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TAMIL NADU ARCHIVES

GOVERNMENT OF TAMIL NADU

J.W.D. DEPARTMENT

G.O. No.	814 W	Press.
B.P. No.		Mis.
Dated	25. 3. 1884/19.	

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57

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25TH MARCH 1884, No. 814 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

General.
Establishment.

AD—the following paper :—

No. 6 E.W.

Note by the Acting Chief Engineer for Irrigation.

I have just inspected the whole of the Buckingham canal for the first time since it was placed under the Chief Engineer for Irrigation, and consider that the present system of working requires considerable modification.

2. Prior to the late re-organisation of the Public Works Department, the Buckingham canal was under the charge of a Superintendent of Works, and the plans for the completion of the canal were designed by that officer under the personal superintendence of General Sankey, who took great interest in the work. General Sankey continued to direct the preparation of the estimates, even after the appointment of Superintendent of Works was abolished and the Canal division was placed under the superintending Engineer, V Circle, and finally submitted them to the Government of India without their having passed through the Superintending Engineer's office. In consequence, the Superintending Engineer has had little to do with the work and has never inspected it.

3. The canal is at present divided into three sub-divisions. The southern, consisting of the junction canal through Madras and the whole of the southern canal, a distance altogether of about 72 miles, is under the charge of a Sub-Engineer with no assistance; head-quarters, Madras. The central sub-division, extending from Madras a distance of about 91 miles, is in charge of a Sub-Engineer and Honorary Assistant Engineer with one supervisor to assist him; head-quarters, Madras. The northern sub-division, about 105 miles, to the junction with the Kistna canal, in charge of a Sub-Engineer with one overseer to assist him; head-quarters, Ramapatnam. The Executive Engineer's head-quarters are in Madras. In fact, the Executive Engineer and his two senior upper subordinates reside in Madras, and the junior upper subordinate, whose nearest point is more than 90 miles from the Executive Engineer's head-quarters, is left very much to his own devices. His works are very rarely inspected, and the clearance of the canal, on which very large sums are spent annually, never can be checked at all.

4. The completion estimates having now been sanctioned, and a promise made by the Government of India to grant a yearly sum of $1\frac{1}{2}$ lakhs towards the work, if possible, on condition that $1\frac{1}{2}$ lakhs are granted from Provincial, which condition the Government of Madras has accepted, there will be for some time a yearly expenditure of 3 lakhs on new works. Under the arrangements at present made it is doubtful if this amount will be expended. Important works in the neighbourhood of Madras and as far north as the upper part of the Pulicat lake are in hand, and beyond this only the embankment of rivers has been commenced. While allowing the importance of the works near Madras, I consider it unwise to spend nearly the whole of allotment (if it can be done) on these works, and looking to the importance of encouraging navigation from the Kistna southwards, and the complaints, which are not altogether unfounded, of the state of the canal, I think it desirable to commence from Pedda Ganjam and carry out the completion works thoroughly and continuously, forming a good line of navigation as we go southwards. I would besides continue the important work of draining the rivers throughout the length of the canal.

5. I do not think it will be necessary to make any considerable increase to the existing establishment in order to take up the work properly. The sanctioned scale is 1 Executive Engineer, 1 Assistant Engineer, and 4 upper subordinates; while the existing establishment is 1 Executive Engineer, 3 Sub-Engineers (1 of whom is an Honorary Assistant Engineer), 1 supervisor and 1 overseer. I suggest merely providing an Assistant Engineer instead of 1 Sub-Engineer and adding 2 overseers; and I propose to arrange this establishment as follows:—

Southern Sub-division.

From Adyar to Merkanam, about 66 miles.

Head-quarters: Sadras.

Establishment.—1 Sub-Engineer in charge.

1 Overseer.

Central Sub-division.

From Adyar to Kistnapatam, about 96 miles.

Head-quarters: Madras.

Establishment.—Executive Engineer in charge.

1 Supervisor.

1 Overseer.

Northern Sub-division.

From Kistnapatam to Pedda Ganjam, about 105 miles.

Head-quarters: Ramapatnam.

Establishment.—1 Assistant Engineer in charge.

1 Sub-Engineer.

1 Overseer.

6. I shall expect the Executive Engineer not to allow a longer interval than six weeks to elapse between his inspections of the northern sub-division, and the Assistant Engineer must of necessity spend most of his time in a boat. The boats at present in use on the canal are most wretched affairs, and altogether unfit to live in either in hot weather or in rains. I have sanctioned a new boat for the Executive Engineer being constructed from tools and plant, and will now arrange for two rather smaller boats being constructed for the Assistant Engineer and senior Sub-Engineer, the best of the existing boats being put in order for the other subordinates, and those past repair being sold.

CAMP, COMMAMUR CANAL,
18th January 1884.

(Signed) J. O. HASTED, Col., R.E.,
Acting Chief Engineer for Irrigation.

To the Chief Engineer, Public Works Department.

ORDER—dated 25th March 1884, No. 814 W., Public Works.

The proposals of the Chief Engineer for Irrigation for the future supervision of the Buckingham canal are approved.

2. It is hoped that the changes will result in a much more vigorous prosecution of this very important work.

3. An Assistant Engineer will be allotted to the division as soon as possible.

(True Extract.)

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

To the Superintending Engineer, V Circle.
,, Chief Engineer for Irrigation.
,, Examiner, Public Works Accounts.

Exd. E. Fernandez.

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814
2

GENERAL.
ESTABLISHMENT.

Govt. of (1884) Madras.
PUBLIC WORKS.

Dated March, 25th.

Recd.

Encl.

G.O., 25th March 1884, No. 814 W.

MARCH.

Buckingham Canal

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Irrigation for the future supervision of the
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the personal Superintendence of General
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Head Quarters - - - - - Sadras.

Establishment - 1 Sub Engineer in charge

1. Overseer.

814
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5

Central Sub Division

From Adyar to Kistnapatnam - about 96 miles

Head Quarters - - - - - Madras.

Establishment - Executive Engineer in charge

1 Supervisor.

1. Overseer.

Northern Sub Division

From Kistnapatnam to Peddaganjam - about 105 miles,

Head Quarters - - - - - Ramapatnam

Establishment - 1 Asst. Engineer in charge.

1 Sub Engineer.

1. Overseer

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Camp
Commander
Canal
18th Jan'y 1884
Dep't 302

Is. estd.

Col. R.E.

Ag. Chief Engineer for Irriga

To

The Chief Engineer
D. P. W.

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altogether unfit
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Sub Engineer, the
boats being pu
other Subordin
repair being so

No. 841 Wd/Ho. 3. 83
" 842 Wd/Ho. 3. 83
" 2331 Wd/Ho. 3. 83
" 562 Wd/Ho. 2. 83

Camp
Commander
Canal
18th Jan'y 1884
Dep't 30

To

The

Enc: 20/3/84 R. H. Sankey

814/387
List of Plans and Estimates of the Buckingham Canal Project to accompany the letter to the
Government of India, No. 842 W., dated 14th March 1883.

Index No. of Portfolio.	Subject.	Number.
1.	Index Map, showing the alignment of Buckingham Canal and its component parts.	1
2.	Longitudinal and Cross Sections of the Northern Buckingham Canal, showing proposed alterations and improvements	1
3.	Longitudinal and Cross Sections of the Southern Buckingham Canal, showing proposed alterations and improvements	1
4.	Type Designs of Masonry Works on Buckingham Canal	1
5.	Longitudinal Diagram of the Northern Buckingham Canal, showing Maximum and Minimum Tide Levels and proposed Bed Level	1
	Summary of Estimates for improving the several reaches of the Buckingham Canal as sanctioned in detail from time to time by the Madras Government (printed with Report)	1

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

14th March 1883.

14TH MARCH 1883, No. 842 W., PUBLIC WORKS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

No. 108.

LETTER—from

COLONEL R. H. SANKEY, C.B., R.E.,
Secretary to the Government of Madras,

Public Works Department,

To

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

SIR,

I am desired to submit, for the information and sanction of His Excellency the Governor-General in Council, the plans and estimates, as per accompanying list, for the completion of the Buckingham Canal.

2. Full and complete information regarding the details of this important work having been afforded in the report on the estimate and the appended Note by the Chief Engineer, it will suffice here to remark that although commenced very early in the present century, the work languished from lack of means for its prosecution till the late famine, when it was vigorously prosecuted for relief purposes.

3. Though then left in a very incomplete state, the value of the canal as a communication connecting Madras with the Godavari and Kistna Delta Systems to the north, and with Merkanam to the south, has now been fully established, and its importance as a Protective Work during famine placed beyond doubt.

4. The work was classed under this latter head in G.O., 9th July 1881, No. 1697 W., Appendix D, and subsequently in the communications as per margin.

1. Letter to Government of India, No. 1697 W., dated 9th July 1881.

2. Letter from Government of India, No. 681 G., dated 5th May 1881, paragraph 7.

3. Letter from Government of India, No. 1250 G., dated 23rd September 1881, paragraph 9.

4. Docket to Government of India, No. 2922 W., dated 23rd November 1881.

5. Letter from Government of India, No. 473 A.G., dated 22nd December 1881.

6. Letter to Government of India, No. 88 W., dated 11th January 1882.

7. Letter to Government of India, No. 348 W., dated 7th February 1882.

Telegram from Government of India, dated Calcutta, 13th February 1882.

8. Letter from Government of India, No. 33 A.I., dated 14th February 1882.

9. Docket to Government of India, No. 1307 W., dated 25th May 1882.

10. Letter from Government of India, No. 107 A.I., dated 14th July 1882.

5. Of the total estimate for the work, Rs. 63,87,000, about Rs. 32,25,000 will have been expended by the close of the current official year, leaving Rs. 31,62,000 for outlay in 1883-84 and subsequent years.

6. It is not considered that even with the needful temporary increase to the Divisional Establishment more than three lakhs can be satisfactorily expended annually, and as Provincial can, with justice to other pressing calls, only spare one lakh towards the work, I am to solicit a grant-in-aid from Famine Insurance Funds to the extent of two lakhs per annum during the next ten years.

7. It is, of course, to be understood that Provincial has to meet not only all repair and maintenance charges without

814
98
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14TH MARCH 1883, No. 842 W., PUBLIC WORKS.

assistance for the work, but has also to pay for the needful establishment, the special grants for which heretofore made from Protective ceasing in future if the above arrangement be acceded to.

I have the honor to be,

Sir,

Your most obedient servant,

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

FORT ST. GEORGE,
14th March 1883.

Exd. A. F. Goodall.
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814
9

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of Madras.

PUBLIC WORKS.

Dated March, 14th.

Recd.

Encl.

14th March 1883, No. 842 W.

MARCH.

No. 108.

Buckingham Canal.

FORWARDING plans, estimates, &c., for the
completion of the —.

18TH AUGUST 1883, No. 2331 W., PUBLIC WORKS.

8/14
10

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

READ—the following paper :—

Office Note from the Examiner, Public Works Accounts, dated 14th August 1883,
No. 499.

ERRATUM.

In the Statement in paragraph 19 of the Chief Engineer's Note printed with
G.O., No. 562 W., dated 20th February 1883, page 29—

For
" Total per mensem Rs. 258
Total per annum " 3,096 "

Read
" Total per mensem Rs. 204
Total per annum " 2,448 "

(True Extract.)

(Signed) R. H. SANKEY, Major-General, R.E.,
Secretary to Govt., P.W.D.

To the Chief Engineer for Irrigation.
" Superintending Engineer, First Circle.
" " " Second Circle.
" " " Third Circle.
" Board of Revenue.
" Revenue Department.
" Examiner, Public Works Accounts.

Exd. E. Fernandez.
Spare Copies

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of (1883) Madras.

PUBLIC WORKS.

Dated August, 18th.

Recd.

Encl.

G.O., 18th Aug. 1883, No. 2331 W.

AUGUST.

Erratum

*In the Statement in paragraph 19 of the
Chief Engineer's Note printed with G.O.,
No. 562 W., dated 20th February 1883,
page 29, regarding the revised Navigation
Rules.*

814
11

REPORT ON THE BUCKINGHAM CANAL.

