require abutments of the strongest masonry; but the heel-posts of each couple of gates must be built as close together as possible to avoid superfluous masonry; and with this object the heavy wooden levers now used for opening the gates of locks in Godávari and Kistna must be dispensed with in the Buckingham Canal locks and some other expedient adopted for opening the gates. The chamber walls between the gates need not be of masonry, and the floor between the gates need not be very massive, as a rule the difference of level between the canal and the rivers will be slight and the velocity of the water entering the lock will be small. The banks might be substantially constructed of earth with a core of puddle and revetted strongly inside. The floors might consist merely of 2 or 3 feet of concrete (hydraulic).

70. The drainages which it is settled are to be passed across the canal should be provided with inlets and outlets, water not to rise more than 2 or 3 feet above high tide. Hitherto the rivers when in flood have been allowed to wander along the canals and pass into backwaters, &c. By providing locks and making other improvements in the way of banking and training, the floods, so to speak, will become more concentrated; they will scour out deeper channels and the bars must necessarily from this action, it is thought, be improved and, as a result, the tides in some of the rivers will have a greater range than before.

71. The level of bed of each section of the canal will be arranged with reference to the tide in the rivers or estuaries at the ends of each section. In Ennore, Pulicat and Dugarázpatnam section, the rise of the tide is comparatively small. In the Pennér, Kundelairoo, Gundlakamma and Rompairoo it is high being frequently something between 3 and 4 feet. Of course I am fully aware that there are objections to locks—

1st.—Expense of construction;
2nd.—Pay of establishment to manage them;
3rd.—Delay to traffic.

The first will, I consider, be more than balanced by the lesser depth required for the canal.

Locks have the great advantage of preventing to a very large extent the deposit of mud and sand in the canal. At present although the north canal has only been open two years the deposits already in the canal amount to a very large quantity in spite of the exertions made to remove it, and the large quantity of money expended with this object.

The delay to traffic will not be very great, in fact I question whether the delay due to locks will be anything like so great as the detention caused by deposits in canal, and contrary winds in crossing lakes. Tidal observations are now being taken on all the rivers and lakes crossed by the canal. The only (at all reliable) registers kept were those for Pennér, Kundelairoo, and Rompairoo.

The disadvantages of having no locks.

1st.—Canal must be cut and kept deeper.
2nd.—Boat basins more expensive.
3rd.—Maintenance far more expensive owing to silting and slopes washing in.
4th.—Branch channels more expensive.
5th.—Many parts of spoil banks unnecessarily high.

72. I subjoin a few general remarks as to the action of the various tidal rivers, &c., crossed by the canal.

Rompairoo and Gundlakamma keep the sections between those rivers in good depth. Between Gundlakamma, and Moosee, Palairoo 20 miles, tidal floods supplemented by Moondegonda Creek keep this section deep, except between Moosee and Palairoo which is very much silted.

Between Palairoo and Manneru the reach is 6 miles; served by both floods, their action has shoaled up the canal particularly at Manneru.

Manneru to Chippelairoo, the reach 27 miles, neither of tidal floods is very great and the latter bar closes some months in the year. Chippelairoo to Pydaru is 10 miles. Tide floods small, latter bar not always open, but Pennér tides affect this part.

Pydaru to Pennér 6 miles, much silted up, and but for the help of the Pennér floods would be quite obstructed.

Pennér to Kundelairoo 25 miles.—Tidal range large in both rivers.

From Kundelairoo no open bar till Dugarázpatnam is reached 20 miles.

This tidal rise is not great, owing to small size of bar and large extent of backwater.

Kundelairoo floods run down to Soornamookhee 13 miles; rise in Soornamookhee about 9 inches (observed).

Dugarázpatnam flood about a foot.

Dugarázpatnam to Coromandel.—Tidal flood, no great range and that only at ends for a few miles nearest the bars.

Pulicat tide apparently rarely rises to 18 inches.

Between Pulicat and Ennore no open bar. Pulicat tide runs to Chintamony backwater for 5 or 6 miles where it is lost. Tidal rise of Ennore lake varies considerably, never much more than a foot. The bar does not keep open throughout the year; the tide is felt at Shadiencoopum 4 miles to south.

Thirteen bars were open during my inspection:—

Ennore; this has since closed.
Pulicat.
Dugarázpatnam.
Kundelairoo.
Pennér.
Pydaroo.
Chippelairoo.
Manneru.
Palairoo, } Bar common to both rivers.
Moosee, }
Moodegonda.
Gundlakamma.
Rompairoo.

73. The information available regarding tidal ranges is very defective. In most of the rivers no gauge had been up to date of my inspection set up. Gauges have now been set up in all, and I have impressed upon the Executive Officer the great importance of correct registers. Before concluding this memorandum I may perhaps be permitted to remark that the limit of draught fixed for boats (2½ feet) is very small, and that it would be desirable to increase this to 3¾, the same as that for Kistna and Godávari. We should, I think, aim at making the minimum depth of the canal 4 or 4½ feet. I understand that the British India Steam Navigation Company and other merchants contemplate placing steamers on the canal, and if their draught is to be limited to 2½ feet their speed will be interfered with, as they will have to be made with very flat bottoms.

74. Mr. Executive Engineer Ottmann accompanied me in my tour up and down the canal, and I wish to state rendered me every assistance in his power, and furnished me with a great deal of valuable information. He has also assisted me by compiling the notes which I took in survey book form during my return journey. Although not a part of the canal, I may be permitted to remark that the lunkas or berms of the Commamoor Canal are now much covered with water and nanul grass, and this greatly interferes with the tracking. I would suggest that order should be given for the formation of towing-paths along this canal and cutting down the nanul.

75. I subjoin a statement showing approximately the drainage basin of the various rivers, &c.

Adyar.
Cooum 275 square miles.
Cortelliar into Ennore lake.
Pulicat lake drainage 1,859 square miles.
Area of Pulicat lake 280 square miles.

Perhaps 60 of them are islands, leaving 220 for lake proper; much of this very shallow, but in flood time the water can spread over this.

	Square Miles.
Soornamookhee ...	1,318
Kundalairu ...	1,170
Pydaroo	108
Chippelairoo ...	370
Manneru	1,245
Paleru	768
Moosee	1,012
Moodegonda ...	147
Gundlakamma ...	4,500 to 5,000
Pennér	20,000 or more.

(Signed) H. M. VIBART, Major, R.E.,
Ag. Supg. Engineer, Third Circle.

CHEPAUK,
27th September 1879.

To the Chief Engineer, Public Works Department.

No. 17. ORDER THEREON, 6th February 1880, No. 284 W.

ORDERED to be recorded.

(True Extract.)

(Signed) R. H. SANKEY, Colonel, R.E.,
Secretary to Govt., P.W.D.

Exd. E. C. Shunker.
Spare Copies

17/284

GENERAL
ESTABLISHMENT

Govt. of 1880 Madras.
PUBLIC WORKS.

To

Dated February 6th.

Issued

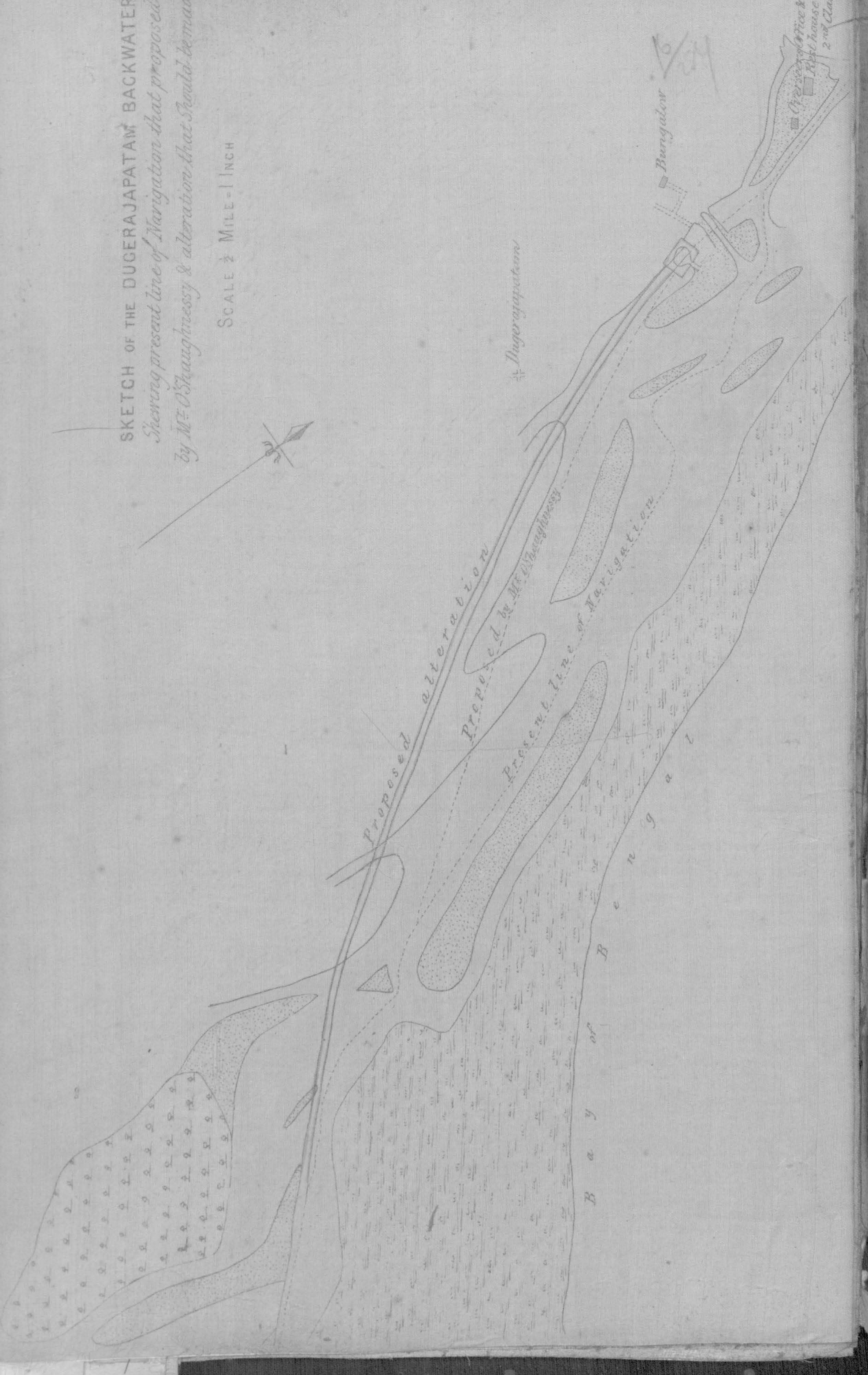
Recd. Encl.

G. O., 6th February 1880, No. 284 W.

FEBRUARY.
Nos. 16-17.

Buckingham Canal.—Inspection notes of the Superintending Engineer, Third Circle, on the —, recorded.

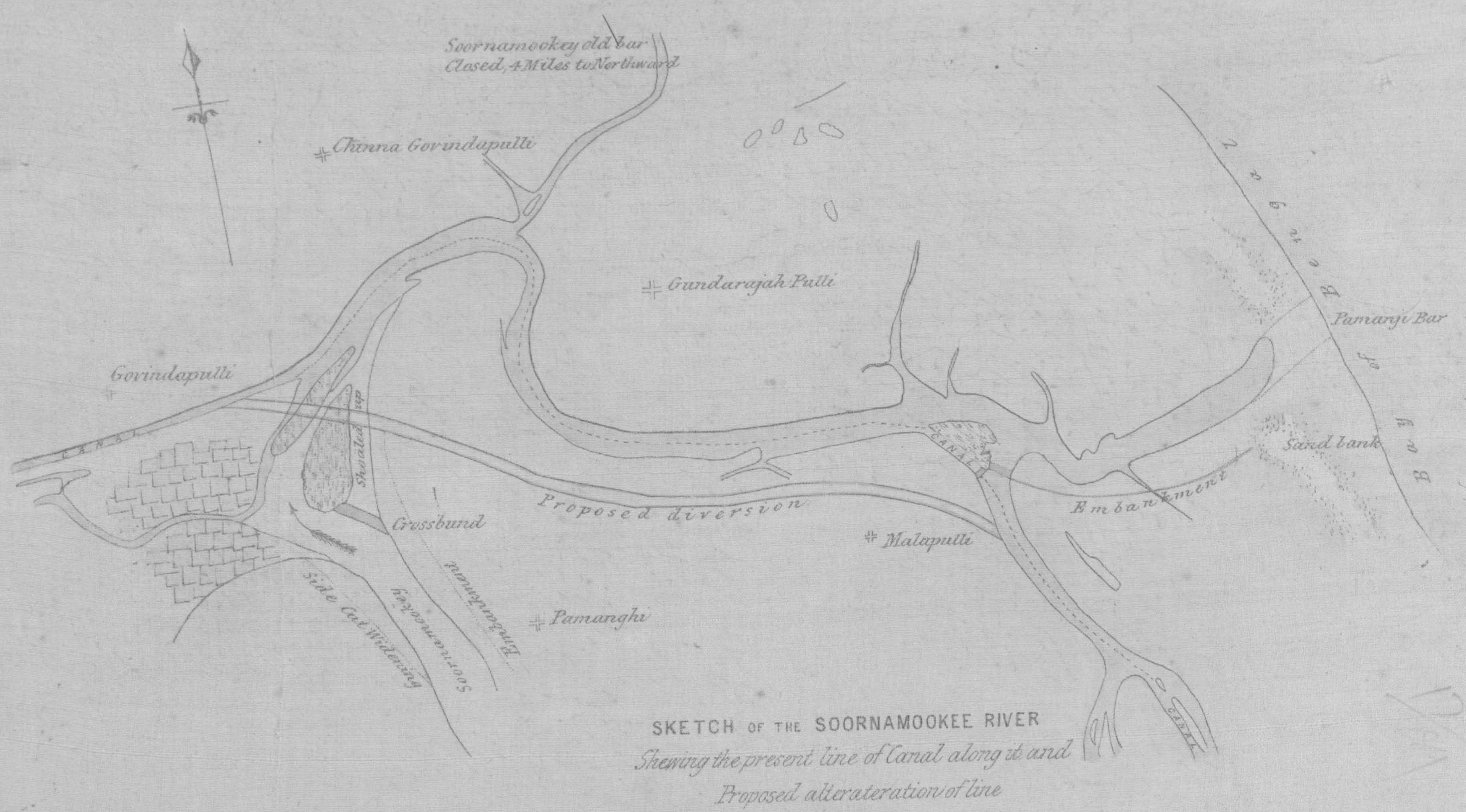
16/284



SKETCH OF THE DUGERAJAPATAM BACKWATER.
Shewing present line of Navigation that proposed by Mr. O'Shaughnessy & alteration that should be made

SCALE ½ MILE = 1 INCH

Bungalow
Overseer's Office & Store.
Rest house 2nd Class
Dugerajapatam
Proposed alteration
Proposed by Mr. O'Shaughnessy
Present line of Navigation
Bay of Bengal



SKETCH OF THE SOORNAMOOKEE RIVER

Shewing the present line of Canal along it and Proposed alterateration of line

SCALE ½ MILE 1 INCH

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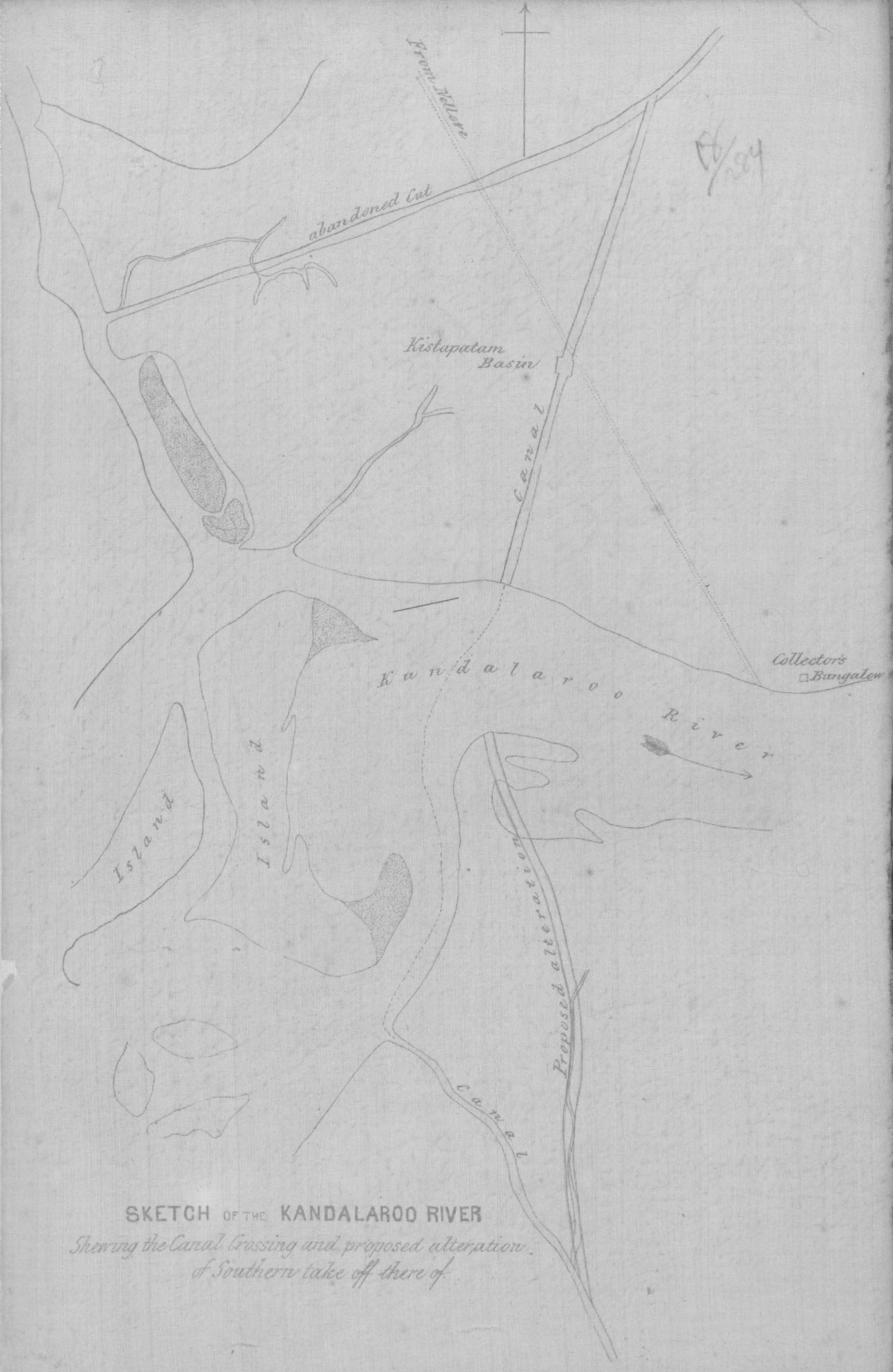
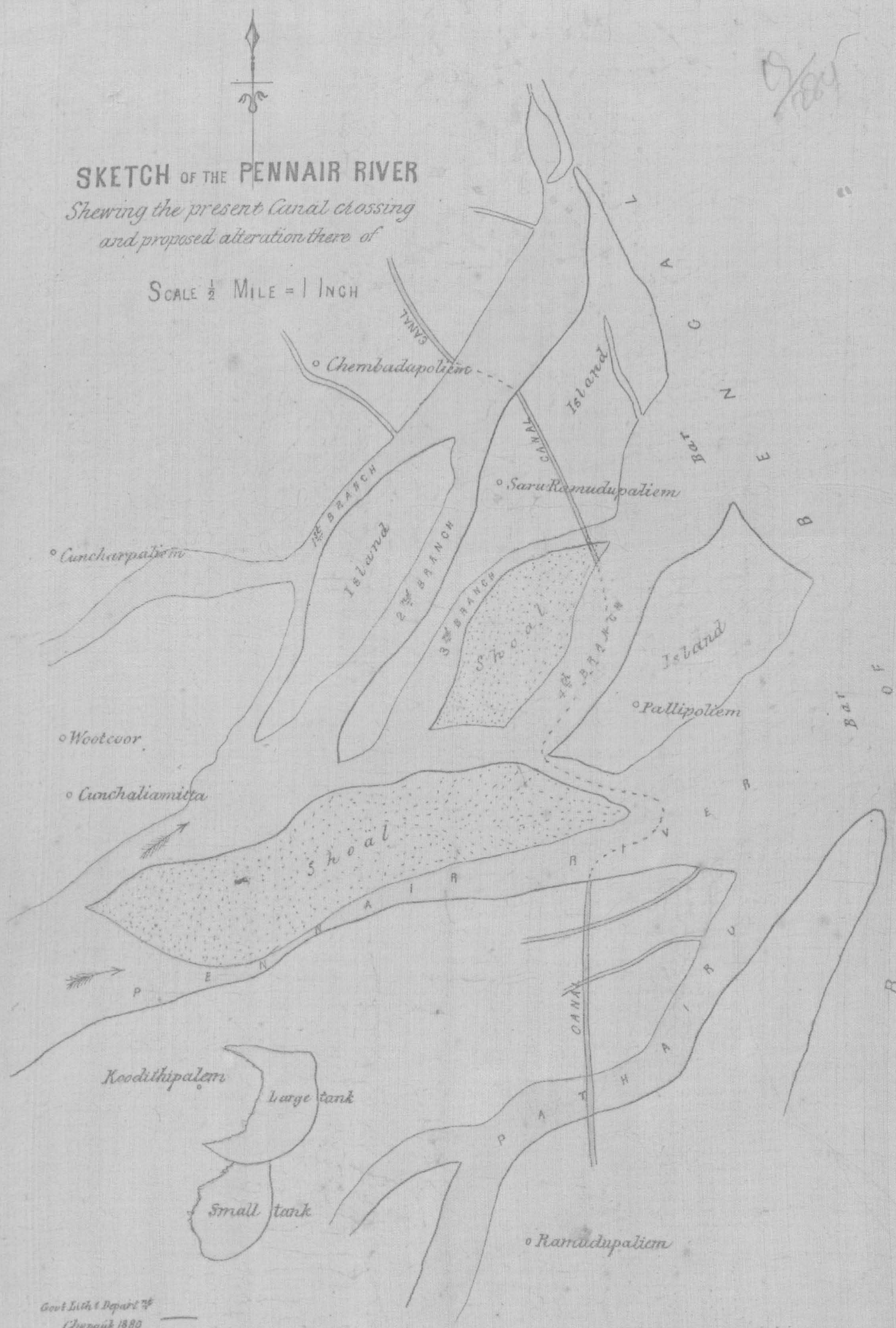


SKETCH OF THE KANDALAROO RIVER

Shewing the Canal Crossing and proposed alteration of Southern take off there of.

