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TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

PUBLIC WORKS DEPARTMENT

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1943-4

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

23rd July 1879, No. 1,943 W.

Buildings and Roads.
Civil Works.

Read the following papers :—

No. 158. From H. C. LEVINGE, Esq., C.E., Joint Secretary to the Government of Bengal, Public Works Department, Irrigation Branch, to the Secretary to the Government of Madras, Public Works Department, Irrigation Branch, dated Darjeeling, 12th June 1879, No. 28 T.

I AM directed to inform you that plans and estimates for a canal to connect Calcutta with Orissa along the Coast have recently been submitted for sanction to the Government of India.

2. The tidal creeks and estuaries in the delta of the Mahanadi are now being improved, and it is confidently hoped that before many years elapse the Chilka Lake will be connected by canal with Calcutta.

3. It is understood that the East Coast Canal in Madras will shortly open up communication between Cocanada and Madras; so that, could Cocanada and Ganjam be connected, uninterrupted navigation by canal from Madras to Calcutta would be established.

4. I am to inquire whether there is any probability of this link being constructed. The Lieutenant-Governor believes that the advantages to the country by thus connecting the two canal systems would be very great; especially in times of famine, when grain could be supplied to the stricken districts without incurring the dangers and difficulties of loading and unloading in the open roadsteads which constitute the ports along the coast.

5. A copy of the report on the proposed Coast Canal in this Province is forwarded for information.

No. 158-A. *Note by the Joint Secretary to Government, Irrigation Branch.*

The letter from the Government of Bengal has been addressed to this office under the impression apparently that the Buckingham Canal is dealt with in this department. In transferring the papers however a few remarks on the matters on which information is desired may be useful.

2. Through communication has, by means of some temporary expedients at the lower end of the Commamur Canal, Kistna Delta, been already established between Madras and Cocanada, and in the course of a few months, on the completion of the

tidal lock, the permanent connection between the Kistna Delta and the Buckingham (East Coast) Canal will be opened. The total distance is about 393 miles, viz. :—

			MS.	CHS.
Kistna Delta ...	Buckingham Canal, about	...	196	0
	Commanur " "	...	57	0
	Main Canal, Western Delta	...	13	0
	River Kistna, about	...	1	0
	Main Canal, Eastern Delta	...	0	45
Godavari Delta...	Kistna, Ellore Canal	...	40	0
	Godavari, Ellore Canal	...	40	27
	Main Canal, Western Delta	...	6	11
	Godavari river, about	...	5	0
	Main Canal, Eastern Delta	...	4	12
	Cocanada Canal	...	27	48
	Creek and Cocanada river, say	...	2	17
			393	0

3. A Coast Canal north-eastwards from Cocanada has not, it is thought, been heretofore inquired into. A proposal was made many years ago for an extension of the Samulcottah Canal to Tuni (Toonee) on the frontier of the Vizagapatam District, a distance of about 35 miles, but the scheme was not estimated for in detail. The amount of drainage which would have to be crossed would be large.

4. So far as can be judged from the atlas sheet, there would be apparently no difficulty in carrying a Coast Canal as far as the Tuni river some 38 miles. Parts of the line between this river and Vizagapatam, some 54 miles, would be easy and possibly no part would be difficult until a point some 7 or 8 miles south-west of Vizagapatam was reached. There however bold rocky hills come down to the sea which washes their base, and again to the north of the Vizagapatam river as far as Himlipatam, about 18 miles, there is first the high ground on which the Military station of Waltair stands, and then, as the atlas sheet indicates, hills very near the shore line. The next 40 miles to the Chicacole river appear to be less difficult. Thence to Calingapatam 15 or 16 miles the line would apparently be easy. The distance, 85 miles thence to Gopalpur (Machlesum Gopalpoorum of atlas sheet No. 107), would seem to present considerable facilities. From Gopalpur to Ganjam, 12 miles, the country has been examined and a canal estimated for, and from Ganjam to the Chilka Lake, some 15 miles to where the artificial channel ends, a canal is in existence.

5. Out of the total distance of 263 miles from Cocanada to Ganjam there are then about 26 miles, viz., from about 8 miles south of Vizagapatam to 13 miles north of that town which are likely to present very considerable, and it may be insuperable, difficulties to the formation of a through line of water communication. If a canal can be designed through this section however, it is probable that a continuous canal from Calcutta to Madras would be feasible. Possibly some of the difficulties might be overcome by a high level section supplied from reservoirs, but the atlas sheet indicates that the difficulties of getting a line for a canal of any kind near Vizagapatam are likely to be very formidable.

6. It will be seen from the Note on the Coast Canal in Orissa that the proposed

* Minimum 71 feet.

† Do. 7 do.

arrangements as regards both width* and depth† of water are on a scale much in excess of the provisions made for navigation in the delta canals and, it is believed, of those in the Buckingham Canal. The delta canals will have a minimum depth of 6 feet during the irrigation season, or while

the rivers can supply sufficient water to maintain this depth, and the minimum depth with still water navigation is intended to be 4 feet, *i.e.*, where there are locks water will be held up above each lower lock so as to secure 4 feet of water on the lower sill of the next upper lock. The locks on the first-class canals and all delta canals on the through route from Cocanada to Madras *via* the Buckingham Canal are first-class, are 150 feet by 20 feet, and at the tidal locks the lower sills are placed at not less than 3 feet below L.W. springs. The minimum width of water surface in some of the old canals has been fixed at 50 feet. Without reservoirs navigation in the Kistna Delta is not likely to be feasible in ordinary years for more than nine or ten months at most, but it is believed that a site for at least one large reservoir of sufficient capacity is available at the point where the Gundlacumma comes through the hills, should it be found necessary at some future date to supplement the Kistna supply in the dry season.

OOTACAMUND,
24th June 1879.

(Signed) JOHN MULLINS, Col., R.E.,
Joint Secy. to Govt., P.W.D.,
Irrigation Branch.

To the Secretary to Government, Public Works Department.

No. 159. ORDER THEREON, 23rd July 1879, No. 1,943 W.

ORDERED that the following letter be sent to the Government of Bengal.

(True Extract.)

Major, R.E.,
Ag. Under Secy. to Govt., P.W.D.

Exd. E. C. Shunker.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Gobt. of (1879) Madras.
PUBLIC WORKS.

To

Dated July 23rd.

Issued

Recd.

Encl.

G. O., 23rd July 1879, No. 1,944 W.

JULY.

Nos. 158-159.

Orissa Coast Canal.—Letter from the Government of Bengal forwarding copy of report by the Chief Engineer on the proposed —, and inquiring if it is contemplated to establish a connecting link between Cocanada and Ganjam so as to ensure uninterrupted navigation between Madras and Calcutta.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

No. 1,944 W.

No. 160.

FROM

THE SECRETARY TO THE GOVERNMENT OF MADRAS,

Public Works Department,

TO

THE JOINT SECRETARY TO THE GOVERNMENT OF BENGAL,

Public Works Department, Irrigation.

SIR.—In reply to your letter No. 28 T, dated Darjeeling, 12th June 1879, forwarding copy of the report on the proposed Coast Canal designed to connect the existing Hidgellee Canal with the river and canal system of Orissa, and inquiring if it is in contemplation to establish a connecting link between Cocanada and Ganjam (so as to insure uninterrupted navigation between Madras and Calcutta), I am desired by His Grace the Governor in Council to forward copy of a note on the subject drawn up by Colonel Mullins, R.E., Joint Secretary for Irrigation in this department.

2. Information on the subject will be called for in regard to the difficult portions of the line adverted to by Colonel Mullins, and, should any decision be arrived at by this Government, a further communication will be addressed to you on the subject for the information of His Honor the Lieutenant-Governor; at the same time so far as is now known, and especially considering the large sums of money still needed to complete the canal communication between Madras and Cocanada, there is no probability of the subject being seriously considered for some years to come.

3. I am to request that if the report of Mr. Vertannes on the proposed Orissa Coast Canal be in print, this Government may be favored with a copy of it.

I have the honor to be,

Sir,

Your most obedient servant,

Colonel, R.E.,
Secy. to Govt., P.W.D.

OOTACAMUND,
23rd July 1879.

Exd. E. C. Shunker.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Gobt. of (1879) 313d 15.

PUBLIC WORKS.

To

THE SECRETARY TO THE
GOVERNMENT OF BENGAL.

Dated July 23rd.

Issued

Recd.

Encl.

G. O. 23rd July 1879. No. 1,244 W.

JULY.

No. 160.

INTIMATE that there is no probability at present of establishing the canal communication between Howrah and Ganjam; and requests that if the report of Mr. Fortshoes on the proposed Orissa Coast Canal be in print, a copy of it may be furnished to this Government.

No. 1672I.

FROM H. C. LEVINGE, Esq.,

Joint-Secretary to the Government of Bengal,
Public Works Department, Irrigation Branch,

TO THE SECRETARY TO THE GOVERNMENT OF INDIA,
PUBLIC WORKS DEPARTMENT.

Dated Calcutta, the 28th April 1879.

SIR,

With reference to your No. 372T. of the 19th October last, and previous correspondence, I am directed to submit the detailed plans, estimates, and reports of the Orissa Coast Canal, together with a note by the Chief Engineer and a memorandum by the Secretary in the Financial Department of this Government.

2. The tidal canal is designed, in continuation of the existing Hidgellee Canal, to connect the Hooghly with the river and canal system of Orissa.
3. The length of this connecting link is $92\frac{1}{4}$ miles, divided into three ranges, as follows:—

	Miles.
(1)—From the end of the present tidal canal to the Soobunreeka ...	31 $\frac{1}{4}$
(2)—From the Soobunreeka to the Burrabullong at Balasore ...	23 $\frac{1}{4}$
(3)—From the Burrabullong to the Metai (a tidal river falling into the Brahmini at Dhamra) ...	38
Total ...	92 $\frac{1}{4}$

The total distance by this route between Calcutta and Cuttack is 270 miles which can easily be traversed by steamer in 48 hours, the river and canal navigation being 91 and 179 miles respectively.

4. The proposed works consist of simple cuts between the tidal rivers with level beds and locks at the ends of each section. Ample provision has been made for drainage and for the passage of flood-waters across the canal, while a new arrangement of supply sluices of peculiar construction has been proposed for the admission of water in the dry season, by which it is confidently expected that the deposit of silt and consequent expense in maintenance will be much reduced.

5. The minimum depth of water in the canal will be seven feet, and the surface width (with that depth) 71 feet; the locks will be 150 feet long and 20 feet wide; the canal will therefore be well-suited for steam traffic.

6. The estimated cost of the canal is for works only Rs. 26,71,110, and with establishment and tools and plant Rs. 34,45,742. The usual book charges raise the amount to Rs. 38,43,498, inclusive of Rs. 2,41,201 interest at seven per cent. during construction; this item was omitted by the Chief Engineer for reasons stated in paragraph 49 of his note, but it appears that it should have been included.

7. The returns calculated on the actual existing traffic are estimated by the Chief Engineer at Rs. 2,60,000, and by the Secretary in the Financial Department at Rs. 2,56,000, while the cost of maintenance and interest on capital amount to Rs. 2,10,000.

8. In refutation of the statement made by Mr. Beames, Officiating Commissioner of Cuttack, in his No. 114 of the 30th October 1877, which appears to have attracted the attention of the Government of India, I am desired to refer to paragraphs 71 to 80 of the Chief Engineer's note. The Commissioner's remarks had not been previously criticised, because the Lieutenant-Governor considered that on the face of them, they were so absurd, so manifestly exaggerated, and so ignorant and illogical as not to be deserving of notice.

9. The tidal creeks and estuaries at the mouth of the Mahanuddy south of the Dhamra are now being opened up and improved, and it is expected that no difficulty will be experienced in connecting them with the Chilka Lake. Ganjam will thus be brought into communication through the coast canal with Calcutta.