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of (1883) Madras.

PUBLIC WORKS.

Dated August, 18th.

Recd.

Encl.

G.O., 18th Aug. 1883, No. 2331 W.

AUGUST.

Erratum

*In the Statement in paragraph 19 of the
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No. 562 W., dated 20th February 1883,
page 29, regarding the revised Navigation
Rules.*

814
11

REPORT ON THE BUCKINGHAM CANAL.

814
12

CONTENTS.

	PARAS.
Position of the Canal	1
Length of main Navigable Canals	2
Distance from the sea	3
General nature of the country in which the Canal is made	4
How these natural features have been taken advantage of for Navigation	5
Cochrane's Canal, 6 miles	ib.
Katupalli do. 8 "	6
Condition of the Canal in 1852	7
Shadayankuppam Lock, 7 miles 3 furlongs	8
Pulicat Lake to Dugarápatnam, 44 miles	9
Dugarápatnam to Kistnapatnam, 21 miles	10
Estimate and Expenditure on the above section	11
Kistnapatnam to Pennér River, 24 miles	12
Pennér River to Pedda Ganjam, 82 miles	13
Famine work	ib.
Pennér River to Chippalairu River, 18 miles	14
Chippalairu northwards for 22 miles	15
Northern 42 miles to Pedda Ganjam	16
Surveys and Estimates delayed owing to supervision of actual work in progress	17
Comparison between the line proposed by Captain Chambers and adopted	18
Bed level	ib.
Errors in the levels of Canal between Kistnapatnam and Pennér	ib.
Bed width	19
Canal slopes	ib.
Total Excavation	ib.
Estimated rate	20
Actual quantity and rate	ib.
Amount of work done	ib.
Total length of canal cut in thirteen months	ib.
Number of people employed on the work	ib.
Named after His Grace the Duke of Buckingham at Mr. O'Shaughnessy's request	21
Portion previously named after Lord Olive	22
East Coast Canal, a more suitable name	23
Southern Canal	24
Canal beyond Merkanam for a distance of 23½ miles	25
Junction Canal	26
Cyclone of 1879	28
Results of the cyclone	29
Discussion thereon and estimates framed	30
Sole aim of the several projections of making the Canal a safe line of internal navigation.	31
Principle acted on did not admit of regulating works	32
If natural conditions were permanent above principle correct	33
Recurrence of cyclones	34
General condition of Canal after cyclone	35
Hence the principle of non-regulation cannot be maintained	36
Measures necessary to be adopted for regulation	37
Principles upon which the completion estimates are based	ib.
Reasons for and against the construction of Locks as regulating works	38
Flood Gates	
Their description	
Their utility	
General provisions under which the present estimate has been framed—	39
(1) Isolation of reaches	
(2) Treatment of minor cross drainages	
(3) Unnecessary river bars to be closed	
(4) Result of experience of cyclones	
(5) Detail of construction of canal	

(6) Shallow rivers to be embanked ...	PARAS.
(7) Diversion lines to be formed ...	
(8) Canal removed where necessary out of backwaters ...	
(9) Boat Basins and lay-hys to be provided ...	
(10) New Bridges constructed and existing ones altered ...	39
(11) Inspection bungalows and accommodations for Toll Establishments ...	
(12) Terminal Basin at Madras to be improved ...	
Method of dealing with different reaches of the Canal ...	40
Junction cut from Buckingham Canal to Commamur Canal ...	41
Pedda Ganjam to Gundlakamma River, 8 miles ...	42
Gundlakamma River to Mudigondi River, 3 miles ...	43
Mudigondi River to Moosee River, 14 miles ...	44
Moosee River to Palairu River, 1 mile ...	45
Palairu River to Mannairu River, 8 miles ...	46
Mannairu River to Elikaru River, 10 miles ...	47
Elikaru River to Chippalairu River, 18 miles ...	48
Chippalairu River to Pydaru River drainage, 9 miles ...	49
Pydaru River to the Pennér River, 7 miles ...	50
Pennér River reach, 2½ miles ...	51
Pennér River to Gungapatam River, 3½ miles ...	52
Gungapatam River to Kódúr River, 9½ miles ...	53
Kódúr River to Nalatúr River, 6 miles ...	54
Nalatúr River to Kundalairu River, 5½ miles ...	55
Kundalairu River to Swarnamukhi River, 14 miles ...	56
Swarnamukhi River to Dugarápatnam River, 8½ miles ...	57
Dugarápatnam River to Coromandel, 41 miles ...	58
Coromandel to Arni River, 3 miles ...	59
Arni River to Ennore backwater, 13 miles ...	60
Ennore backwater to Cooum River, 11 miles ...	61
Cooum River, 1 mile ...	62
The Junction and Southern Canal ...	63
Adyar to Covelong, 15 miles ...	64
Covelong to Kokkelamodu, 16 miles ...	65
Kokkelamodu to Pálar River, 8 miles ...	66
General summary of Estimates ...	67
Substitution in certain items of Estimate proposed ...	68
Total outlay on the work ...	69
Soil in foundations of masonry works ...	70
Data for rates allowed in Estimates... ...	71
Particulars of Traffic ...	72
Description of boats plying on the Canal ...	73
Registration of Tides ...	74
Limiting levels for determining improvements to Canal ...	75
Peculiar circumstances of certain reaches in the Canal ...	76
Necessitating reclamation of the backwaters with which they are connected ...	77
Instances of the Pulicat Lake ...	
Proposed method of reclamation ...	
Resultant benefits derived from the canal ...	

NOTE.—The figures entered in the margin of the Report thus, ¹³⁴III to ¹³²VI, denote miles and furlongs.

REPORT ON THE BUCKINGHAM CANAL.

Fund.—Provincial.

Financial Head.—33, Irrigation and Navigation.

Budget Head.—Works for which neither Capital nor Revenue Accounts are kept.

Departmental Head.—Original Works.

Name of Work.—Buckingham Canal.

REFERENCES.

- G.O., No. 2153-A, dated 17th August 1876.
 Do. " 920, dated 17th March 1877.
 Do. " 1238, " 10th April " "
 Do. " 266 W., dated 18th June 1877.
 Do. " 845 W., " 19th February 1878.
 Do. " 283 W., " 6th " 1880.
 Do. " 284 W., " 6th " "
 Do. " 2080 W., " 3rd September "
 Do. " 2081 W., " 3rd " "

814
103
14

REPORT.

THE Buckingham Canal is a salt-water canal (tidal to a great extent whenever the river bars are open), extending along the East Coast of the Madras Presidency, southwards 66 miles from Madras to Merkanam, and northwards 195 miles from Madras to Pedda Ganjam, at which place communication is made (at the end of the high level Commamur channel) with the fresh-water canal system of the delta of the Kistna, which again communicates with the canal system of the delta of the Godáviri.

2. The total length of main navigable canal to Cocanada and northwards thus made available is as below, viz. :—

	MILES.
Length of main navigable canals.	261
Buckingham Canal of the Kistna Delta Systems	112
High level canals (Commamur channel) of the Godáviri	89
Do. do.	
Total ...	462

this length being exclusive of any but the direct line of fresh-water canal from Pedda Ganjam to Sámalkót, viz., Bezváda, Ellore, Dowlaishweram, and Cocanada; though the branch canals of the Kistna and Godáviri will, no doubt, acting as feeders, bring much traffic to the main line.

3. The canal runs within 3 miles of the sea-coast throughout its entire length, and in many parts is within half a mile of it.

4. The general features of many parts of the East Coast of the southern portion of India are briefly as follows :—
General nature of the country in which the canal is made. Close to the sea there is generally a line of sand dunes, between which and, frequently, a second line of dunes, there is a hollow which may be taken as the result of the action of waves, currents and winds on the extension of the coast line eastward due to the silt, &c., brought down by each river into the sea. These hollows, frequently forming back-waters, are filled with water, and are of sufficient depth in many places for navigation, being supplied with sea water through the bars of the rivers with which they are in connection.

5. Early in this century (1801) the narrow strips of backwater found at the mouth of the river Kortalayár suggested to Mr. Heefke to obtain from Government permission to cut a canal, about 11 miles in length, from Madras to the southern end of the Ennore backwater; this permission was granted, and Mr. Basil Cochrane was the surety to Government for the terms being complied with.

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103
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General nature of the country in which the canal is made. Close to the sea there is generally a line of sand dunes, between which and, frequently, a second line of dunes, there is a hollow which may be taken as the result of the action of waves, currents and winds on the extension of the coast line eastward due to the silt, &c., brought down by each river into the sea. These hollows, frequently forming back-waters, are filled with water, and are of sufficient depth in many places for navigation, being supplied with sea water through the bars of the rivers with which they are in connection.

5. Early in this century (1801) the narrow strips of backwater found at the mouth of the river Kortalayár suggested to Mr. Heefke to obtain from Government permission to cut a canal, about 11 miles in length, from Madras to the southern end of the Ennore backwater; this permission was granted, and Mr. Basil Cochrane was the surety to Government for the terms being complied with.

The contractor, Mr. Heefke, and Mr. Cochrane ultimately obtained the whole control of the canal—completed the section of the canal from Madras to Ennore backwater in 1806. Some cuts were also made near Katupulli between the backwaters so as to complete the communication with the Pulicat lake, 27 miles distant from Madras. Mr. Cochrane became sole proprietor of the canal for a period of 45 years, dating from 1st November 1802, with permission to levy tolls on it. In 1837, he having left India, the canal got into bad order, and Government took it over, paying to him Rs. 14,061 a year, which was the average amount he had been realizing from the traffic, until 1847, when his lease expired.

6. Such was the commencement of the East Coast Canal, and from the condition of the waterway, as shown in Appendix II of the first Report of the Madras Public Works Commissioners, there had by 1852 been great silting up of the bed. The system followed in construction was merely that of joining the backwaters in the cheapest manner possible.

7. The Shadayankupam Lock, 7 miles from Madras, was commenced in 1854, with the object of keeping the level of the water in Cochrane's Canal high during periods when the Kortalayár bar at Ennore is open. It was originally sanctioned at 16 feet wide and 105 feet long, but Captain Chambers, R.E., the then Superintendent, obtained permission during its construction to alter it to 20 feet wide and 150 feet long.

8. In the first Report of the Public Works Commissioners, compiled in 1852, in Commissioners' Report. Appendix II, paragraphs 27, 28, notice is taken of improvements to the canal by extending it to Dugarápatnam, 69 miles from Madras, from the northern end of the Pulicat lake; along this line strips of backwater more or less were found, so that the cutting was not heavy and the work was in progress in 1854, and is shown by the Progress Report for 1856-57 to have been "recently extended" to Dugarápatnam. In the same year improvements were also made to Cochrane's Canal to the extent of Rs. 72,800, inclusive of the Shadayankupam lock, estimated to cost Rs. 25,000.

9. In the same Progress Report mention is made of a proposed extension of the Dugarápatnam to Kistnapatam, 21 miles. East Coast Canal from Dugarápatnam to Kistnapatam backwater (the estimated cost being Rs. 1,13,665) as having been included in the budget of 1855-56, and the project was recommended to the Honorable Court of Directors in 1855; this estimate was framed by Captain Chambers, R.E., but was not carried out. As shown by G.O., No. 189, of the 20th January 1865, Mr. W. Fraser, C.E., was engaged about that time in a comparison between the merits of Captain Chambers' design of December 1854 and one proposed by Mr. Kennedy in November 1863, and estimated to cost Rs. 2,35,000. Government, however, were unable to provide funds for either.