9/284



SKETCH OF THE PENNAIR RIVER

Shewing the present Canal crossing and proposed alteration there of

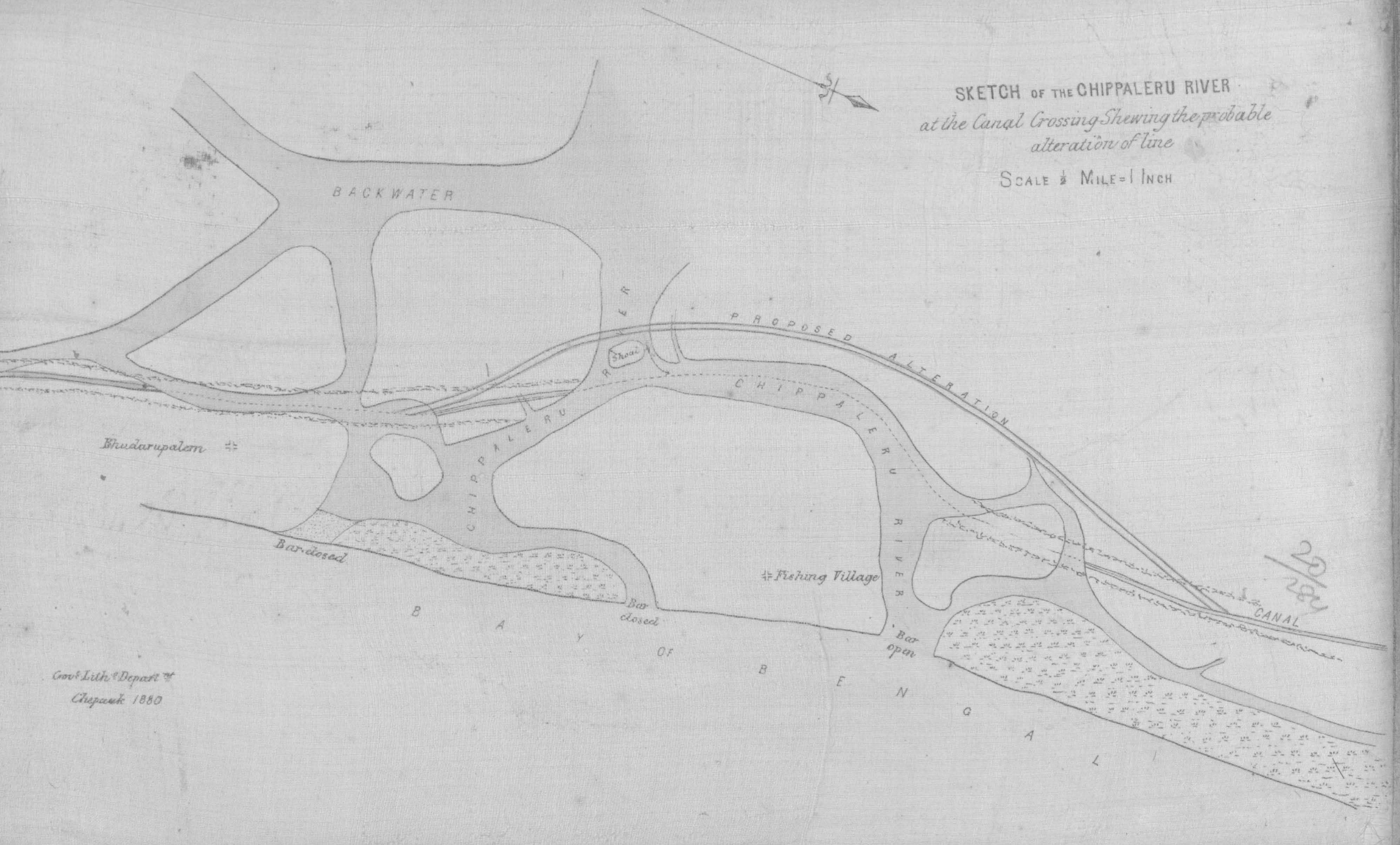
SCALE ½ MILE = 1 INCH

Govt Lith. Depart.
Chepauk 1880

SKETCH OF THE CHIPPALERU RIVER

at the Canal Crossing Shewing the probable alteration of line

SCALE ½ MILE = 1 INCH



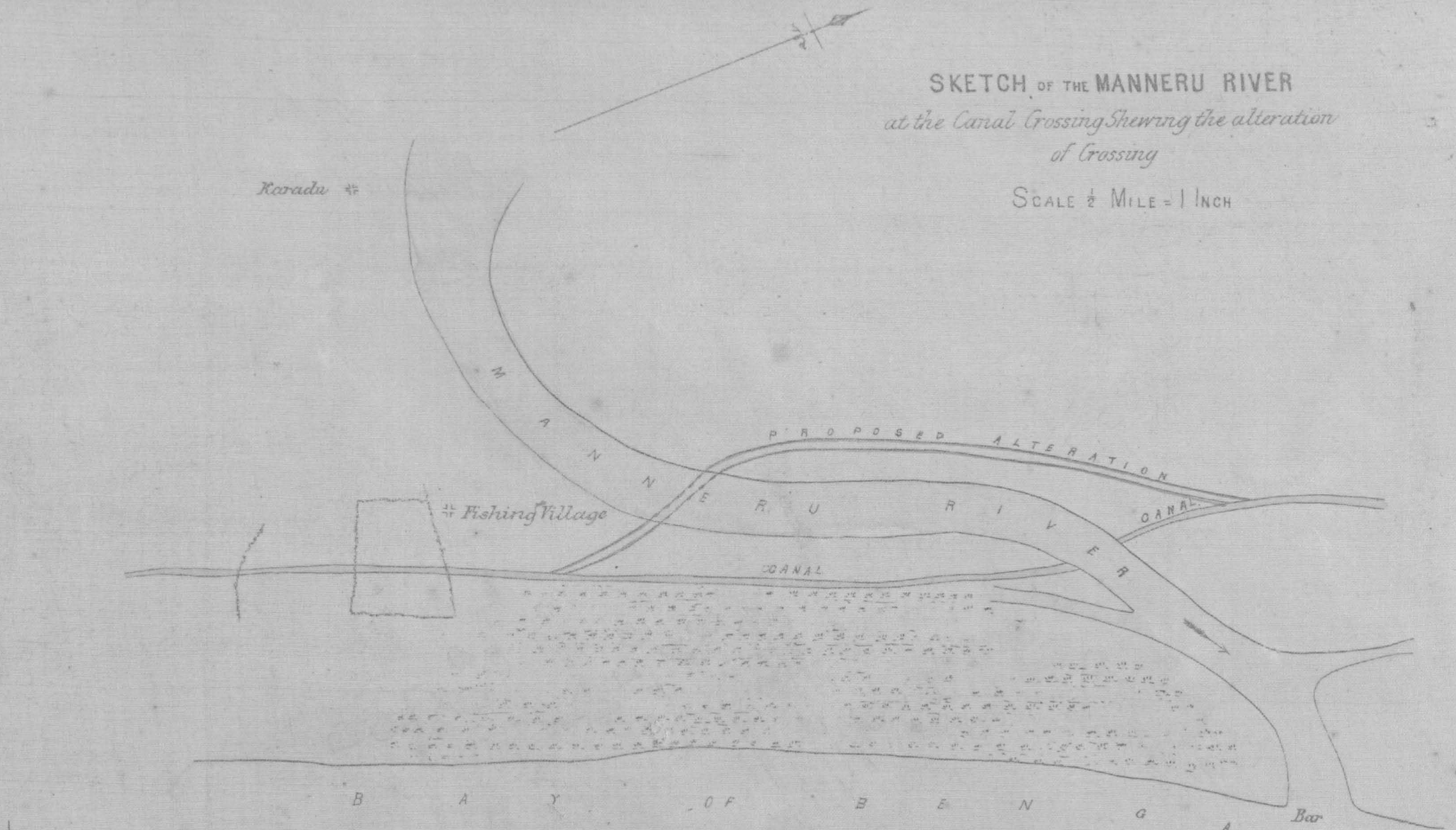
Govt. Lith. Depart.
Chepauk 1880

20/284

SKETCH OF THE MANNERU RIVER

at the Canal Crossing Shewing the alteration of Crossing

Scale ½ Mile = 1 Inch



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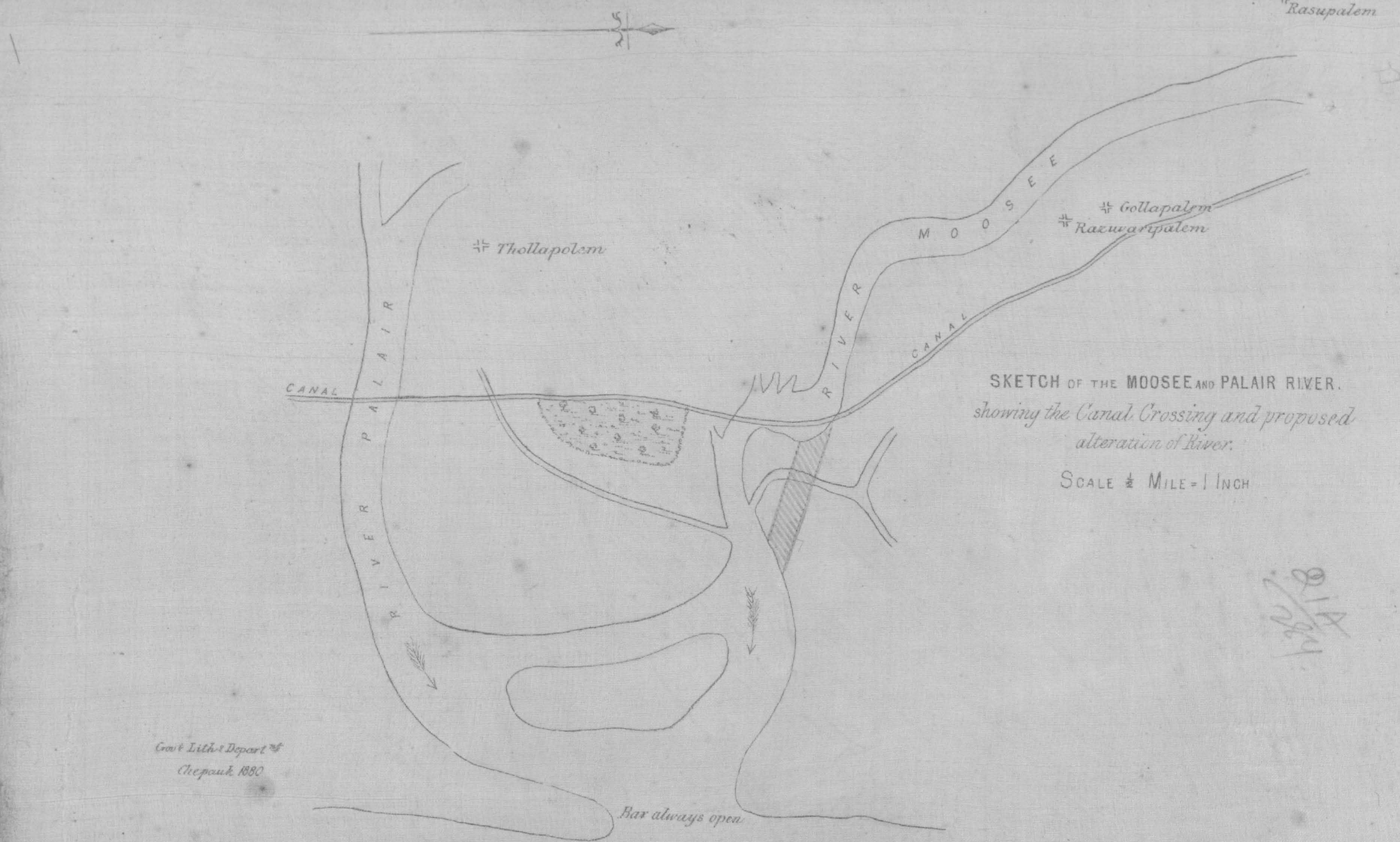
2/284



SKETCH OF THE MOOSEE AND PALAIR RIVER.
showing the Canal Crossing and proposed alteration of River.

SCALE ½ MILE = 1 INCH

Gov't Lith: Depart ᵗ
Chepauk 1880

81A/284

Observations on the Buckingham Canal, made by the Acting Superintending Engineer 3rd Circle during ~~the~~ his Tour of Inspection of the Canal, from 18th August to 6th September 1879.

N.B. The following notes are compiled from the Survey field book kept during the Tour, for every Mile and furlong of Canal. The Mileage of Canal commences from the Groyne at S.W. corner of General Hospital premises, and just below S. I. Railway Bridge.

1 and 2 Miles. The Depth of Canal in this reach, the gauge reading 5.8 that is to say 1.30 above M. S. L., ranged from 4.6 to 6 feet and under Bridges from 7 to 10 feet. The Headways of the several Bridges in this reach, with reference to above recorded level, are, S. I. Railway 6 feet. Span of opening only 14 feet, and only one span of 6 feet headway, the others being much less. General Hospital Bridge, centre opening 9'-3" headway. Railway Iron Girder Skew Bridge, 8'-6" headway. Elephant Gate Bridge present headway 6½ ft. but when the arrangements for altering support of Pipe (Municipal Water Supply main) are completed, the headway will be 10 ft. Salt Cotaur Bridge, Timber, 7 feet headway

and obstructed with struts &c.- Basin Bridge 11-9" headway.- The S. I. Railway Bridge particularly needs to be raised at once to give more headway,- and near the Salt Cotaurs Bridge needs also to be altered at once, for the same reason, and as this Bridge is more an accomodation one and not for cart traffic it can readily be altered.- A landing is required at General Hospital and Elephant gate Bridges, for paſsenger traffic:- and along the entire reach, towpaths are much - wanted, for which an alignment of grounds from Park, Central Station, Salt Cotaurs will be neceſsary.- At the Basin, very extensive wharfs are required for the convenience of Traffic, for loading and unloading.- Just now a very few boats only can discharge or load, the grounds attached to Basin, very extremely limited, and private property bordering so close on the Basin borders. It may be neceſsary also to take up the limekiln grounds to accomodate traffic, which is greatly obstructed now, and obstructs the Canal entirely.- It is probable the wharfs will have to extend

from

from Basin to Railway Bridge, some 2 furlongs and more, and on both sides of Canal.-

3 to 8 Miles.- On this portion the Canal needs to be properly banked in, and drainage provided for.- The East side particularly, has no banks.- The present berms, serve pretty well as towpaths. The old drainage shoots - masonry - need to be removed, being uſeleſs, and in the way of trackers and more or leſs in ruin. On 8 Mile, embankment is being made on west side, owing to the locality having been breached over, by Cyclone.- On 8 Mile is the Shadayancooppam Lock, the sill of which is said to be 6.40 below M. S. L.- The gauge readings were 5'-9" on North and 5.10 on South (Madras) side.- with 6 ft. on this South gauge, the depth from Basin to Lock will be 4 feet generally There is not much tidal effect, felt at the Lock, owing to its distance, 4 Miles, from Ennore Bar, and the large areas of Backwater intervening ~~intervening~~. The Maximum rise of Tide at the Lock, is found to be 1 f as ascertained from the gauge registers f whole year.- The Lock gates are in decay

and will soon have to be renewed.. The Lock chamber is 150 × 20 feet.. The Cyclone (May/79) flood at Lock was gauged at 8.70 feet.. The Cyclone flood of 1872 went over the Lock, reading 13.36 feet, the chamber walls being 11½ feet.. The Tidal flood can scarcely effect the reach from Basin to Lock, owing to the narrow opening of the Lock, through which only it can run down.. On N.W. side of Lock, a large drainage enters the Canal, which will have to be regulated, by an inlet and banked.. The Huts of the Lock Establishment are in very great disrepair.. should be permanent structures..

9 to 11 Miles.. This reach of Canal, is composed of the Ennore backwaters, generally of large area, without banks, salt pans on both sides more or less, and course tortuous.. It has been stated already that the gauge reading on N. Side of Lock was 5'-9".. The depth of this Canal backwater ranges from 4 to 5½ feet, but the water level falls as low as 4½ feet, at times, when there is

somewhat

somewhat less than 3 feet in places at others.. On 11th Mile on east borde are the garden houses of Ennore.. The two channels or waterway, as Ennore i neared, one that keeps along west border, and the proper channel,.. the other keeps along Ennore border, but is not navigable for deeply laden boats, in places, when w. level of Ennore Lake, is low, along Ennore however, the East border of Lake is deep.. The Canal, should be laid out, in these Miles, along east border and within it, so as to be free of the Backwater wholly,.. such Canal will probably open into deep part of Ennore Lake, near the R.C. Chapel, where the Lock will be placed, the present Lock being abandoned..

12 Mile.. An Extensive spur, runs out from 11 Mile Stone west border, into Lake almost half way across Lake, with scarcely a foot of water on it.. This spur, makes the deep water Canal, very tortuous, and in high or adverse winds boats have great difficulty in rounding it being exposed to the open Lake.. The west border along

the

Mile [illegible] at 11 M. Stone and about it, is - and swampy with salt pans on it.. - the east border from $\frac{11}{4}$ is high to end of Mile.. The Canal, should commence again at $\frac{11}{4}$ in the high border, with a Lock,- and opening into the deep Lake,- and should be carried northwards along and within east border, so as to avoid the Backwaters entirely, from this, for several Miles northward.. This 12th Mile is thro. Lake.- Garden houses along east border.-

13th to 17th Miles.- Thro. Backwater continuously, course tortuous, the deep channel zigzaging from one side back other to the other side,- the arms of backwater being very wide in places, with shallow and slushy borders, rendering the work of tracking very difficult.- all along the west borders are salt pans,- and in some parts along east borders also.. The Canal should be carried along east border and within it, so as to be quite separated from the Backwater.- The Salt Dept. should take down their piccotas, when the working season is over,- as they interfere greatly with tracking.