10. The Lieutenant-Governor is of opinion that the high level canal should eventually be connected with the coast canal by a link from the Metai to Bhuddruk, and that the locks on this link should be of the full size (150 feet by 20 feet). Direct through communication with Cuttack would then be established for a class of boats which cannot traverse the branch canals to the coast, viz. the Taldunda, the Kendrapara, and the Gobri, the locks on which are only 100 feet by 17 feet.

11. The province of Orissa is now the only one in Bengal which is completely isolated and cut off from all communication with Calcutta by rail or river, and thus trade is driven to take the sea route; but the ports are so inferior that transport is attended with many difficulties and consequent expense. False Point harbour is said to be rapidly deteriorating, and the steamers of the British India Steam Navigation Company are forced to lie outside; while the only other port of any importance, the Dhamra, is blocked by a Bar, on which the depth at low water is only nine feet: this port is therefore inaccessible to any vessels except those of limited draft. In the absence of a railway, which from the excessive cost attending the crossing of the enormous drainage intercepted is impossible, the coast canal is an absolute necessity. Since the famine of 1865-66 in Orissa, actually nothing has been done to improve the means of communication with the Province; but were the coast canal once constructed and another famine unhappily to occur in Orissa, a vast number of boats from the rivers of Lower Bengal would be concentrated for the carriage of grain without any additional expense to Government, while the tolls would at the same time be greatly augmented. The importance of this canal, passing as it does through the centre of the most promising rice country in India cannot, in the opinion of the Lieutenant-Governor, be overrated, and he considers that, even if there was no possibility of the interest on capital being repaid, it is a work which should be undertaken from the Famine Fund as a preventive measure.

12. I am to add that the project has the entire approval and confidence of the Lieutenant-Governor, and that he considers it should be taken in hand as soon as possible.

13. With the above strong recommendation of the Lieutenant-Governor, I am to ask sanction to the project at a total cost, exclusive of book charges, of Rs. 34,45,742.

A list of enclosures is annexed.

I have the honor to be,

SIR,

Your most obedient servant,

H. C. LEVINGE,

Joint-Secretary to the Govt. of Bengal,
P. W. Dept., Irrigation Branch.

Bengal Financial Department Memorandum No. 1046, dated 3rd April 1879.

Note by the Chief Engineer, dated the 15th February 1879.

Memorandum by the Superintending Engineer, South-Western Circle.

Report by the Executive Engineer, Balasore Survey Division, dated the 10th January 1879, with Appendices A, B, and C.

DRAWINGS.

AS IN BOOK No. I.

Number of drawing.	Description of drawing.	For Range No. of the Orissa Coast Canal.	REMARKS.
1	General index map, four miles to an inch, shewing the navigable channel, existing as well as proposed, from Calcutta, on the Hooghly river, to Metai river, a branch of Dhamra.	For all Ranges.	
2	General index section of ditto, scale four miles to one inch.	Ditto.	
3	Index map and section, scale one inch to a mile	For Range No. III.	
4	Ditto ditto ditto	For Range No. IV.	
5	Ditto ditto ditto	For Range No. V.	
6	Plan and section of Range No. III, from 0 to eighth mile, scale four inches to one mile.	For Range No. III.	
7	Ditto ditto, from eighth mile to 16th mile, scale four inches to one mile.	Ditto.	
8	Ditto ditto, from 16th mile to 24th mile, scale four inches to one mile.	Ditto.	
9	Ditto ditto, from 24th mile to end of Range No. III, scale four inches to one mile.	Ditto.	
10	Plan and section of range No. IV(a), from 0 to eighth mile, scale four inches to one mile.	For Range No. IV(a).	
11	Plan and section of ditto, from eighth to 16th mile, scale four inches to one mile.	Ditto.	
12	Plan and section of ditto, from 16th to 17th mile, and of IV(b) up to end, scale four inches to one mile.	Ditto and No. IV(b).	
13	Plan and section of range No. V, from 0 to eight mile, scale four inches to one mile.	For Range No. V.	
14	Plan and section of ditto, from eighth to 16th mile, scale four inches to one mile.	Ditto.	
15	Plan and section of ditto, from 16th to 24th mile, scale four inches to one mile.	Ditto.	
16	Plan and section of ditto, from 24th to 32nd mile, scale four inches to one mile.	Ditto.	
17	Plan and section of Range No. V, from 32nd mile to end, scale four inches to one mile.	Ditto.	
18	Plan and section of the proposed embankment on the right bank of the Burrabullong river, from the commencement of Range No. V to village Gabgan, scale eight inches to one mile.	Ditto.	
19	Survey and section of Bullong and Sarhtee Nullahs and Panchpara river, scale eight inches to the mile.	For Range No. IV.	
20	Survey and section of Nullahs and Burrabullong river, scale eight inches to the mile.	Ditto.	
21	Survey and section of Goochira Nuddee, scale eight inches to the mile.	For Range No. V.	
22	Survey and section of Pragnag Nuddee, scale eight inches to the mile.	Ditto.	
23	Survey and section of Talpada river, scale inches to the mile.	Ditto.	
24	Survey and section of Kansbans River, scale eight inches to the mile.	Ditto.	
25	Survey and section of Gomai river, scale eight inches to the mile.	Ditto.	
26	Cross section of Orissa High Level Canal, Ranges Nos. II and III.		

Number of drawing.	Description of drawing.	For Range No. of the Orissa Coast Canal.	REMARKS.
1	Supply sluice	General design for all Ranges.	
2	Block plan for terminal lock and supply sluices	Ditto ditto.	
3	Inlet sluice on the Bartana supply channel	For Range No. III.	
4	Inlet and outlet sluices	Ditto.	
5	Ditto ditto	General design for Ranges Nos. IV and V	
6	Flood escape	Ditto ditto.	
7	Terminal lock on the Bogda river, opposite Sur-pai village.	For Range No. III.	
8	Terminal lock on the Soobunreka river near village Bhograi.	Ditto.	
9	Terminal lock on the Panchpara river	For Range No. IV.	
10	Ditto ditto Metai river	For Range No. V	Also for Burrabul-long river.
11	Inspection bungalow and out-offices	Ditto.	

H. C. LEVINGE,

Joint-Secretary to the Government of Bengal,
P. W. Dept., Irrigation Branch.

Note on the proposed Orissa Coast Canal
by H. C. LEVINGE, Esq., Chief Engineer,
Public Works Department, Irrigation
Branch, Bengal.

General description.

1. THE Coast canal, plans and estimates of which are now submitted in the fullest detail, is designed to connect the Hooghly with the rivers and canal system of Orissa. The line will skirt the coast from the end of the present tidal canal at the Russoolpore river in Hidgelee, and terminate in the Metai, a deep tidal river in direct communication with the Dhamra, whence navigation is open *via* the Gobri canal to Cuttack, and by tidal creeks to False Point. A moderate outlay in improving the creeks south of False Point and in opening out a few new cuts would bring the Chilka lake and Ganjam into communication with Calcutta, and thus connect the large towns and marts marginally noted,* but this question belongs to the Orissa scheme, and will not be discussed here.

2. Before entering into details of the project now submitted, a few words must be said on the subject of the completion of the high level canal, which was originally designed by the East India Irrigation and Canal Company to connect Calcutta with Cuttack. From Buddruck, near which town the canal now ends, to the junction with the Midnapore canal, the distance is 134 miles, divided into two sections—

	Miles
(1) Buddruck to Balasore	50
(2) Balasore to the Midnapore canal	84

The first section has been laid out and estimated in detail. The cost, according to Mr. Vertannes, Executive Engineer, would be 43½ lakhs of rupees, while the estimates for the second portion, based on the most reliable data of cost of similar works already constructed, or estimated for in detail, would be 53½ lakhs, making a total of 96½ lakhs for works only, or 145 lakhs, inclusive of book charges. The very lowest estimate for the first portion, that is, from Buddruck to Balasore, amounts to 31½ lakhs, while the estimates now submitted for the whole Coast canal to connect the Hidgelee canal with the Metai are 36 lakhs. It appears to me to be unnecessary to say anything more on the subject; but if it be urged in favour of the high level canal that it will afford irrigation as well as navigation, I would refer to a note by Colonel Haig, dated 5th October 1877, in which it is shown that the interest on the

* Calcutta.
Balighat in Hidgelee.
Balasore.
Chundbally.

High Level Canal.

Cuttack.
Poore.
Ganjam.

expenditure on distributaries alone, which are not included in the estimates of the canals above given, would no more than cover the water rates. I think this disposes of the question of the high level canal as an alternative line, for the present at all events.

3. It has been stated, however, that the high level canal from Cuttack at present "terminates abortively in a paddy field." This is true, and the question has been discussed whether it would not be desirable to connect it with the proposed tidal canal by a link from Buddruck to the Metai. I believe it will be worthwhile to do so eventually. The discussion of this point may, however, be postponed for the present. An approximate estimate for this link has been prepared by the Superintending Engineer, Orissa Circle, amounting to 10 lakhs, without book charges.

4. The canal which it is now proposed to construct is divided into lengths or ranges as follows (the numbering of the ranges is in continuation of the two already made and termed the Hidgelee tidal canal):—

Range III.—Connects the Bagda river, a branch of the Russoolpore in Hidgelee, with the Soobunreekha in Balasore ...	31½
Range IVA.—Between the Soobunreekha and the Panchpara rivers in Balasore ...	17
Range IVB.—Between the Panchpara and the Borabullung rivers, near Balasore ...	6½
Range V.—Connects the Borabullung with the Metai in Balasore ...	38
Total miles ...	92½

Each of these ranges will be simply an open cut with level bed, provided with a lock at each end. During the dry season they will be filled by the tides, and during the rains by surface drainage from the adjoining country; and, as will be seen further on, full provision has been made for passing all drainage which would otherwise be intercepted.

5. The canal has been laid out generally parallel to the great line of sand-hills, which, as will be seen in the accompanying plans, extends uninterruptedly (except at the mouths of the rivers) along the whole coast from Contai in Hidgelee to the Dhumra; thus the canal is to a great extent protected from injury during the occurrence of cyclones, the wave being confined to the rivers.

6. An alternative alignment has been proposed at the commencement of range III, as it is in contemplation by the Revenue authorities to reclaim by embankments the 'Julpi,' or old salt lands,

Link line, Buddruck to the Metai.

Division of Coast canal into ranges.

General alignment.

Alignment of Range III.

colored green on the plan (sheet III of book 1), in which case the diminution of tidal flow would inevitably cause the Badga creek to silt up. I am of opinion that it will be best to construct the lock at Baintghur, opposite Kalinuggur, the terminal lock of range II, and to lay-out the canal in the direction of the yellow dotted line on the map, utilizing a portion of the creek between Serpai and Contai, and building a drainage sluice at its mouth. By this arrangement the length of the canal will be increased three miles; but a saving of two miles of excavation will be effected. If the lock is built at Serpai, as proposed by the Executive Engineer, and hereafter the inundated lands are reclaimed, there will, I am confident, be much trouble in keeping the creek clear as far as Serpai. This alternative scheme is noticed by Mr. Vertannes in the 6th paragraph of his report. No alteration is required in the estimate, as the change will effect a slight saving if anything. Range III terminates in the Goocheeda river, which falls into the Soobunreekha about one mile below the point selected for the lock site. The Goocheeda drains a large area of country, and is not likely therefore to deteriorate. The width of the stream at low water is 180 feet, and its depth 12 to 15 feet. The position of this lock has been judiciously chosen.

7. The alignment of the greater part of range No. IVA is between two great ranges of sand-hills, in the tract known as the *Toolsa Pât*; the canal is thus thoroughly protected on the east and west, while inundation is excluded on the north and south ends by existing embankments. After passing this 'pât,' the line traverses a low tract of country subject to inundation from the Panchpara river, and occasional floods from the Soobunreekha.

8. Range IVB also traverses a low country, quite flat and subject to inundation. The positions of the locks call for no remarks. It may be asked why the southern terminal lock of range IVB and the northern terminal lock of range V were not placed nearer to the town of Balasore; the reply is that the high ground comes down on the right bank nearly to the lock site, and that to have placed it further up would have involved heavy cutting. The drainage, which finds its way into the Borabullung on the left bank above the lock site, would have caused difficulty. For these reasons I think the Executive Engineer has chosen wisely. The distance by river, which is deep and wide, from the canal crossing to the town of Balasore is four miles.