10. Captain Hasted, R.E., in June 1870, submitted a revised estimate of Estimate and expenditure on the above section. Rs. 2,87,000 for this section of the canal, which was at the time being out, following Captain Chambers' line in preference to Mr. Kennedy's; the estimate of Rs. 2,35,000 for the latter was, however, the one on which the work was executed—

	RS.
The expenditure in 1867-68 was	6,248
Do. 1868-69	64,796
Do. 1869-70	35,154
Do. 1870-71	29,827

when work was suspended under G.O., No. 274, of 28th January 1873. Funds were provided for the remainder of the work on Colonel Hasted's estimate, and orders were

given to push on the work in 1873-74 from Provincial Funds, and work to the extent of Rs. 67,000 was carried out in that year; Rs. 59,845 were expended in the year 1874-75, the section being completed in 1876-77 at a total cost of Rs. 2,85,532, thereby placing Nellore in easy communication (with a short length of road from Kistnapatam) by water with Madras. This section was reported open for traffic in May 1875, the portion up to Siddaveram having been made by Mr. Fraser, and from Siddaveram to the Kundelairu by Lieutenant C. B. Henderson, R.E.

11. The next section of the East Coast Canal undertaken was that from the Kundelairu river, close to Kistnapatam, to the Pennér river. The work was sanctioned under G.O., No. 814, of the 23rd March 1875, and the line followed is for the most part identical with that proposed by Captain Chambers nineteen years before; the estimate amounted to Rs. 2,74,000. In G.O., No. 266 W., of the 18th June 1877, certain modifications, including the Kistnapatam basin, were sanctioned, estimated by Mr. O'Shaughnessy to cause an addition of Rs. 14,100. This section was commenced by contract in 1875-76, in which year 25,000 rupees were spent on it, Rs. 1,71,658 being spent in 1876-77. Six miles were completed by November 1876. In the year 1877-78 this section was employed as a famine work for the distressed of the Nellore District, Rs. 1,06,755 being expended, and the work completed in 1878-79 at a total cost of Rs. 3,63,536. This section was open for traffic in May 1877; having been under Lieutenant C. B. Henderson, R.E., from 1873-75, under Lieutenant Cotter, R.E., in 1876, and, lastly, under Sub-Engineer Ottmann and Supervisor Stephens.

12. G.O., No. 1302, of 24th May 1873, shows the state of the work up to that date, and points to the anxiety of Government to complete at an early date the communication with the Godávari and Kistna Systems of Navigation. Lieutenant Cotter, R.E., in June 1875, had reported on the section from the Pennér to the Chippelairu, and had pointed out that the high floods of October 1874 in the Pennér had altered the features of that river since Captain Chambers had selected his line as being the most suitable one for the canal.

13. The pressure of famine being very severe in the districts to the west of Nellore, it was decided in G.O., No. 3060, of 15th November 1876, that this section of canal should be immediately proceeded with by famine labor imported from the Bellary, Kurnool, and Cuddapah Districts. Under the orders of Mr. O'Shaughnessy, the District Engineer of Nellore, Lieutenant C. B. Henderson, R.E., was directed to lay out the section of canal between the Pennér and Chippelairu, and he did so, following where practicable, Captain Chambers' line and giving a bed width of 30 feet with side slopes of $2\frac{1}{2}$ to 1. The bed of the canal was fixed at $3\frac{1}{2}$ feet below a mean of all low tides recorded for six months and 3 feet below the lowest recorded spring tides. This section was ordered to be carried out by 10,000 coolies from Bellary and Kurnool. After laying out the portion to the Chippelairu, Lieutenant C. B. Henderson, R.E., was directed to survey and lay out the section to the north of the Chippelairu for the employment of a second batch of 10,000 coolies.

14. At the same time Lieutenant C. C. Rawson, R.E., was directed to commence at Pedda Ganjam and survey and set out work for the employment of 20,000 more coolies on 42 miles. Chippelairu northwards for 22 miles. Northern 42 miles to Pedda Ganjam.

15. The surveys and estimates were pushed on as quickly as practicable, but in this case, as in all the famine works, it was primarily necessary to employ and pay or feed the coolies, and so the work of projection and estimation had necessarily to take a secondary place; however,

Lieutenant Henderson, R.E., in the Pennér to Mannairu section, and Mr. deGroussillers, an Executive Engineer of the Bengal Public Works Department, in the Mannairu to Pedda Ganjam, nevertheless, pushed on the plans and estimates quickly, at the same time that they supervised the execution of the works.

16. In his original report on the Pennér to Pedda Ganjam section of the canal, Mr. O'Shaughnessy states that the line is generally the same as that selected by Captain Chambers in 1855, but that certain deviations had to be made; in the first four miles a deviation to the westward was made, as Captain Chambers' line was too near the sea; in the 7th and 8th miles a deviation was made to avoid cutting through a high ridge; in the 10th to the 14th miles a deviation was made to obtain a sufficient cutting for towpaths and embankments; in the 15th mile a deviation to avoid a deep cutting was made. Between the Chippelairu (about the 20th mile) and the 52nd mile north of the Pennér no deviation was made from Captain Chambers' line; from the 52nd to the 56th miles a trifling deviation was also made to carry the line further from the sea. A considerable deviation was made from the Moosee river near Ethamukala to the Ongole road, between the 56th and 63rd miles, to avoid a very heavy cutting through sand, and also to keep clear of some valuable land.

17. In regard to the level of the bed, Mr. O'Shaughnessy writes:—"Hitherto 4½ feet below mean tide level has been the specified depth of the canal. It was supposed that the range of tides was about 3 feet, and that a depth of 4½ feet below M.S.L. would give a minimum depth of 3 feet for navigation at low tide." * * * "It has been found, however, that the range of the tides is more than 3 feet at Kistnapatam; a gauge has registered a range of 3 feet 10 inches, and at the Mannairu, 71 miles further north of the gauge, has shown a difference of level between high and low water of springtides of over 4 feet; if the canal was cut to 4½ feet below mean tide in those reaches, there would be only 2 feet 6 inches or 2 feet 7 inches of water at low tide, or about 6 inches less than the depth required."

18. Mr. O'Shaughnessy points out that this error has been carried through the section between Kistnapatam and the Pennér, but to the north of the latter river it has been avoided by fixing gauges to a depth of 3 feet below the lowest readings on the gauges. The width at the bed was made 30 feet, with side slopes of 2, 2½, and 3 to 1, according to the nature of the soil.

19. Mr. O'Shaughnessy estimated that the whole excavation required for the canal from the Pennér to Pedda Ganjam would be 8,652,146 cubic yards at 1 anna 10 pies per yard, and his subsequent report shows that in actual working 7,959,708 cubic yards completed by the end of May 1878 had cost on an average 2 annas 2¾ pies per yard, an excess which he had attributed to the employment of famine labor.

20. The same officer reports that including 16¼ miles of the Kistnapatam to Pennér section and 16¾ miles of new canal along the margin of the Pulicat lake, a total length of 115½ miles of canal were open to traffic between December 1876 and January 1878, and gave employment to an average of 32,000 work-people daily, while the greatest number of people on the work at one time was 61,200 (or including women and children, 100,000 persons were at one time on the work

during the famine); and he concludes his report by an allusion to the fact that he had asked for, and obtained permission from His Grace the Duke of Buckingham to name the canal after him. It may here be observed that the portion of the canal from Madras to Ennore appears to have been originally (*vide* Atlas Sheet No. 78) named after the great Lord Clive. The designation subsequently applied to the work, "East Coast Canal," so distinctly pointed to the position of the work on the Map of India that it seems doubtful whether, looking also to the fact that Government did not take the initiative in the matter, His Grace did not permit it to be called after himself rather than wound the feelings of an energetic District Engineer, during whose charge of the Nellore Division the junction with Kistna system of canals had been completed. That the work was no new design, but had been steadily prosecuted, at intervals, ever since the beginning of the century, especially in the years 1867 to 1870, and with even more vigour again in the years 1872 to 1875, will have been observed from the history as above narrated. The designation of the work as the Buckingham Canal is, however, so far the accepted one, that there is now no sufficient reason for again altering it.

Portion previously named after Lord Clive.
East Coast Canal a more suitable name.

21. Turning to the Southern Canal, Colonel Foord's memorandum, dated the 29th November 1878, printed with G.O., No. 1102, of the 20th May 1879, puts on record in paragraphs 26 to 47 the whole history of the work, which is quoted below for ready reference:—

"26. The project of excavating a canal along the Eastern Coast between the Adyar and the Pálár, with the view of perfecting the long line of inland water communication north and south of Madras, was brought forward for consideration in the year 1854. Two points in connection with this project particularly claimed attention—

- "(1) The possibility of keeping the canal navigable throughout the year; and
- "(2) The substitution of masonry bridges in lieu of ferries, recommended by the Chief Engineer, at each of the places where the road crossed the proposed water communication.

"27. The Chief Engineer, who made a personal examination of the canal, reported that it was quite possible to keep up an unfailing supply of water, averaging 4 feet 6 inches, in seasons of the greatest drought, by artificial cuttings of the bars at Covelong and at the mouth of the Pálár. This result, however, could only be attained by a proper system of locks with a sluice or calingulah at Covelong, for the admission of tidal water. Bridges were also recommended at three places. The whole cost of the work was estimated at Rs. 2,21,800.

"28. The length of the canal was to be 40 miles. The first section extended from the river Adyar to the town of Sadras, a distance of 35 miles. This section was commenced in May 1855 and completed in the early part of March 1857, with a surface width of 45 feet, and a depth varying from 3 feet 6 inches to 4 feet 6 inches. Boats drawing 1 foot 6 inches were, in March 1857, enabled to use this section throughout, and it was calculated that there would be sufficient water for passenger traffic, and the transport of light goods even when the Adyar, Covelong, and Yeroor bars were closed.

"29. The expenditure on the canal amounted to Rs. 1,75,500 against the sanctioned estimate of Rs. 2,21,800.

"30. The extension to the river Pálár, 5 miles south of Sadras, was estimated to cost Rs. 54,750. The average cost of the 40 miles of canal between the rivers Pálár and Adyar, including five large bridges, each 60 feet span, was thus Rs. 7,000 per mile.

"31. In March 1857 an estimate, amounting to Rs. 7,800, was sanctioned for completion of a cut through pure sand, close to the sea, between Sadras and the Pálár, 1½ miles in length. The object of the work was to improve the alignment.

"32. In the same year a Committee was appointed to consider the question of the existing navigation, and the measures necessary for its improvement and extension. As regards the Southern Canal, the Committee recommended the establishment of landing places in different parts of Madras, with the view of bringing the Cooum into use for purposes of traffic, and the construction of feeder roads. The Government recognized the importance of the proposed measures, and called for plans and estimates.

G.O., No. 166, dated 29th January 1856.

814
16

"33. The estimate of Rs. 7,800, sanctioned in March 1857, for the extension of the canal from Sadras to the Pálar river, was, in December 1859, superseded in favor of an estimate of Rs. 21,000. This estimate provided for the alignment being taken further inland.

"34. In July 1861 the Government, on a representation of the Chief Engineer urging the commencement of the work, remarked that they did not see sufficient prospect of its proving so remunerative as to then justify the proposed large outlay. It was intimated, however, that as it was intended ultimately to connect the canal terminus at the Adyar with the Northern Canal, the scheme would be considered as a whole.

"35. The estimate of Rs. 2,21,800 for the Sadras Canal was subsequently reduced to Rs. 2,18,873, and of this sum Rs. 1,91,000 were spent, when further outlay was suspended for financial reasons, leaving the canal incomplete. In April 1862 the Government sanctioned a further expenditure of Rs. 29,000 for deepening and widening the canal between the Sadras river and Salancoopum. This estimate provided for deepening the southern portion of the canal to 4½ feet below mean tide, and was designed to complete the canal as allowed for by the estimate of Rs. 2,18,873.

"36. One of the main considerations in sanctioning the Sadras Canal was its capability of being prolonged to Cuddalore, to join there the canal from Porto Novo, which again is connected with the line of water communication between Coimbatore and the sea-coast through the district of Tanjore. This section of canal was sanctioned by the Government of India in July 1853 at an estimated cost of Rs. 40,000, and provided for connecting the ports of Porto Novo and Cuddalore by a cutting from the river Vellár near Porto Novo to the Paravanár or Cuddalore river. The canal was designed to give sea outlet to the traffic carried by the navigation of the Coleroon and Vellár rivers, the former of which runs inland a distance of 150 miles through Tanjore and Trichinopoly into Coimbatore.