Depths

Depths in this reach (13 to 17) 4 to 5 generally, in a few places 3 feet. The village of Pooleedevakkam is on 16 Mile east border, and in this mile east border are casuarina plantations and paddy fields, a very narrow strip of which only would be required for Canal, the line being laid more along border and banked off from Backwaters.- On 17th Mile is the village of Katoopully, with paddy fields on east borders.-

18 and 19 Miles.- Thro. cutting depths 3½ to 4½ feet for about 3 furlongs at beginning of 18 Mile, there are no banks, but flat berms, which serve as towpaths.- On rest of Miles, the banks are high and rugged with much prickly pear on them,- paddy fields on east side behind bank, and Police lines.- Field drainages discharge with open cuts.- On west side are several salt brach boat channels.- No proper berms or towpaths, banks sloping down, irregularly to water's edge.- On 19th Mile towpaths being formed, with the spoil taken out from deepening, slopes being turfed.-

20 Mile.- Canal enters backwater again.

4 to 5 feet depth.- East border casuarina plantations.- west border some what high grounds, backwater wide.- The Tides from Pulicat Bar reach thus far, the Canal should keep along east border.-

21 Mile.- Thro. an extensive backwater partly which might be designated Chinta-mony backwater, and which has a "Bar," that opens only in very extraordinary floods.- The deep water channel is very tor-tuous, zigzaging about, in this wide ex-panse of water.- Depth 3 to 4 feet.- At $\frac{20}{5}$ the Canal enters a cut, which has a depth of $4\frac{1}{4}$ to $5\frac{1}{4}$ feet.- This cut has been much scoured and widened by floods, banks rugged- berms destroyed;- tracking thro. this cut is difficult owing to high broken banks and that slopes to waters edge.- The cut extends to end of Mile, entering backwater again beyond.- The Canal if made, along east border, will cross Chinta-mony backwater, thro. which it will need to be embanked on one side, west, to meet above cut.-

22nd Mile.- Thro. Backwaters for first

2 furlongs

2 furlongs, from which it will have to be cut off by banking, if Canal is to be reconstruct-ed.- East side high border.- Depths $4\frac{1}{2}$ to $5\frac{1}{2}$.- Rest of Mile in cutting up to $\frac{21}{7}$ where the Canal enters Backwater again of the Pulicat Lake.- Banks of cutting high rugged- berms and towpaths swept away by scour of floods thro. cut.- The Pulicat and Ennore Backwaters are continuous, with just a few cuts and straighten course, which is still even very tortuous.-

23 to 25 Miles.- Thro. Pulicat Backwater.- Depths $3\frac{1}{2}$ to $4\frac{1}{2}$ feet. Deep channel course zigzags about the Backwater, making navigation very difficult.- At 23 M. shore- sea border close- originally an old bar.- At $\frac{23}{2}$ village of Jatancoopum East border. Casuarina plantations all along East border. On 25th Mile, shoals are forming from both margins across backwater which are likely soon to meet and form a bar to navigation.- The Canal, if reconstructed, should be made along east border and within it, opening out into the Pulicat Bar channel, with a Lock and Tidal weir.-

26th Mile.- Canal runs partly along W. border of

Pulic

Pulicat Lake, and then crosses the deep Pulicat Bar channel, to opposite shore, the east border of which it hugs where the Lake is deep. On the first portion of channel, along west border, the depth is 4 to 5 feet.-

27th Mile Along east Coramandel border of Lake- deep channel.- garden houses along east border.- The 27th M. Stone, is at the very ~~northernmost~~ house of Coramandal.- along side the house, will be the probable position for Canal, with Lock and tidal weir.- The Cyclone flood of May 79, reached to 9.69 or 5.19 above M.S.L.- The 1872 Cyclone flood was 10.30 or 5.80 over M.S.L. which is 4.5 above Canal Datum.-

28 to 34 Mile.- In this reach is comprised the 1st cut thro. Lake.- It commences at $\frac{27}{5}$.- The depths are 5 to 7½ on 28.- 5 to 7 on 29.- 5½ to 6 ft on 30.- 3¾ to 5½ on 31 (shoaled owing to breaches.- 5 to 5½ on 32.- 4½ to 5¼ on 33.- 4¾ to 5 in 34.- 35 Mile 4 to 3 ft.- The cut is carried thro. shallow border of Lake, but far away from border generally- ~~thus impounding~~ a portion of Lake on one (east) side, all along the west bank, so to berm it, is quite

exposed

exposed to the Lake, and built in water.- This W. bank has been quite destroyed by the Cyclone in May- remnants only being left- the berms too have been mostly carried away.- All that is left now is the lower portion of bank varying in height from 4 ft. to 1 foot above W.L.- and much of this also is breached, which is being repaired slowly, as earth cannot be got.- The east bank, was originally made, a low flat narrow berm a properly towpath 2 ft. above water,- this is much damaged and breached, and several M. and F. stones planted on it have fallen.- The Southern Mouth of cut, is constantly being shoaled across, owing to action of S.W. and W. winds. The northern end of cut also, which runs submerged for a couple of furlongs into open water of Lake, is hard to keep open, for reason given above:- and the submerged banks are a great hindrance to navigation, in strong or adverse winds.- At $\frac{28}{7}$ at $\frac{30}{2\text{-}3}$ at $\frac{33}{4\text{ to }7}$ the main land high border abuts on the Canal.-

35 to 38 Miles.- In open Lake up to $\frac{34}{7}$ where 2nd cut commences.- Depth in open Lake 4 to 5 feet.- The head (south end) of this second

cut, is being constantly filled up by the action of the winds and waves; it runs submerged for some distance in the open water, and as in the case of 1st cut, the submerged banks are obstructive to traffic.- This cut runs thro. a neck of land, and has a good foreshore on Lake side, to check the waves, and protect the bank, which has escaped without much injury.- There is from 4 to $5\frac{1}{4}$ feet water in cut.- The western berm and turfed tow-path, 3 to 4 feet above water- are in good condition.- The west bank will need to be properly finished and turfed.- On east side, only a flat towpath 3 to 4 feet over water, and about 2 yards wide had been made and turfed- and more or less preserved- some breaches occurred,- the main land drainage has to be provided for, through these openings, but not in such number.- At $\frac{36}{2\text{ to }5}$ the Lake washes against the bank, there being a creek running in from the line of foreshore- here the bank will need strengthening and protecting.- The Tettipunt village is on $\frac{37}{6}$ Mile.-

This

This cut at North end, runs submerged into open water of Lake as at other end, and very diffi[illegible] [illegible] open- the submerged [illegible] also being a great inconvenience to traffic,- a fencing of piles with brushwood behind is being planted, on west side into Lake, towing the w. bank, so as to arrest deposit, and at the same time protect mouth of cut,- the portion already planted is acting well- and is to be extended- and same done to south end of cut to prevent the shoaling.- The 38 Mile, except a short length at begining, is in open Lake 3 to 4 feet water.-

39 Mile.- In this Mile is the 3rd cut, which is a total failure, and great inconvenience to navigation. In short the boats avoid it by taking to the open Lake, when the wind permits.- This cut may be described as a submerged one,- it has no banks- but it was intended by the help of piling- brushwood planting etc, to rear up a bank on lake side at least. The Main land border, abuts on Canal on 3 to 5 furlongs, the rest of cut beyond at either end, is in

open water for several furlongs, either way - and the [illegible] a great obstruction [illegible] cut has 3 to 4 feet water in it and difficult to keep open - the Lake waves washing over it. -

39 to 40 Miles. - In the open Lake 3 to $4\frac{1}{2}$ feet deep.

41 to 43 Miles. - This reach of Canal forms the 4th Lake cut. - It commences about $\frac{4}{6}$ submerged, with piling on Lake side and brushwood planting to protect the submerged cut. - The cut ends at $\frac{43}{5}$ where the Canal, enters the main land border, and where old head of Canal into Lake was. - There is from 4 to $4\frac{1}{2}$ water in this cut. - The west or Lake side bank, was destroyed by the Cyclone, leaving only the pane of bank, more or less submerged also except ~~the~~ near the N. end of cut where bank is high - On east side, there is only a towpath turfed berm - which also has been damaged owing to water (cut off portion of Lake) behind it. - The South end of cut, is difficult to maintain open, exposed as it is to the Lake. - Some piling with fencing is being planted to break the waves and wash. - Navigation along this cut, where Lake side bank is gone, during adverse wind is very difficult, the boats being bathed on the submerged bank. - 18 boats were moored in this cut, with cargo for Madras, which could not attempt the boisterous open parts of Lake, and had been waiting since the previous day. - Four boats that ventured a few days ago, are said to have sunk. - At $\frac{43}{5}$ there is a Mosque and Chuttram. - The rest of 43 Mile being cut along border of Main Land, is fairly well protected - with 4 feet of water. - The old opening into Lake, breached during last Cyclone, and only temporarily closed. -

N.B. In respect to this Lake section, 27 to 43 Miles, it will be necessary to abandon it and carry the line along and within east border - a portion of 4th cut - very little of it only however, - nearly the whole of 2nd and 1st cuts can be utilized in the alteration. -

44 to 46 Mile. - Along border of Main land, with a natural well turf grown berm towpath

generally.- Village of Cusbah and Mission station at $\frac{45}{1}$.- The west bank which is exposed to Lake, has had its bank above berm destroyed- but berm remains intact and has well turfed slopes.- This continues up to $\frac{46}{3}$ only, where the berm is very low and bank quite swept away.- Depth in this reach $4\frac{1}{4}$ to $4\frac{3}{4}$ feet- was deepened during famine.- On 46 Mile there is swampy land behind east bank.-

47 to 57 Miles.- The features in this reach are the same in every mile- border, pause of shallow Lake, on west side- swamp and backwater east side.- The Lake side bank is quite gone, and only a few inches of berm left breached in many places also- The east bank is a flattish berm really, 3 to 4 feet above water- and serves as towpath,- drainages from impounded backwater east side, need to be provided for.- There are some branch boat channels on east side, to the wood loading basins.- This entire section must be fully embanked on Lake side, and on east side just sufficient to keep out flood water.-

The

The village of Royadoroovoo is on $\frac{57}{5}$.- The depths of Canal in this reach are on 47 Mile $3\frac{3}{4}$ to $4\frac{1}{4}$ - 48th Mile $3\frac{1}{2}$ to $4\frac{3}{4}$ - 49 and 50 Miles $3\frac{1}{2}$ to 4 - 51 Mile- $3\frac{3}{4}$ to 3. 52 Mile $3\frac{3}{4}$ to 4 - 53 and 54 Miles $3\frac{1}{2}$ to 4 - 55, 56, 57 Miles $3\frac{3}{4}$ to 4.- The Lake on west side bordering on Canal is very shallow, ~~and~~ with only a few inches water in some places- which in dry months is probably high and dry.-

58 to 65 Miles.- In this reach there is Lake backwater on west side all along, with here and there, high grounds abutting on Canal bank.- The backwater has shallowed up and only during floods is it covered.- From 58 to $\frac{64}{4}$ there is no bank on west side- all carried away by Cyclone- just a trifle of berm left and that submerged and breached in places- tracking on this side is most difficult and for miles in water.- At $\frac{64}{4}$ there is something of banks and high ground on west side.- On east side, there are no regular banks, but merely berms which serve as towpaths- several parts breached. There are several

boat channels branching from Canal on this side, to the wood basins of the Govt Jungles.- In this reach also, the westbank must be fully made up, and to some extent on east side, as there is backwater and swamp all along on this side also, up to 64 Mile. The Pumbly village is on $\frac{63}{7}$ on east side.- The depths of Canal in this reach, are as follows.- 58th Mile $3\frac{1}{4}$ to 4 - 59 Mile 3 to $4\frac{1}{4}$ - 60 Mile $3\frac{3}{4}$ to $4\frac{1}{4}$ - 61 Mile 4 to $4\frac{3}{4}$ - 62 Mile 4 to $4\frac{1}{2}$ - 63 Mile 4 to $4\frac{1}{2}$ - 64 Mile $3\frac{1}{2}$ to $4\frac{3}{4}$ - 65 Mile 4 to 5 feet.- On 65 Mile east side are casuarina plantations.-

66 to 69 Miles.- This portion of Canal, zigzags thro. the Doogarazupatam Backwater; course very tortuous and trying to navigation, in adverse winds, as in no other way can the boats be got along them by poling, and that thro deep slush.- At the southern entrance of Canal into Backwater, the deep channel is kept open with much difficulty owing to shoals forming from both borders, and there is barely passage way enough for two boats without the constant clearing.- The

depth

depth thro. this backwater varies from 3 to 5 feet, but generally three.- The Backwater is very shallow along west border, and this filling up extends far into the Backwater eastward.- From a plan of alteration of line in this reach, which Mr O'shaughnessy intends to propose I observe, that the alteration will still be in the Backwater, and come out at south end, in the same place, where the difficulty of maintaining an open channel is already very great.- I consider the alteration which is absolutely necessary should, hug the west border and within it - running from $\frac{65}{5}$ to $\frac{69}{3}$.- The one large drainage, that enters from this side will be provided for with outlet.- The line will thus avoid the backwater entirely, and which alone will preserve the Canal in this reach free from obstruction.- The western border is low, so will not entail expensive cutting.- Doogarazupatam at 69 M. Stone.-

70 to 72 Miles.- Along east border of Doogarazupatam backwater - west border somewhat high sand plains, with casuarina

plantation

plantations.- On east side here and there, there are short lengths of very small bank- and other parts open to the Backwater- This reach will need to be ~~planted~~ banked off quite from Backwater, with a large inlet to supply Tidal water from Doogarazupatam Bar.- The depths in this reach are 4 to 5 feet in 70 Mile- 3½ to 4½ in 71 Mile- 4 to 4½ in 72 Mile.- at $\frac{70}{6}$ is the fishing village of Koondoor-palliem on west border. The site selected for Rest House on $\frac{69}{3}$ is too low, and exposed to floods.- The M&F. stones, concrete foundations in this reach, are all bad, being mere jelly.- Along 70 and portion of 71 are heavy casuarina plantations along west border.- A somewhat large drainage enters at $\frac{71}{4}$ which will need to be provided for with outlet and inlet.- From $\frac{71}{5}$ the Canal is in cutting virtually with rough uneven banks to 72 Mile Stone and on east side, a small field drainage enters, which can be diverted into Lake further down south.- The Tidal flood in Doogarazupatam

Backwater

Backwater has not much of an effect- owing to narrow opening of Bar, and great expanse of Backwater. The Tidal flood scarcely rises a foot.-

73 to 75 Miles.- These miles are in cutting, and connect the Doogarazupatam with the Pamanjee backwaters.- Depths, in 73 Mile 4 feet- 74 Mile 3½ to 4¾ feet- 75 Mile 4 to 5 feet.- Banks high and irregular- field drainages both sides, which might all be connected together and discharged in any one convenient place, on either side, or dropped down further south or north into Backwaters.- At $\frac{74}{3}$ the Pamanjee backwater is joined, which is merely a gully here.- In this reach the banks, berms, and towpaths need to be properly formed.-

76 and 77 Miles.- At $\frac{75}{4}$ the Canal enters the Soornamookee, originally the Pamanjee backwater.- The Soornamookee which originally, ~~destroyed~~ discharged by a bar several miles north of Pamanjee,- some years ago, during a high flood, forced its way down south to the Pamanjee Bar, taking up the Canal, and scouring it to a River

width, as now.- navigation along these two miles of River is difficult, as a deep channel in River bed can scarcely be maintained, zigzaging about also.- In some parts there is deep channel enough- On 76 there is $3\frac{1}{2}$ to $4\frac{3}{4}$ feet of water- In 77- $3\frac{1}{4}$ to $4\frac{1}{2}$, and more along deep east border- The River turns off westward at $\frac{76}{7}$, where the Canal enters deep cutting.- At $\frac{75}{4\cdot5}$ a deep and wide channel to the eastward leads to Pamangee Bar, now closed, and which is now the Soornamookee Bar, virtually as before said.- There is a Tidal rise of about 6 inches, in the Soornamookee, the result of the Kundalaroo Tides, that enter the Canal in $\frac{89}{6}$.- When the Doogarazupatam Bar is well open, its Tides serve up to the Soornamookee also.- It seems very advisable, to abandon the Canal, in the Soornamookee bed, and cut a new channel, to westward, from 77 M. S. or thereabouts to about $\frac{75}{2}$, and banking the Soornamookee from this point down to the Bar, on South side, so as to keep its floods out of

Canal

Canal quite at the River crossing $\frac{76}{7}$ the floods will need to be locked out.-

78 to 90 Miles.- This reach of Canal is thro cutting mostly, and in some parts very deep cutting. In other places, old gullies have been utilized, by which the course of Canal, has been rendered very tortuous especially at northend of this reach.- The drainages that enter from both sides, are from fields of no great are, and are now nearly all provided with pottery pipe outlets.- The slopes are well Turfed generally, and banks grown over with grass &c.- Where the berms are very high, the cutting of towpaths was commenced but not completed.- On the whole the berms serve as towpaths. The banking of this section fully suffices, and very little needed to complete Towpaths.- The Canal is not deep enough.. The readings were on 78- $3\frac{1}{2}$ to 4 - 79- 4 to $4\frac{3}{4}$ - 80- $4\frac{1}{2}$ to 5- 81- 4 to $4\frac{3}{4}$ - 82- $3\frac{3}{4}$ to 5- 83- $4\frac{1}{2}$ to $4\frac{3}{4}$ - 84- $3\frac{3}{4}$ to 5- 85- 4 to $5\frac{1}{4}$ - 86- 87 $4\frac{1}{2}$ to 5 - 88- $4\frac{3}{4}$ to 5- 89- 5 to $5\frac{1}{2}$ - 90- 5 to $5\frac{1}{2}$. The Tide gauge read 6·9 - the Tide has Ebbed 3".. Considering that the reach under review is

Tidal, the Canal, it will be seen is very short of depth.- At $\frac{89}{6}$ the Canal enters the Kundalaroo with a very very serpentine course for about half a mile.- The Mouth can scarcely be kept open, to 3 ft. at low Tide, owing to this part of Kundalaroo shoaling up - and as the mouth also is very inconveniently placed, with respect to the take off; of the northern mouth, it seems absolutely necessary to alter the southern mouth, to a more eastward position to face the Northern mouth.- The Canal line will need to be altered, from about 89 M. Stone, and runs more eastward along the low ground; to the position above referred to.-

91 Mile.- Along the deep Kundalaroo River - which commences at $\frac{89}{6}$ and is left at $\frac{90}{6}$.- In this Estuary, which has a very wide and open bar, Ships of 300, 400 Tons come in to refit.- The Kundalaroo Tidal floods, from the Registers, are shown to rise 2·6 feet.- In the cutting at end of Mile, leading to Kristnapatam - the depth of Canal was 7 to $7\frac{1}{4}$ feet, but at mouth

$5\frac{1}{4}$ to

$5\frac{1}{4}$ to $5\frac{1}{2}$ feet.- It was high tide about this time.- The Canal mouth shoals up, and requires a jetty on west side run into deep water.-

92 Mile.- Kistnapatam. Depth $6\frac{1}{2}$ to $7\frac{3}{4}$ ft. high tide.- Basin at $\frac{91}{2}$.- The end walls of Basin are much shaken. Basin much too small, both in length and width, as boats obstruct the Canal way.- Road to Nellore at this Basin. No good water here within $1\frac{1}{2}$ Miles.- There is backwater on both sides of Canal - the banks which are merely flat berms need raising above highest floods level.-

93. Mile.- Depths 4 to $5\frac{1}{2}$ feet - only berm west side - and much breached. Salt channel also on this side.- On east side great expanse of backwater, open to Canal generally.- Both banks need to be fully made up, backwaters shut off - and low swampy grounds west side, which are salt pans.- At $\frac{92}{1}$ the old cut (the old take off of North Canal) joins.- considering it is high Tide, this Mile is very shallow compared with 92.-

94 to 96 Mil

94 to 96 Miles.- These Miles are thro. deep sand cutting - high banks generally, which need more planting and turfing.- On 94 the banks are not so high, and low grounds both sides.- Kistnapatam village to west.- The berms serve as good towpaths all along - slopes turfed.- Depths in 94 Mile 5 to $6\frac{3}{4}$ - 95 Mile $4\frac{3}{4}$ to 6 - 96 Mile 5 to 6 feet.- At $\frac{95}{7}$ the Nalatoor backwater is entered, which has a closed Bar, that rarely opens.- On 96 Mile on west side, the banks that were made are quite gone, and only flat berms left.- The Nalatoor drainage enters here, and requires an outlet into Canal - On east side also, the backwater needs to be banked out.-

97 and 98 Miles.- This reach of Canal follows the Nalatoor Backwater, crossing and recrossing it several times. No banks to speak of only berms low and flat - with several openings. Canal course tortuous.- Some bends of Backwater are cut through this reach needs to be properly banked - and inlets for drainage provided in any one

place

place or more, with side drains behind.- Depth in 97 - 5 to 8 feet - in 98 - $5\frac{1}{2}$ to 7 feet.-

99 to 101 Mile.- This portion of Canal is in cutting generally, and enters Kodoor Backwater in $\frac{100}{6}$.- Banks high generally - planted to some extent.- Towpaths incomplete - Berms gullied by drainage running down.- Banks in 100 are high and unfinished.- In 101 for 6 furlongs banks as above - rest of Mile banks low, with openings for drainage both sides should be banked and drainage provided for.- Depths in 99 Mile 6 to $7\frac{1}{2}$ feet - in 100 Mile 6 to 7 feet - in 101 Mile, the same -

102 Mile.- The Kodoor backwater continues - and there is a Bar for outlet, - now closed.- Depth of Canal in this Mile 6 to $6\frac{3}{4}$ feet.- Several openings for drainage, both sides - Only flat low berms and no banks, except for a furlong at end - needs to be properly banked in.- Kodoor Village on this Mile to westward.-

103 to 106 Mile.- At $\frac{102}{4}$ Kodoor backwater ends - turns inward.- From here

North

northwards high banks - deep cutting generally sand, banks, berms, towpaths, unfinished in parts, planted with Rabbit-root generally and turfed - at $\frac{103}{2}$ old bar closed.. Depth in 103 Mile 6 to $6\frac{1}{2}$ feet - 104 Mile 6 to 7 feet - 105 Mile $6\frac{1}{2}$ to 7 feet - 106 Mile 6 to 7 ft.