Alignment of Range IVA.

Alignment of Range IVB.

1943-44
8

9. The line of canal in range V, after leaving the Borabullung, trends towards the coast to avoid high land, and thence runs nearly straight to the Metai. Four rivers are crossed—the Gummye, Prag, Talpudda, and Kansbans. Between the two last there is a ridge, involving from 10 to 15 feet cutting, which, however, cannot be avoided. The southern terminal lock of the fifth range has been placed at a point on the Metai where that river is 130 feet wide at low water, with a depth of 10 to 15 feet; thence it gradually becomes wider and deeper until it joins the Brahminee near Dhumra.

10. The draft of the largest boats that are likely to navigate the canal is $6\frac{1}{2}$ to $6\frac{3}{4}$ feet; the minimum depth of water in the canal has therefore been fixed at 7 feet, and the bed level in the different ranges must be arranged accordingly. In order to determine this, the following points have been taken into consideration:—

- (1) Level of source of supply;
- (2) Loss of water, by—
 - (a) Evaporation;
 - (b) Leakage through locks and sluices; and
 - (c) Lockage.
- (3) Surface area of each range.

As already stated, the canal will be filled in the dry season by the tides, and in the rains by the surface drainage of the country; and as the latter is always higher than the former, the supply from the tides only need be taken into consideration. The Executive Engineer states that by actual experiment at Burdwan, the loss by evaporation was found to be $\frac{1}{4}$ inch in 24 hours; on the Coast, then, it is not likely to be more. For loss by leakage, the Executive Engineer assumes 4 cubic feet per second in each range; and as the soil is very retentive, this may be accepted. For loss by lockage, the contents of 80 locks, 40 at each end, daily have been taken, from which must, however, be deducted the displacement of the boats; usually several will pass through the locks together, the allowance therefore seems to be sufficient.

11. As regards the width of the canal, I am decidedly of opinion that the minimum of 50 feet base should be adopted, the difference of cost between this and a canal of 40 feet base is only Rs. 1,21,000, and for steam navigation a wide canal is unquestionably best. The ratio of side slopes has been taken at $1\frac{1}{2}$ to 1, the soil throughout being exceedingly

Alignment of Range V.

Determination of bed level.

Width of canal base and calculation of bed level.

stiff. The data having been thus determined, the calculation for bed level is simple, as follows:—

Range III.— $31\frac{1}{4}$ miles.	
Loss by evaporation, $\frac{1}{4}$ inch daily.	
Average spring tide level	110.00
Assumed lowest canal level	108.50
	<hr/> 2) 118.50

Mean surface level	108.25
Bed level	101.50
Mean depth	<hr/> 7.75

Side slopes being $1\frac{1}{2}$ to 1 and base 50 feet, the surface width will be:—

$$2 (7.75 + 3.875) + 50 = 73.25 \text{ feet; then } 73.25 \times 31.25 \times 5280 \times \frac{1}{2} = 167,864 \text{ cubic feet daily loss, or for ten days} = 1,678,640 \quad (1)$$

$$\text{Loss by leakage—} \\ 4 \text{ cubic feet per second} = 345,600 \text{ per day, or for ten days,} = 3,456,000 \quad (2)$$

Loss by lockage—	
Mean level of water in canal	109.25
Ditto ditto in river	103.50
Depth in lock	<hr/> 5.75

$$\begin{aligned} \text{Contents of lock—} \\ 155 \times 21 \times 5.75 &= 18,715 \\ \text{Deduct displacement of} \\ 50 \text{ ton boat—} 50 \times 36 &= 1,800 \\ \hline &16,915 \end{aligned}$$

$$\text{and } 16,915 \times 80 \text{ (number of locks full)} = 1,353,200 \text{ daily, or for ten days } 13,532,000 \quad (3)$$

The total loss in ten days' interval of tides will therefore be:—

(1) Evaporation	16,78,640
(2) Leakage	34,56,000
(3) Lockage	13,53,200

$$\text{Total cubic feet} \quad 186,66,640;$$

and as the average surface area is $73\frac{1}{4} \times 31\frac{1}{4} \times 5,280 = 120,86,222$, the actual depth drawn off will be $\frac{186,66,640}{120,86,222}$ or $1\frac{1}{2}$ feet nearly. The water level being $110 - 1.50 = 108.50$, and the minimum depth 7 feet, the bed level of range III should be 101.50.

12. The Executive Engineer, in his report and accompanying statements, shows that the levels in the different ranges must be as follows:—

Range III	101.50
„ IVA	99.00
„ IVB	98.00
„ V	101.00

In ranges III, IVA, and V these levels have been determined with reference to average spring tides in the cold season, recurring at intervals of ten days; but it must be remembered that only for eight or ten days in the year, that is, during

Bed Levels.

the tides of December, January and February, will the water fall so low as seven feet. During the rest of the year the tides will be higher. In range IVB the bed level has been fixed with reference to neap tides, because the consumption of water in so short a reach would lower the surface so rapidly that before the recurrence of spring tides the depths would be reduced below the minimum required. In this range only has the minimum been fixed at eight feet instead of seven; this is, I think, a prudent precaution; because from the more frequent admission of tidal water, the tendency to silt will be greater.

13. The levels of lower sills of locks had been fixed by Mr. Vertannes at four feet below lowest water of spring tides, so as to allow of steam navigation being carried on at all times of tides; but after carefully considering this point, I have come to the conclusion that it will be sufficient to fix them at two feet below lowest tidal water, for the following reasons. *First*, to take an extreme case, if a steamer drawing, say, three feet, were to arrive at a lock when the tide was falling, and only three feet on the sill, she would have to wait till the water fell, and rose again to three feet—this would be somewhat under two hours—and if she were thus detained at one lock, she could not be again detained on the same day at any other lock, Balasore being the halting place; moreover, this possible detention could only occur at lowest spring tides. *Secondly*, very great difficulty has been experienced in keeping the entrance to the lock clear of silt to four feet below low water. *Thirdly*, on the ground of economy and facility of construction, there are obvious advantages in placing the sills at the higher level.

14. The levels of the coping of the locks at the Panchpara, Borabullung, and Metai, which had been fixed by the Executive Engineer at one foot above the maximum flood levels of those rivers, have been lowered three feet, four feet, and four feet respectively. There is no advantage whatever to be gained by raising the lock walls to such a height; all that is necessary is to keep the upper gates and forebay above the flood level. The submersion of the rest of the lock for a day or two, once in ten or twelve years perhaps—these extraordinary floods are of rare occurrence—is a matter of no importance. At such times navigation would probably be suspended for country boats, owing to the danger of crossing the rivers, as they might then be swept out to sea. If, however, they could cross, they would pass round the locks and enter

Level of lock sills.

Level of coping of locks.

the canal at any of the gaps left for the passage of the drainage to be hereafter described. The bank of the river, and in fact the whole country, would, during such extraordinary floods, be submerged many feet deep, and be formed into a great lake.

15. The canal embankments will be three feet above the flood waters of the streams intersected. The crest will be eight feet wide, and side slopes 2 and 3 to 1 on the canal and inundation sides respectively. The levels are all shown on the longitudinal section in book 1. The banks of the northern end of range III are shown to be above the level of the highest recorded cyclone wave, while the southern end is protected by the side embankments of the Soobunreekha river. Tow-paths on a lower level have been provided, which will be above ordinary high flood level in the canal, but will be liable to submersion in extraordinary floods, a matter of no importance, as towing can be equally well managed from the tops of the embankments.

16. The canal will be supplied, as has already been stated, during the rainy season from the surface drainage of the country through inlet sluices, and during the dry months from the tidal rivers and creeks crossed by it. The loss of water in range III has been shown in paragraph 11 above to be 186,66,640 cubic feet in 10 days, or 21 cubic feet per second. Supposing it were quadruple that amount, the canal could be supplied through one of the inlet vents with a velocity of $3\frac{1}{2}$ feet per second. Numerous inlet sluices have been provided for drainage purposes: they are distributed at intervals along the canal; a supply is therefore ensured from one source or another, probably from March, when the north-west storms begin, and certainly during the monsoon. No silt will be carried into the canal by this water, coming as it does from a perfectly flat country.

17. The tidal ranges of the Midnapore canal, and the first and second ranges of this canal, already constructed, are supplied through the locks at the ends; the result has been an enormous deposit of silt. This has always formed the greatest objection to tidal canals, and has been an endless source of expense in maintenance. Mr. Vertannes now proposes to supply the canals in the dry season through inlet sluices, instead of through the locks, and, in order to reduce silting to a minimum, he would only allow the water to enter the canal through the sluices at the top of the tide, and from

Canal embankments.

Water Supply.

Method of supply to avoid silting.

the surface. Until the experiment is actually tried, it is impossible to say what the result may be; but the proposal commends itself as a thoroughly practical solution of what has always been a difficult problem. The plans of these sluices will be found in sheets I and II of book 2. The object of the double channel shown on sheet II is to allow of the sluices being used alternately, so that one may always be available while silt clearance is going on in the other. As the water will only be allowed to enter with a depth varying from 1 to 3 feet, the length of waterway must be calculated accordingly. Mr. Vertannes, in his report and statements accompanying it, enters very fully into the question, and shows by careful calculation what waterway it will be necessary to allow for each range. It is unnecessary to give this calculation here. In order to suit the varying conditions of tide levels, the sluices will be provided with grooves into which planks may be dropped, so that the water will only be admitted at the top of the tide. The supply sluices of range III will be placed at the north end, in the Bagda river. Ranges IVA and IVB will be fed from the Panchpara river, which contains less silt than the Borabullung. Range V will be supplied from the outlet sluices provided for drainage in the several creeks crossed by the canal. In order to prevent the entrance of water through the lock gates, 'porte-valets' will be introduced in the gate recesses, by which means the gates will be kept closed against the rising tides. The silt-laden water, which can enter the canal, will then be confined to what is required for the passage of boats only.

18. The average depth of water in the canal during the cold season will be 8 feet, and during the rest of the year 10 feet; the minimum depth during average spring tides has been calculated at 7 feet, but at the lowest spring tides the depth may possibly be reduced for three or four days in the year to $6\frac{1}{2}$ feet in range III or $6\frac{1}{2}$ feet in range V. It is not expected, however, that this will cause any inconvenience to traffic. The average width of the water surface will be 74 feet in the cold season and 80 feet during the rest of the year.

19. The question of intercepted drainage is one of great importance, and will be dealt with in detail. It must be remembered that the country through which the canal passes is very flat and generally subject to inundation, partly from the overflow of the rivers. A natural sand ridge, extending along the coast, prevents

Depth of water in canal.

Drainage.

the escape of the inundation water except at the points where the rivers debouch into the sea.

Drainage intercepted in Range III, Doobda jheel.

20. In range III the principal drainage intercepted is that which collects in the low tract traversed by the canal in miles 12 to 17, known as the Doobda jheel, into which flows the drainage of 114 square miles of country. The Executive Engineer reports that after heavy rain, the water in this jheel, which is 26 miles in extent, is raised to the level of 112.50, and as the ground level, according to the section, is about 109, the depth will be $3\frac{1}{2}$ feet. At first sight it would appear that the whole of this water might be drawn off by cuts into the Balighai khal, and that the expense of constructing sluices in the canal bank might be thus avoided. The objections to this arrangement are that (1) the khal is much silted up, and that it would be necessary to incur considerable expense in clearing it out, while there is no certainty that it would not again deteriorate; (2) that a bridge now existing at Balighai would have to be pulled down and rebuilt, the waterway being insufficient; and (3) that the salt tidal water would be admitted into the jheel and destroy the crops. It will be necessary, therefore, to construct inlet and outlet sluices across the canal. Inspection of the map, sheet I, book 1, shows that 14 square miles of the jheel will be finally drained through the Peechabunny khal, and 12 square miles by the Balighai khal. It seems to me to be quite sufficient to provide sluiceway in the canal banks for the discharge of six inches of water off the 14 square miles of country in 24 hours. The Executive Engineer has allowed for the discharge of four inches only, but the Superintending Engineer has enlarged the sluice and provided for the extra cost in the estimates. With a head of one foot and sectional area of 24 square feet, 18 vents will discharge 2,160 cubic feet per second, or nearly the required quantity. The requisite head can be obtained by lowering the water in the canal through the outlet sluices opposite, and by the valves in the locks and supply sluices. Only during heavy rain will it be necessary to lower the canal water in this manner, and usually the flow across the canal will be very quiet.