"37. There being through water communication along the coast from the Adyar to the Sadras, and from Cuddalore to Porto Novo, it was proposed in March 1856 to excavate a canal through the intervening country. The project was originally framed as a prolongation of the Sadras Canal all the way to Cuddalore, a distance of 59 miles, but the southern part of the canal appearing to need more careful investigation, and arrangements having to be made with the French authorities for the passage of the canal through French territory, the Madras Government laid before the Government of India only a portion of the project, which included 34 miles of canal, estimated to cost Rs. 3,75,000.

"38. The canal was to be cut to a depth of 4½ feet below mean tide, and it was believed that even at the worst season there would be sufficient water in it for passenger and light cargo boats. The framer of the project provided for no locks, preferring to add them afterwards if found necessary; the bed of the canal being left to be acted upon by the flux and reflux of the tide, and to be scoured by the passage of the land drainage to the sea. The Chief Engineer, however, included two locks and falls, being of opinion that in a tract so destitute of large streams sufficient scour would not be obtained. Instead of admitting the intercepted minor drainage into the canal, the Chief Engineer proposed to lead it, wherever practicable, along the outside of the western bank by small channels until it reached a backwater or other main drainage, into which it would be made to enter at some distance from the navigation. Three bridges of masonry and three of timber were provided. The section allowed for the cutting gave a bottom width of 20 yards. This width was considered necessary in consequence of the sandy nature of the soil. Some difficulty was anticipated in keeping the canal free from sand-drifts, and it was intended to plant the top of the banks with palmyra as a protection, and the slopes with shrubs and marine creepers. In some places the banks were considered to require puddling.

"39. The Government of India took exception to the project, on the ground that it did not appear clear how its level could be steadily maintained unless there were a lock at each point where it enters and emerges from the tidal lagoons, through which it passes. To this it was replied that though locks formed no part of the original project, yet two were included in the revised estimate drawn up in the Chief Engineer's Office, that such works would not have been thought so indispensable to maintain a sufficient depth for navigation had the fact been known that the extreme difference of level between spring and neap tides in the backwaters is under 2 feet, while the actual rise and fall is only from 6 to 9 inches; and that the depth of the bed of the canal being assumed at 4 feet 6 inches below mean tide, and the fall of tide in neaps being, as above stated, only 1 foot below this level, the minimum depth of water lasting perhaps not more than a few hours once a fortnight, would still be 3 feet 6 inches. It was added that the locks introduced into the project in the Central Office were doubtless intended for increasing the depth of water in the canal by the retention of land floods, and, though not quite sufficient in number to effect that object entirely, would still add greatly to the efficiency of the

communication. The framer of the project, Lieutenant Chambers, was, however, of opinion that tidal locks in estuaries with such little rise and fall as those on the East Coast are not of unmixed good to the canals on which they are constructed. He held that in connection with weirs, their adjuncts, they offer obstruction to the free flux and reflux of the tidal wave, and diminish greatly its scouring power, and he was of opinion, therefore, that their construction need not be simultaneous with the establishment of any one section of the coast line; in fact, that the locks should not be built until experience shall have pointed out their necessity or utility, or at least not until after a few years' scour, to allow the banks, berms, and sides of the main channel and of the drainage cuts of a tidal canal to assume their normal shapes and slopes. These views were concurred in generally by the Superintending and Chief Engineers, the latter of whom remarked that the two locks added to the estimate were intended for the junction of the canal with the estuary of the Pálar on the north, and that of the Merkanam river on the south, between which points there exist no drainage outfalls which may not be regulated by simple weirs, which being provided with ample sluices, will always admit as much tidal water as will keep the canal full when the bars are open. The Chief Engineer added that the locks would, in his opinion, be necessary to prevent or retard the subsidence of the canal surface with the evaporation of the backwaters during the hot season. When fully completed the canal would, the Chief Engineer stated, form one long backwater or lagoon, receiving all the drainage of the country it traverses, and discharging the surplus by the waste weirs, both intermediate and terminal, and that on the proper construction of these works would greatly depend the freedom of the channel from deposits.

"40. The project was brought forward to the Government of India, for an appropriation of funds in the budget of 1858-59, but no funds were granted, and the Court of Directors seemed to think that the time had not then arrived for expending the large amount of money required for the completion of the line of water communication along the East Coast of the Presidency.

"41. The coast canal in the South Arcot and Chingleput Districts was again brought forward in connection with the recent famine as suitable work on which to employ the distressed population.

"42. This section from the south bank of the Pálar to Merkanam at the southern boundary of the Chingleput District was ordered to be lock-spitted in G.O., No. 412 W., dated 25th January 1878. In August of the same year an estimate of Rs. 1,79,600 was submitted for the execution of work. The total length of this portion of the canal is 20 miles 3 furlongs, which added to the portion already open, will give a length of 60 miles 6 furlongs from the Adyar.

"43. On leaving the Pálar, the canal, as now aligned, skirts for a short distance a sandy ridge, and is then taken through 3 miles of wet cultivation. It afterwards follows the course of backwaters almost the whole way to the boundary of the Chingleput District. There is, however, a bit of very high ground, about 2 miles in length, between the Cheyúr and Merkanam backwaters. The cutting required here is 7 yards. The estimate, amounting to Rs. 1,79,600, for this portion of the canal received the final sanction of Government in G.O., No. 2102, dated 9th October 1878, F.R.

"44. From Merkanam to French territory estimates for the canal have been prepared. The cost of the earthwork is estimated at Rs. 3,28,000, and that of the masonry at Rs. 1,19,700. To this a sum of Rs. 45,800 has to be added for compensation for land, making a total of Rs. 4,93,500 for the portion of the canal which is in English territory. For a distance of 2½ miles the canal runs through French territory. This length is estimated to cost Rs. 1,70,880. The total cost of the portion of the canal between Merkanam and French territory will therefore amount to Rs. 6,64,380.

"45. The section of the canal from the Vellár river near Porto Novo to the Paravanár was estimated for in 1878. This section was originally cut in 1856, and was commenced as a famine relief work, but not completed. The excavation was not taken as far as it should have been. A depth of 4½ feet below M.S.L. and 20 feet bottom width has now been allowed, and an estimate, amounting to Rs. 85,855, sanctioned by Government in the Famine Department in G.O., No. 1518, dated 11th July 1878.

"46. In September 1878 an estimate, amounting to Rs. 31,290, was submitted for completing the canal from Vellár at Porto Novo southward to the Killiar, which communicates with the Coleroon. The canal was cut more than twenty years ago, but not apparently to the full depth of 4½ feet below M.S.L., and as it has not been repaired since the work was stopped in 1857, there is now a large quantity of silt to be removed. The length to be cleared is 3½ miles. The rest of the communication between the Vellár and Coleroon is by a natural backwater.

"47. The following statement shows the estimate sanctioned for the coast canal within Chingleput and South Arcot limits, and the budget provision made in successive years" —

Number.	Work.	Amount of Estimate.	Government Order sanctioning the Work.	AMOUNT APPROPRIATED IN				
				1866-67.	1867-68.	1868-69.	1871-73.	1878-79.
1	Adyar Junction Canal.	Rs. 5,02,378	G.O., No. 2874 W., dated 13th July 1878.	Rs.	Rs.	Rs.	Rs.	Rs.
2	From Adyar to Palár.	2,21,373	G.O., No. 321, of 10th July 1855.	1,21,873	40,931	27,306	6,12,166	46,867
3	From Palár to Merkanam.	1,79,600	G.O., No. 1243, dated 25th June 1857.	..	..	..	..	..
4	From Merkanam to the French territory.	4,92,500	G.O., No. 2102, of 9th October 1878, F.R.	..	..	..	..	5,12,582
5	From the French territory to Ouddalore.	1,70,880	Estimates under consideration.	..	..	..	..	..
6	From Ouddalore to Porto Novo.	49,000	G.O., No. 230, of 17th August 1853.	..	..	..	..	..
		85,856	G.O., No. 1518, of 11th July 1878, F.R.	..	..	..	..	1,56,856

21A. The portion between the Palár and Mudaliyarkupam (58 miles south of Madras) was opened for traffic in the latter months of 1880, and from this point down to Merkanam (66 miles south of Madras) was opened for traffic since April of the current year. Boats prior to 1880 were able only to ply between Madras and the Palár river (46 miles south of Madras).

22. The portion beyond Merkanam, not included in the present estimate, for a distance of 23½ miles, as far as the northern boundary of French territory (Pondicherry), the line has been surveyed, and for the work an estimate for Rs. 6,64,380 has been prepared, though probably requiring to be again checked and put into shape. This line of canal, though not at present proposed for execution, would form an excellent famine work, and would, it is considered, bring a good deal of traffic to Madras.

23. For many years it had been in contemplation to cut a canal between the Junction Canal, Cocum and Adyar rivers, in order to complete the water communication between the northern and southern canals. This work was carried out under instructions in

* This is the amount at which Mr. Fraser estimated the canal; a revised estimate is under consideration, completed as a famine relief work.

Actual Outlay.		Probable Normal Cost.	
1876-77	..	Rs. 28,306	Rs.
1877-78	..	5,83,861	16,982
		6,12,166	5,16,556
1878-79	..	46,867	5,32,638
Sanctioned as a famine relief work.			44,097

Actual Outlay.		Probable Normal Cost.	
1878-79, 1st April to 30th September	..	Rs. 12,582	Rs. 10,656
Ordered to be carried out as a famine relief work in G.O., No. 1720, of 9th August 1878, F.R.			

Actual Outlay.		Probable Normal Cost.	
1877-78	..	Rs. 5,566	Rs.
1878-79, 1st April to 30th September	..	6,587	..
		11,142	8,913

G.O., No. 3225, of 29th November 1876, the bed of the canal being 20 feet wide and the depth 3 feet below low-water springtides with side slopes of 2 to 1. A headway of 9½ feet clear above M.S.L. was ordered to be allowed for all bridges, which gives 6 feet above highest water level of the canal. The bridges are without towpaths, and the span of several of them being only 20 feet is inconvenient. The provision of towpaths which must subsequently be made will further contract the already over-restricted space, while the narrowness of the span has added sensibly to the cost of the bridges, owing to the long and heavy wing-walls thereby entailed. While the head of the canal was open to the river Adyar and Cocum, this construction of the waterway was a source of weakness to the bridges owing to the scour set up in the channel; but with the construction of the double lock sanctioned for 1881-82 at the south end of the Junction Canal, and which is intended to shut off the Adyar or Cocum floods, whichever may be the highest, all danger of this kind will be at an end.

24. As a conclusion to this brief history of the Buckingham Canal it may here be noted that before the estimates were submitted in detail for the work done during the famine, and before the banks were protected by well-grown vegetation, that portion of the coast through which it runs to the north of Madras was, in the months of May and November 1879, visited by cyclones, which, though perhaps not of maximum violence, were of sufficient force to damage the works considerably, and to prove clearly the necessity for modifications of the design in many particulars.

Cyclone of 1879.

25. The several G.Os. quoted at the head of this report under "References" show in detail the results of the cyclones alluded to, and Colonel Sankey's memorandum of the 10th April and 29th May 1880 printed therewith, give the conclusions which up to that time had been arrived at.

26. Since then certain points of detail have been discussed, and estimates for several portions of the work framed, and had orders passed on them.

27. With a large work of this character carried across the whole drainage of the country, and exposed in an exceptional manner to cyclones of the greatest severity, it would be impossible, without expanding this report to an undesirable length, to note fully in detail the effects that have been produced by these occurrences, or to set forth all the reasons for the modifications and improvements now considered essential, in order to give the desired stability to the work, and make it a safe line of internal navigation throughout the year.

28. As will have been gathered from the history of the work above narrated, the sole aim of the several projects has been to cut a navigable canal close to the sea-coast, taking advantage of all backwaters and depressions lying to the west of the outer line of sand dunes, so as to minimise the amount of excavation, and necessarily, therefore, the expense.