107 to 114 Mile.- High banks - deep cutting generally - towpaths more or leſs formed.- Banks etc. mostly planted over.- On 107 Mile field drainages from both sides enter Canal and need to be provided with inlets.- On 108 Mile is the Horattur Village west side, and Horattur P.W. Bungalow east side half a Mile from Canal, with a branch channel or rather creek leading to it.- On 109 Mile also are openings for field drainage both sides at $\frac{108}{7}$ an old, closed Bar.- The banks generally on this mile are veary weak, and low, no banks in places.- On 110 Mile high banks well planted - field drainage from w. side. On 111 Mile also banks high well planted, field drainages both sides.- At $\frac{110}{7}$ Gangapatam Backwater is entered which extends to $\frac{111}{2}$.-

There

There is a Bar adjacent of this Backwater, but is closed.. This backwater is croſsed again at $\frac{111}{4\cdot5}$ which is 4 to 6 feet deep.- Tide ebbing.- The banks of 113 are unturfed at $\frac{112}{1\cdot2}$ backwater is croſsed $3\frac{1}{2}$ to 4 ft. deep.- The high banks continue up to $\frac{113}{2}$ where the old Pennair is croſsed.. From this point banks generally low - unturfed and unfinished, here and there a bit of high bank, - on east side behind bank low swampy grounds.- At $\frac{114}{2}$ is the South border of Pennair.- The depth of Canal in these 9 Miles is $4\frac{1}{2}$ to 5 in 107 - 4 to 5 in 108 - $5\frac{3}{4}$ to 6 in 109 - $5\frac{1}{2}$ to $5\frac{3}{4}$ in 110 - 5 to $5\frac{3}{4}$ in 111 - $3\frac{3}{4}$ to 5 in 112 - 4 to $5\frac{1}{4}$ in 113 - 4 to $4\frac{1}{2}$ in 114 (short depth being close to River).- At Canal Mouth in River, shallow, silted by floods, which has constantly to be removed.-

115 to 117.- Pennair Croſsing.. The south border is at $\frac{114}{2}$ - the North border $\frac{116}{6}$ - The cut thro. Island in River extends from $\frac{115}{4}$ to $\frac{116}{3}$.. The River croſsing, viz of 3 branches of River, with a natural channel between southern and central

branc

branch that has been utilized - a very tortuous and round about course - and a cut through Island, to reach the northern branch. - The crossing is a most trying and somewhat dangerous one to navigation. - A sand spit has formed in front of Canal southern Mouth, necessitating a circuit eastward, too near the Bar in strong winds, to round it, and make the channel between the southern and central branches. - Similarly the central brach is a trying one, to make the Island cut. - The cut again is most difficult to maintain. - It has scarcely a foot of water at low tide fills up yearly. - The crossing is to close to the Bar to be safe, even ordinarily. - In floods the

risk

risk is great. - It wou[illegible]e better to cross higher up about 2 Miles near Ootacoor, beyond which it is said the tide serves. - Survey required for the River crossing. - There is just now a small fresh in River. - The northern branch crossing is the least trying, though there is not much depth, - except along south border. - Pennair Tides rise 3.63 feet. -

118 to 120 Miles. - The 118 and 119 and 120 miles up to Ramtheertham Backwater $\frac{119}{4}$, are in deep sand cutting high banks, planted - From $\frac{119}{4}$ to 120 M.S. in backwater, banked through. - West bank entirely carried away by Cyclone and deposited in Canal. - East bank a low flat berm only damaged. - At $\frac{119}{4}$ is also the Bar, of this Backwater which is closed. - Canal runs too near the Bar. The Canal line needs alteration here, and should run

straight across from 120 M. stone southward joining about 119 M. stone perhaps, so as to be free of the Backwater, a bend in which needs also to be cut to send the drainage direct to the Bar and force it open.- The depths in this reach are in 118 Mile 5 to 6 ft. in 119 Mile and 120 the same.- The 120 Mile has just been cleared out, to 3 feet below low water.- the Tide now being in gives the longer depth of 5 to 6 feet.- The proposal shown on Survey to bank the Ramatheertham drainage, and send it across to Pyderoo will not only be expensive, but unsuccessful.-

121 to 123 mile.- The 121 Mile is thro. deep cutting - sand - high banks turfed and planted mostly.- Tide running up.- Depth 5 to 5½ feet.- This Mile is much silted, almost 2 feet.- On 122 Mile up to 5 furlong deep cutting and banks planting etc. as above. Depth 5 to 6 feet.- The Pyderoo Backwater is entered at $\frac{121}{5}$, W. bank weak and unfinished.- Ram theertham Village on 121 Mile.- On 123 Mile, depth 5 to 5½.- Line runs along border of high

ground

ground on east side - O[illegible] west side ~~broad~~ broad expanse of shallow ba[illegible] with scarcely any bank, and this [illegible]

124 Mile.- The Py[illegible] is on this Mile - Bar open - crossing at $\frac{123}{5-6}$ - and makes almost a right angle bend, most trying to Boats.- The Canal should be placed more to eastward, so as to cross more conveniently, and Canal beyond each side, run more within the high border. On west side is a broad expanse of shallow backwater and oyster beds, of which the small low track is formed.- On east side, from 2nd to 6th furlong there is no bank but a small ridge.- Depths in this Mile 4 to 6 feet.-

126 and [illegible] Miles.- Along the East border of Pyde[illegible] backwater which is of great expa[illegible] and shallow.- The line would hav[illegible] better laid, more within the border,- so as to be less exposed to Backwater influence, and the bank would have been more effective. The present west bank is more or less damaged, and low.- Depth in 125, 6 to 6½ feet. In 126, 5½ to 6½ feet.- The east

side being mar[illegible] and border, banks are not wanted.

127 and 12[illegible] The [illegible]deroo backwater extends more in zigzags along here. At $\frac{126}{3\text{ to }6}$ the arm of Pyderoo backwater is crossed, which goes to sea at Eskapully. Bar now closed, low ridge. Opens occasionally in the year. The depth on 127 is from 5 to 5½ feet. The deepest part of crossing is on 5-6 furlong of Mile. The east side is high border. west side backwater, with merely a strip of small low flat track left, and which is all oyster shell. The berm and tracking path formed on this side, was swept away in the Cyclone. On 128 Mile depth 4 to 5½ feet. low and high grounds alternate on this Mile, the high ground and cutting commencing on [illegible] side at $\frac{126}{6}$. at $\frac{127}{1}$, the branch channel to Eskapully P.W. Bungalow takes off. At $\frac{127}{4}$ an arm of the Backwater, which crosses here, has been banked across, but banks are weak. Salt pans on west side. and Eskapully village to west on this Mile. The bad

soil

soil on this mile, prevents banks being turfed or planted.

129 Mile. The Chippalaroo Backwater is next with a bend of Mile. The depth on this Mile is 3½ to 5 feet. The cutting is generally deep on this mile. High banks turfed. Low grounds behind banks. On west side, the side drain lopping up the several arms of drainage, needs to be made very spacious, to prevent accumulation of water. At end of Mile, on east side, is a closed Bar, which opens in extraordinary floods only.

130 to 133 Miles. The Chippalaroo backwater zigzags about in this reach, crossing and recrossing several times. On 130 Mile depth 4½ to 6 feet. On 131 5¼ feet. On 132 4 to 6 feet. On 133 Mile 4 to 7 feet, except at [illegible] where [illegible] is only 3 ft. On 130 Mile, very high sand dunes. sea close. water both sides generally. Bank low in parts high in other. Side Drain w. side needs to be more capacious. Banks both weak generally. On 131-2-3, the backwater is crossed. cuts thro. bends.

In the cuts banks high and good with towpaths.- at the crossings banks low and breached.- The side drains both sides need to be spacious to prevent accumulation of drainage.- At $\frac{132}{5}$ the Canal enters the main arm of the Chippalaroo backwater and river.- The mouth shallow much and has to be constantly deepened. only 3 ft. water at mouth.- Noses of Canal mouth, run too far out, so breach and wash in.- A branch of River, runs to Eastward to an old bar, which is now closed.- All banks, in the above several Miles, under influence of Chippalaroo floods, must be well made up above flood level.-

134 Mile.- The Chippalaroo River crossing is in this mile, commencing on $\frac{132}{5}$ and extending to $\frac{133}{4}$.- The River widens out into an estuary in this reach.- Deep Channel very tortuous, and in parts very shallow. Tracking difficult. The Canal line must be altered, as it is a very troublesome crossing, and the take off of Canal North

North, rather near the sea.- A good line inland might be made, crossing the main arm of River and avoiding the Estuary.- The mouth of northern take off of Canal, also, is shallow 3 ft., while within it is 4 to 6 feet, in the rest of Mile.- At $\frac{133}{6\frac{1}{2}}$ is a breach in east bank, which is much damaged on this Mile, by Cyclone floods washing over it. Both banks must be made above Flood reach.- Tide running out. Bar open.-

135 to 142 Mile.- This reach of Canal is a hollow between sand ridges, old backwater of Chippalaroo. The depths of each Mile are, 135- 6 to $6\frac{1}{2}$ ft. 136- 6 to 7 ft. (high tide nearly) 137- $5\frac{1}{2}$ to 7 feet (village of Nadoompully on this Mile) 138- 5 to 7 ft. 139- 6 to $6\frac{1}{4}$ feet. 140 and 141- $5\frac{1}{4}$ to $6\frac{1}{4}$ ft. 142- 5 to $6\frac{1}{4}$ ft.- The side drain cut along this reach on west side, must be made more capacious to admit of free drainage of low grounds on this side. The grounds on both sides are low and swampy.- Some banking along Chippalaroo may be necessary to keep

out its spill water from the low lands about this reach.- Banks throughout this reach low, except the portions in cutting, where they are high and turfed,- as also are low berms turfed.- Tummalapenta village and salt pans on 141 Mile.- There are openings for drainage in some places.- It will be neceſsary to provide outlets for some of this drainage, as all cannot be run down to the Cheppalaroo by a side drain.- At $\frac{141}{2}$ Canal enters deep cutting thro. sand ridges.-

143 to 150 Miles.- This reach is in very deep cutting - sand - as much as 20 feet cutting in places.- Banks berms towpaths, well formed, planted or turfed.- In 143 and 144- 5 to 6 ft. deep.- In 145 - 4½ to 6 - In 146-147 - 5 to 6.- In 148. 4½ to 6 - In 149 - 5 to 6¾ - In 150 - 5 to 6 ft.- At $\frac{148}{3-4}$ the Ramapatam River croſses, and runs parallel to Canal, up to $\frac{149}{2}$ where its Bar is situated.- Bar opens during floods. Ramayapatam village on 150 Mile, on west bank.- Temporary and proposed Rest House, at end of Mile, on either side of Canal.- The East bank along 150, needs

much

much raising and strengthening.- The Ramayapatam River will need inlet and outlet at its croſsing. Part of west bank, also and East in 149 will need raising.- and side drainage channels on 147 to 149. provided for spaciously. The excavation of 149 Mile, to some extent, is in laterite rock - also in 150 Mile.- At $\frac{146}{6}$ a small drainage has to be provided for.-

151 to 160 Miles.- This reach also is in deep cutting - sand - high banks well planted - berms and towpaths made and planted or turfed.- Depths, 5 to 6 in 151 - 4½ to 6 in 152 - 5 to 5½ in 153-4 - 5 ft in 155,- 5 to 5½ ft. in 156 - 5 ft in 157,- 5 to 5¼ in 158,- 5 ft. in 159 and 60.- It will be well to plant Palmyrah trees, along toe of slopes inside and outside, which will be productive of Revenue by and bye. In this reach, towards the end, there is 18 to 24 inches silt.- At $\frac{150}{7}$ the Elekaroo croſses to sea.- Bar closed - Is very near to Canal.- In 151 Mile, there is some cutting in Laterite.- Some banking will be needed in 152 in lieu of present low berms only.- Rabbit ~~root~~ wort planting where failed should be renewed on banks and berms.- The Yoonga and Woolva graſs

planted along borders of Canal, along slopes, in this reach and elsewhere, answers very well and looks thriving.-

161 Mile.- The Munnaroo crosses in this Mile at between 3 and 4 furlong- crossing very shallow, which is said to have been very deep before Canal was opened for Traffic- Mouths of Canal very shallow at their entrances.- Tide just running in 2½ to 3 ft. North entrance - 3½ ft. South entrance.- Canal in deep cutting - high banks, well planted or turfed- Much prickly pear about River borders.- In Canal 3½ to 4 ft. only.- The Canal both ends silts very much from River floods.- Some alteration will be necessary in the case of this crossing also, which meets the River very obliquely.

162 to 168 Miles.- The depths of Canal in this reach are 4 ft. in 162 - 4 to 5 ft. in 163 - 3½ to 4 in 164 - same in 165 - 3¾ to 4 in 166 - 4½ to 5 in 167 and the same in 168 - The first few Miles from the Munnaroo were very shallow, silted to 2 ft. and more, and now being deepened - or the readings should not have been as much as above recorded.- It may be

be necessary to embank the Munnaroo by to prevent spill water, getting behind 162 mile the banks of which are low and weak with several drainage openings, which may be closed up, or looped in case [illegible] the spill water is dealt with. On 162, a salt channel on west bank will need to be provided with a sluice. Coast line very [illegible] along this Mile. Banks must be raised and strengthened materially with reference to Munnaroo floods.- On this Mile are the salt pans of Isla[illegible] [illegible].- The other Miles are in deep cutting [illegible] with high banks berms towpaths are planted or turfed.- More planting required.- On 164 Mile, the site selected for the Rest House is low and swampy.- At 164/5 the Pakala Drainage, has been banked across but banks are very weak. There is a bar on East side [illegible] near to Canal but closed up.- Provision must be made for drainage, [illegible] east side.- At 166/1 the Pakala swamp which was banked across breached the Canal [illegible] cyclone.- The Bar [illegible] near to Canal but closed [illegible]

The

here from the sand ridges of Mummaroo and Eramookla on coast, to very near Great Northern Trunk Road over 4 Miles.- The flood rises and spills to such extent, while the Moosee and Mudigondi bars are closed.- Since the construction of Canal both bars have kept permanently open, the floods being directed more to the bar channels than heretofore perhaps.- But there is liability at all times for the floods to rise as high at any time, as in Cyclone of 1877 and previous such seasons of flood.-

178 Mile.- The Canal here enters the Thondaroo at $\frac{177}{1}$ and leaves it at $\frac{177}{7}$.- This gully is formed by the spill waters of Moosee, before referred to, running to the Kotapatam swamp. It is very shallow
2 to 3 feet, but deep in flush.- Nothing was
a done, to improve this place, with reference
ry to Canal navigation except to shut it
ope off from the spill waters entering and
The a side drain has been cut behind
bank to carry away the Moosee water
to the swamp, which is far too in-
-adequate of waterway, to relieve a high
flood

flood from the Moosee side.-
The Thondaroo is over 60 yds. wide.- Orders have been given to excavate a deep channel along east border for present purposes.- There is no bank on east side, which must be provided, and the extensive field drainage allowed for.- The ends of this Mile are in deep cutting well banked - with towpaths etc. complete.-

179 to 183 Miles.- The 179 Mile is in deep cutting. Present water 5 to 6 ft. deep.- On the 4th furlong, the Kotapatam - Ongole Road crosses by a temporary Timber Bridge, which is very shaking and unsafe. A Basin is to be provided for here, but should be merely an enlargement of Canal both sides. Up to the Road, both banks south of it are high, turfed etc.- North of Road for the rest Mile, is in swamp, with scarcely a bank east side.- On west side bank is higher unturfed.- Tide seems to rise here 2 feet.- Along the other miles on west side, the Kotapatam swamp washes.- Banks high but unturfed.- Swampy soil does not take turf.- East bank on

East bank across Bar channel needs to be made very strong.– This swamp [illegible] the spill water of the Palaroo River, which if embanked from Canal to Pake [illegible] be bund, will prevent [illegible] water running across to the above swamp and remove [illegible] prevent inconveniences.– The [illegible] in the section between Munaros and Palaroo should be 3 to 4 ft. [illegible] high floods of the Rivers.– Cyclone [illegible] 10 ft above Canal bed.–

169 [illegible] 70 Miles.– [illegible] Palaro [illegible] Moosee are crossed in this [illegible] have a common bar, which of late [illegible] is always open.– The cut between two rivers silts up as fast as cleared, as in the case of Pennair Island cut. The crossing of the Palaroo is at $\frac{168}{2}$, and [illegible] at $\frac{169}{1 to 3}$. The Palaroo crossing [illegible] as deep before Canal was opened for [illegible], is now very shallow.– The Moosee crossing is very deep.– Tide [illegible].– At the Palaroo mouths [illegible] scarcely $2\frac{1}{2}$ ft. water, [illegible] In the cut

between

between Rivers there is $2\frac{1}{2}$ to $4\frac{1}{2}$ feet water.– The reach between the Rivers is deep cutting, well bank. with towpaths, turfed and planted mostly.– The Moosee crossing needs to be rectified – or rather the River needs rectification of its very winding course, by straightening it, thro. a very deep bend, which will render the Canal crossing less dangerous than it now is, the current being very rapid, and Canal following River course for about 2 furlongs with an elbow bend at each end.– The rest of 170 Mile is in very deep cutting, high banks, berms, towpaths all good.– The west bank is exposed to the wash of the spill waters of the Moosee, which spread on both sides of River to a large extent.–

171 to 177 Miles.– Thro. deep cutting clay loam, high banks – berms – towpaths – all good well laid out Turfed.– The depths in this reach is from 5 to 6 ft.– Cyclone Flood Mark 10 feet over bed (4.5 below M.S.L.). The west bank in this Entire length, is exposed to the shock of spill waters of Moosee, which spread over the country here,

here from the sand ridges of Mumaroo and Chanookla on coast, to very near Great Northern Trunk Road over 4 Miles. The flood rises and spills to such extent, while the Moosee and Mudigondi bars are closed.- Since the construction of Canal both bars have kept permanently open, the floods being directed more to the bar channels than heretofore perhaps.- But there is liability at all times for the floods to rise as high at any time, as in Cyclone of 1877 and previous such seasons of flood.-