Drainage intercepted in Range III.

21. In the first seven miles of the canal two small khals are crossed; this intercepted drainage is provided for by a new cut shown on the plan, sheet I. But if the lock is built at Baintghur, and the tidal creek from Serpai towards Contai is canalized, as recommended in paragraph

6, this cut will not be required. A drainage sluice must, however, in that case be built at the mouth of the creek. Between the 7th and 12th miles of the canal the drainage intercepted is that due to the flow off six square miles of country, which is now discharged by existing sluices in Government embankments. Three vents of five feet each have been provided for this, which should be sufficient. In the 31st mile of the canal similar sluiceway has been allowed for the drainage of six square miles in the Bograi pergunnah, bordering on the Soobunreekah river.

22. In range IVA the country through which the canal passes to the 9th mile is protected on the east and west by natural sand ridges, and on the north and south by the Government embankments. The sluices provided for in this part of the canal have the same waterway as those now existing in the embankments, and have been found sufficient.

23. In ranges IVA and IVB the canal passes through a flat country, subject to inundation of great width, caused by the Panchpara river and the spill of the Soobunreekah. This inundation can only find vent by the rivers through the gaps in the line of sand-hills before mentioned: it might, therefore, be thought sufficient to raise the canal banks above the flood level, and to connect the rivers by back drains, by which the water would be drawn off the country to each side, and it might fairly be said that this arrangement could, in fact, do no more harm than the natural sand-hills have already done. It must, however, be borne in mind that, by excluding the portion of country between the canal and the sand-hills, and thus reducing the inundated area, the floods east of the canal would be raised and a portion of the country be brought under the influence of the floods which has hitherto been free from them. This arrangement must, therefore, be discarded, and the water be passed across the canal freely by wide gaps left in the banks; at the same time catch-drains must be made, and the tidal creeks, where required, deepened so as to thoroughly drain the lands after the floods have subsided. The objection to this arrangement which first occurs to the mind is that, if flood waters are allowed to flow across the canal, it must inevitably silt up. Consideration of the following circumstances, however, shows that such need not be the case. *First*, the water will in all cases be quite clear. Covering, as it does, a large area of flat land, it must necessarily deposit its silt before it

Drainage intercepted in range IVA, mile 0 to 9.

Drainage intercepted—Ranges IVA and IVB.

reaches the canal, and, as a matter of fact, tanks which have been constructed for years in the inundated tracts have not silted at all. *Second*, the canal will always be filled up to the level of the ground by the inlet sluices at the commencement of the rains, so that the water will flow across the canal without plunging into it, and eroding the slopes. *Third*, the length and area of waterway provided is so large that the water will be carried across the canal with a velocity of only $2\frac{1}{2}$ feet per second. The Executive Engineer had designed masonry floors and sides to these gaps, but I consider such a provision quite unnecessary, and have directed that brick rubbish only be used, wherewith to cover the floor and slopes. No arrangement could possibly be more simple, and yet there is no reason why it should not be perfectly effective. There will, moreover, be this advantage, that if the waterway proves to be insufficient, as much more as may be required can be provided by the simple expedient of cutting away the banks and depositing the soil in long lines at right angles to the direction of the canal; while, on the other hand, if the waterway is found to be unnecessarily large, it may be contracted by partially filling in the gaps. The above remarks apply also to range V.

24. It would swell this note to an inordinate length to enter into the whole of the details of the passage of the flood waters across the canal in ranges IV and V. For these details I must refer to the Superintending and Executive Engineers' reports; the calculations made by Mr. Vertannes have been verified so far as data are available, and, if anything, err on the side of safety. I will as briefly as possible summarize the results.

25. In ranges IVA and IVB the highest local floods rise to 116.00 above datum, the level of the country being 111.50; the depth of flood is therefore $4\frac{1}{2}$ feet, and it covers about 60 square miles in 24 hours, which is equivalent to a flow of 90,000 cubic feet per second. To provide for the passage of this volume of water, we have flood escapes of 6,800 and 4,000 lineal feet in ranges IVA and IVB respectively, besides the spaces between the terminal locks in the Panchpara and Borabullung rivers, which are 2,800 and 4,700 feet; thus the waterway aggregates 17,800 feet in length, and the mean depth being $2\frac{1}{2}$ feet, the sectional area of waterway will be 44,500 square feet, sufficient to discharge 90,000 cubic feet with a velocity of about 2 feet per second. Ordinary local floods only rise

to 113.00 above datum, that is 3 feet lower than the highest local floods, and pass off in two or three days.

26. With reference to the discharge of extraordinary floods, which attain, on the rare occurrence of an extreme flood in the Soobunreekha, say every 8 or 10 years, a height of 118.00 above datum, or two feet higher than the highest local floods, it is to be remarked that this level can only be reached if an extraordinary flood in the Soobunreekha should come down on top of a high local flood. The time occupied in covering 60 square miles two feet deep is said, from enquiry, to be 12 hours; but only six are taken, which is indeed allowing a very large margin for safety. A discharge of 154,860 cubic feet per second has therefore to cross the canal, for which the waterway is, as before, 17,800 lineal feet by $5\frac{1}{2}$ feet in depth ($\frac{118}{2} - 111.50 = 5.5$), or 97,900 square feet, which will discharge 154,860 cubic feet with a velocity of about $1\frac{1}{2}$ feet per second. The velocity might of course be very much higher without doing any injury, and therefore the waterway provided is excessive. The discharge by the rivers is left out of account, as their channels will not be interfered with, and they will continue to act as heretofore.

27. In paragraphs 47 and 48 of his report, Mr. Vertannes enters into a calculation of the discharge of the rivers at the points where they are confined to their channels by the ridge of sand-hills before mentioned. He shows that the aggregate discharge may be 118,940 cubic feet per second less than that for which provision has been made at the canal crossing; but I attach no importance to this result, as it is based on an assumption, and Mr. Vertannes acknowledges that there are no data for ascertaining the velocity at the intersection by the sand-hills, and the effect of the tides is not known. So far as it goes, however, it is confirmatory of the statement above made, that the waterway allowed across the canal is excessive.

28. In range No. V the principal drainages crossed are the Talpudda and the Kansbans. The index map in book I of plans shows the area drained by the various streams. The surveys of the sand ridge along the coast and sections of the rivers are given in sheets 21 to 25. The drainages of range V may be divided into two portions:—

1st.—That from the Borabullung river to the ridge between the Talpudda and Kansbans;

2nd.—That between this ridge and the Metai river.

Drainage intercepted in range V.

The area of country inundated in this first portion is 30 square miles, of which 10 square miles are intercepted between the canal and the sand-hills. The depth of the inundation is $116 - 111.50 = 4\frac{1}{2}$ feet, and local enquiry shows that from 24 to 36 hours are occupied in raising the water to the full height. The volume of water required to fill this area to a depth of $4\frac{1}{2}$ feet in 24 hours is equivalent to a flow of 9 inches in that time from the whole surface of the catchment basin, which, as will be seen from the index map, is 180 square miles. This would yield a discharge of 43,000 cubic feet per second. Applying Colonel Dickens' formula, $D = 825M^{\frac{1}{2}}$, M being the area in square miles, the discharge would be 40,500 cubic feet per second, which is sufficiently close. The discharge is provided for by flood escapes aggregating 3,000 feet in length and $4\frac{1}{2}$ feet in depth, and 300 square feet of sluice way, making in all 13,800 square feet. The velocity would therefore be 3 feet per second. In this calculation the retarding effect of this inundation is not taken into account, and it is improbable that a higher velocity than $2\frac{1}{2}$ feet would ever be attained; the provision made for the passage of this drainage is therefore ample. The Superintending and Executive Engineers have adopted a different method of calculation, but the results arrived at are practically the same.

29. In the second portion of this range, from the ridge between the Talpudda and the Metai, the area inundated cannot be ascertained; but that it is very large may be seen from the map, sheet 5 of book 1. The principal rivers crossed are the Kansbans and the Gummye; the area of their catchment basin is 400 square miles, which, by Colonel Dickens' formula, above quoted, would give a discharge of 73,000 cubic feet per second. The waterway provided by the Executive Engineer is 4,000 lineal feet of flood escape and 225 square feet of sluice way; and as the depth of inundation is $4\frac{1}{2}$ feet, the total area will be 18,225 square feet, which, if the whole of the floods were to cross the canal, would require a velocity of 4 feet per second. Such a velocity is never likely to be attained, as neither the retarding effects of the inundation or the great area flooded has been taken into consideration, nor the fact that a large volume of water finds its way across the country into the Metai. It is improbable that even a velocity of $2\frac{1}{2}$ feet per second would be reached. It would appear to be very desirable to connect

the Gummye nulla with the Metai west of the canal, and thus to draw off some of the drainage water from the former river into the latter. The effect would be to relieve the Gummye floods, and at the same time to improve the Metai; the more water that can be thrown into the latter, the greater the certainty that it will keep open. It seems unnecessary to say anything more on the subject of the drainage intercepted, but I may here repeat that if it is found that sufficient waterway has not been allowed, it will be easy to remove a portion of the canal embankments, and thus afford more room for the passage of the floods.

30. Inlet sluices have been provided in the banks, so as to admit water to fill the canal to the level of the ground before the freshes occur; at such times the outlet sluices will be shut down until the required level is reached. The position of these sluices is shown in the sections and plans in book No. 1 of the drawings, and the calculations will be found in the Executive Engineer's report in detail. The number of openings in each range is as follows:—

Range.	Number of openings.	Size of openings.
III ...	23	5
IVA ...	14	5
IVB ...	7	5
V ...	30	5

31. Outlet sluices, so called, are required, partly for the regulation of the water in the canal, and partly as a source of supply for the admission of tidal waters in the dry season; the position of these works is also shown on the plans and sections. The number of openings provided in each range is as follows:—

Range.	Number of openings.	Size of openings.
III ...	8	5
IVA ...	8	5
IVB ...	10	5
V ...	21	5

32. The drawings of the masonry works will now be briefly noticed. The sluices designed for the canal are similar to those already in use all over the Hidgelee district. I have directed that the thickness of masonry in the floors be increased to two feet from out to out of wing walls, inclusive of six inches of concrete, as I consider the dimensions allowed in the drawings insufficient. Full description of the various sluices is given in the Executive Engineer's report, paragraphs 63 to 68.

33. As already stated, I have altogether altered the design for the flood escapes, and substituted brick rubbish flooring for the masonry and concrete proposed

Inlet sluices.

Outlet sluices.

The masonry designs.
Sluices.

Flood escapes.

by the Executive Engineer, thus effecting a large saving in the estimates. The velocity will not exceed $2\frac{1}{2}$ feet per second, and the canal will be filled up, through the sluices, to the ground level previous to the passage of flood-water across it. The brick rubbish will therefore be sufficient to preserve the soil from erosion. Immediately in front of the escape, the Executive Engineer proposes to excavate the canal one foot below the normal bed level, and thus to form a silt trap. I hardly think this precaution necessary, but as the cost will be trifling, it may as well be done.