29. With the one exception of the lock at Shadayankupam (specially constructed in the interests of Madras sanitation), there were practically no regulating works of any kind. The principle acted on did not admit of regulating works. The principle acted on was simply improving a line indicated as it were by nature, allowing rivers and drainages to spill across the canal uninterruptedly on their way to the sea, did not admit of any regulating works which would cause obstruction. As explained by Sir Arthur Cotton, the object to be aimed at was the construction of an "effective" work at the least possible outlay.

30. If the conditions which exist in all ordinary years were only permanent, none would be disposed to question the thorough soundness of this principle.

If natural conditions were permanent, above principle correct.

814
18

39. The general provisions under which the present estimates have been framed are as follows:—

(1) Isolation of reaches. end of such reach being provided with flood-gates, and the channel embanked on both sides, where necessary, so as to keep out the highest known floods, above 3 feet generally, and in certain places

(2) Treatment of minor cross drainages. drainage shall be by open inlets, where such expedient is feasible, and that all excess pipes in places, or by open inlets, where such expedient is feasible, and that all excess drainage water be discharged either at ends of the "reach", or at other convenient outlets; that all river bars which it is unnecessary to open shall be closed, and the

(3) Unnecessary river bars to be closed. other major natural outlets, thereby increasing the depth of the channels, and correspondingly improving the crossing of the canal. From the experience gained in two successive cyclone years, it has been demonstrated that many of the

(4) Results of experience of cyclones. The experience of cyclones, and that land and river floods, if left unregulated, have a tendency to spill in all directions, thus clearly showing the necessity for bars referred to are superfluous, and those absolutely essential for the discharge of the have a tendency to spill in all directions, thus clearly showing the necessity for bars referred to are superfluous, and those absolutely essential for the discharge of the

(5) Detail of construction or canalization shall include, but not be limited to, the following:
 recorded tide in each "reach;" that the embankments be made to the highest known flood according to circumstances; that all diversions found necessary to the tow path, which will be up to the tow path, shall be specified up to the tow path level; that beyond the tow path level the section to that above specified being 2 to 1; that at or below tow-path level the slope shall be 1 to 1.

approach the sea, throw out spill water over the land, and, if the land is not
 fined by flood-banks, the operations, however, of this character being
 rivers only, as have been proved in cyclone years to require this mode of treatment
 improved by excavating diversion lines, as in the case of the Pennér rivers, b

and by training works, and, as in the case of the Back River, where it has proved it to be necessary, the canal shall be removed out of the back channel, and a new independent channel be constructed, and it has been proved that the

excavated, leaving the backwaters for both difficult and expensive, and navigation toilsome and risky; that boat basins should be provided at the places where experience has shown such to be necessary; that

(9) Boat basins and dry-docks	(10) New bridges constructed and existing bridges altered.	(11) New bridges constructed and existing bridges altered.	(12) Bridges repaired and existing bridges altered.

places (and these very few in number) where their necessity has been indisputably established; that certain existing bridges shall be altered so as to give the requisite headway; that necessary inspection bungalows, rest-houses, overseers' quarters, toll offices, and lines shall be provided for employes and of the travelling public; that the basin at Madras shall be improved and extended to meet ascertained demands of traffic.

(11) Inspection bungalows and accommodations for toll establishments.

(12) Terminal basin at Madras to be improved.

40. The following notes on the mode of dealing with different reaches of the canal.

41. As experience has shown that this section * has not, as a rule, suffered from the effects of cyclone floods, it is not proposed to isolate the reaches, and the work is therefore of an ordinary character calling for no special remarks.

42. It is proposed to isolate this reach by "flood-gates" at the ends, with outlet at selected places, to embank on the Raperla and Oopogondur swamp drainages, which spill over the Kanuparti ridge, and to construct a flood-bank for these measures being necessary to obviate cutting off the Gundlacamma river spill, the necessity for keeping an opening in the canal near the Kanuparti bar. At this latter place a *diversion* † of canal is proposed in order to take the channel further from sea than it is at present. From the Gundlacamma river to Pedda Ganjam there is a rising ground, on which the village of Kanuparti stands; if the low places at certain points of this ridge are banked off, and spill of river floods diverted by judiciously placed banks, the reach (closed at it will be at each end by flood-gates) should be sufficiently secure, especially as otherwise, there is but little land drainage to be taken into the canal. On the east or sea side, however, of this reach, the ground being low and exposed, the canal bank will have to be strengthened, and further rendered secure by cross and training banks at all the old bars which are to be closed as being unnecessary.

Section V as per General Abstract.

† 191 to 190
IV to III

It may be necessary hereafter in this reach to provide for other embankments at the south end of the Kanuparti † ridge, but at present it is considered needless to provide specifically for these. The land drainage on west side of Kanuparti ridge finds an outlet northwards through swamp already referred to, to the large masonry outlet at Pedda Ganjam, § which is now being built by the officers of the Western Kistna Division.

43. This reach is necessarily short, as the Mudigondi opening must be maintained. It will be isolated by flood-gates, embankments; also by a flood-bank for directing the spill of the Gundlacamma river. The eastern, or sea-side, bank of the canal in this reach has to be very strong, as the ground up to the sea-shore is very low and exposed. The western bank also requires to be strong, as being much exposed to the Mudigondi floods.

It will be well to mention here that, although the Mudigondi stream itself is insignificant when the floods are supplemented by the spill of the Gundlacamma river on one side, and those of the Moosee-Enegalaroo spill on the other, a large quantity of water is banked up and becomes dangerous to the canal. When once the proposed flood banks, however, have been carried out, it is considered that no further danger here need be apprehended.

44. This reach is a large one, but exposed only at the north end for some five miles to Mudigondi floods, and also for about three miles to the effects of storm waves from the sea side. This reach will be isolated by flood-gates, outlet sluices, embankments; also by a flood-bank for the Moosee river. With the elevated line of coast from Kotapatam * to near the Moosee river there is no need for a high canal bank on that side, as also from Thondaroo to Moosee. On certain occasions the flood-waters of the Moosee and Enegalaroo have been known to extend from near the trunk road on one side up to the sand ridges of the coast line, thus forming a vast sea of water. This was, in fact, twice experienced during construction of canal in this reach, and the Thondaroo drainage is believed to have been formed by these floods. To deal effectually with this reach it is proposed to *abandon* † that portion of the line which runs through the Thondaroo drainage, which the channel as now formed cannot maintain at the proper depth without undue expenditure.

† 177 to 177.
VII

45. The Moosee and Palaroo river reach is short and difficult, if not impossible, to maintain as now existing. This reach will be isolated by flood-gates and strong banks, but even with these this short piece of canal is so much exposed to rapid silting that it is considered highly desirable, in order to provide against all inconvenience being experienced by traffic, to have an alternative portion of canal close alongside which can be used while the main line is being cleared.

The Moosee ‡ river makes an awkward bend at the crossing which it is proposed to cut through, in order to rectify this objectionable feature. The banks of the Moosee river on the left side for about 4 furlongs (up to village), are also to be levelled down, so as to give the river a perfectly free spill. Experience has shown that where perfect isolation cannot be secured by means of sufficiently high banks, &c., the less the obstruction opposed to the flood the better, even at cost of having to maintain yearly the open reach of canal up to the flood-gates. In this case the latter will be placed near the village of Anantapuram. §

‡ 169 M.

46. This reach suffers severely every year, and has been much injured by the cyclones of 1879 and 1880. It will be isolated by flood-gates and by strong embankments and by flood-banks to both rivers to train the spill water. Outlets are also needed. The east or sea side bank must be strongly constructed, as the coast line is low and exposed and the sea very close to canal. In 1879 the storm wave from the sea reached nearly to top of banks. The west bank, when once the land floods are regulated in the manner proposed, need not be very strong, as the only drainage of any importance derived from surplus is that from the Pakala || tank series. As this terminal reservoir rarely, however, gets a full supply, no apprehension need exist respecting it. This part of canal reach is also exposed to the spill of the Palaroo ¶ river. At the other end, the rising ground at Singarayekonda acts as a sufficient protection, and there is thus only Binginipally ** and Somarazapally †† tank drainages to disposal of their surplus water, such as it is, will be readily made. In order to improve the crossing of the Munnaroo river, a *diversion* †† of the canal, on the north side for a mile, has shown itself to be necessary. The head of old course of Munnaroo must also be closed, in order to afford proper protection to the diversion line from injury by floods.

|| 166 M.

¶ 168 M.

** 162 M.

†† 163 M.

Index Survey Sheet No. ‡.

‡ 160 to 159
VI to VII

or Munnaroo northern diversion.

All the old river openings and bars in this reach are to be securely closed, it being neither desirable nor necessary that they should be kept open.

flood from Pennér Delta cultivation, may be found best, but this, like a few other minor details, may with advantage be left open for the present. In the estimate, however, provision is made for making the Gungapatam river discharge opening on the information previously obtained, and this may stand as a provisional arrangement.

Any alteration of the design here will not in any material way affect the estimate. The reach will have flood-gates at both ends, and an outlet which may conveniently be placed in the bed of the so-called "Old Pennér." The embankments will be strengthened, particularly the eastern one, as the coast line is here low, and the channel rather exposed from that side. South bar will be closed.

53. This reach will have flood-gates at both ends with "outlets;" except for 2 miles at north end, the coast line is very high, consequently no banks are wanted on that side. None are moreover required on the west side, so far as rising ground in the neighbourhood of Kódúr extends; but beyond it northward to the Gungapatam river the country is low and all under wet cultivation, and here protection is essential. A number of old river bars must be closed in this reach, which are not wanted, in addition to the Gungapatam drainage bar. Training banks in the neighbourhood of the bars are to be provided with a view to keep flood-water from getting behind the banks along the swampy hollows. A *diversion* of canal will also be made at south end of this reach, so as to secure a good cross-carrying for the Kódúr river, and confine this drainage in a distinct channel capable of carrying off a maximum flood.

Further experience of the full effects of the works undertaken with the object of training the Pennér river into one channel may as above show the desirability of amalgamating the two reaches mentioned in this and preceding paragraph with, in addition to the end outlets, two others at intermediate points to discharge surplus drainage.

54. The isolation of this short reach is unavoidable, as the Nalatur drainage brings in a large volume of water, which must be provided for. At the north end there will be a *diversion* in continuation of that of preceding reach to avoid the drainage which comes from south and to provide separately for the drainage, which now crosses the canal in several places and runs through the canal doing mischief. At the south end a strong bank will be required on the east side to prevent the flood and tide water from entering swamp and getting behind the bank. On the east side but slight banking will be required, as the ground along the coast line is here high. The west side bank, on the contrary, requires to be strong in order to effectually keep out land-floods.

55. This reach, which is unavoidably short, is to be isolated by flood-gates and outlets at both ends. For three miles from north end the cutting is deep through sufficiently high ground, and will not require much banking. After this up to the Kundaleroo river, the line is through swamp and backwater, where Kistnapatam backwater is also to be made, as this will be cheaper than to embank both sides through the portion of exposed backwater. The left border of Kundaleroo river will likewise be embanked at all the low places up to the Mootocoor high ground, so as to keep that river spill from getting behind canal along the Kistnapatam swamp on the west side of canal.

This part of reach from the Kundaleroo river to the Kistnapatam * high grounds is exposed to floods and the swamps on both sides and will need strong banking.

* 93 M.

56. This is a well-protected reach, situated in a hollow between high sand ridges. Flood-gates will isolate it, and an outlet will be constructed for the discharge of the small field drainage. Banks not wanted, but it will be essential to fill in certain gaps in saddle of the ridges, as during the floods of November 1880 these low portions were overtopped by the flood-water, seriously damaging the canal. The side field drains can be disposed of by pottery-pipes across the berms, simple cuts in bank being sufficient to pass the drainage. Originally it was intended to sluice all these openings, but after isolating the reach it is thought that no such measures will be necessary.

A short *diversion* † cut, $6\frac{1}{2}$ furlongs long, at the Kundaleroo river end, will be made to give the canal a conveniently placed mouth in deep water.

Section III as per General Abstract.