178 Mile- The Canal here enters the Thondaroo at 177/1 and leaves it at 177/7.- This gully is formed by the spill waters of Moosee, before referred to, running to the Kotapatam swamp. It is very shallow 2 to 3 feet, but deep in flush.- Nothing was done, to improve this place, with reference to Canal navigation except to shut it off from the spill waters entering and a side drain has been cut behind bank to carry away the Moosee water to the swamp, which is far too inadequate of waterway, to relieve a high

flood

flood from the Moosee side.-

The Thondaroo is over 60 yds. wide.- Orders have been given to excavate a deep channel along east border for present purposes.- There is no bank on east side, which must be provided, and the extensive field drainage allowed for.- The ends of this Mile are in deep cutting well banked - with towpaths etc. complete.-

179 to 183 Miles.- The 179 Mile is in deep cutting. Present water 5 to 6 ft. deep. On the 4th furlong, the Kotapatam - Ongole Road crosses by a temporary Timber Bridge, which is very shaking and unsafe. A Basin is to be provided for here, but should be merely an enlargement of Canal both sides. Up to the Road, both banks south of it are high, turfed etc.- North of Road for the rest Mile, is in swamp, with scarcely a bank east side.- On west side bank is higher unturfed.- Tide seems to rise here 2 feet.- Along the other miles on west side, the Kotapatam swamp washes.- Banks high but unturfed.- Swampy soil does not take turf.- East bank on

180 and 181 were low breached - backwater behind the banks in places.- Along 182 & 3 the east bank is high and turf, but turf failed owing to bad soil.- The depth of Canal in 180 is 5 to 6 feet - in 181 the same - in 182 - 5 feet - in 183 - 5 to $5\frac{1}{2}$ feet. This reach will need proper banking and securing.-

184 Mile.- The Mudigondi crosses in this Mile at $\frac{183}{3}$.- The waterway allowed for it is insufficient for it spreads for 2 Miles in width and more.- Between Beerangoonta and Davarampad, the present small opening by concentrating the flood has had good effect on the Bar keeping it permanently open.- Crossing needs to be regulated by inlets and outlets.- Village of Motoomalay to eastward. The depth on this mile is 5 to 6 ft.- Banks high - with towpath berms. soil does not take turf.- W. Bank exposed to Moodigondi floods.-

185 and 186 Miles.- On $\frac{184}{2}$ an arm of Mudigondi is banked across - should be connected with main branch or

allowed

allowed separate outlet and inlet.- Both Miles exposed to Mudigondi floods.- Cutting deep - banks high - turf put on failed owing to bad soil.- Depth on 185 - 6 to $6\frac{1}{4}$ feet - On 186 - 5 to $6\frac{1}{2}$ - at $\frac{185}{7}$ a drainage crossing has been banked and diverted to Gundulcamma by a side drain, which is of doubtful utility.- The drainage between Kotapatam Road and Gundulcamma, needs to be carefully considered and provided for.-

187 Mile.- The Gundulcamma River is crossed on this Mile.- It has an open Bar - always open - and deep - Small native craft come in for repair and refitting.- The right border is very shallow, shelving downward gradually.- The left border is deep but for a short reach only.- This border has high vertical banks.- Tide Ebbing.- No gauge. ordered one to be erected.- The River crossing is in $\frac{186}{7}$.- First portion of Mile, banks high with berm towpaths - Turfing not fully done.- The banks at south mouth ' ' have been carried to

far into River, causing silting up of mouth.- Depth on this Mile 5 to 6 feet.-

188 to 191 Mile.- Depths in 188 - 5 to 6 ft. in 189 - $5\frac{1}{2}$ to 7 feet - in 190 - $6\frac{1}{2}$ feet - in 191 6 feet.- On 188 banks are high generally but need finishing and turfing, as also the towpaths. At $\frac{187}{7}$ the spill water of old Gundulcamma is banked across.- It has a bar, closed.- At $\frac{188}{3}$ another arm of the same is banked across.- This also has a bar, closed.- A salt channel on w. side at $\frac{188}{3}$ has to be provided for with a sluice.- High banks both sides of this Mile, well turfed.- The drainage that meets the w. bank of 189 must be provided for, either by outlet and inlet or dropped into Gundulcamma,- by a spacious side drain.- The banks of 190 are high and well turfed.- Hanooparti village and salt pans to left. Road to village required, if only a bank, ground being swampy.- On 191 also the banks are good and turfed. At $\frac{190}{6\text{-}7}$ there is a closed bar, very near Canal - A great breach occurred

here

here, running to sea, during cyclone.- It has since been closed,- but will need good protection.- The Canal here makes a most awkward right angle bend - and this portion of Canal course needs rectification - as also further on - on west side on this mile there is just a low flat towpath - no bank - In short the Canal in 191 enters the Hanooparti backwater.-

192 to 197 [illegible] - Depths in this reach are 6 ft. in [illegible] to $5\frac{1}{2}$ in 194-5 - and 5 to $5\frac{1}{2}$ in 19[illegible] [illegible] $\frac{[illegible]6}{5\frac{1}{2}}$ the Canal enters the Ramperoo - In this Mile depth $4\frac{1}{4}$ to 5 feet. Mouth in Ramperoo shallows up, and is [illegible] constantly cleared.- In 192-3 M[illegible] the Canal course is unnecessarily tortuous, zigzaging along the backwater - no banks proper, but low berm [illegible] paths 2 to 3 feet above water. The Canal line must be laid commencing at $\frac{192}{2\text{ or }3}$, cutting more on east border, cross below 19[illegible] & then across the low ground west of [illegible] meeting at $\frac{190}{3\text{ or }4}$ to do away wit[illegible] [illegible]ssary detour and elbow

bend before referred to.- On 194-5-6 banks
high, well turfed with towpaths &c.-
Side drains required to relieve pent
up water, as line runs in a hollow
generally between ridges.- In $\frac{19^{1}}{5\text{-}6}$ the
Kanooparti Backwaters Bar channel
is crossed.- Bar closed. Outlets and
inlets will be required at this crossing.-
at $\frac{19^{5}}{4\text{-}1}$ Pedda Ganjam creek crosses.
The Kistna P. W. D. have arranged
to provide maso   t and outlets
here.- The Comm   nal joins
here.- Cut from   t quite completed.-
Tide Gauge in Ca   ows off 7'.3" is the
highest Tide registere   this gauge,
it is said on 197 M   ks are high,
not fully turfed.- T   ks have been
run too much into   mperoo, flood
waterway, so have been swept by
Cyclone floods.- Ther   fresh just
now in Romperoo, the result of rains
the past few days.- Full moon
31st August, on morn   which
late, the notes of
tion

were

were comme

4/81

Major R.E.
Actg. Supg. Engineer.
3rd Circle

Supg. Engi ie }
Chepauk

Enclosure to
S.E., 3rd No. 5684
27-9-79

see original
of G.O. No. 284 W
d/ 6 Feb. y/80

14/9

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Res in this
state

48/284

Appendix to G.O., No. 284 W., of 6th February 1880.

OBSERVATIONS BY THE CHIEF ENGINEER ON MAJOR VIBART'S BUCKINGHAM CANAL INSPECTION NOTES DATED 27TH SEPTEMBER 1879.

Paragraph 1.—The requisite survey establishment has been sanctioned, and the Superintendent of Works, Captain Awdry, is engaged in preparing the estimate for submission to the Government of India. Tide gauges have been established in all backwaters and open estuaries, as also at intermediate points along the canal.

2. *Paragraph* 3.—For sanitary purposes it is most desirable that the level of the water in the Cooum and Adyar rivers should, as far as possible, be maintained at 3·5 feet above mean sea level, and to do this the lock here proposed would be indispensible, as with the Covelong bar open (maximum rise of tide 2·92 feet above and low water 0·70 below M.S.L.) the water would otherwise escape through the southern canal. The necessity for constructing a dam here is not sufficiently apparent to warrant the work being included in the estimate as yet.

3. *Paragraph* 4.—Under the present arrangements for taking the tolls, the proposed landing place would not help traffic, but Captain Awdry has a proposal for altering the sections so soon as the channel shall be open as far as the Cheyoor backwater, which if combined with a proper opening, headway being given to the South Indian Railway bridge, would permit and encourage traffic through the Junction Canal.

4. *Paragraph* 5.—Appended is a detailed statement of the spans and headways of the bridges, the former being generally under 20 feet each, and the latter as low as 9·22 feet at M.S.L. The headway is thus only 5·72 feet when the level of the water is 3·5 feet above M.S.L., and is therefore much too low. The expense of altering all these bridges, fourteen in number, would be prohibitory for the present, but means should be found by corbeling or otherwise to provide an 18-inch wide board for the towing coolies to pass. To prevent water escaping from the Cooum when the Adyar bar is open, a lock should be built at south end of the Junction Canal. So long as it can be managed without injury to the channel or the bridges a scour may be provided for in order to remove silt.

STATEMENT showing the clear headway and span of Bridges over the Buckingham Canal.

Mileage from Basin.		Name of Bridges.	Minimum span at M.S.L. in feet.	Maximum height above M.S.L. in feet.	Remarks.	Height available above M.S.L. for boats	
						With tops 10 feet wide.	With tops 13 feet wide.
M.	F.	*Bridges north of Cochrane's Basin.*					
0	4	Ráyapuram Railway bridge ..	59	10·72	Iron girder bridge	10·72	10·72
1	4½	Washermanpettah bridge ..	43	10·00	Masonry segmental arch ..	9·60	9·40
3	6	Theroovattoor bridge	43	10·00	Do. do. ..	9·58	9·36

Statement showing the clear headway and span of Bridges over the Buckingham Canal—*cont.*

Milage from Basin.		Name of Bridges.	Minimum* span at M.S.L. in feet.	Maximum height above M.S.L. in feet.	Remarks.	Height available above M.S.L. for boats	
						With tops 10 feet wide.	With tops 13 feet wide.
M.	F.	*Bridges south of Basin.*					
0	0	Basin bridge	50·00	12·52	Masonry segmental arch ..	12·17	11·94
0	4	Salt Cotaur bridge	29·66	***8·64**	Wooden bridge	8·64	8·64
0	6½	Elephant Gate bridge	49·00	10·94	Masonry segmental arch ..	10·52	10·28
0	7	Central Station Railway bridge ..	64·00	**9·35**	Iron girder bridge	9·35	9·35
1	4¼	General Hospital bridge	49·00	11·04	Masonry segmental arch ..	10·62	10·38
..		South Indian Railway bridge ..	13·91	**7·03**	Wooden bridge	7·03	7·03
1	6	Saint Mary's bridge	29·00	11·49	Do. metalled ..	11·49	11·49
2	3	Government House bridge ..	32 00	10·40	Masonry segmental arch ..	9·74	9·53
3	0	Marine Villa	19·83	10·92	Iron piles rough stone abutments.	10·92	10·92
3	2	Chepauk bridge	19 62	10·92	Masonry segmental arch ..	9·92	9·17
3	6	Pycroft's road bridge	19·62	11·29	Do. do. ..	10·29	9·54
3	7½	Soonkarammah Street bridge ..	20·17	11·52	Masonry and wooden platform.	11·52	11·52
4	2	Ice House road	19·83	11·68	Masonry segmental arch ..	10·68	9·93
4	6½	Elliott's road	20·17	11·77	Masonry semicircular arch ..	10·44	9·35
5	0	Barber's bridge	27·33	**9·71**	Masonry and wooden platform.	9·71	9·71
5	3½	Moondacunny Covil road bridge ..	20·00	13·22	Do. do. ..	13·22	13·22
5	5	Cutcherry road	19·58	10·42	Masonry semicircular arch ..	9·09	8·00
5	5½	Brodie's road bridge	20·17	10·89	Do. do. ..	9·68	8·77
..		Poonthotum aqueduct	20·42	10·05	Masonry wooden platform ..	10·05	10·05
6	3	Yellapatha Mauda Covil road ..	20·25	**9·22**	Do. do. ..	9·22	9·22
..		Soolay Cauthoy Syphon	21·83	10·00	Do. do. ..	10·00	10·00
7	1½	Greenaway's bridge	21·00	13·03	Masonry segmental arch, skew ..	12·03	11·03
8	0	Guindy bridge, span excluding tow paths.	45·00	15·42	Masonry elliptical arch ..	15·17	15·09
10	0	Lattice bridge do. do. ..	43·00	12·14	Masonry abutments and wooden structure.	12·14	12·14
42	0	Sadras bridge do. do. ..	43·75	13·83	Masonry elliptical arch ..	13·58	13·50
45	0	Ismalpett bridge do. do. ..	35·00	14·75	Masonry semicircular arch ..	14·38	14·13

* The figures in antique show the Bridges having the least headway.

5. *Paragraph* 7.—Observations concurred in.

6. *Paragraph* 8.—A flood-gate which would form no impediment to traffic would answer all purposes.

7. The sewage of all the north portion of Black Town should unquestionably be diverted from discharging into the canal by an intercepting sewer, to be constructed by the Municipality.

8. *Paragraph* 9.—Agreed.

9. *Paragraph* 10.—Approved, but the question will require further study. Some of the present lime kilns which occupy the needed ground must be removed.

10. *Paragraph* 12.—New bridges should be provided for, but the removal of the present structures is not a matter of urgency.

11. *Paragraphs* 13 *and* 14.—This lock has not sufficient height to clear it in maximum floods, and is at least half a mile too far north. It will be necessary to remove this lock and take a new isolated channel from 6 M. 6 F. through the ground to the east as far as 9 M. 3 F. where there should be a flood-gate. By these arrangements the canal will be preserved from the effects of the floods of the Kortalayár and of the Red Hill tank drainage, from both of which it now suffers greatly at times.

12. *Paragraph* 15.—From 11½ to 20½ M. should be taken in a new isolated channel east of the backwater, with flood-gates at either end. The existing deep portion of canal between 17 M. and 19 M. might be included in this new line. Owing to the oozy nature of the bottom in the existing backwater, dredging would have no permanent effect.

13. The opening into the Chintamony backwater will have in any case to be left open for the free passage of flood water. From immediately beyond this point, and to the entrance of the lake beyond the town of Pulicat, careful study is required. So far as can be judged, however, a feasible plan would seem to consist in making an isolated channel 4½ miles in length along the west margin of the backwater, between 20½ M. and 25 M., with flood-gates at either end.

14. I do not approve of the proposal to bank across the opening at 20½ M., nor to take the canal along the east margin close up to the bar; this would certainly be dangerous for boats during flood.

15. *Paragraph* 17.—The only apparent means for ensuring a sufficiently protected line along all this portion will be to take a new isolated line, as proposed, along the depression which commences a little north of the Pulicat bar. Some palliatives are feasible, *e.g.*, altering slightly the end of the south cut in the lake so as to carry it into deep water, but there is no radical cure apparently for the admitted difficulties of the present line, which is throughout exposed to the wide expanse of water on the west.

16. The only part of the line which can be considered as adequately protected between Pulicat and Cusbah is the short portion between 35 M. 7 F. and 38 M., and this of course can be taken into the new line.

17. From a peculiarity in the conformation of the Pulicat lake, it appears that, when the waters of excessive floods begin to subside, the canal from a little north of 36 M. acts as a surplus channel. A very beneficial scour is thus found to have been set up throughout the line to its southern debouchure in the lake at 27 M. This peculiarity should be turned to use for the new isolated line by the construction of a powerful head sluice in the west bank at 36 M., and a scour produced in the channel down to the bar whenever circumstances favor. A sluice with five or six openings, 6 feet wide each, would apparently suffice.

18. Whether a flood-gate would be needed at the southern extremity near the Pulicat bar is not as yet clear.

19. *Paragraph* 22.—From Cusbah, 45 M., northwards a strong west bank, well above flood level, is essential, and the canal should be isolated up to 68 M., where a flood-gate may be placed. An interval will here have to be left for the passage of flood water, and the new cut to the west of the backwater, as suggested by Major Vibart, made up to Dugarázpatnam, 69 M. This short portion will also need to be isolated by flood-gates at either end. The proposed basin at Dugarázpatnam should, as elsewhere, consist of a simple widening of the channel.

20. *Paragraph* 24.—If on further inquiry the drainage which enters at 71 M. 5 F. cannot safely be barred from entering the canal, a flood-gate must be placed a little north. I do not consider a sluice weir, as proposed here, to be suitable. Another flood-gate will be needed a little south of the Swarnamukhi river. This reach of canal, 4 miles in length, will thus, with the embankments proposed, be thoroughly isolated in case of flood.

21. *Paragraph* 25.—The crossing of the Swarnamukhi river is a complicated matter, and calls for further examination. So far as can be judged, Major Vibart's proposed deviation from a point near the village of Govindapulli to Mullapulli, combined with training the river by means of embankments and strongly constructed cross bunds east and west, appears to hold out the best solution.

22. *Paragraph* 27.—No remark called for further than that at either extremity of these 14 miles of canal flood-gates might with advantage be placed. It does not appear essential to make so long a deviation, (1 mile in length,) as proposed here by Major Vibart. If the present end of the channel as it enters the Kundalairoo river is turned east and north for about 2 furlongs, and made to enter the backwater close to the west of the Gungapalliem village, it will answer all purposes, as the backwater is believed to remain permanently deep at this point.

23. *Paragraph* 30.—The Kistnapatam basin must be extended as proposed. A flood-gate will be required south of the basin, and as regards the canal to the north, the banks must be raised and the channel isolated.

24. *Paragraph* 31.—At Nellatoor it will be necessary to cut a fresh channel for nearly two miles (95 M. 4 F. to 97 M. 6 F.,) a little east of the present line in rather higher ground, thus leaving the present channel free for the passage of drainage.

25. *Paragraph* 32.—The whole of the drainage here must be collected and passed across the channel at one point.

26. *Paragraph* 33.—Here again, of the three openings the central one must be kept clear for the passage of the drainage, closing the others.

27. *Paragraph* 34.—The Pennér river (114 M. 3 F. to 116 M. 6 F.) crossing is probably the most difficult matter to deal with in the length of the canal. Some Rs. 11,000 were spent in taking the silt out of the cut here (115 M. 4 F. and 116 M. 3 F.) within the first year of opening the canal, and in both the cyclones of 1879 not only has the same cut again silted up to within 9 inches of L.W.L., but the several branches of the river, five in number, show such a tendency to change their course that it has become a serious matter for consideration as to how the canal can here be kept open for traffic. Even were steam-dredges available, the canal would still be closed after each ordinary fresh in the river to all but top-boats and others of very light draft taking advantage of high tide, and the stoppage would be absolute after a cyclone flood of any intensity. No mere palliatives will therefore answer here, and my conviction is that the best and. in the end, by far the most economical course will be to train the Pennér in such a way from the head of its delta that the discharge shall take place entirely through its southernmost channel, closing all the others. This can be done by training the river from a point near the village of Utakoor, about three miles west of the canal, on the left bank. At the same time, groynes should be so constructed on the right bank, a little north of Kuddipalem, that the present line of river bank and the flood embankment within it shall be preserved from invasion. The left embankment would probably extend from Utakoor to the destroyed village of Palipalem. By this means not only would a sufficiently deep channel be always preserved in the southern branch of the river, but by closing the canal ends north and south with flood-gates, these would be preserved from the silting which now causes the difficulty. I do not consider that there should be any serious difficulty in training the Pennér as proposed, but further careful study of all the features is necessary.

28. *Paragraphs* 37 *and* 38.—Banking across the Ramatheertham drainage is inadmissible ; it will be essential to cut a new line, of about six furlongs in length, to the west of the present line, so as to avoid getting dangerously close to the bar.

29. *Paragraphs* 39 *and* 40.—As with the Ramatheertham so with the Pydaru (123 M. 6 F.) and the Eskapally (126 M.) drainages, free vent must be allowed across the line of canal, but a strong west bank to keep out floods should be constructed. Whether it will be necessary eventually to isolate each of these portions with flood-gates (that at 117 M. is essential) cannot however be decided with certainty.

30. *Paragraph* 42.—The plan suggested of training the river so as to occupy and deepen out its central channel, and further to make a new cut to the west, of about two miles long, through ground 3 or 4 feet above M.S.L., seem essential. Since the cyclone of May 1879 the existing channel through the backwater has changed no less than four times.