34. The lock drawings are shown in sheets 7 to 10 of book II. The dimensions of the chambers are 150×20 feet. The upper gates and forebay will be raised in all cases over extraordinary flood and cyclone-wave levels; but the coping of the chamber walls may be kept to one foot over spring tide level. The last five locks have been accordingly reduced in height. The lower sills have been in all cases raised two feet, for reasons already given in paragraph 12; thus a considerable saving has been effected. The mean thickness of the chamber walls will be $\frac{1}{4}$ of the height; the necessity for such unusual thickness has been made apparent by the recent failure of several tidal locks. Water will be admitted through filling culverts running the whole length of the chamber walls; but the number of small outlets to the chamber shown on the plan will be reduced by half. They will also be made rectangular instead of circular. The gates are to be of teak, sheathed in copper. The sills and quoins will be of artificial stone, which has been found to answer well in the existing locks of the tidal canal. The length of the channel between the lock and the river bank has been limited to 150 feet; its sides will be protected by dwarf walls, which greatly facilitate the removal of silt, which accumulates at the lock entrance more than anywhere else.

35. For protection against floods, the canal banks in ranges III and IV have been raised above flood-level. This has also been done in range V; but besides this, a small embankment is required on the right side of the Borabullung river to connect the canal bank with the high ground. The details of this are shown in sheet No. 18 of book I of plans. The waterway of the Borabullung will not be interfered with, as the area now flooded does not exceed one square mile. The east side embankment of the canal will

Locks.

Protective works.

for 3 miles be raised above flood-level, so as to exclude the floods from the Bora-bullung, which spill over below the canal crossing.

36. The only communication of any importance intercepted by the canal is the Midnapore and Contai road, which is crossed in the 10th mile of range III. I consider it unnecessary to construct a bridge at this place, but would provide a thoroughly efficient and good ferry-boat. The reasons against the bridge are, that it would cause immense inconvenience to the enormous traffic which is sure to arise on the canal, and that the road is hardly at all used for wheel traffic. The number of villages to the east of the canal is but small; wherever necessary, ferry-boats will be located.

37. In ranges III and IV of the canal several inspection bungalows already exist in connection with the Government embankments. These can, though at some inconvenience, be utilized for inspection purposes and for the accommodation of the officers during the construction of the works. But in range V there are no buildings of any sort; it is therefore necessary to construct a second class bungalow, which should be 'pucca,' as a thatched roof would suffer in such an exposed locality from the violent storms so common on the coast. The out-offices, as designed, have been altered and much reduced; 15 temporary shelter sheds have been provided, at a cost of Rs. 1,250 each, for the use of the subordinate establishments while the work is under construction. The sum of Rs. 15,000 has been included in the estimates for buildings for a permanent store-godown and office at Balasore, the head-quarters of the division; this will certainly be required, but the detailed plans and estimates have not been submitted.

38. The rates have been most carefully worked out by Mr. Vertannes, and seem to me to be amply sufficient; the details will be found in statement N. He proposes to burn the brick and lime required for the locks with coal, which he estimates will cost from 7 annas at the northern end of the canal to 13 annas at the southern end. It is hoped, however, that by the use of wood fuel, which exists in large quantities in the jungles on the Metai and in other places, and also by the adoption of 'Bull's kilns,' the rates for bricks will be much reduced.

39. Gooting or kunkur is found at intervals along the line in the tidal khals and nullas. All the mortar to be used in the locks will be ground in steam mills,

Intercepted communications.

Buildings.

Rates of work.

Lime.

Lock-gates.

Earthwork rates.

1782
16
5.112 annas

27
427 8/4

122 2/4

16.50.24

1.65 annas a cubic yard

average depth of cutting 3.65 yards

1.65 annas a cubic yard

1.65 annas a cubic yard

1.65 annas a cubic yard

1.65 annas a cubic yard

1.65 annas a cubic yard

1.65 annas a cubic yard

for which provision has been made in the estimates.

40. The rates for lock-gates, culverts, valves, and gearing, &c., have been fixed from the actual cost of similar works on the Midnapore and Orissa locks.

41. The earthwork rates have been determined for the different ranges with reference to the facilities for procuring labour and the hardness of the soil, average depths of cutting and lead. To the rates thus fixed have been added 10 per cent. for maintenance during construction and 5 per cent. for contingencies; the result is as follows:—

Range III	...	3.45	Rs. per 1,000 c.ft.
" IV ^a	...	3.90	" " "
" IV ^b	...	4.05	" " "
" V	...	3.90	" " "
Average	...	3.82	" " "

The average depths of cutting in the several ranges is as follows:—

Range III	...	8.88
" IV ^a	...	11.31
" IV ^b	...	13.22
" V	...	10.38

The above rates seem to me to be sufficient, from the following considerations:—(1) The actual cost of the earthwork on the tidal canal and diversion at Gowkhalli was Rs. 2.5 and Rs. 2.6 per 1,000 cubic feet, inclusive of all contingencies, and was mostly done by imported labour; (2), the earthwork of the great sea dyke, varying in height from 16 to 18 feet, and with a base of from 130 to 140 feet in width, cost Rs. 2.6 per 1,000, excavation having been made from one side only; (3), the rate of earthwork for repairs is only Rs. 2 per 1,000 at the present time; (4), labour will generally be plentiful, and work will be provided for the people almost at their doors. Mr. Vertannes states that the people engaged in manufacturing salt for the merchants at Balasore refused to take advances from them in the hopes of getting employment on the canal; (5), the percentage allowed for contingencies and maintenance during construction will suffice to cover the cost of hutting coolies, drainage of excavation while in progress, temporary cross dams, &c. Mr. Walker, in his letter dated the 16th December last, No. 544, recommended that the rates for earthwork should be—

For Range III	...	= 4.29	per 1,000 c. ft.
" " IV	...	= 4.29	" " "
" " V	...	= 4.40	" " "
Average	...	4.33	per 1,000.

That is about 8 annas per 1,000 only, higher than Mr. Vertannes' rates. Mr. Walker based his recommendation on the assumption that the coast canal traversed a country similar to that through which the Kendrapara canal extension to the

Jumboo passos. There is, however, no resemblance in any way; the one is well cultivated and inhabited, the other a jungly wilderness; the soil in the one is stiff and impervious to leakage, as has been fully tested by trial pits; in the other it is soft; there can therefore be no comparison. The work will be done by petty contractors, and the rates have been fixed accordingly.

42. Several objections have been raised to the construction of this canal on engineering grounds, which will now be briefly noticed. It has been said—

Objections to canal on engineering grounds.

- 1st.—That the soil is so soft that there will be difficulty in excavating the canal, and in maintaining it afterwards.
- 2nd.—That the cross drainage will wash back the soil into the excavation, and that silt will be deposited.
- 3rd.—That cyclones will seriously damage the works.
- 4th.—That, owing to the bed being below the tide level, it will be difficult to execute the works, and that on this account the rates allowed are insufficient to cover the cost of contingencies.

With regard to the first objection, borings have been made at the sites of the principal masonry works and at intervals along the line of canal. The specimens are now before me, and show that the soil is hard. For most of the proposed locks ghooting lime will be procured from the adjoining khals and rivers, which sufficiently indicates the nature of the soil; and in the canal excavation the difficulties to be contended with will arise more from the hardness of the soil than from its sandy or soft nature. Pits, 10 to 15 feet deep, have been dug without meeting water; there will therefore be no leakage. With reference to the second objection, the liberal water-way allowed, which can be added to *ad libitum* by simply removing a part of the canal banks, will pass the drainage across the canal with a velocity not exceeding $2\frac{1}{2}$ feet per second, which, as is well known, will not affect clay; moreover, the banks will be turfed, and the beds of the escapes will be covered with brick rubbish. That some silt will enter the canal from the supply sluices at the ends of the ranges during the dry season is inevitable, but I think the arrangements made to feed the canal from the surface water, and at the top of the tide when the current is slack, will reduce the silt deposit to a minimum. During the rest of the year the supply will come from the drainage of the country, and the water will pass

into the canal almost free from silt. Specimens of the water have been collected, and show this to be the case, and if further proof is wanted, it will be found in the fact that tanks excavated many years ago and covered by the inundation have not silted or shown signs of deterioration. Referring now to the third objection, cyclones fortunately are of rare occurrence. It has been shown that a long line of natural sand-hills protects the country, and that the wave could only reach the canal through the mouths of the rivers. It is probable that as cyclones are usually accompanied by heavy rain, the country would be, at all events, partially submerged, and thus the damage likely to occur would be minimized. But we have experience to guide us in this matter; the cyclone-wave of 1874 having swept over the lock-gates of the second range of the canal, submerged the coping three feet, and traversed the canal from end to end. The whole damage done was repaired at a cost of Rs. 248. The fourth objection is groundless, as the bed is above low water level of spring tides and accumulated rain-water can be drained out by a temporary self-acting sluice or shoot fitted with a valve. There will be no leakage water.

43. The estimated cost of the works is as follows:—

	Rs.
Preliminary expenses	10,000
Land	1,07,906
Regulators	44,810
River and Torrent works	1,89,787
Navigation works	8,76,746
Buildings	39,250
Earthwork	14,02,611
Total works	26,71,110
Establishment at 25 per cent.	6,67,778
Tools and plant at 7 „	1,06,854
Total direct charges	34,45,742
<i>Indirect Charges.</i>	
Capitalization of	Rs.
abatment of land	
revenue	23,000
Provision for pensions 20 per cent.	
on establishment	1,33,535
	1,56,555
Total	36,02,297

Mileage cost.

Provision for Establishments.

44. The mileage rate for works only will be Rs. 28,799, and for the total, exclusive of indirect charges, Rs. 37,150.

45. The provision made for establishments, at 25 per cent. on cost of works, is, I believe, more than is actually necessary; 20 per cent. would have been sufficient, as fully one-half the cost is for

simple earthwork, which requires but little supervision; but as it is certain that more men will, in the present state of the establishments, be sent to supervise than are actually necessary, I have left the figures as given by the Superintending Engineer.

46. In a work containing such a large percentage of simple earth digging—probably 60 per cent. including excavation of foundations—4 per cent. on the whole cost will be ample for tools and plant, including ferry-boats. The Executive Engineer states that the labourers will bring their own 'kudalies.'

47. The item capitalization of abatement of land revenue requires no remark; the figures have been obtained from the civil authorities.

48. The provision for pensions is in accordance with the last orders of the Government of India on the preparation of estimates for irrigation projects.

49. The Superintending Engineer, in paragraph 36 of his report, has added an item of Rs. 2,41,201, interest at 7 per cent. on the cost of works, establishments, and tools and plant; this has been arrived at by supposing that it would take three years to complete the works. He has therefore taken $4\frac{1}{2}$ per cent. for one-and-a-half years, or, in round numbers, 7 per cent. on the whole sum. I see no necessity for including this item in an estimate sent to the Government of India for sanction, as the charge will be entirely provincial, and will rest with the Government of Bengal to pay.

50. In discussing the scheme from a financial point of view, the first consideration is the cost of maintenance. Colonel Haig, in his note of the 15th February 1878, paragraphs 52-56, shows that the actual cost of maintenance of the Tidal canal in Hidgelee from 1873 to 1878 was Rs. 742 per mile; and from considerations of the conditions of the proposed canals as compared with the existing ones, he states that "it may be safely assumed that it will not exceed Rs. 800, and may perhaps be kept down to Rs. 600." The relative conditions are—(1), that the number of locks in the Hidgelee canal is one in every seven miles, while in the proposed canal there will be one in every 12; (2), that the Hooghly and Huldee carry more silt than the southern rivers; (3), that in the proposed canals the water will be below the ground level, instead of, as in the Hidgelee canal, some feet above it; (4), that during the rains the canal will be fed by the surface drainage of the country, which will be free from silt; and (5), that during the dry season the water will be supplied, not through the locks, but at the top

Tools and plant.

Capitalization of abatement of land revenue.

Provision for Pensions.

Interest on borrowed capital.

Cost of maintenance.

of the tide through side sluices from the surface.

51. I feel confident, then, that maintenance will not cost over Rs. 500 per mile, and we may with safety state that it will not exceed Rs. 600. I may here mention that the proposal to supply water only at the top of the tide, and through side sluices, instead of through the locks, had not been contemplated by Colonel Haig at the time he wrote his note of the 18th February 1878.