† $\frac{89}{VII}$ to $\frac{89}{I}$

altered to 4 to 1, and the banks thrown back.

57. This reach requires extensive works for its isolation. First, a *diversion* ‡ of canal will be made at Soornamooke end, which will have the effect of keeping the canal away from the river, and of training the river to its old bar. Second, a *diversion* § will be formed from above the Tupuli drainage along Kódúrpalliem and Dugarápatnam, so as to remove the line from the backwater. The only land drainage that has to be disposed of in this portion is that of Tupuli, and this can be readily received into the canal by proper inlet arrangements. The reach will have flood-gates and outlets as usual with all isolated portions. The Soornamooke diversion works are explained in the annexed estimate, which is among those already sanctioned by Madras Government.

As regards the other diversion, it will suffice to observe, that it is essential in order to avoid the backwater. This line will run at the back of Kódúrpalliem, which, being purely a fishing village, would otherwise be inconvenienced by having the canal between it and the sea. The cutting will here be deep, but this is unavoidable.

58. Dugarápatnam to Coromandel is the longest isolated reach which it has been found possible to make in the entire canal. It starts with a *diversion* ¶ at the north end to avoid the backwaters of Dugarápatnam. At south end there will also be a long *diversion* †† of 17 miles to avoid the Pulicat Lake along and indeed almost through which the existing line is carried and which experience has shown is dangerously exposed. There will be flood-gates to isolate it with four outlets, one at each end, and two placed immediately on the east side; the coast line is high, but there is a great width of land here between the canal and the sea; large provisions for drainage have to be made. On the west side the bank will be made up to full height for 22 miles to keep out the lake floods. With the two diversions and the lake-side bank this reach is necessarily a costly one, but under all the circumstances the improvements here proposed will be found well to repay the outlay. On east side a low bank will suffice.

It may here be mentioned that in the lake diversions the present so-called "Tettupet" †† cut will be included and utilized.

†† 38 M.

59. Virtually this reach will be but $1\frac{1}{2}$ miles in the land, the rest being along open lake and across the Pulicat river.

Index Survey Sheet No. $\frac{3}{6}$
Section I as per General Abstract.
Coromandel to Arani River, 3 miles.

high wind and proves troublesome to the boatmen, and in which also as in all backwaters it has been found both difficult and costly to maintain a channel efficiently to the needful minimum depth. The *diversion** here proposed will run from Pulicat river, along west border, along Pulicat† and Edamany. The northern arm of

* $\frac{125}{VI}$ to 24.

† 25 M.

Arani river by which spill water now enters the channel will be embanked across on both sides of canal line, and there will be a subsidiary bund higher up the arm so as to render the crossing safe. This arm is virtually the spill of the lake at the back of Pulicat and forms a swamp. By shutting up this opening, the flood-water will concentrate in the main arm of the Arani river and keep the crossing deep, which is therefore very desirable to have a distinct channel for navigation. The reach will have flood-gates, but outlets are not required. Two boat basins formed by simply widening the channel will be formed at Pulicat. The basin for the fishing village will be small and sufficient for immediate wants, the other is needed for traffic and boat building, a large number of boat owners and builders being residents at Pulicat.

60. Arani river to Ennore will be a comparatively costly reach, as it will consist of a new‡ canal throughout for nearly the whole distance placed beyond reach of backwater along the east border. The expense here is chiefly enhanced by the

‡ $\frac{23}{VII}$ to $\frac{11}{IV}$

compensation which will have to be paid for land and plantations. Parts of the existing canal along Chintamony§ and Kalánji|| will be utilized, their western side being strongly embanked. As the ground along the coast is here high, there will be no need for a high bank along the new line; the reach will be isolated by flood-gates, and have outlets for land drainage. Across Chintamony backwater on 21st mile the crossing on west side will be embanked so as to keep out the land floods. The old bar being closed no bank will be required on the east side for the present, though possibly hereafter some special work with this object may be needed.

§ $\frac{20}{II}$

|| $\frac{18}{IV}$

61. The work proposed in this reach with a view to the proper isolation of the

Index Survey Sheet No. $\frac{2}{6}$

Ennore Backwater to Cooum River, 11 miles.

¶ 11 to $\frac{7}{IV}$

** $\frac{7}{II}$

with a surplus self-acting sluice on west side. The existing Trivettore surplus sluice will be altered, so as to make the shutters more effective. The Ennore†† end of the diversion channel will have a flood-gate. It is not practicable to carry this head of diversion more to the north, and a stretch of about a mile of open lake will therefore have to be crossed. In order moreover to obtain a direct crossing, the shoal now forming across lake, from west border and extending towards bar, will be cut through.

†† 10 M.

With a flood-gate at Ennore end, and strong high banks from that place to Madras, there will be no need to make any alterations to the existing Shadayankupam lock.

A flood-gate is not requisite at the point where the canal enters the Cooum river at Madras, as the bar of this river is invariably cut through so soon as the water level rises to 3.5 feet above mean sea level.

At the Madras (better known as "Cochrane's") Basin an extensive wharf will be constructed to supersede the present basin, the walls of which have sunk, and the form found inconvenient. The improvement of basin here provided for will be limited to the east side for the present. The form of wharf will consist of a widening of canal by 60 feet for 1,800 feet in length, 50 feet being allowed for canal. The wharf will be formed by a concrete wall to M.S.L., above which there will be steps of laterite. The basin grounds will be enclosed in with palisading, and the ground adjoining entirely cleared of native huts, provision being made for compensating the owners. The existing lime kilns, with the exception of one or two, will not be touched. To afford the requisite facilities for traffic, roads will be run from the wharf wall directly across to existing line of road.

The only improvement to be made on the west side is the construction of a short branch channel to join the basin at the Government lime kilns. This will allow of the shell boats unloading there instead of at the former shell platforms which have been now surrendered.

The Government grounds on which the lime kilns are placed will also be fenced off from the canal. The Trivettore and Washermanpet bridges, as they obstruct navigation, will be altered by removing the arches and substituting iron girders to give the requisite headway.

These bridges, as also all the others up to the Cooum, save the railway and salt bridges, will have tow-paths constructed under the arches. The South Indian Railway bridge, which is now a temporary structure for running trains to the Harbour Works, will if eventually made permanent (a point still open for consideration) need to be much enlarged, but no provision for the work is necessary in this estimate. The Timber Salt Depot bridge will be altered, as the centre span is quite obstructed.

At the Shadayankupam lock an embankment will be made eastwards to Trivettore, so as to afford means of access across the swamp and fields to the toll and lock establishments.

62. The only work required in this reach will be deepening and forming the channel which along all this portion is carried through the river bed without any special arrangements as far as the north end of the next reach known as the Junction Canal.

Cooum River, 1 mile.

63. This reach, better known as the Junction Canal, will be closed at the Adyar* end by a lock which is so arranged with double sets of gates facing in opposite directions as to afford means for keeping out floods whether coming from the Cooum or the Adyar river ends.

Index Survey Sheet No. $\frac{2}{6}$
The Junction and Southern Canal.

* Zero of mileage as per map.

As it is essential for the health and comfort of Madras so to work its two rivers (the Cooum and Adyar) that there shall always, if possible, be water in their beds from 2 to 3.5 feet above M.S.L., so as to keep all offensive mud banks covered with water, it would be useless to attempt to do what is necessary by flood-gates alone. The lock at Shadayankupam and the other to be constructed permanently at south end of the Junction Canal are both indispensable with this object. The inconveniently low headway and small waterway of all the bridges, by raising them large traffic spring up) necessitate the alteration of all the bridges, by raising them and substituting iron girders for the existing arches. The cost of altering the fourteen bridges involved will not be serious, but under existing circumstances no such change is urgently required, and no provision for the work has therefore been made in this estimate. Some other improvements may also in future be desirable, but tow-paths only are immediately necessary at present, and an item for this is inserted. The Adyar river, the bed of which above and below the point of crossing of the line of canal has been very much encroached upon by the silting up of the

59. Virtually this reach will be but $1\frac{1}{2}$ miles in the land, the rest being along

Index Survey Sheet No. $\frac{3}{8}$
Section I as per General Abstract.
Coromandel to Arani River, 3 miles.

open lake and across the Pulicat river. A short reach here is unavoidable, in order to avoid the backwater along Pulicat, which is much exposed during high wind and proves troublesome to the boatmen, and in which also as in all backwaters it has been found both difficult and costly to maintain a channel efficiently to the needful minimum depth. The *diversion** here proposed will run from Pulicat river, along west border, along Pulicat† and Edamany. The northern arm of Arani river by which spill water now enters the channel will be embanked across on both sides of canal line, and there will be a subsidiary bund higher up the arm so as to render the crossing safe. This arm is virtually the spill of the lake at the back of Pulicat and forms a swamp. By shutting up this opening, the flood-water will concentrate in the main arm of the Arani river and keep the crossing deep, which is the point to be aimed at. The Pulicat backwater is shallowing up very fast, and it is therefore very desirable to have a distinct channel for navigation. The reach will have flood-gates, but outlets are not required. Two boat basins formed by simply widening the channel will be formed at Pulicat. The basin for the fishing village will be small and sufficient for immediate wants, the other is needed for traffic and boat building, a large number of boat owners and builders being residents at Pulicat.

60. Arani river to Ennore will be a comparatively costly reach, as it will consist of a *new*‡ canal throughout for nearly the whole distance placed beyond reach of backwater along the east border. The expense here is chiefly enhanced by the

‡ 23 to 11
VII to IV

compensation which will have to be paid for land and plantations. Parts of the existing canal along Chintamony § and Kálánji || will be utilized, their western side being strongly embanked. As the ground along the coast is here high, there will be no need for a high bank along the new line; the reach will be isolated by flood-gates, and have outlets for land drainage. Across Chintamony backwater on 21st mile the crossing on west side will be embanked so as to keep out the land floods. The old bar being closed no bank will be required on the east side for the present, though possibly hereafter some special work with this object may be needed.

§ 20
II

|| 18
IV

61. The work proposed in this reach with a view to the proper isolation of the channel from the backwater is a *diversion* ¶ extending from Ennore to the lock at Shadayankupam **, and embankments from the latter place to Madras, with a drainage channel along the low swampy ground on the east side. This will provide for the Madras drainage being led to a point north of lock, where it will join diversion line, and be furnished with a surplus self-acting sluice on west side. The existing Trivettore surplus sluice will be altered, so as to make the shutters more effective. The Ennore †† end of the diversion channel will have a flood-gate. It is not practicable to carry this head of diversion more to the north, and a stretch of about a mile of open lake will therefore have to be crossed. In order moreover to obtain a direct crossing, the shoal now forming across lake, from west border and extending towards bar, will be cut through.

¶ 11 to 7
IV

** 7
II

With a flood-gate at Ennore end, and strong high banks from that place to Madras, there will be no need to make any alterations to the existing Shadayankupam lock.

A flood-gate is not requisite at the point where the canal enters the Cooum river at Madras, as the bar of this river is invariably cut through so soon as the water level rises to 3.5 feet above mean sea level.

At the Madras (better known as "Cochrane's") Basin an extensive wharf will be constructed to supersede the present basin, the walls of which have sunk, and the form found inconvenient. The improvement of basin here provided for will be limited to the east side for the present. The form of wharf will consist of a widening of canal by 60 feet for 1,800 feet in length, 50 feet being allowed for canal. The wharf will be formed by a concrete wall to M.S.L., above which there will be steps of laterite. The basin grounds will be enclosed in with palisading, and the ground adjoining entirely cleared of native huts, provision being made for compensating the owners. The existing lime kilns, with the exception of one or two, will not be touched. To afford the requisite facilities for traffic, roads will be run from the wharf wall directly across to existing line of road.

The only improvement to be made on the west side is the construction of a short branch channel to join the basin at the Government lime kilns. This will allow of the shell boats unloading there instead of at the former shell platforms which have been now surrendered.

The Government grounds on which the lime kilns are placed will also be fenced off from the canal. The Trivettore and Washermanpet bridges, as they obstruct navigation, will be altered by removing the arches and substituting iron girders to give the requisite headway.