31. Flood-gates will be required, one north of the Chippelairoo, at probably 134 M. and another at the 148 M. 2 F.

32. *Paragraph* 46.—The Ramapatam drainage, which enters at 148 M. 3 F. might have its outlet to the sea barred permanently, and the drainage thus taken into the canal utilised with a view to bringing a beneficial scour to bear on the northern portion towards the Elikeru.

33. *Paragraph* 47.—As regards this drainage it will be best to embank across the northern outlet, placing a flood-gate at 151 M. leaving the present southern opening (150 M. 6 F. to 150 M. 7 F.) free to discharge by the open bar.

34. To prevent the silting of the channel south of the Manneru, a flood-gate will be necessary at about 160 M.

35. The spill of the Manneru floods over the left bank of the river must be stopped by an embankment, but the most essential work here, and one which there should be no delay in carrying out, is the deviation of the present channel for about three furlongs in length, as suggested by Major Vibart. Without any cyclone flood in 1878 some three miles of channel here silted up to a depth of over 2 feet with ordinary freshets, and there can be no question that flood-gates are essential at both the Manneru and Palar ends of this reach of the canal.

36. *Paragraphs* 49 *and* 50.—Agreed. It is essential that the spill of the Paleru floods over its right bank should be barred by a strong embankment from the north end of the present Pakala bank as far as the canal.

37. *Paragraph* 51.—The short portion of canal, six furlongs in length, between the Moosee and Palar rivers, having silted up in both the May and November cyclones of 1879, barring navigation, some early and effective means must be found for curing the present defects.

38. Hand-dredging alone has not sufficed to allow of a passage being opened for any but boats of very light draft at high tide within two months after the last flood, and even then cargo boats drawing over 1′ 9″ have had to unload and have the goods carried by hand three-quarters of a mile. For a short time after the November cyclone there was a passage to the east, close to the united bars of the two rivers, but this did not last long. Had powerful steam-dredges been available, and at once set to work, a passage might no doubt have been opened at an earlier date, but at the best it may be assumed that, subsequent to each of the cyclones of last year, this portion of the canal must have been closed to traffic for five or six weeks ; it is thus clear that exceptional measures are called for to prevent as far as possible the recurrence of such delays, which if allowed to continue must affect very injuriously the traffic on the canal. Were it feasible to divert one or other river, so as to discharge both streams by a single channel into the sea, the difficulty now experienced would vanish, but as this means cannot I consider be adopted, it appears that the most effective and economical plan will be to excavate a second channel parallel to, and a little west of, the present cut, six furlongs long. This channel, measuring 15 feet in breadth at bottom and carried to 2½ feet below M.S.L., should be excavated as soon as possible. When opened to traffic the existing channel should be closed, cleared and deepened, opened for traffic, and the new subsidiary canal closed by temporary banks and prepared to receive the traffic after the next flood. By thus working alternately on two channels alongside of each other a feasible palliative for the existing difficulties will at least be provided. No west bank will be needed for the new channel, all spoil going to form a high strong bank for the existing cut so as to insure its isolation. Flood-gates at each extremity of the latter will also be needed, if not indeed for both channels.

39. *Paragraph* 57.—The preservation and management of the stretch of canal from one mile north of the Moosee bar (about 170 M.) to the Gundlakamma river depends on the treatment of the spill of the former river during flood over its left bank. Whether it be feasible to train the river by means of a left embankment, starting from a point near the village of Tirupu Nayadipalum, and thus force the whole floods through the present bar, is not clear, but the subject should receive attention.

40. For the present, immediate relief will be given by cutting away entirely the banks which were injudiciously thrown across the Tondairoo creek at 177 M. 2 F. and again at 177 M. 6 F. The effect of any further flood will be to bring a beneficial scour to bear on the whole length of the channel northward, towards the Gundlakamma.

41. Should, however, the training bank for the left bank of the Moosee river as suggested prove feasible, it would in that case probably be desirable to cut a fresh channel for the canal in the four furlongs a little to the east, so as to keep clear of the Tondairoo creek as proposed by Major Vibart. There should be a flood-gate at the end of the canal as it enters the Moosee river.

42. *Paragraphs* 57 *and* 58.—The basin at Kottapatam may, as suggested, consist of nothing more than an enlargement of the channel to the east and north of the present bridge. This latter, though shaken by the November cyclone, is now sufficiently secure to last with repairs for some years, and though boats in passing it have to lower their masts, there is no serious inconvenience, as they invariably halt at the place.

43. The road dam immediately west of the bridge must be removed (as being much too close to the canal) to a point on the Ongole road 300 yards further west ; and be

there reconstructed 100 yards in length, lowest point of invert being 1 foot above H.W.L. The materials of the present dam will nearly suffice for the new, and the same style of tail apron should be employed. The western embankment of the canal (south of the bridge) should be much strengthened, and the road well raised over the site of the present dam, so as effectually to prevent any future invasion by flood water. The laterite bridge, which with its nine elliptical arches of 18 feet span carries off all the residue of the Tondairoo drainage not vented by the canal, should be thoroughly repaired as its flooring is still sound. The unworkman-like additions made on either side of the arches to bear the parapets, and which were much injured by the November flood, must be removed and the roadway reduced to about $9\frac{1}{2}$ feet in width. The removal and reconstruction of the road dam above adverted to must be charged to the canal, but the alterations of the bridge ought to devolve on the Local Fund Board, who may also fairly undertake the construction of the proposed Moosafirkhana at Utapotu.

44. *Paragraphs* 59, 60, 61.—Northward from Kottapatnam (179 to 187 M.) the banks originally low have suffered severely during the November cyclone, first by the action of the storm wave from the east, there being no protecting "dunes" here, and second, from the land flood which supervened. But notwithstanding this destruction of the banks the channel has been, if any thing, improved owing to the fact that the surplus of the Moosee river flood vented itself through the Tondairoo creek, and finding its way into the canal scoured it throughout and cleared it of silt. Practically, therefore, little work is required in this reach. In a few places a strong, well planted, east bank will be needed to counteract the action of a storm wave; but on the west the less obstruction presented to the land flood the better, unless at some future time the expense of a sufficiently high and strong isolating west bank be considered essential. As matters stand, levelling down the bank as much as possible and bringing the tow-path into order is all that need be thought of. No vegetation seems to thrive here owing to the salt dust carried by the west winds which smothers and kills even the "woolsa" rush and the salt plant "eela," both of which thrive elsewhere. So long as the channel is not isolated no flood-gate is necessary at the Gundlakamma.

45. *Paragraph* 62.—The crossing of the Gundlakamma river calls for no special remark.

46. *Paragraph* 63.—As regards the proposals in this paragraph I have seen reason for the present at least to prefer flood-gates nearly everywhere to locks, the grounds for which will be found elsewhere.

47. *Paragraph* 64.—For five miles north of the Gundlakamma river the canal is exposed to serious wash, particularly at two places where bars opened in the November cyclone, and which must therefore be left free of any obstruction. To all appearances, however, the spill water from the Gundlakamma might, as suggested by Sub-Engineer Ottmann, be effectually checked by constructing a strong training bank along the left bank of the river, two or three miles in length, and diverting the drainage from the Kanuparti swamp. The alternative to this plan would be to construct a strong west bank all along the canal. In addition to protection on the west, a well-planted east bank is also needed at two places, but only for short lengths. Major Vibart has suggested an entirely new channel between $199\frac{1}{2}$ and $191\frac{1}{2}$ M. but as the object here must be to get sufficiently inland from the Kanuparti bar, to which the present line is dangerously near, it will suffice to make the new cut to the westward of only three furlongs in length at a distance of 200 yards from the existing channel.

48. *Paragraphs* 66, 67, 68.—Little remark called for. It may be doubted whether the position of the new lock at Feringy Dibba has been judiciously selected, and whether, looking to the great drainage which sweeps over the whole country south of Santaravoor, it would not have been safer to have given another flight to this latter lock, and dropped the canal thus direct into the Rompairoo drainage. It is now however too late to suggest any alteration of the arrangements here.

49. *Paragraph* 69.—The reasoning here employed by Major Vibart in favor of isolating the different reaches of the canal which intervene between drainages that cannot safely, particularly during flood, be barred in the passage to the sea, derives additional force from the effects of the November cyclone which followed on the one which occurred in May and which is the subject of his report. But there is such a strong and, it must be admitted, well-founded objection to the delays inseparable from locks, added to the great expense of first construction and subsequent working, a regular establishment being necessary for each all the year round, that I have proposed for the present at least to construct flood-gates at the end of each reach. These would only be closed on extreme occasions to exclude silt and flood from the channel. They would be comparatively cheap in construction, could be made portions of locks at any future time should such be considered requisite, would in no way interfere with or delay traffic, and need only have a small establishment to look after them in the cyclone or flood period. Inlet weirs I also see no immediate necessity for, but the depth of the canal and even its section may now with advantage be much diminished to meet actual requirements. These and other subjects will however be discussed in a separate paper.

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50. *Paragraph* 70.—The training of the several large drainages, and the necessity for a special study of each case, has been sufficiently pointed out in the above remarks, but here, as elsewhere, Major Vibart seems to favor the use of inlets and outlets of masonry for the disposal of minor drainages. I very much question the applicability of works of this character to the canal, as in hardly any case is there means of securing a proper outfall for the water on the down or eastern side of the channel. There may however be a few cases in which the principle might be accepted, and where this is the case the plan might be tried, adding however a capacious silt trap on the upper or west side of the canal. This should be kept always clear. It seems to me that all drainages which cannot be effectually shut out and diverted into other lines must of necessity be allowed free vent at a level across the canal, and that everything in the shape of an obstruction would be a mistake.

R. H. SANKEY, Colonel, R.E.,
Chief Engineer.

CHEPAUK,
10th April 1880.

15-2-95

+ Please note that
the original has bee
given to C.A.-W. this
day- D.S.
To 16-2-95
Supdt Genl Record Off
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6 February 80
No. 284

Inspection Notes.

Buckingham Canal

Tour of inspections lasted from 18th August to 6th Septr 1879 both days inclusive

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I propose to note in this Memorandum the present state of the Buckingham Canal as well as the improvements which I would recommend to be carried out to render it thoroughly efficient. In the first place

Surveys.

the surveys of the Canal are far from satisfactory. They are in many respects meagre and having been done before the work was commenced or finished they are inaccurate. It is of great importance that a correct and complete survey of the whole line from Madras to the Rompairoo should be available. Careful surveys are required of the various rivers crossed by the Canal with soundings and tide registers must be kept on all the rivers and backwaters which are open to the influence of the tide. Orders have already been given on this point. Until proper information is obtained on both these points (not omitting maximum river floods) it will be impracticable to prepare in detail a scheme for the proper completion of the Canal.

2. I will now commence at the Adyar & work up towards the North.—

3. Adyar. The Lock on the Adyar at the head of the Southern Canal is a temporary structure formed of stakes, sand bags &c. It should in the new scheme, be replaced by a permanent work & it would be desirable to construct a dam across the Adyar. Where?

4. On the left bank of the Adyar there should be a landing place. The

The Sadras section ends at the Adyar Lock and boats coming into the Junction Canal would under the new Rules be called upon to pay a second toll for merely going perhaps to the Cooum.

Junction Canal. 5. The Junction Canal is very narrow – all the bridges have insufficient water way & of some the head way is too small. They will certainly interfere with the traffic, should it increase. When there is a flood in one of the rivers only, (as occurred lately) there is a strong current through the Junction Canal – which causes scour under the bridges. The channel is somewhat filled up, but at the bridges the Canal is found to be deeper owing to this scour. Would it not be a good thing to arrange for closing the Junction Canal at pleasure.

Cooum. A Channel should be dredged along the bed of the Cooum. The proper channel alignment would pass under Govt. House bridge, then under St. Mary's Bridge about a mile and a quarter in length.

a temporary make shift
Eventually an extension of [illegible]
channel will have
taken along to west of left
bank as may be best

6. Junction Canal.

The deposit in the Junction Canal is about an average of 9", varying in depth from 2'-4 & 2'-1 near Ice House and Soongavaru Street Bridges to a few inches. There are 14 bridges across this Canal. The headways of these vary greatly. & would appear to have been regulated by the road approaches; when traffic increases some will require alteration.

7. Cooum

The Cooum from Marina Villa to Govt. House bridge and thence on to St. Mary's requires to be deepened by 6 or 8" but from St. Mary's to South Indian Railway Bridge & beyond it, the deepening required amounts to 15" or 18". From the General Hospital bridge to the Madras Rail Girder Bridge slight clearing is required. Some of bridges especially the South Indian Railway Bridge & the Salt Cotaur Bridge require raising as in their present condition they will greatly interfere with traffic.

8. Lock at General Hospital Bridge

At the General Hospital bridge it has been proposed, I understand, to build a lock. I presume this is intended to exclude some sewage from the Cooum. The lock will, I venture to think, be a considerable impediment to traffic & the sewage cut off from the Cooum will be pent up in the Canal between the Railway station & the Shadiencoopum Lock. It would be better to get rid of this sewage by some other means & prevent it entering the Canal at all.

9. Canal between Central Station & Basin.

Between the Central station and the basin dredging is required also towpaths. A narrow strip of land is required on the West bank from People's Park and on the East along the Railway as far as the Elephant Gate bridge. From the Elephant gate bridge nearly up to the bridge near the basin (close to the Lime Kilns) both sides of the Canal are occupied by the Salt Dept. Towpaths are much required there & the Salt Dept should be called upon to give up sufficient ground for this purpose.

10. The basin

The dimensions of the basin are utterly inadequate even for present requirements. When I arrived at Madras on 6th Instant the bridge was completely blocked with a great number of large firewood boats &c & the basin especially on the East sides was crammed with boats. This basin must be very largely extended and I would advocate the formation of a basin right up to the Rail bridge a distance of about a quarter of a mile.

Some

Some land will have to be bought up, on the margins.

Rail Girder Bridge
from Royapuram station

11. The Railway Girder bridge has fair headway - at the time I passed there was 4½ ft water & 10½ ft headway - total 15 feet - occasionally the headway is only 8 or 9 feet.

Canal up to Shadiencoopum Lock.

12. Between the Railway bridge and the Shadiencoopum Lock the channel is in fair order. It is silted up for about a foot or 18" with fine mud which should be removed by dredging. There are 2 old masonry bridges with very insufficient headway on this part of the Canal. They should be removed & replaced by girder bridges with ample water and headway.

Shadiencoopum Lock

~~12~~ 13. The Shadiencoopum Lock is at 7^{m}-4^{f}. The Lock sills are 6.12 below M.S.L., while the chamber walls are 11½ ft high. The flood of 1872 passed completely over the Lock being 1.86 higher than the walls or 7.24 feet above M.S.L. The Cyclone flood of

May 1879 was much smaller 4.66 ft below this level.

14. Shadiencoopum Lock to Ennore.

The channel from Shadiencoopum Lock to Ennore in the 9th, 10th & 11th miles passes through comparatively narrow parts of the Ennore Lake. At 9th mile the Cortelliar falls into the backwater on the West side. On the East of the backwater opposite mouth of river & for some distance north there is a deep channel which appears to have been scoured out by the action of the Cortelliar floods. At the 11th mile a long spit runs out from West side of the backwater halfway across the Lake. This renders the course of the deep channel very tortuous. The Lock at Shadiencoopum should be dismantled, a lock being built to replace it at Ennore, (a new channel being made along the margins of the backwater) close up to the Catholic Chapel.

Lock proposed at Ennore.

The

The rise of the tide in the Ennore Lake is not great, probably not much more than 1 foot. With the view of being able at pleasure to raise the water in canal reach between Ennore & Madras a sluice weir should be built 50 ft long, so as to take in water at high tide. The crest of the weir being laid at Lake mean tide so as to take in water if required without passing it through the Lock as at present.

× will this be sufft?

Canal beyond Ennore. 15. From the 12th to 14½ the channel passes through a wide backwater with salt pans on both sides. There are no proper towpaths. The deep channel is very tortuous. This is a great obstruction to traffic, as the trackers have to wade & with an adverse wind the only means of getting along is by poling. The canal should follow the East margin of the backwater & be completely enclosed so as to be in no way affected by the floods in the Ennore Lake.

A Lock should be built at about the 11½ miles with a sluice weir to give the Canal the benefit of the tide at the Ennore bar. Through the 15th & 16th miles the channel is along an arm of the backwater flanked on East side by Casuarinas, and cultivated fields. The compensation for these fields would be rather high - but no great quantity of ground would be required. The deep channel is tortuous and there is, generally speaking only 3 feet depth of water. At 17th mile - the banks begin - for the first half mile low - but afterwards they become high & irregular - sloping down to the water with much prickly pear growing on the slopes. Depth of water 3 to $4\frac{1}{2}$ feet. At $19\frac{1}{4}$ mile this cutting ends - where the channel enters the Chintamony backwater.

Chintamony backwater

At $20\frac{1}{2}$ there is another cut & at this point we find the bar of the Chintamony backwater - which is high and very seldom open. This backwater at present gets the benefit of the Pulicat lake tide, but the water apparently only rises some 6 or 8". I would

propose

propose that the channel should be banked across this bar opening. The cut at $20\frac{1}{2}$ mile is much enlarged by action of floods. It has very high banks with the berms quite swept away &, no towpaths.

Pulicat backwater.

It continues to the end of 21st mile where it enters the Pulicat backwater. The East border is now planted with Casuarinas till end of 22nd mile, where there are high natural sand banks close to the sea. At $25\frac{1}{2}$ we reach Pulicat. I would propose to have a lock at Pulicat on the East side of the Backwater, so that there would be an enclosed channel from Ennore to Pulicat $11\frac{1}{2}$ to $25\frac{1}{2}$. The Lock would open out into the channel leading to the bar & would be provided (as all others along the line) with a sluice weir to let in sea water when tide was high.

16. In the 26th mile we reach Coromandal. Here there are a number of garden houses built close to the margin of the lake, so that we cannot find a suitable place for a Lock at Coromandal

till

this cut runs out a long way into the lake with submerged banks. This part is much silted up, there being only 3 ft of water for nearly a mile.

19. The 3d Cut is entered at 39¼ miles. This is actually in the lake and is hardly a mile long. There was only 3 to 4 feet of water in it while the ends extend far into the lake with submerged banks. In these parts it is much shoaled there being barely 3 ft of water. On leaving this cut about 2 miles of of open lake have to be crossed with depth varying from 3 to 4½ ft. Near the 42d mile the 4th Cut is entered. I should have mentioned that on the West side of the 3d Cut there is no bank, but merely stakes with brushwood fencing to break in some measure the force of the waves. The 4th Cut extends up to 44¼ where the village of Jonangipolliem is situated. On the East side there is lake waterspread & lowground. On the West a low flat berm more or less destroyed being artificial & exposed to the severe action of the lake. There was

42

was about 4 ft of water in this part. I would propose to abandon all these cuts, except No ~~3~~ 2 & part of No 4 & follow the margins of the lake on the lowgrounds so as to form a most substantial bank on West side and have wherever practicable a good foreshore outside the bank. No ~~3~~ 2 cut is a good one & I would retain the whole of it. Parts of No 4 are also worth preserving.

602?

No 2?

Canal beyond Jonangipolliems

20. From Jonangipolliem to Cusbah a distance of 1½ miles there is a low flat berm on East side with towpaths well turfed, but bank very slight. On the other side is a berm of 3 feet with bank washed away by cyclone flood. Outside of this a wide expanse of lake. From Cusbah at 45-2 to Royadurwoo at 57-5 there is a fair channel bordered on the West by a wide expanse of shallow water (Lake). The berms generally throughout are good but the banks are more or less damaged and on both sides they need to be thoroughly made up.

Detail observation forwarded with this report.

21. I have got details of the whole Canal throughout in

Survey form. These are being put together in a readable shape and when complete will be forwarded for reference.

22
Royadoruvoo to Dugarazapatam.

x [illegible] 62-7 [illegible]

From Royadoruvoo to entrance of Dugarazapatam backwater 57-5 to 65-5 the channel runs through a shallow backwater. Banks &c. require to be made up on both sides with a few inlets for drainage.

23.
Dugarazapatam backwater
Sketch enclosed.

At 65-5, the present channel enters Dugarazapatam Backwater, which it crosses to Dugarazapatam. The channel across the backwater undefined & difficult. I propose to take a new cut along the West margin of the backwater so as to have the channel completely enclosed, an inlet & outlet being required to dispose of a drainage which now enters the Backwater. This cut will extend for 5 miles up to Dugarazapatam.