52. Now, taking the cost of maintenance at Rs. 600 per mile as above, and the rate of interest at $4\frac{1}{2}$ per cent. on cost of works, establishment, and tools and plant, the annual charges will be—

	Rs.
Maintenance of 93 miles of canal at Rs. 600 per mile	55,800
Interest at $4\frac{1}{2}$ per cent. on capital of Rs. 34,45,742	1,55,058
Total	2,10,858

Annual charge for interest and maintenance.

Probable traffic.

53. I now proceed to consider the traffic which may be expected on the canal. This question has been very fully considered by Colonel Haig in his note of the 15th February, above quoted. He shows in paragraphs 22 and 23, from statements carefully compiled by Mr. Vertannes, that the total export and import trade of the ports of False Point, Chandballi, and Balasore, with its minor ports, for the average of four years, 1873-74 to 1876-77, amounts to 65 lakhs of rupees, of which 52 lakhs, or five-sixths is with Calcutta, and that the imports are wholly from that place as well as two-thirds of the exports. The proportion of the latter would have been greater, but for the abnormally large export to the south in consequence of the famine in 1876-77. In paragraphs 24 and 25, Colonel Haig quotes from a report from the Collector of Balasore, and shows that the ports on the coast of Orissa are unsuited for the requirement of a great trade. The Dhamra and Balasore rivers can only be entered by vessels of small draft. False Point is said to be rapidly deteriorating, the steamers of the British India Steam Navigation Company being now compelled to anchor outside; Pooree is an open roadstead. Ordinary ocean-going vessels must therefore lie outside at all these places, and in such cases the risk and expense connected with loading is well known.

Importance of canal in times of famine. Colonel Haig's views.

54. In paragraph 31 Colonel Haig says, "In this connection it may be well to advert to the importance of such a coast line of canal in times like those of the last two years, when vast quantities of grain are

"set in motion. No sea route could supply the place of a canal. The Dhamra can only be entered by steamers of limited draft, and the number of these cannot be increased on an emergency, except at such an enormous expense as the Government only could bear. False Point is at a similar disadvantage, and Balasore worse off still. But were a canal in existence, thousands of boats would swarm to it from all parts of Bengal, were the demand to arise, and such a traffic as famine only can create would be accommodated without any expense or interference on the part of Government, and with the sole effect of doubling or trebling the navigation tolls, as in Hidgelee last year."

55. There can be no question of the correctness of this view of the matter. As a preventive against famine the canal is indispensable, and it is not too much to say that if it had been in existence in 1865-66 the grievous famine of that year could not have occurred. Mr. Norman, Collector of Balasore, writes in paragraph 13 of his letter No. 1369, of the 12th March 1878, as follows:—

Mr. Norman's views.

"It seems to me almost impossible to lay too much stress upon the importance of this canal in case of famine. The isolation of the province of Orissa during the famine of 1865-66, the immense difficulties that beset every attempt to throw grain into it, and the consequent paralyzation of private trade and appalling loss of human life are notorious. I believe that every intelligent person who is thoroughly acquainted with the facts must admit that, were another famine unhappily to occur now, the province of Orissa would find itself virtually in the same condition with regard to difficulty of access as in the great famine of 1865-66. This being so, a canal, which would bring every part of the province within easy reach of the great rice mart of Calcutta, would operate more efficiently both in mitigation of famine and in lessening the strain on imperial resources than any other measure which can be devised, except a railway, the cost of constructing which in Orissa would be so enormous that a railway at the present time seems quite out of the question."

56. Again, in paragraph 16 Mr. Norman says,—

"My opinion on the subject of the proposed Coast canal has now been fully expressed. I consider that it will confer vast benefits on the country; that it will be impossible to devise any other public works beneficial in a like degree except a railway; that admitting a railway to

"be impossible, the construction of a navigation canal connecting Orissa with the rest of the presidency is absolutely necessary as a protection against famine in the province; and that there is every reason to believe the project now under consideration is financially sound, and will at least pay interest on the capital sunk, together with working expenses. Though myself fully convinced of the superiority in point of durability, efficiency, and economy of tidal canals in this part of the country over high level canals, yet I have forbore to touch on this question, as it can be discussed more adequately by the Engineer Officers of Government."

57. The next question for consideration is the comparative cost of carriage by existing routes and by the proposed canal. Mr. Vertannes in his very carefully prepared report of the 19th June gives the following particulars:—

Comparative cost of carriage by existing routes and by canal.

NAME OF STATION.	PRESENT RATES OF FREIGHT.				Probable rates by the proposed canal.	REMARKS.
	By land, via Midnapore.	By dloop, by sea.	By steamer and boat from Chandballi.	By steamer to False Point and thence by boat.		
	Per ton. Rs. A. P.	Per ton. Rs. A. P.	Per ton. Rs. A. P.	Per ton. Rs. A. P.	Per ton. Rs.	
Jellasore ...	13 8 0	...	...	...	3 50	
Balasore ...	17 8 0	11 0 0	...	...	4 00	
Chandballi ...	...	...	11 8 0	...	6 51	
Cuttack ...	...	...	19 8 0	23 0 0	7 51	There is no steamer to Balasore; when there was, the rate was Rs. 15 per ton.

Present actual cost of carriage.

"From the above table it will be seen that the traffic is paying at present for all stations, except for Chandballi, three-times as much as it will pay when the proposed canals are ready."

58. The following are some particulars of present charges:—

	Rs. A. P.
I.—Calcutta to Cuttack via False Point—	
Shipping charges in Calcutta, per ton ...	2 8 0
Freight to False Point, per ton ...	15 0 0
Boating to Cuttack ...	5 8 0
Total ...	23 0 0
II.—Calcutta to Cuttack via Chandballi—	
Shipping charges in Calcutta ...	2 8 0
Freight, average ...	9 0 0
Boating to Cuttack ...	8 0 0
Total ...	19 8 0
III.—Cuttack to Calcutta via False Point—	
Boating from Cuttack to False Point ...	5 8 0
Steamer freight ...	9 0 0
Landing charges ...	2 8 0
Total ...	17 0 0
IV.—Chandballi to Calcutta for rice—	
Shipping charges at Chandballi ...	1 5 0
Freight, per bag Rs. 0-4-0 ...	4 0 0
Landing charges in Calcutta ...	2 8 0
Total ...	7 13 0

With reference to the last, it is explained that the low rate of freight per bag was due to competition, the usual rate being eight annas.

59. Now, with regard to the cost of carriage by canal, Mr. Vertannes has shown the estimated cost of the proposed canal as compared with the actuals on existing routes in Bengal as follows:—

	Estimated.	Actuals.
	Pies.	Pies.
(1) Cost of carriage, exclusive of tolls, per ton mile ...	2.55	2.27
(2) Cost of carriage, inclusive of tolls, per ton mile ...	5.52	5.32
(3) Cost of conveyance of passengers, per head ...	1.64	1.28

The rate of toll proposed for the Coast canal is one anna per 100 maunds per mile, the same as on the Midnapore canal; but that is on the measured maundage of the boat, which, inclusive of the return journey of the empty boat, on which toll is also levied, is 2.56 times the actual weight of the cargo.

60. Mr. Vertannes allows for the conveyance of 100,000 passengers per annum on the proposed canals. Mr. Norman, the Collector of Balasore, considers this much too low, and would double the number. On the Midnapore canal in 1876-77 137,000 passengers were carried over 48 miles of canal. Now, when we consider the vast number of travellers that flock to Cuttack and Pooree, and their known dislike to the sea, I think there is little doubt of the correctness of Mr. Norman's views, that 200,000 travellers will take the canal route. We shall be perfectly safe in calculating on 100,000.

61. The following figures in decimals of a rupee, taken from Mr. Norman's report, show the estimated cost of conveying each passenger from Calcutta to the principal stations along the canal:—

	Soobunreekha	Balasore.	Metel river.	Chandballi.	Patamundi.	Cuttack.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Tollage ...	.275	.395	.582	.582	.582	.934
Cost of boat and crew ...	.398	.531	.703	.888	.959	1.19
Total cost of conveyance ...	.673	.926	1.285	1.470	1.541	2.124

The Chandballi steamers carried in 1876-77 66,880 passengers, the price of a ticket being from Rs. 2-8 to Rs. 3-8, and on occasions of great demand Rs. 15 was given for a passage.

62. The following tables, abstracted from statement W attached to Mr. Vertannes' report of 19th June 1877, show the estimated cost of transport to the

Cost by proposed canal.

Probable passenger traffic.

Mr. Norman's estimate of conveying passengers by canal.

Statement of cost of carriage of goods and passengers by canal.

different points along the coast and to Cuttack:—

Goods.

	DISTANCES FROM CALCUTTA.			COST PER TON.			Cost per ton mile.
	River.	Canal.	Total.	Boat charges.	Tolls.	Total.	
	Miles.	Miles.	Miles.	Rs.	Rs.	Rs.	
Balasore ...	52½	81½	134	2.18	1.01	4.09	5.86
Chandballi ...	89	119	205	2.72	2.79	5.51	5.16
Patamundi ...	108	119	227	2.81	2.79	5.60	4.73
Cuttack ...	91	179	270	3.04	4.21	7.25	5.58

Passengers.

STATION.	DISTANCES FROM CALCUTTA.			Boat charges per head.	Tolls per head.	Total per head.	Total per head per mile.
	River.	Canal.	Total.				
	Miles.	Miles.	Miles.				
Balasore ...	52½	81½	134	.785	.305	1.16	1.68
Chandballi ...	89	119	205	1.12	.582	1.70	1.59
Patamundi ...	108	119	227	1.20	.582	1.78	1.50
Cuttack ...	91	179	270	1.44	.934	2.37	1.08

Probable returns.

63. The estimate of returns will be found in statement D of Mr. Vertannes' report, which has been summarized as follows:—

Revenue from Goods Traffic.

	Goods traffic.	Proposed tolls per 100 maunds.	Revenue.
	Mds.	Mds.	Rs.
(1) Direct—			
Range III.—Rassoolpore to Soobunreekha ...	25,24,000	2.61	65,876
Do. IV.—Soobunreekha to Balasore ...	15,41,600	2.05	31,603
Do. V.—Balasore to the Metel ...	8,60,600	3.26	28,056
Total direct revenue ...			1,25,535
(2) Indirect—			
Range III ...	11,53,000	0.93	11,068
Do. IV ...	11,53,000	1.48	17,064
Do. V ...	2,15,000	3.67	7,912
Total indirect revenue ...			36,044
Total estimated revenue from goods ...			1,61,579

Revenue from Passengers.

	Number of passengers.	Proposed tolls.	Revenue.
		Rs.	Rs.
(1) Direct—			
Range III ...	100,000	.168	16,795
Do. IV ...	95,000	.133	12,635
Do. V ...	85,000	.217	18,445
Total direct ...			47,875
(2) Indirect—			
Range III ...	100,000	.062	6,200
Do. IV ...	100,000	.096	9,595
Do. V ...	45,000	.277	12,465
Total indirect ...			28,260
Total passenger revenue ...			76,135

64. Colonel Haig has pointed out, in paragraph 49 of his note, that Mr. Vertannes has omitted from the anticipated traffic of ranges I and II of the canal 9,34,000 maunds of goods which are sent by land from Balasore to Balighai, and he shows that this should be included in the traffic returns, which would add Rs. 22,600 to the receipts.

65. The revenue would then be as follows:—

	Rs.	Rs.
Goods revenue	... 1,61,579	
Ditto	... 22,600	
Passenger revenue		1,84,179
Total		2,60,314

This is more than sufficient to cover the working expenses and interest on the cost, *vide* paragraph 52.