These bridges, as also all the others up to the Cooum, save the railway and salt bridges, will have tow-paths constructed under the arches. The South Indian Railway bridge, which is now a temporary structure for running trains to the Harbour Works, will if eventually made permanent (a point still open for consideration) need to be much enlarged, but no provision for the work is necessary in this estimate. The Timber Salt Depot bridge will be altered, as the centre span is quite obstructed.

At the Shadayankupam lock an embankment will be made eastwards to Trivettore, so as to afford means of access across the swamp and fields to the toll and lock establishments.

62. The only work required in this reach will be deepening and forming the channel which along all this portion is carried through the river bed without any special arrangements as far as the north end of the next reach known as the Junction Canal.

Cooum River, 1 mile.

63. This reach, better known as the Junction Canal, will be closed at the Adyar* end by a lock which is so arranged with double sets of gates facing in opposite directions as to afford means for keeping out floods whether coming from the Cooum or the Adyar river ends.

Index Survey Sheet No. $\frac{2}{6}$
The Junction and Southern Canal.

* Zero of mileage as per map.

As it is essential for the health and comfort of Madras so to work its two rivers (the Cooum and Adyar) that there shall always, if possible, be water in their beds from 2 to 3.5 feet above M.S.L., so as to keep all offensive mud banks covered with water, it would be useless to attempt to do what is necessary by flood-gates alone. The lock at Shadayankupam and the other to be constructed permanently at south end of the Junction Canal are both indispensable with this object. The inconveniently low headway and small waterway of the bridges may at some future time (should a large traffic spring up) necessitate the alteration of all the bridges, by raising them and substituting iron girders for the existing arches. The cost of altering the fourteen bridges involved will not be serious, but under existing circumstances no such change is urgently required, and no provision for the work has therefore been made in this estimate. Some other improvements may also in future be desirable, but tow-paths only are immediately necessary at present, and an item for this is inserted. The Adyar river, the bed of which above and below the point of crossing of the line of canal has been very much encroached upon by the silting up of the

river margins and the formation of numerous large islands therein, requires to be considerably improved. It is proposed to effect this by a system of groyning and the construction of flood-banks to confine the floods within fixed limits, and thereby increasing the scour, establish a deep and permanent waterway for the river for some distance upwards from its mouth. The amount required for carrying out these improvements has been provided for in item No. 68 A of the general abstract of the estimate for Southern Canal.

64. This reach will be isolated by a lock at the north with gates facing towards the river and flood-gates at south end. The lock is essential for keeping up the requisite water level in the Adyar, Junction Canal, and Cooum river (see previous remarks). In this reach there will be a *diversion* * from Solanganallur along

Section II as per General Abstract.
Adyar to Covelong, 15 miles.

* $\frac{8}{IV}$ to $\frac{15}{I}$

east border to take the channel out of the backwater, and obtain a good crossing at the Covelong opening. The west bank will be made strong. The coast line on the east being well raised no high bank will be wanted on that side. One outlet will suffice for this reach, as there is little land drainage taken in and disposed of.

65. This reach is at present in every way unsatisfactory, running as it does through swamp and backwater, and becoming quite a sea during high floods, rendering the navigation very troublesome.

Covelong to Kokkelamoodoo, 16 miles.

A *diversion* † will be made for its entire length along the east border. Flood-gates will also be employed for closing both ends. Outlets at both ends will moreover be constructed for relieving the

† $\frac{15}{II}$ to $\frac{31}{II}$

land drainage which, however, will not be much. The west bank will be made strong, but as the ground along the coast is high, the east bank of the canal need not be high.

The Kokkelamoodoo bar does not generally open, but as there will be no other relief to drainage in this portion of the canal, it is considered essential that this opening shall be maintained.

66. A short *diversion* ‡ line in continuation of the preceding one is required at the north end of this reach to join on to the existing canal. There will be flood-gates and outlets at both ends of this reach. Training banks running from canal eastward will also be constructed with a view to keep the flood from get-

Index Survey Sheet No. 1.

Kokkelamoodoo to Palar River, 8 miles.

‡ $\frac{31}{IV}$ to 39.

ting behind banks throughout the swampy and low grounds.

A drainage near the Sadras bar will be strongly banked on the sea side and the drainage taken into the channel; so also with the next drainage at Sembadakupam, § which will be banked across on east side and drainage similarly disposed of. An old outlet to the south will now be restored, and will no doubt be kept open by the above two drainages, discharging through the flood-gate and outlet. The direction of this old cut will be altered with reference to the Palar river crossing. Here, contrary to the case of the Pennér river, the southern channel of the Palar will be closed, and northern one only maintained, as the present choked up condition of the bed of the former and the more free and open passage down the latter favor this arrangement, which in other respects accords with the local features.

A *diversion* || cut will also be made through the islands to the south, near the end of which the flood-gate will be placed. The estimate, it will be observed, provides for the flood-gates for right bank of Palar

|| 39 to $\frac{41}{III}$

at the end of extension canal. No large drainages cross the extension canal.

67. Having thus, as far as possible, detailed the method of treatment proposed for the improvement of each reach of the canal from its most northern limit * from Madras to the Palar river at 47 miles south of Madras, and to a point whence the extension canal into the Merkanam backwater is continued, a summary of the headings of the estimate for each section of estimates, will now be given. From the

General summary of estimates.
Appendix A.

of the proposed work, and the amounts of estimates, as well as Statement A it will be seen that the total outlay on the canal contemplated, as well as that already incurred, amounts to Rs. 63,87,100. It is believed that this sum will be found sufficient for all requirements, and that it is even quite possible savings may be effected by the substitution of artificial stone composed of Portland cement concrete in the quoins and floors of the flood-gates for cut granite, and either of indigenous teak, or by employing Jarrah wood from Australia in the flood-gates, instead of the more expensive Burma teak.

Total outlay on the work.
Appendix B.

68. The distribution of the whole outlay, past, present and future, will be seen from Appendix B, and divides itself naturally into three distinct periods, viz.:-

	RS.
(1) Outlay from the commencement of the work to the last famine ...	5,49,078
(2) Outlay during the famine, i.e., from October 1876 to 31st March 1879 ...	21,93,854
(3) Subsequent outlay, viz.:-	
(a) From April 1879 to 31st March 1882 ...	3,44,253
(b) Probable in current year ...	1,54,300
(c) From end of the current official year ...	31,45,615
Total ...	63,87,100

The figures given under (1), (2), and (3) (a) have been supplied by the Examiner, Public Works Accounts, and have been finally accepted as correct by the Accountant-General.

69. The soil all along the canal is pretty constant in its character, a surface layer of sand and light loam with denser clayey strata underlying it. No borings were found necessary, and in the construction of the foundations of the flood-gates grilles of timber with sheeting piles have been provided for with a view to distribute the superincumbent pressure over the subsoil.

70. The data upon which the rates have been based are those obtained from the actual construction of works along the canal and in the neighbourhood, and Data for rates allowed in estimates. sufficient margin has been allowed to accommodate them to such moderate increment of charge as unforeseen circumstances may entail.

71. The traffic on the canal has shown a tendency to increase in the successive years, during which registers have been systematically maintained. Appendix C gives the abstract of the traffic inwards and outwards from the terminal station at Madras for the successive half-years from 1st July 1878 to 30th June 1882. In the year 1879 the tonnage arriving at the Madras Basin amounted to 185,491 tons, and the departures amounted to 49,133 tons during that period. For 1881 the figures were 241,207 and 208,630 tons respectively.

The first half of the current year shows a considerable falling off owing to the long-continued drought during that period having so far reduced the depth of water in the backwaters through which the canal passes as to close them for over two months against any but the smallest description of boats.

Of the commodities carried over the canal, the largest and most important is salt; after which come firewood, food-grains, and shells (for burning lime) in order of their

84
24

importance. The import of these articles into Madras amounted in 1881 to 85,301, 54,654, 22,020, and 21,971 tons respectively. Numbers of boats with passengers and goods now find their way from Cocanada and Dowlaishweram, as also other intermediate places to Madras; and it can scarcely be doubted that on the execution of the completion works of the Godavari and Kistna Delta schemes lately sanctioned by the Government of India, adding greatly to the existing irrigated area, the traffic in grain, &c., must greatly increase; and in the event of famine occurring, the value of such through communication with the Northern Delta Works would be of incalculable benefit. Further impetus may also be ere long looked forward to owing to proposed reductions of tolls and simplification of license fees. The mode of travelling by boats is decidedly popular with the natives, and efforts of this character cannot fail to produce beneficial results.

With the opening, moreover, of the Singareni coal-fields in the Nizam's Dominions, about 80 miles north-west of Bezwada, a traffic in carrying coal down for the use of the Madras and South Indian Railways may not improbably spring up. The fact of the canal as a highway will be thus still further established, as through no other route could these coal-fields be tapped so economically as by means of the canal.

In the Proceedings, Madras Government, No. 450, dated 21st November 1868, reports on the traffic on the Godavari, Kistna and East Coast Canals gave full details regarding the working of the boats plying on those canals. The conditions then obtaining have not in any great degree altered, and the rates charged for goods have not materially decreased. These Proceedings were communicated to the Government of India in G.O., No. 3652, of 21st November 1868. The suggestions then made by Colonel Anderson, the Chief Engineer for Irrigation, that a scheme of a coast canal be taken up in earnest, met with the approval of the Madras Government, and is now an accomplished fact.

72. In Appendix D is shown the number, tonnage, and description of boats which ply on the canal. Amongst the class that are built specially for cargo, the largest number are of 20 tons burden, whilst the tonnage of the class which carries 28 and 29 tons respectively gives the largest aggregate results. The whole of the cargo boats work out to an average of $16\frac{3}{4}$ tons, which is a convenient size both for being handled with ease and of a draught better suited to the varying depths of water in the several reaches of the present canal. The largest boats are used for conveying firewood from the plantations within 45 miles north of Madras, as they afford stowage to compensate for the light nature of the freight carried by them. Of covered cargo and passenger boats, the most numerous are those of 4 and 5 tons respectively, commonly called "top" boats, and the total number of these works out to an average capacity of 6 tons for each. The deck and dinghy boats are the description used most generally in the Northern Circars, and which, plying on the Godavari and Kistna Canals, have taken out licenses for the Buckingham Canal as well.

Appendix E contains the text of the rules for navigation now in force on the canal, which were approved and sanctioned by the Madras Government in their Proceedings, No. 1801-A W., of 8th July 1879. These rules differ in several respects from those obtaining on the Kistna and Godavari Canals. There is no apparent reason why this difference should exist; the Madras Government have therefore ordered a Committee to convene and take into consideration the advisability of establishing a uniform set of rules for the whole of the coast canal license system, and abolishing most of the tolls. This, however, will not do away altogether with the toll establishments now maintained, as particulars of traffic will have still to be recorded for each section of the canal as is done at present. As there will be no money collections, this work can in future be carried out by a clerk and one peon on Rs. 15 and Rs. 6 per mensem.

73. The fluctuations of the tides were registered at thirty-eight stations along the canal during the years 1879, 1880, 1881, and 1882, but these were necessarily only of value during the period when the several bars were open along the coast. The

recorded readings during the times when the rivers were in flood, and again when some of the bars were open, whilst others were closed, gave very conflicting results, and have proved of doubtful value in determining the nature of the works to be carried out for the improvement of the canal. The M.S.L. was the datum to which it was at first proposed to refer all bed levels of different sections of the canal, and the sills of the masonry works along them. The M.S.L. in use in this Presidency was, till recently, that established by the late Colonel De Havilland, of the Madras Engineers, and referred to a bench-mark stone placed by him some forty years ago on a marble slab in the Fort wall near the north gate at Madras. The tidal observations carried out in the Great Trigonometrical Survey of India have, however, proved De Havilland's bench-mark to be very nearly 1 foot below its true value.