24.
Channel beyond Dugarazapatam.

The Channel from Dugarazapatam towards the North now in existence (69th to 73-3) is more or less in connection with the backwater as only in parts is it provided with a bank on the East side & those which

exist

[illegible] isolated Canal [illegible]
will be taken along with [illegible]
up to 76-5 — [illegible] might
be a [illegible] of the Canal
[illegible]
any [illegible]
the drainage [illegible] at 71-5
[illegible] diverted [illegible]
[illegible] across and
[illegible]
[illegible] 72 [illegible]
[illegible]
[illegible] at 74-4

exist are very weak and low. This it is proposed to thoroughly embank & provide a sluice weir in this bank opposite the bar at Kondoorpollem, so that the Canal may be supplied with water during the rise of the tide. At 73-3 the Canal enters a cut through high ground, banks rugged and berms damaged. At 74-3 the cut ends & we enter Pamanji Backwater.

25
Sooramookhee River.
Sketch enclosed.

At 75-4 the Soornamookhee river joins the Canal. This river originally discharged into the sea through a bar to the North, afterwards it changed its direction & discharged through a new mouth to the East. At both these places there are now bars which but seldom or ever open. Shortly after the Canal was connected with the Soornamookhee, the river instead of continuing to discharge through its original bar possessed itself of the Canal & now discharges at intervals through the Pamanji bar & Dugarazapatam Backwater a long way to the South. From 75-4 to 77 the Soornamookhee bed is used as the Canal.

The Canal course through the river is difficult to maintain & in parts the trackers have to wade in the water. At the time I passed there was a depth of 3 to 4½ ft. Of course this part as well as the Canal as far as Dugarazapatam is occasionally subject to somewhat violent floods. At the point where the Canal North of the river leaves the river bed, the Soornamookhee has 2 branches with a high bank between. It is proposed to bank up one of these & so force the river into one channel. – Close up the 2 cuts from the Soornamookhee into the Pamanji – Embank the South bank of the Soornamookhee from these cuts to some high sand dunes near the sea; cut the Pamanji bar & thus force the Soornamookhee through the above bar to the East. The Canal is to be taken in a new cut from 75th to 77th miles – a lock being built on each side of the river to keep out river floods. There will thus be an enclosed reach

reach of Canal from Coromandel to Soornamookhee supplied with sea water at Coromandel Dugarazapatam & Soornamookhee. There might be 5 sluice weirs to supply the necessary water – placed at average distances of 12 miles apart.

26. At present the tidal rise in the Soornamookhee appears to be not more than 8 or 9" – which water appears to be received from the Kundalairoo through the Canal which is some 12 miles long.

The opening of the Pamanji bar, if it ×can be kept open, will greatly increase this rise.

× This must remain an Open Question

27 – Soornamookhee to Kundalairoo

The Channel from the Soornamookhee to the Kundalairoo 77 to 89 – is generally good, with high banks and towpaths, but the ×channel is too narrow in parts & sometimes unnecessarily winding. There is not sufficient berm and if the channel is ever considerably widened (which we may look on as certain to be ×requisite) the widening will be expensive, as one bank will have

(?)

Evidence of bad Engineering × (?)

have to be removed. The Channel is shallow in parts & must be deepened. With the exception of field drainage from certain wet cultivated lands there is none in this section. Before the present cut joins the Kundalairoo, the Canal follows the course of an old drainage and is consequently tortuous and formed with many curves.

Entrance to Kundalairoo.
Sketch enclosed.

The entrance to the river was well situated for the previously intended North Canal, but it does not suit the present canal as the River has to be followed for nearly a mile. The mouth of the cut cannot be maintained deep.

× It is suggested that the end of the canal be taken a little further and close [illegible] [illegible] [illegible] [illegible] to [illegible] it deeper

28. I propose to abandon about half a mile of the Canal & run a new channel from the point (½ a mile away from the river) straight across through low ground nearly opposite to the entrance of the North Canal. The Canal from the Soornamookhee will be enclosed with a lock & sluice weir at each end. This reach will be 12½ miles long. The Kundalairoo River is very deep, the

the bar always open. Tide rises fully 3 feet. Large ships of 3 or 400 tons enter this estuary to refit.

29. Mouths of the present cuts have silted up 2 ft. At High tide in the river there is fully 7 ft of water, while at the mouth of the cut there is only 5 ft. Where the North Canal leaves the Kundalairoo there will also be a lock. It would be as well perhaps if a "nose" was run out from extremities of canal, some little distance into the river so as to check this shoaling.

Is it advisable to construct a lock here as at 92-111 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]

30 Canal North of Kundalairoo.

× About ½ a mile from the river we reach Kistnapatam. At 92 the new cut joins the old channel. The new cut is deep throughout with towpaths. There are however no banks, backwater & low ground on both sides. There is a basin at this place, but it is far too small, not wide or long enough. The present one is also damaged at the ends from boats striking against the laterite masonry.

Through Kistnapatam Backwater

for about a mile the banks of the Canal are destroyed & the channel much silted up (as much as 2 to 3 ft). all this requires to be embanked.

From 93rd mile to 94 also the banks requires raising &ca.

From 94th to 95½ the channel is in deep cutting - banks high, towpaths good &ca.

From 95-4 to 97-6 the Nellatoor Drainage is crossed & recrossed many times. The banks and towpaths in this section require completion and the drainage must be provided for. It is not however a large one. It is crossed for the last time at Ananthapoorum. The depth of water in the Canal varies from 3 ft opposite to the Nellatoor bar, where the banks breached, to 6 & even 7 ft in other parts.

From 97-6 to 100-6 the channel is in deep cutting with high banks, fairly planted with rabbit wort. Towpaths good.

31.

Between [illegible] there are [illegible] cattle crossings in the vicinity of [illegible] [illegible] [illegible]

Nellatoor Drainage.

[illegible]

At 100-6 we reach the Kodoor backwater which continues till 102-4. Banks are generally wanting through this sections.

32

Kodoor Drainage.

This drainage [illegible] [illegible] Flood rise abt 4½' above M.S.L.

At 102-4 to 111, the Canal again passes through a deep cutting with good banks, well planted towpaths on both sides. A few field drainages have alone to be provided for.

33

Gungapatam Drainage.

[illegible]

At 111 the Gungapatam Backwater is entered. In the next 1¼ miles this backwater is crossed twice. At 112-2 there is a bar where an inlet & outlet would be desirable. After this for the space of a mile the banks are high and good, but only partly turfed.

At 113-2 one of the old Pennair channels is crossed. This old channel might readily be banked out at the point where it leaves the river.

34

Pennair River.

Sketch enclosed.

[illegible]

The tongue of the island [illegible] [illegible] be removed

114 3

At 115, we reach the Pennair River. In this portion the East side banks are all low, while on the West parts are high. The channel crosses the Pennair right branch to a large island - this is passed by means of a cut a mile long which cannot be properly maintained. At low tide it has scarcely a foot of water & large sums have to be spent yearly (some 8 to 10,000 Rs) in maintaining it simply in its present inefficient condition.

In addition to this in front of the entrance of the Southern Canal a long shoal has formed, which necessitates a long detour for vessels. It would be better, I think, to cross the river some 1½ or 2 miles higher up in the neighbourhood of Utakoor, where there are no islands & the river runs ~~up the river~~ in one bed. There is a ferry at this village & it is understood that the tide runs up the river several miles. Survey of the river is required with its islands & shoals and cross sections should be taken from present crossing point up as high as Utakoor.

Should be investigated

35. Between Utakoor & the present Canal mouth, the river runs in 3 streams, there being 2 islands with a shallow stream between. It might perhaps be feasible to close this centre stream, & so help to keep clear the others and remove shoals which form in them.

might be tried

36. If the river was to be crossed higher up as proposed, the ends

of

of the present North and South cuts would be useless, as the North and South channel would have to leave the present channel fully half a mile from the river and curve to the West. The new enclosed channels North & South of the Pennair might be supplied with sea water through the present mouths where sluice weir could be built. The island cut would also be abandoned. In the Cyclone flood the Pennair rose 10 feet above true bed of Canal, but in 1874 the flood must have been far greater than this.

10. 5.5 above bed

37. Canal North of Pennair

The Canal on the North of the river commences at 117-2. The channel has silted 1½ to 2' owing to the floods of the Pennair. Up to 119-4 the banks of Canal are high but then there is a breach caused by the Ramatheertham Drainage. This was banked up and an attempt made to take it into the Pydaru, but the bank across the drainage was swept away during the late Cyclone.

There is at present a rough bank which has been formed from recent clearings. Banking up the Ramatheertham & running it into the Pydaru, I think, inadmissible. It would probably not be successful & it would certainly cost a great deal of money as the ground between is high. Moreover it would increase the difficulties of dealing with the Pydaru which are not small as it is.

Ramatheertham Drainage.

38.

The Canal at present passes too close to the Ramatheertham bar; it should cross the drainage where cutting ends at 120-1 & join cutting other side, ¼ mile up. The channel appears to have silted ~~#~~ to a depth of about 2 feet. Upto 121-5 Canal continues through deep cutting banks turfed and planted - but more planting required here & there.

39. Pydaru Backwater

From this point the Canal follows generally the bed of the Pydaru. On the East side the Canal runs along border of high ground while on the West side it

it is separated from the backwater by a low and weak bank. At 123-4 we find the Pydaru bar. It would be better to cross the Pydaru close to the bar & skirt the margin of the high ground to the East. The ends of the Canal proper would then be brought much closer together. In the Survey, the Canal is shown as having a fine curve at this point, but as a matter of fact, there is an abrupt turn forming about a right angle. A weir should be provided as an outlet from the Pydaru at this point.

Pydaru River crossing

This will have to be large as the Pydaru appears to drain about 110 sqr. miles of Country.

After crossing the Pydaru stream the Canal continues (till it reaches Eskapally Backwater 126th mile) with high ground on the East, and broad expanse of water on the West side. Banks on both sides are somewhat low being 10 ft above bed. The channel might, I think, have been taken with considerable advantage somewhat nearer the sea. Across the backwater the banks have been almost washed away by Cyclone of May last & they are now but 6 inches above the water. They are chiefly composed of oyster shells. This being so, tracking (especially with a West wind) is rendered very troublesome as the shells cut the feet of the trackers. The deep stream in the backwater is at $\overset{m}{126}$-$\overset{f}{5\frac{1}{2}}$.

Eskapally Backwater.

40.

may possibly be remedied by banking the oyster [illegible] the banks of the [illegible] should be [illegible]

41. At 127-4. we reach the Eskapally bar, the drainage here is banked across. Some parts of the Canal are in deep cutting, others through low ground with banks. At 129, there is the Tullipalem bar. In this section there is a cut on the West to take the drainage into the Chippelairoo further on. This like all the others is not large enough, the waterway is very insufficient.

was [illegible]

banks where low [illegible] cut away [illegible] further [illegible] [illegible] left

42. It is at $\overset{m}{130}$-$\overset{f}{3\frac{1}{2}}$ that the Canal first crosses the Chippelairoo -

Chippelairoo River

a

(a branch of which runs almost parallel to the coast) - it then enters a cutting for 3 or 4 furlongs, emerging whence it crosses it a second time. The drainages at both these places are banked across. The Canal runs in this way close to and occasionally crossing the Chippelairoo till 132-5, where it enters the main Chippelairoo River. Banks good in parts, but sometimes weak.

43. At 132, the branch of Chippelairoo is again banked across. Where the Canal enters the river, × 2 "noses" are run out far into the river - too much across the stream. Canal line should, I think, run ~~[illegible]~~ further inland.+ Accurate survey required of this river. The crossing of the Chippelairoo is exceedingly troublesome and lengthy. In the Canal

× These "noses" were [illegible] [illegible] flood [illegible] [illegible] the [illegible] - [illegible] Seems that [illegible] training of the river above to deepen the main stream - [illegible] of channel would be about 2 miles [illegible] [illegible] 3' above M S L

Flood remained [illegible] days 5 & 6 ft above M S L [illegible]

Channel [illegible] 133 [illegible] flow

+ as shown in sketch

some distance before it reaches the river the depth of water is 6, 6½ & even 7 ft while at & near the mouth it shoals to 3 or 4 ft. The distance to be passed in the river is nearly a mile. Great difficulty is experienced in entering Canal on both sides owing to the shoaling up of the entrances. At the mouth of the North Canal there is only 3 ft of water & at 3rd furlong only 4½ feet. Both banks from River to 133-7 require raising to keep out floods. It seems to me that ~~a mile~~ some of the present Canal should be abandoned & the Canal taken in-land - furthest point being about a ¼th mile from where it now is. In all this I speak under correction as no trustworthy surveys are available for study.

134th mile passes through lowland on East & Paddy fields. 44.

135th banks good - but require raising as they are subject to

Chippelairoo

Chippelairoo floods. The Chippelairoo might perhaps be banked from Canal to sand ridges on the West & the local drainage let into the Canal or if necessary across it. At high tide the depth in Canal 6½ to 7 feet.

45. 136th Banks &c good up to the village of Nadumpally.

From 137 for a distance of 5 miles the Canal runs in low lying ground situated between sand ridges parallel to one another at a distance of a few furlongs. Drainage immaterial, but still needs some small inlets into Canal. The banks are fairly good, but want raising in parts.

After this the Canal enters a deep cutting which is partially filled up with drift sand &c. At the 3rd furlong (142-4) the cutting is nearly 20 ft deep. High banks ~~[illegible]~~ turfed and planted with rabbit root.

Low path

Towpaths 3 ft wide, depth of channel varies from 4½ to 6 ft.

46. Ramapatam River

Up to Ramapatam River at 148-3. high banks, partly turfed and good, towpaths mostly completed. Drainage channels outside to divert drainage have insufficient waterway. At 147-4, the banks for a short distance are weak having been washed away partially. At this point the depth is only 4½ to 5 ft, whereas a furlong further each way, the depth is 6 ft. Laterite is found in this Cutting. The Ramapatam backwater is crossed at 148-3. This was previously banked across up to towpath level. It is now open. Inlet & outlet required here. The Ramapatam bar is opposite 149-2 where the banks are low for a quarter of a mile & require strengthening. With this exception past Ramapatam Temporary Rest House to 150-7, the banks are good, towpaths

towpaths formed and well planted with rabbit wort, but in the channel bed we find a great quantity of muddy sludge brought in by the Elikeru drainage crossed about 2 miles further on.

47. Elikeru Drainage.

The Elikeru was also banked across, but it was breached during the Cyclone of May 1879. There are 2 branches of the Elikeru; one might be substantially banked while the other should be provided [illegible] outlet to discharge the whole drainage through the bar. Up to 152nd mile the ground continues low, but at that point a sand ridge running from the West joins the Canal. From 152 up to the Mannaru (160^{m}-2^{f}.3) it runs through this sand ridge in a deep cutting of fine sand. Rabbit wort has been planted all along, but has not thriven equally well. Towpaths have been formed. One to two feet of sand has formed in the bed. It is, I fancy, chiefly drift from the banks. All this should be removed.

It would be well, I think, if Palmyra trees were planted all along the banks in these sections. Two grasses grow well on the slopes of this Canal. Toonga and Woolsa.

48

From 159-4 to 160-3 the Manneru runs parallel to the channel. As the channel approaches the Manneru it is found to be very much silted. The proper depth of water at high tide should be 7 ft while at 159-6 it is only 5 ft

— 159-7 — $4\frac{1}{2}$ ft
— 160 — 4 ft
— 160-2 — 4 ft

and at junction $2\frac{1}{2}$ to 3 ft. On the other side of the river at entrance to Canal it is $3\frac{1}{2}$ to 4 ft & this depth is continued all the way to the Pakala

Backwater

Manneru

sketch enclosed

The line of Canal might be altered as shown in sketch. This can be considered when the surveys are ready.

by must silted and found only a few inches of water at low tide. Professor [illegible] [illegible] [illegible] 3 furlongs [illegible] right bank and [illegible] on left — [illegible] [illegible] should be [illegible] out and trained to [illegible] channel

Backwater 166. In the 161st mile the banks are low. The Manneru left bank might, it is thought, be embanked with advantage from the Canal up to ridge near Ringanapally to prevent the spill of the rivers. The Manneru drainage basin is 1245 sqr miles — the river is however not much more than a furlong in width. Although the Manneru is crossed by Canal at 160-$\frac{2}{3}$ the bar is found to be opposite 161-$\frac{6}{7}$ — a mile and a half further North — the Manneru working considerably to the North. At 162-3 another drainage crosses the Canal. This might be diverted to 161-6$\frac{1}{2}$ & outlet provided so as to discharge it through the bar. Banking good in parts, but washed away in places. A salt creeper grows well here — it is understood somewhat similar to the

Rabbit wort

[illegible] this with [illegible] much [illegible] [illegible] north [illegible] [illegible] be cut off

All badly silted [illegible] [illegible] 3 [illegible] miles of [illegible] [illegible] [illegible] [illegible] cyclone flood

[illegible] to [illegible]

The left bank requires [illegible] up to 162-5 [illegible] the bank [illegible] higher

Rabbit wort. The natives called it merely "Oopu Tega" or salt creeper. Owing to the floods of the Manneru, the banks require raising to the extent of perhaps 3 feet.

49. In 163^d mile, the banks &c are good, but more planting & turfing is required

Pakala Drainage

At 164-4½ there is a bar of the Pakala Drainage very close to the Canal. Cross banks require strengthening.

At 166 to 166-2, there is a second Pakala bar. Bank here very weak & almost destroyed. There is a large swamp on the west side of the Canal. The bar is very low & close to the Canal. East bank of Canal is much exposed & must be remade very strong. The Paleru spill water now falls into the Pakala Swamp. The Paleru should be embanked from Canal

bank

The [illegible] [illegible] may bypassed by banks both sides & the [illegible] drainage diverted

bank to Pakala Tank bank & then there will be only a small quantity of drainage to be disposed of into or through the Canal.

50: In 167th mile the banks are good. The whole country above the Canal on the west is occasionally flooded from the Paleru & the Manneru so that the west bank is required high and strong. It is sufficiently so nearly everywhere. It should be 15 ft above bed of Channel. The Cyclone flood which was not particularly severe rose to 10 feet. In this section "Eela" a salt shrub grows on the berms.

51. Paleru River

The river Paleru (drainage area about 767 sqr miles) is met at $168^{m}-1^{f}.2$. This river a few years ago, before the Canal was made, was 8 or 9 ft deep at low tide – it now has barely 2 ft at the same period.

Since it was connected by the Canal with the Moosee it has shoaled up from the Moosee water entering the Paleru by means of the Canal, the Moosee being more frequently in flood than the Paleru.

Suff^t. depth upon since [illegible]

The Drainage area of the 2 rivers is approximately

Moosee	1011
Paleru	767
	1778 sq^r. miles.

52. Cut between Paleru and Moosee. Sketch enclosed.

The cut between the Paleru & Moosee cannot, I fear, be avoided. It silts up terribly and will be a constant source of trouble & expenses. Depth at low tide 2½. 2¾ & 3 ft. Banks and towpaths are good, but the slopes are affected by the floods.

Has been silted up to 15 inches above M.S.L. and not yet cleared down to M.S.L. — silting will always be [illegible] & the only remedy appears to be to have a good working channel [illegible] [illegible]

53. Moosee River

At 169^th. mile we reach the Moosee. Crossing is difficult. The Moosee has a very winding course. It would perhaps be advisable & feasible to straighten the river, by a new cut as shown in sketch attached. The river crossing

May be considered but I would [illegible] as not [illegible] [illegible]

crossing is almost about 3 furlongs in length. At the entrance of the South Canal the depth at low tide is 2½, 3, 3½ feet. In the river there is 5 feet while at the North entrance into Canal the depth is 4 ft.

54. The Moosee spills over the country & comes down on banks. The banks are good, but the cut between the rivers is greatly silted.

55. From 170 to 175 the banks are high, good & turfed. The towpaths are all right. The course of the Moosee for nearly 2 miles above the Canal crossing is generally parallel to the North Canal, nowhere 3 furlongs distant and at 2 points hardly a furlong away.

Thondairoo Drainage.

From 175 to 177 banks are good, fairly turfed, towpaths complete. depth of water 6 ft shallowing to 5 near the Thondairoo at 177.1. The West bank is exposed to great floods from the spill waters of the Moosee.