66. Mr. Vertannes, in preparing his statement D, above summarized, has taken it for granted that the whole land and sea-borne traffic from Balasore to Calcutta, as well as all that by sea between Calcutta and Chandballi and False Point, will be carried on the canal, and in the calculations of probable returns he has added but little to what the traffic actually is at present. The principal item of trade is rice. The following tabular statement shows the quantities actually exported and the assumed probable traffic:—

YEAR.	QUANTITY OF RICE ACTUALLY EXPORTED TO CALCUTTA.				
	From False Point.	From the Soobunreekha.	From Balasore.	From Chandballi.	Total.
	Cwt.	Cwt.	Cwt.	Cwt.	Cwt.
1873-74	...	15,400	280,955	233,508	509,823
1874-75	...	732	232,708	464,010	697,450
1875-76	...	20,700	141,415	180,285	362,812
1876-77	...	183,973	17,113	41,114	242,800
Total	...	204,882	43,708	675,592	1,112,603
Average	...	102,341	10,927	168,898	278,142
Assumed probable canal traffic	...	110,000	16,000	184,000	300,000

Considering the great area of country, the produce of which should find its way to False Point, the quantity allowed, 5,500 tons of rice, seems to be ridiculously small.

67. Mr. Vertannes takes no credit for miscellaneous receipts, which the Collector of Midnapore thinks would be Rs. 12,000, *vide* paragraph 23 of his report; and if Mr. Norman's estimate of passenger traffic be correct, Rs. 75,000 more should be added to the receipts on that account. Mr. Harrison, Collector of Midnapore, in paragraphs 20 to 22 of his report of the 18th October, suggests the imposition

Additional goods traffic on ranges I and II.

Probable revenue.

Rice trade with Calcutta.

Other probable sources of income.

of tolls on boats using the Huldee, Russoolpore, and Metai, and other tidal estuaries, and considers that such taxation would be perfectly justifiable. If this could be done, the increase to the income would be very great. Mr. Beadon, Collector of Cuttack, in his report No. 1088, of the 1st November, in paragraph 6, quite independently of Mr. Harrison, makes a similar suggestion as regards the tidal creeks in Orissa. The facilities of carriage given by the canal would probably drive the locally manufactured salt out of the field, and bring Liverpool salt into the market. This question is dealt with by Mr. Norman in a special report on the subject, No. 1369, of the 12th March 1878, which was called for by His Honor the Lieutenant-Governor. Mr. Norman gives calculations which show that the cost of each kind would be the same after the completion of the canal, and points out that as the Liverpool article is pure and white, and the locally made salt dirty, the former would be preferred. Here, then, is another probable source of income. Mr. Norman in his report also mentions that the tributary estate of Moyarbunge would probably yield supplies of slate, timber, and other produce which would be brought down for the Calcutta market when facilities for transport are afforded.

68. I think it may fairly be assumed that the stimulus given to trade by the immense reduction in cost of carriage and the opening up of the tidal creeks in Orissa, by which Pooree and Ganjam will be brought into direct communication with Calcutta, will largely increase the traffic, but no credit has been taken in calculating probable returns on this account. I feel very confident of the success of the project financially, and am satisfied no more promising scheme has ever been laid before the Government.

69. It will be seen from the reports that the Collectors of Midnapore and Balasore have expressed strong opinions in favour of the Coast canal, and now I may quote from the former, paragraph 26:—

"I would, however, urge that, even if there is a deficiency of Rs. 20,000 or Rs. 30,000 for the first four years, the indirect advantages to be gained ought not to be entirely overlooked. The Midnapore canal has permanently cheapened salt in the bazar by 15 per cent.; it has undoubtedly added to the value of rice, though, owing to the fluctuations in the grain, it is difficult to give the precise amount; it has added greatly to the value of jungle produce and timber; and, in short, I am

Opinion of Collectors of Midnapore and Balasore.

"collecting evidence which tends to show that it has raised the value of landed property within the area tapped by it to the extent of 25 to 200 per cent. It is certain that the land opened up by the canal is improving so rapidly in value that it sells at for 26 to 35 times the profits. Orissa is temporarily settled, and the facilities of trade which the canal must infallibly bring to at least some part of the country will tell upon the next assessment of land revenue."

Mr. Norman, Collector of Balasore, has expressed himself even more strongly in favour of the Coast canal, *vide* quotations *ante*, paragraphs 55 and 56.

70. Mr. Beadon, Collector of Cuttack, in his report No. 1088, dated 1st November, says but little on the subject, merely stating that he doubts whether the imports or exports of Orissa can ever justify the construction of the link line between the high level canal and Metai river. As this is not at present contemplated, nothing more need now be said about it. Mr. Beadon, however, strongly advocates the improvements of the tidal creeks along the coast, so as to open up the Pooree district.

Opinion of Collector of Cuttack.

71. It is necessary for me now to notice the report of Mr. Beames, the Commissioner of Cuttack, who is opposed to the construction of the Coast canal, and to reply *seriatim* to his objections.

Mr. Beames' (Officiating Commissioner of Cuttack) opinion.

72. In paragraph 3 he states that "it requires no professional knowledge to see that a canal running across shifting sand, liquid mud, bottomless morasses, and tidal rivers, will be costly to execute, difficult to maintain, and liable to frequent interruptions." This statement has, I trust, been completely refuted by the facts mentioned in this report as to the nature of the country; and from personal knowledge of the ground, I can myself say that it is utterly devoid of foundation.

73. In paragraph 4 Mr. Beames quotes Mr. Ravenshaw, as follows:—"I believe the tidal canal will never provide satisfactory thorough communication free from serious interruptions. It follows the coast swamps and avoids all the chief centres of trade, and will prove a very penny-wise and pound-foolish project." But the fact is that the canal *does* pass through, or close to, Balighai and Balasore, and will connect with Chandballi, and these are the principal marts and centres of trade.

74. In paragraph 5 Mr. Beames states that the leading merchants were unanimous in stating that the canal was not required, and would not be used for trade. He also gathers from an article

which appeared in a local newspaper that the traders considered the canal unnecessary. This is not to be wondered at, when it is explained that these traders and the newspaper proprietors are owners of sloops!

75. How far the statements in paragraph 6 are correct may be judged from the reports of the Collectors of Midnapore and Balasore, so often quoted in this report. Mr. Beames states that Commissioners, Collectors, Deputy Collectors, Superintending and Executive Engineers, native traders, and leading landholders "are unanimous in considering it (the canal) absolutely useless."

76. In paragraph 8 the Officiating Commissioner states that Mr. Vertannes "has with very great care, patience, and labour collected and arranged a mass of facts which prove distinctly the following points:—

"I.—That the trade of Orissa does not at present follow the direction to be taken by the proposed canal."

How could it do so? There is at present no road or other means of communication in that direction.

"II.—That, in order to yield a return which will pay the interest on 30 lakhs, it will be necessary that the canal shall absorb all the trade, both export and import, which at present passes through the ports on the Orissa coast.

"III.—That consequently the whole trade of the province must be diverted from its present channel." It is to be regretted that Mr. Beames did not, apparently, read the headings of the statements which Mr. Vertannes "had, with very great care, patience, and labour collected and arranged." If he had done so, he would have seen that that officer based his calculations on the trade with Calcutta only (*vide* statement Z attached to Mr. Vertannes' report of 19th June 1877).

"IV.—That to effect this change the only inducement we can offer is the great saving in cost of carriage, viz. from Rs. 25 per ton, as at present, to Rs. 7-8 per ton by the proposed canal."

I should have thought this inducement quite sufficient to attract trade.

77. The figures given in paragraph 17 of Mr. Norman's report of 6th November 1877 completely refute the statement made by the Officiating Commissioner in his 13th paragraph. It is shown that for the last four years an average of 97½ per cent. of the total imports, and of 71 per cent. of the total exports, were in connection with Calcutta, and that the latter would have been much higher but for the famine

in Madras in 1876-77, which drew off 54 per cent. to the south in that year.

78. I am unable to follow Mr. Beames in his argument in paragraph 16, that the loss to Government in the Customs Department from the export duty on rice must be set against the profits from the canal. The canal will not take produce to foreign ports; there cannot, therefore, be any loss in customs. It is more likely to increase them by facilitating transports to the ports from the producing districts.

79. In paragraph 17 the Officiating Commissioner says:—"As to passengers, I will only say that time is valuable to a certain extent even to natives, and that the much greater rapidity of the sea route would always make it a formidable competitor to the slow canal route." The whole distance from Calcutta to Cuttack is 270 miles by canal and river; this would be accomplished with ease by suitable canal steamers in 48 hours. I would invite a perusal of the 14th paragraph of Mr. Norman's report on this subject, but I cannot refrain from quoting part of it here. Alluding to the steamers plying between Calcutta and Chandballi, he says:—

"The steamers are exceedingly inconvenient and distasteful to natives. Both the Chandballi steamers arrive and depart on the same days, and passengers arriving at Chandballi from the interior have sometimes to wait almost a week for their steamer. Chandballi is during the rainy season a place exceedingly difficult of access by land, as the routes leading to it consist of tracks which become entirely submerged for long distances together and to considerable depths. In the steamers the passengers are packed together very much like sheep: the females, except first class passengers, have no secluded accommodation, and males and females alike are half-starved during the voyage, as caste prejudices prevent their eating cooked food on board. In spite of all these drawbacks, the Chandballi steamers during 1876-77 carried 66,880 passengers, and would have carried more had their carrying capacity at times of religious festivals been greater. On such occasions, indeed, the temptations to overcrowding are very great, and overcrowding sometimes occurs. Masters have three times been convicted of it, and punished very heavily during the past three years. Under these circumstances, there can, I think, be no reason to doubt that were a canal made, the whole of the passenger traffic now carried by steamers would be transferred to it."

80. I have been thus particular in commenting on the statements made in the Officiating Commissioner's letter, because naturally great weight would otherwise be given to his remarks.

81. It only remains for me now to mention the manner in which the plans, estimates, and reports have been prepared. I have quoted with confidence from the statements of trade and traffic so laboriously collected by Mr. Vertannes, and it is satisfactory to be able to state that the Collector of Balasore has testified to their correctness and satisfied himself "of the care, diligence, and fidelity which have been bestowed on the compilation of his statements." Equally satisfactory is the care that has been taken in the preparation of the detailed drawings and estimates, and the collection and compilation of statistics connected with the drainage of the country, and the calculations of water-supply, &c. I think it must be acknowledged that no more carefully prepared project has ever been submitted for sanction of Government. The credit of this is entirely due to Mr. Vertannes. Colonel Haig was sanguine that the project would prove highly remunerative, and I have myself every confidence in its success, and trust the Government of India may be pleased to accord early sanction to the construction of the canal.

15-2-79.

H. C. LEVINGE.
Chief Engineer.

Mr. Vertannes, Executive Engineer.

DM 746

FROM H. C. LEVINGE, Esq., C. E.,

Joint Secy to Govt of Bengal, P.W. Deptt
Irrigation Branch,

To The Secretary to the Government of Madras
P.W. Irrigation Branch.

Dated *Darjeeling* ~~Port William~~, 12th June 1879.

SIR,

Irrigation

I am directed to inform you that plans and estimates for a Canal to connect Calcutta with Orissa, along the coast, have recently been submitted for sanction to the Government of India.

~~the~~ creeks, & Estuaries, in the delta of the Mahamuddy, are now being improved and it is confidently hoped, that before many years elapse, the Chilka Lake will be connected by Canal with Calcutta.

3. It is understood that the East Coast Canal in Madras will shortly open up

com

communication between Coconada and Madras, so that could Coconada and Ganjam be connected, uninterrupted navigation by Canal from Madras to Calcutta would be established.

4. I am to enquire whether there is any probability of this link being constructed. The Lieutenant Governor believes that the advantages to the country by thus connecting the two Canal systems would be very great; especially in times of famine, when grain could be supplied to the stricken District, without incurring the dangers and difficulties of landing and unloading in the open Roadsteads which constitute the Ports along the Coast.

5. A copy of the report on the proposed Coast Canal in this
Pro-

Province is forwarded for information.

I have the honor to be

Sir

Your most Obedient servant

J. H. Georgey C. E.

Joint Secretary

Go 1102-20-579 R.D.
Go 2091 W 28-6-8

Cir 4.1.89 Det 311/8
No. Chel 42 Lane

P. 3

Letter N^o. 28. T. 12 June 1879 from Govt
of Bengal P. W. D. Irrigation Branch.

1943-44
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Noted by the Joint Secretary to Govt. P. W. D.

The letter from the Government of Bengal has been addressed to this office under the impression apparently that the Buckingham Canal is dealt with in this Department. In transferring the papers however a few remarks on the matters on which information is desired may be useful.

2. Through communication has, by means of some temporary expedients at the lower end of the Commamur Canal, Krishna Delta, been already established between Madras and Cocanada, and in the course of a few months, on the completion of the tidal lock, the

permanent connection between the Krishna Delta and the Buckingham (East Coast) Canal will be opened.

The total distance is about 393

miles viz: -

	miles	chains
Buckingham Canal.	about 196.0	
Commamur Canal -	57.0	
Main Canal, Western Delta -	13.0	
River Krishna	about 1.0	
Main Canal Eastern Delta -	0.45	
Krishna Ellore Canal -	40.0	
Godavari Ellore do. -	40.27	
Main Canal Western Delta -	6.11	
Godavari River	about 5.0	
Main Canal Eastern Delta -	4.12	
Cocanada Canal -	27.48	
Creek and Cocanada River by	2.17	
	<u>393.0</u>	

3. A coast canal north eastwards from Cocanada has not, it is thought, been heretofore enquired into. A proposal was made many years ago for an extension of the Samulcotta Canal to Luni Long. 82.3 (Loonee) on the frontier of the Vira- Lat. 17.2

patam, a distance of about 35 miles but the scheme was not estimated for in detail. The amount of drainage which would have to be crossed would be large.

1943-44
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Sheet 94

Sheet 109

Sheet 108

4. So far as can be judged from the Atlas Sheet, there would be apparently no difficulty in carrying a coast canal as far as the Luni river some 38 miles. Parts of the line between this river and Vinagapatam, some 54 miles, would be easy and possibly no part would be difficult until a point some 7 or 8 miles S.W. of Vinagapatam was reached. There however bold rocky hills come down to the sea which washes their base, and again to the north of the Vinagapatam river as far as Bimlipatam, about 18 miles, there is first the high ground on

which the Military Station of Waltair stands, and then, as the Atlas sheet indicates, hills very near the shore line. The next 40 miles to the Chicacole river appear to be less difficult. Thence to Calingapatam 15 or 16 miles the line would apparently be easy. The distance 85 miles thence to Gopaulpore.

(Natchlesum Gopalpoorum of Atlas Lat 19.15 sheet N° 107) would seem to Long. 84.58½ present considerable facilities.

From Gopaulpore to Ganjam, 12 miles, the country has been examined and a canal estimated for, and from Ganjam to the Chilka lake, some 15 miles to where the artificial channel ends, a canal is in existence.

5. Out of the total distance of 263 miles from Locanada to Ganjam there are then about 26 miles viz from about 8 miles south of Vizagapatam to 18 miles

north of that town which are likely to present very considerable, and it may be insuperable, difficulties to the formation of a through line of water communication. If a canal can be designed through this section however it is probable that a continuous canal from Ploenta to Madras would be feasible. Possibly some of the difficulties might be overcome by a high level section supplied from reservoirs, but the Atlas sheet indicates that the difficulties of getting a line for a canal of any kind near Vizagapatam are likely to be very formidable.

6. It will be seen from the state on the Coast Canal in Orissa that the proposed arrangements ^{minimum} 7 feet as regards both width and depth ^{minimum} 7 feet of water are on a scale much in excess of the provisions made for navigation in the Delta

Canals and, it is believed, of those in the Buckingham Canal. The Delta Canals will have a minimum depth of 6 feet during the irrigation season, or while the rivers can supply sufficient water to maintain this depth, and the minimum depth with still water navigation is intended to be 4 feet i.e. where there are locks water will be held up above each lower lock so as to secure 4 feet of water on the lower sill of the next upper lock. The locks on the first class canals, and all Delta Canals on the through route from Cocanada to Madras via the Buckingham Canal are first class, are 150 feet by 20 feet, and at the tidal locks the lower sills are placed at not less than 3 feet below L. W. springs. The minimum width of water surface in some of the old

16
Canals has been fixed at 50 feet. Without reservoir navigation in the Krishna Delta is not likely to be feasible in ordinary years for more than 9 or 10 months at most, but it is believed that a site for at least one large reservoir of sufficient capacity is available at the point where the Gundlacumma comes through the hills, should it be found necessary at some future date to supplement the Krishna supply in the dry season.

Cochinmand.
24 June 1879

Under Secy. Colonel St.
Joint Secretary to Govt. P. & D.
Irrigation Branch

To
The Secretary to Govt.
P. & D.

Encl. 7
 P. 10/11/46
 8/11/46

Letter No. 28.T. 12 June 1946 from Gov. of Bengal to
 the Joint Military Com. I.B.
 The letter from the Gov. of Bengal is
 forwarded to this Office under the impression of
 perceiving that the Buckingham Canal
 is still in this Department. In
 transferring the matter to the
 the matters on which information
 is desired may be useful.

2. Through communication has by means
 of some temporary expedients at the
 lower end of the Ganges, Krishna
 Delta being established between
 Howrah and in the course of a few
 months the permanent connection between
 the Krishna Delta and
 Buckingham (East Coast) Canal will
 be made. The total distance is about 398

Krishna Delta	main canal	195.0
	main canal Western Delta	57.0
	Riser Krishna	13.0
	main canal Eastern Delta	45.0
	Krishna Main Canal	40.0
Gomavari Delta	Gomavari Main Canal	27.0
	main canal Western Delta	6.11
	Gomavari River	5.0
	main canal Eastern Delta	4.72
	Cornwall Canal	27.48
Total		2.17

Cir. 4-1-49. Dtd 21.7.49.
 P.L. Seal 22 June

North India
3. A coast canal from Cochin
has not been thought of here for
many years. A proposal was made
many years ago for an extension of the Suez
Canal to India on the frontier of the
Vizagapatam, a distance of about 25 miles
but the scheme was not estimated for in
detail. The amount of drainage which
would have to be exposed would be large.

4. So far as can be judged from the Atlas
Sheet, there would be apparently no diffi-
culty in carrying a coast canal as far
as the Tami river some 20 miles. Parts
of the line between this river & Vizagapatam
some 50 miles would be easy and possibly
part would be difficult water as point
7 or 8 miles S.W. of Vizagapatam

Long 82.35.40
Lat 17.20.45

Sheet 94

Sheet 109

Sheet 108

Lat 19.15
Long 84.50.20

comes down to the sea which would be the
base and again to the north of the Vizagapatam
river as far as Pundarikotam, there is a
the high ground on which the military
Station of Waltair stands and there, as the
Atlas Sheet indicates, lies only near the
shore line. The next 40 miles to the Orissa
River appear to be less difficult. Thence to
Calcutta 15 or 20 miles the line would
apparently be easy. The distance thence to
Bopalpore (Macpherson Bopalpore of Atlas
Sheet 107) would seem to present considerable

12 miles
facilities. From Bopalpore to Ganjam the
country has been examined and a canal estimated
for and from Ganjam to the Chilka Lake some
15 miles to the artificial channel and a
Canal is in existence.

5. Out of the total distance of 263 miles from
Cochin to Ganjam there are there about
20 miles or more from about 5 miles South of
Vizagapatam to 10 miles North of that town
which are likely to present very considerable
and it may be impossible difficulties to
the formation of a through line of water
communication. If a canal canal
designed through this section however it
is probable that a continuous canal from
Calcutta to Madras would be feasible.
Possibly some of the difficulties might be over-
come by a high level section supplied from
reservoirs but the Atlas Sheet indicates
that the difficulties of getting a line for
a canal of any kind near Vizagapatam
are likely to be very formidable.

6. It will be seen from the note on the
Coast Canal in Orissa that the proposed
arrangement as regards both width and
depth of water are in accordance with the
provisions made for navigation
in the Delta Canal and it is believed of
those in the British India Canal.

minimum
7 feet
x minimum 7 feet

Delta Canal will have a minimum depth of 6 feet during the irrigation season or while the rivers can supply sufficient water to maintain this depth and the minimum depth with still water navigation is intended to be 12 feet i.e. when there are locks water will be held up above the lower lock so as to secure 12 feet of water on the lower side of the next upper lock.

The locks on the first class Canals from Delta Canals on the through route from Cocanaba to the Trucking Canal are first class,

are 150 feet by 20 feet and at the tidal locks the lower sills are placed at not less than 3 feet below L.W. Springs.

The minimum width of water surface in some of the old Canals has been found at 50 feet.

Without reservoirs navigation in the Western Delta is not likely to be feasible in ordinary years for more than 9 or 10 months at most but it is believed that at least one large reservoir of sufficient capacity is available at the point where the Gondla River crosses through the hills, should it be found necessary at some future date to supplement the Western supply in the dry season. 24/6/39.

To Secy to Govt. 24/6/39.

P. S. I will sign -

For orders 1943-44 31

In submitting the orders a communication has been made enquiring about the prospects of establishing through Canal Communication between Calcutta and Madras. I send for approval draft of the reply which I propose should be sent.

I shall then call on the Supt. Engineer P. A. to report more fully on the subject. I am sure information as to the feasibility obtain from the local Officers - It will I presume be useless in the present state of funds & the crippled state of the department to start any detailed survey etc.

As Mr. Verma's Report might be

Cir 4.1.19. Dtd 21.7.39. P. S. Chet 42 page

Of some use in deciding
certain points regarding
the Pennington Canal
and at least as a matter
of convenience I have
attached for a copy

Ally

4/7/79

1943-44
13th
L. works
No 1943 Wa/23 July 79

Ordered that
the following letter
be sent to the
Govt of Bengal.

2/2

9/2/7
~~Ch. E. for L.~~
~~12-1st line to~~

Ordered by his Grace

For Approval

No. 1944 Wd/23 July 1879

To the Joint Secy. W.I.
Govt. of Bengal

Sir

In reply to your
letter No. 287 dated
Bengal 12 June 1879
forwarding copy of the
Report on the proposed
Coast Canal designed
to connect the existing
Widjellee Canal with
the river the Canal system
of Orissa, and enquiring
if it is in contemplation
to establish a connecting
link between Cocanada
and Ganjam (so as to
ensure uninterrupted
navigation between Madras
and Calcutta) I am
pleased by this

the Governor in Council
to forward copy of
a note on the subject
drawn up by Colonel
Mullins R. Fort Sec.
for insertion in the Sept.
2 ~~Further~~ Information
on the subject will be
called for in regard to
the difficult portions of
the line advocated to by
Colonel Mullins, and
should any decision be
arrived at by the Govt
a further communication
will I am to state be
addressed to you on the
subject for the information
of his Honor the Govt.
Governor; at the same
time so far as is now
known, and especially
considering the large
sums of money still

needed to complete
the Canal communication
between Indian and Cocumbe
there is no probability
of the subject being seriously
considered in some years
to come

3 - I am to request that
if the report of de Verteuil
on the proposed Orissa
Coast Canal be in print
his Government may be
furnished with a copy
of it.

~~Att~~

4/7/79

28

Despatch with 1943 W.

5-8-79

Copy

Subt. of 11879) Madras.
PUBLIC WORKS.

29/7/79
31/7/79
J. H. M.
R. H. M.

SC

23 July 1879 1943
1944

Nos. 158/160

Orissa Coast Canal

Letter from the Govt of
Bengal forwarding copy of
report by the Engineer on the
proposed — and enquiring
if it is contemplated to esta-
blish a connecting link
between Cocanada and
Kangra so as to ensure
uninterrupted navigation
between Madras and
Calcutta. — b

Intimates that there is
no probability of present
establishing the Canal com-
munication between

and ~~Bombay~~ Kangra,
and requests that if the
report of the Government on
the proposed Orissa Coast
Canal be in print, a copy
of it may be furnished to
the Government.