At 177-1½ we enter the Thondairoo. On East side there is no bank & the channel is very shallow for 5 or 6 furlongs. Our boat went aground here although drawing less than 2 ft. Depths of water 3, 2-2", 2-0, 1-10, 2½ from 177-1½ to 177-3.
From 177-3 to 177-6 — 3 ft
& at 177-6½ ——— 2½ ft.

There is a side drainage channel here, its capacity is quite inadequate.

56. The spill waters of the Moosee, I understand, stretch from the Canal westward to near the Trunk Road a distance of 4 miles. & cannot be relieved by so small a channel flanked by high ground.

57. The Thondairoo (Kottapatam creek) Could and should have been avoided — or at any rate the Canal taken along its East border.

Kottapatam Bridge & Basin

At 178-3½ we reach the wooden bridge of Kottapatam. It

& [illegible] 177-2

The best way [illegible] at 177-2 [illegible] at 177-6 [illegible] to the Mootoomala creek [illegible]

See above

Stone Steps [illegible] at Kottapatam [illegible]

The road dam [illegible] at 300 yds [illegible] all false portion of the existing bridge [illegible] 3½ ft [illegible] 18" [illegible]

It is very shaky & unsafe. It is of insufficient span, should be removed at once & replaced by an iron girder bridge. The site of basin close to the Bridge. It is proposed to have the basin enclosed with a narrow entrance at right angles to the Canal. It would, I think, be preferable to have the basin simply an enlargement of the Canal. No fresh water is to be obtained at this important station. The water supply is distant, 1½ to 2 miles. Provision for water supply on the spot is highly desirable. On East side of the Canal there is low ground with a drainage side channel which leads [illegible] the connecting the low ground with next swamp. Banks here small. The West bank is high with tow-paths. Kottapatam swamp being behind. The rise of the tides appears to be about 2 feet in this reach.

179½ mile:— There is no bank along East side for ¾ of a mile but merely an artificial tow-path 3 ft above water. East swamp behind requires inlet into Canal. It was banked across – but the Cyclone made several openings. Towpaths eroded in rear. West bank high; but unfinished. Kottapatam swamp behind the floods in this, I am told, rise high. 58.

180 to 182. East bank low unfinished & unturfed; high ground beyond. West bank high, but unfinished & unturfed also. Kottapatam swamps behind – also Beerangoonta Salt Pans on West side, on borders of Swamp. 59.

At 183-2, we reach Moodegonda or Mostoomala creek bar. The Drainage area of this creek is estimated approximately at 146 square miles. In addition it receives spill water

60. Mostoomala creek

of

of Moosee & Kotapatam swamp; a large inlet and outlet required here. Near the Moodegonda on West side ground for half a mile to the North low and swampy; banks and towpaths are good on both sides – turfed, but the turf has got covered with drift soil from inland.

61. At 184, we reach another branch of Moodegonda Drainage. It is banked across. This also will require an inlet and outlet unless it is carried by a cut to the one proposed at 183-2. The banks are high, partially turfed. Towpath 3 ft above water. Swamp to the West & drainage not relieved up to 185.

When Moosee is in flood it spills over. In fact the Moosee requires a more extended channel. It is believed that since the construction of the Canal, ~~this~~ the Moosee has improved, as the bar now keeps continually open and this was not the case before.

The improvement of this river – indeed all the rivers between the Pennair & the Gundalcumma – must be taken in hand and every exertions made to improve their channels & bars.

62.

Gundalcamma River

186 7

The Gundalcamma River is at 187th mile. This has a drainage area of about 4500 or 5000 sqr miles. A lock will have to be built on either bank in connection with sluice weirs. The bar is always open and the floods are considerable. The river runs to the sea in only one channel.

[illegible]

63.

[illegible]

I may mention here that I propose to have a lock on each side of the Manneru – one on South bank of the Paleru and one on North bank of Moosee. Two will be required on the Gundalcamma & one where the channel enters Rompairoo. Thus including the Adyar I propose 18 locks. About a miles from the Gundalcamma

Gundalcamma we reach an old branch of the river which has been banked acroſs. It is much silted & will probably shortly get silted up altogether. At present there is a drainage cut on West side of Canal, connecting old channel with the river – this should be closed. A mile beyond this old channel a sluice is required to supply salt pans.

[illegible]

[illegible]

Kanuparty Backwater.

64 From 188 to 190 – 6 – Banks &ca are good – at the latter point we enter the Kannparthy Back-water, at the mouth of which there is a long low bar. The channel follows this creek for about a miles & as a consequence twists about very considerably. The channel should here be rectified. It should, I think, run from 190 – 4 more to left, croſs the creek at 191 – 4 near the ferry & join the other channel at 192 – 1. The channel would be much improved, awkward curves

[illegible]

curves got rid of. & $\frac{1}{4}$ mile in length saved.

65. In 192nd to 194th miles the banks are not quite completed or completely turfed. Side drainages are also obstructed. Sand ridges on both sides. Towpaths complete. Depth of water in

192nd — 6 & 5$\frac{3}{4}$ ft

193rd — 5$\frac{1}{2}$ & 5.

Where is no [illegible] channel does not [illegible]

66. **Creek at Chinna Ganjam**

At 195th the Canal crosses Chinna Ganjam Creek. An Inlet & outlet is proposed for this drainage 500 ft in length (proposed by Kistna Engineer)

67. **Junction with Cummamoor Canal Kistna**

At 195-1, is the point where the Buckingham Canal will join the Cummamoor channel a short distance below the lock now in course of erection.

68. **Rompairoo.**

At 196-3$\frac{1}{2}$, the Buckingham Canal joins the Rompairoo. Banks incomplete, but fairly good. They extend, I think, too far into the waterway of the Rompairoo. From this point up to the temporary Lock into the Cummamoor Canal near

Feringy Dibba

Feringy Dibba is about 2 miles. There is already a considerable traffic along the Rompairoo to Vetapolliem on the sand ridge beyond Chinna Ganjam. Lock necessary where Buckingham Canal joins the Rompairoo and it would be well to have a channel to the Chinna Ganjam Salt pans.

69. At present no attempt has been made to control the rivers crossed by the Canal so as to prevent their floods entering it. These floods cause enormous quantities of silt & sand to be deposited on the bed of channel. Such attempts as have been made to deal with the minor drainages, have usually been ineffectual and may be considered as a general rule failures. The channels to lead them in other directions have usually proved insufficient and the result has been that the banks raised across the drainages have

have been swept away causing great damage to the Canal. It should not be forgotten that the damages now mentioned are those caused by a Cyclone certainly - but it was as regards rain fall not a very severe storm - other cyclones have been much worse - so in future we may expect to experience far more serious storms and far heavier falls of rain - & the damage to the Canal if left as it is will be proportionately greater. I propose to entirely exclude the larger rivers from the Canal by the construction of a Lock on each bank. I would arrange to keep the water in the Canal up to High tide by providing at or near each Lock a sluice weir of same width as Canal, × say 50 ft with its sill on M.S.L. At each tide sea water could be let into the Canal to bring it up to High tide level and

× Enough for losses by evapn & Lockage?

and replace the water which had in the interval been expended either by Lockage, leakage, or evaporation. If 4½ ft were taken as the maximum depth required at present the Canal need only be excavated to 4½ ft below ordinary High tide or say 5 ft and a foot or 18" of expensive deepening could be dispensed with. This would allow of boats drawing 3½ to 4 ft passing the Canal. As it is possible when the Canal is extended to Calcutta (which I take for granted is a certainty in the future), a greater depth of Canal will be required. (perhaps up to 6 or 6½ feet) I would build the sill of the Locks 1½ feet lower than the present proposed bed of Canal, so that when it is found necessary to deepen the Canal, no alteration would be required to the Locks. The Locks and sluice weirs must be so arranged as to completely exclude floods of rivers as well as to retain level in the canal at Spring tides & with this object the Locks must be provided with a double set of gates. Of course these gates will require abutments of the strongest masonry but the heel-posts of each couple of gates must be built as close together as possible to avoid superfluous masonry – & with this object the heavy wooden levers now used for opening the gates of locks in Godavery & Kistna must be dispensed with in the Buckingham Canal Locks and some other expedient adopted for opening the gates. The chamber walls, between the gates need not be of masonry & the floor between the gates need not be very massive, as a rule the difference of level between the canal & the rivers

will

They have turned out some excellent & easily worked gates at Narora Lock of Lower Ganges Canal

?

will be slight & the velocity of the water entering the lock will be small. The banks might be substantially constructed of earth with a core of puddle & revetted strongly insides. The floors might consist merely of 2 or 3 ft of concrete (hydraulic).

70. The Drainages which it is settled are to be passed across the canal, should be provided with inlets & outlets, water not to rise more than 2 or 3 ft above High tide.

?

Hitherto the rivers when in flood have been allowed to wander along the canals and pass into backwaters &c. By providing locks & making other improvements in the way of banking & training, the floods, so to speak, will become more concentrated – they will scour out deeper channels & the bars must necessarily from this action, it is thought, be improved and as a result the tides in some of the rivers will have a greater range than before.

The level of bed of each section of the Canal will be arranged with reference to the tide in the rivers or estuaries at the ends of each section. In Ennore, Pulicat & Duga-razapatam section, the rise of the tide is comparatively small. In the Pennair, Kundalairoo, Gundalcamma & Rompairoo it is high being frequently something between 3 & 4 feet. Of course I am fully aware that there are objections to Locks.

1st. Expense of construction

2d. Pay of Establishment to manage them.

3rd. delay to traffic.

The first will, I consider, be more than balanced by the lesser depth required for the Canal.

Locks have the great

advantage

//.

proof required

Say chanl
10[illegible] area [illegible]
then say 1/240 [illegible]
5 cyds every year —
in 200 miles — 1,760,000 cyds
at 3 annas a cub yd [illegible]
330,000 Rs —
18 Locks would [illegible]
[illegible]
[illegible]
[illegible]

---

advantage of preventing to a very large extent the deposit of mud and sand in the Canal. At present although the North Canal has only been open 2 years the deposits already in the Canal amount to a very large quantity in spite of the exertions made to remove it & the large quantity of money expended with this object.

The delay to traffic will not be very great, in fact, I question whether the delay due to Locks will be anything like so great as the detentions caused by deposits in Canal and contrary winds in crossing lakes.

Tidal observations are now being taken on all the Rivers and lakes crossed by the Canal. The only (at all reliable) registers kept were those for Pennair, Kundalairoo, & Rompairoo.

The disadvantages of having no locks. —

Canal

1st Canal must be cut and kept deeper.

2nd Boat basins more expensive.

3rd Maintenance far more expensive owing to silting & slopes washing in.

4th Branch channels more expensive.

5th Many parts of spoil banks unnecessarily high.

I subjoin a few general remarks as to the action of the various tidal rivers &c. crossed by the Canal. 72

Rompairoo & Gundalcamma keep the sections between those rivers in good depth.

Between Gundacamma & Moosee - Palairoo 20 miles - tidal floods, supplemented by Moondegonda creek, keep this section deep, except between Moosee & Palairoo which is very much silted.

Between Palairoo and Manneru the reach is 6 miles - served by both floods their action has shoaled up the Canal. particularly

at Manneru.

Manneru to Chippelairoo, the reach 27 miles, neither of tidal floods is very great and the latter bar closes some months in the year.

Chippelairoo to Pydaru is 10 miles. Tide floods small - latter bar not always open, but Pennair tides affect this part.

Pydaru to Pennair, 6 miles much silted up - and but for the help of the Pennair floods would be quite obstructed.

Pennair to Kundalairoo - 25 miles - Tidal range large in both rivers.

From Kundalairoo - no open bar till Dugarazapatam is reached 20 miles. This tidal rise is not great, owing to small size of bar & large extent of backwater.

Kundalairoo floods run down to Soornamookhee 13 miles.

rise in Coornamookhee about 9" (observed)

Doogarazapatam flood — about a foot.

Doogarazapatam to Coromandel — Tidal flood, no great range & that only at ends for a few miles nearest the bars.

Pulicat tide apparently rarely rises to 18".

Between Pulicat and Ennore no open bar. Pulicat tide runs to Chintamony backwater for 5 or 6 miles where it is lost.

Tidal rise of Ennore lake varies considerably, never much more than a foot.

The bar does not keep open throughout the year — the tide is felt at Shadrencoopum 4 miles to South.

Thirteen bars were open during my inspection —

Ennore — this has since closed
Pulicat
Doogarazapatam
Kundalairoo

Pornair

Pornair
Pydaroo
Chippelairoo
Manneru
Paleru } bar common to
Moosee } both rivers.
Moondegonda
Goondalcamma
Rompairoo

73. The information available regarding tidal ranges is very defective. In most of the rivers no gauge had been up to date of my inspections set up. Gauges have now been set up in all and I have impressed upon the Executive officer the great importance of correct registers.

Before concluding this Memorandum, I may perhaps be permitted to remark that the limit of draught fixed for boats (2½ ft) is very small & that it would be desirable to increase this to 3¾; the same as that for Kistna and Godavery. We should, I think, aim at making the minimum depth of the Canal 4 or 4½ feet. I understand that the B. I. S. N. Company & other merchants contemplate placing steamers on the Canal and if their draught is to be limited to 2½ ft, their speed will be interfered with, as they will have to be made with very flat bottoms.

74. Mr Executive Engineer Ottmann accompanied me in my tour up and down the Canal, and I wish to state rendered me every assistance in his power, and furnished me with a great deal of valuable information. He has also assisted me by compiling the notes which I took in survey book form during my return journey.

Although not a part of the Canal

Canal, I may be permitted to remark that the bunds or berms of the Commamur Canal are now much covered with water & nanal grass, and this greatly interferes with the tracking. I would suggest that orders should be given for the formation of towing paths along this Canal and cutting down the nanal.

75. I subjoin a statement showing approximately the Drainage basin of the various rivers &c.

Adyar
Cooum 275 sqr miles
Cortelliar into Ennore Lake.
Pulicat lake Drainage 1859 sqr miles

Area of Pulicat lake may be taken at 280 sqr miles, perhaps 60 of them are islands, leaving 220 for lake proper, much of this very shallow, but in floods times the water can spread over this:–

Soornamookhee	1318 Sqr miles
Kundalairu	1170
Pydaru	108
Chippelairoo	370
Manneru	1245
Paleru	768
Moosee	1012
Moondegonda	147
Gundalcamma	4500 to 5000
Pennair	20,000 or more

Major R.E.
Ag: Supg: Engineer
3d Circle

Chepauk
27th Septr 1879

To
The Chief Engineer
P.W.D.

284W

Statement shewing the Clear headway & span of Bridges over the Buckingham Canal.

Mileage from Basin M.	Mileage from Basin F.	Name of Bridges	Minimum span at M.S.L. in feet	Maximum height above M.S.L. in feet	Remarks	Height available above M.S.L. for boats: With tops 10' wide	Height available above M.S.L. for boats: With tops 13' wide
		Bridges North of Basin					
"	4	Royapooram railway bridge	59	10.72	Iron girder bridge	10.72	10.72
1	4½	Washerman Pettah Bridge	43	10.00	Masonry segmental arch	9.60	9.40
3	6	Theroovottoor Bridge	43	10.00	Do.	9.58	9.36
		Bridges south of Basin					
"	"	Basin bridge	50	12.52	Masonry segmental arch	12.17	11.94
"	4	Salt Cottah Bridge (29.66)	29' 8"	8.64	Wooden bridge	8.64	8.64
"	6½	Elephant gate bridge	49	10.94	Masonry segmental arch	10.52	10.28
"	7	Central station railway bridge	64	9.35	Iron girder bridge	9.35	9.35
1	4¼	General hospital bridge	49	11.04	Masonry segmental arch	10.62	10.38
		South Indian railway bridge	13' 11"	7.03	Wooden bridge	7.03	7.03
1	6	Saint Marys Bridge (13' 9")	29	11.49	Do. Metalled	11.49	11.49
2	3	Government house bridge	32	10.40	Masonry segmental arch	9.74	9.53
3	"	Marine Villa	19.83	10.92	Iron piles rough stone abutts.	10.92	10.92
3	2	Chepauk bridge	19.62	10.92	Masonry segmental arch	9.92	9.17
3	6	Pycrofts road bridge	19.62	11.29	Do.	10.39	9.54
3	7½	Soonkarammah street bridge	20.17	11.52	Masonry & wooden platform	11.52	11.52
4	2	Ice house road	19.83	11.68	Masonry segmental arch	10.68	9.93
4	6½	Elliotts road	20.17	11.77	Masonry semicircular arch	10.44	9.35
5	"	Barbers Bridge	27.33	9.71	Masonry & wooden platform	9.71	9.71
5	3/3	Moondacunny Covil road bridge	20.00	13.22	Do.	13.22	13.22
5	5	Cutcherry road	19.58	10.42	Masonry semicircular arch	9.09	8.00
5	5½	Brodies road bridge	20.17	10.89	Do.	9.68	8.77
		Poonthotum Acqueduct	20.42	10.05	Masonry wooden platform	10.05	10.05
6	3	Yellapatha Mauda Covil road	20.25	9.22	Do.	9.22	9.22
		Soolay Cauthey Syphon	21.83	10.00	Do.	10.00	10.00
7	1½	Greenways bridge	21.00	13.03	Masonry segmental arch skew	12.03	11.03
8	"	Guindy bridge – Span excluding Tow paths	45	15.42	Masonry Elliptical arch	15.17	15.09
10		Lattice bridge Do.	43	12.14	Masonry Abutts & wooden structure	12.14	12.14
42		Sadras bridge Do.	43¾	13.88	Masonry Elliptical arch	13.58	13.50
45		Ismalpett Bridge Do.	35	14.75	Masonry semicircular arch	14.38	14.13

Buckingham Canal Dn. Office
22nd March /80

43.75

A. Awdry Captain R.E.
Superintendent of Works B. Canal

X Appen[illegible]

N.B. The [illegible]

[illegible]

No 5684

3rd Circle Supdg Engrs Office
Chepauk 27th Septr 1879.

From
The Superintending Engineer
3rd Circle.

To
The Chief Engineer
Public Works Department.

Sir,

I have the honor to forward my Inspection Notes on Buckingham Canal taken between 18th August and 6th September both days inclusive together with detailed notes* compiled from the survey field book kept during the tour for every mile and furlong of Canal. With my notes I beg to forward 7 Sketches to illustrate my notes.

Enclosures 9
2. Reports.
7. Sketches.

* retained here in B.C. file.
[illegible]
14/9

Dugarajapatam Backwater. ✓
Soornamookee River ✓
Kundaleru —— Do — ✓
Pennair —— Do — ✓

X Appointment of [illegible]

N.B. The [illegible]
of necessary [illegible]
Canal [illegible]
[illegible]

No 5684

3rd Circle Supt Engrs Office
Chepauk 27th Septr 1879.

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x retained here in B.C. file
14/9

Dugarajapatam Backwater.
Soornamookee River
Kundaleru —— Do ——
Pennair —— Do ——

Chippalern River
Mamern — Do —
Palern - Moosee - Do —

I have the honor to be
Sir
Your most obedient servan

Henry De Vibart
Major &
Ag Supg Engineer 3d Circle.

W. (1879)

No. 6975

From

The Supdg. Engr. 3rd Circle

No. 5684

Enclosures 9

Dated 27th } September/79
Recd.

Buckingham Canal

Forwards Inspection Note on ——

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genl [illegible]

P.W. Dept.

No 284 W. d/ 6th Feby 1880

Proceedings of the Madras Govt.

Read the following

From the Supdg Engr 3rd Circle (H.E. 5/ 27th Sep/79)

Recorded

C.A.W.

85 A / 284

Going through the Buckingham Canal file, I see that a Ct. No. 6975 A / 1879 has been given to an Enclosure, the covering letter not being referred to at all –

Please ask Mr. W. to correct this, or to attach the two papers to the original of C.S. No. 284 W / 6.2.80 – The sketches which came with the S.E. 3rd D. No. 5684 / 27.9.79 must be with W. The "detailed notes" are here & about to be bound with some other papers.

W/10

14/9

Co 6975 A

Govt. of (1880) Madras.

PUBLIC WORKS.

ord.

To

1-2-28

Dated

Issued

Recd. Encl.

G. O., 6 Feby 1880, No. 284 W

Nos. 16-17

Buckingham Canal

Inspection notes of the

Ch. Engr. 3d on the —, [illegible]

No copy available