In a canal running along the coast line, however, and only here and there connected with the sea, as is the case with the Buckingham Canal, it has appeared necessary to work between two limiting levels, viz., the highest storm wave level as yet recorded for the determination of the heights to which the bank of the canal should be raised, and the lowest recorded tide level for the depth to which the bed of each reach should be excavated. The former level was deduced from the cyclone of November 1880, when the canal suffered severe damages from the irruption of the sea; and the latter levels, owing to the peculiar circumstances of each reach of the canal, were taken from the tide gauge readings. To simplify the calculations of quantities in the estimates, average lowest recorded tide levels were struck for each reach, and the longitudinal and cross sections drawn out accordingly, a slightly give-and-take arrangement being thus followed. Below this average L.R. tide level the canal bed has been calculated to 3 feet, and it is at this depth that it should always be maintained.

74. Of those sections of the canal where connection with the sea is liable to be temporarily suspended by the closure of the bars, the most notable are the reaches between Madras and Kundelairu (11th mile), Pulicat (26th mile), Dugarápatnam (69th mile), and Kottapatam (80th mile). The opening of these bars, however, is due chiefly to the fact that large backwaters within the coast line receive upland drainage until they accumulate to a level at which they overtop and clear away the bars formed by the surf. As there are no defined channels out to sea through these bars, it has been found impossible to keep them open when, with the setting in of the south-west monsoon, the wind and littoral current turn northwards up the Bay of Bengal. With the closure of the river bars, and the setting in of the hot weather, evaporation over the areas of backwater goes on apace without any compensating indraught from the ocean, or supplies from local drainage; and the water level in long sections of the canal gradually diminishes as was evidenced more particularly in the present than in probably any other year.

75. These backwaters may, therefore, be looked upon as huge evaporating basins during a time of the year when the canal is cut off from all its sources of supply, and as such should be avoided.

The reclamation of the backwaters in the interests of the canal then is a subject of vital importance, but in doing so the fact must not be overlooked, that a certain storage area is necessary to receive water at high tides from the sea in order to maintain the scouring action on the bars during the ebb. But on the other hand, as in the case of the Pulicat lake, where the area to be covered amounts to 178 square miles, and of which one half at least is covered by high tides during the time the Pulicat bar is open to a depth of something under $2\frac{1}{2}$ feet of water, the width of the bars during this period being under 100 yards, it may be taken for granted that from the month of March, when the bars begin to show signs of closing, down to September, when the lowest tidal variation is reached, the indraught through the bars is not commensurate with loss by evaporation from the surface of the backwaters, and that, owing to their great area, the accession of tidal water does not influence the remoter parts before the ebb sets in. There are thus large areas of these backwaters which after

Instance of the Pulicat Lake.

7

a certain time of the year draw upon the canal for their supply to keep pace with the evaporation from their surfaces, and the water level must necessarily diminish until the bars open again by the influence of the sea, or by the receipt of upland drainage waters.

76. The reclamation by embankments of all backwaters is therefore necessary within certain limits, say, to lands not covered at high tides to a greater depth than 2 feet. Were this done, the drainage falling into the backwaters could be

charged with much silt from the uplands, they may be allowed to deposit the little held in suspension, and then be allowed to flow off through regulating weirs at ebb-tides to increase the action on the bars. By shutters opening towards the backwaters, no salt water need be allowed on to the lands thus reclaimed, which would increase enormously in value owing to their proximity to the canal, and eventually, by their sale, recompense all expenditure incurred on them.

77. As it is on all accounts desirable, therefore, in the interests of the canal, to permanently establish a series of open bars along the coast, and as the only way

this desideratum can be attained is by the concentrated outflow through a defined channel at frequent periods, both as regards all upland waters and of all the tidal outflows of backwater which have up to the present served no other purpose than to dissipate rather than conserve the energy of tidal action, the regulation of the canal in the manner now proposed must lead to the conversion of hitherto useless, if not unhealthy, swamps into valuable cultivated areas.

These areas thus reclaimed may, if desired, be taken over by the Forest Conservancy Department for the growth of timber and fuel trees. The practicability of this has already been sufficiently demonstrated at various points along the course of the canal, and testimony is borne to the utility of the scheme in Proceedings of the Board of Revenue, No. 859, dated 25th June 1880, where the inward traffic in firewood in the Nellore District (through which the canal runs for 150 miles of its course) is ascribed to the "facilities afforded by the improvement of the Buckingham Canal" during the year 1878-79. From the information furnished by the Collector of South Arcot District again, it would appear that large tracts of waste land remain to be planted up with casuarina and other fuel trees, which he is confident will be taken up by private enterprise as the benefits afforded by the canal as a cheap means of carriage come to be realized. The effect of opening up the canal to Merkanam and southwards, as contemplated, will be to raise the local price of fuel by at least 25 or 30 per cent., and thus improve the condition of the villagers along the coast. It would be desirable if the whole of the works now estimated for could be completed within the next six years, which would necessitate an average allotment of 5 lakhs of rupees per annum distributed as follows:—

3 lakhs in 1883-84
5 do. in 1884-85
5 do. in 1885-86
6 do. in 1886-87
6 do. in 1887-88
6 do. in 1888-89

The average amount allotted for New Works on the canal during the last two official years has been Rs. 1,35,000 only.

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal Division.

APPENDIX A.

Summary of Estimates for improving the several reaches of the Buckingham Canal as sanctioned in detail from time to time by the Madras Government.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
					RS.	RS.
		NORTHERN CANAL.				
		Section I.—From St. Mary's Bridge at Madras to Pulicat.				
		Improvements and alterations to Salt Kotar Bridge.	1st mile	Paragraph 61	13,000	
1	ab	Improvements to the basin at Madras	2nd "	Do. 61	95,685	
2	..	Improvements to canal from basin to Shadayankupam Lock.	2nd to 7th mile	Do. 61	19,775	
3	..	Improvements and alterations to Washer-manpett Bridge.	3rd mile	Do. 61	7,090	
4	..	Do. do. to Trivettur Bridge	5th "	Do. 61	7,090	
5	..	Toll Office and Establishment sheds at Shadayankupam Lock.	7th mile 3rd furlong	Do. 39 (11).	759	
6	..	Diversion to canal from Shadayankupam Lock to Ennore.	7th mile 3rd furlong to 11th mile.	Do. 61	42,250	
7	..	Flood-gate south bank of Ennore Backwater.	11th mile	Do. 60	19,380	
8	..	Do. north bank of do.	12th "	Do. 39 (11).	6,715	
9	..	Second-class Rest-house at Ennore	12th to 25th mile	Paragraphs 59 and 60.	1,43,360	
10	..	Diversion and improvements to canal from Ennore to Pulicat.	6th furlong.	Paragraphs 59 and 39 (9).	4,640	
11	..	Siding basins at Pulidivakkam, Kattupally, Kalanjee, and Karangaloe.	15th, 17th, 19th and 22nd miles.	Paragraph 60	16,650	
12	..	Flood-gates south bank of Arni River	23rd mile 6th furlong.	Do. 59	16,650	
13	..	Do. north bank of do.	24th mile	Paragraphs 59 and 39 (9).	2,685	
14	..	Two siding basins at Pulicat	25th "	Paragraph 59	16,650	
15	..	Flood-gate at the Pulicat Lake end	25th mile 6th furlong.		4,30,759	
16	..	Add Items of General Abstract Estimate, Nos. 65, 68 and 73.			3,653	4,34,412
		Section II.—From Pulicat to Dugarápatnam.				
		First-class Rest-house at Coromandel	27th mile	Paragraph 39 (11).	3,160	
1	..	Diversion to canal from Coromandel to Tettupett.	26th to 28th mile.	Do. 58	99,000	
2	..	Flood-gate at Coromandel end	26th mile	Do. 58	16,650	
3	..	Siding basin at Coromandel	27th "	Do. 39 (9).	510	
4	..	Outlet at do.	27th "	Do. 58	3,950	
5	..	Improvements to canal, 36 miles 2 furlongs to 38 miles.	36th to 38th mile.	Do. 58	7,350	
6	..	Siding basin at Tettupett	38th mile	Do. 39 (9).	635	
7	..	Diversion to canal from Tettupett to Jonaghipolliem, 38 miles to 43 miles 5 furlongs.	38th to 43rd mile.	Do. 58	70,000	
8	..	Two siding basins at Chemigaripolliem and Jonaghipolliem	42nd and 44th mile.	Do. 39 (9).	1,055	
9	..	Second-class Rest-house at Jonaghipolliem.	44th mile	Do. 39 (11).	5,715	
10	..	Improvements to canal, 44 miles to 65 miles 5 furlongs.	44th to 65th mile.	Do. 58	1,35,765	
11	..	One siding basin at Cusbah	46th mile	Do. 39 (9).	395	
12	..	Toll Office and Establishment sheds at Royadoruvu.	59th "	Do. 39 (11).	868	
13	..	Second-class Rest-house at Royadoruvu and Pambali.	59th "	Do. 39 (11).	5,715	
14	..	Two siding basins at Royadoruvu and Pambali.	58th and 64th miles.	Do. 39 (9).	1,320	
15	..	Diversion to canal, 65 miles 5 furlongs to 67 miles 2 furlongs.	65th to 67th mile.	Do. 58	20,430	
16	..	Outlet at 67 miles 2 furlongs	67th mile 2nd furlong.	Do. 58	3,660	
17	..	Flood-gate south bank of Dugarápatnam river.	Do. do.	Do. 58	19,030	
18	..	Add Items of General Abstract Estimate, Nos. 65, 68, 69 and 73.			3,95,208	
					2,63,590	6,58,798

814
22
26

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
		NORTHERN CANAL—cont.			RS.	RS.
		Section III.—From Dugarápatnam to Kistnapatam.				
1	..	Diversion to canal, 67 miles, 2 furlongs to 72 miles 2 furlongs.	67th to 72nd mile.	Paragraph 57 ..	55,570	
2	..	Flood-gate north bank of Dugarápatnam river.	67th mile 3rd furlong.	Do. 57 ..	19,930	
3	..	Outlet at 67 miles 3 furlongs ..	Do. do. ..	Do. 57 ..	3,660	
4	..	Second-class Rest-house at Dugarápatnam.	69th mile ..	Do. 39 (11).	5,715	
5	..	Stores and office at Dugarápatnam.	69th " ..	Do. ..	2,340	
6	..	Siding basin at do.	69th " ..	Do. 39 (9).	1,090	
7	..	Do. at Thupili ..	72nd mile ..	Do. ..	590	
8	..	Outlet at 71 miles 6 furlongs ..	71st mile 6th furlong.	Do. 57 ..	3,660	
9	..	Improvements to canal, 72 miles 2 furlongs to 75 miles 3 furlongs.	72nd to 75th mile.	Do. 57 ..	17,200	
10	..	Swarnamukhi diversion and flood-banks ..	76th to 77th " ..	Do. 57 ..	36,700	
11	..	Outlet at 76 miles 5 furlongs ..	76th mile 5th furlong.	Do. 57 ..	3,450	
12	..	Flood-gate south bank of Swarnamukhi river.	77th mile ..	Do. 57 ..	20,880	
13	..	Do. north bank of do. ..	77th " 1st furlong.	Do. 56 ..	20,880	
14	..	Improvements to canal, 77 miles 1 furlong to 89 miles 1 furlong.	77th to 89th mile.	Do. 56 ..	24,200	
15	..	Second-class Rest-house at Siddavaram ..	79th mile ..	Do. 39 (11).	5,715	
16	..	Two siding basins at Siddavaram and Kanoorpur.	79th and 81st mile ..	Do. 39 (9).	1,270	
17	..	Diversion to canal, 89 miles 1 furlong to 89 miles 7 furlongs.	89th mile ..	Do. 56 ..	8,400	
18	..	Outlet at 89 miles 6 furlongs ..	89th mile 6th furlong.	Do. 56 ..	3,450	
19	..	Flood-gate south bank of Kundaleru river.	90th mile ..	Do. 56 ..	18,040	
		Add Items of General Abstract Estimate Nos. 65, 68, and 73.			2,51,840	
					2,88,409	5,40,249
		Section IV.—From Kistnapatam to Pennér River.				
1	..	Flood-gate north bank of Kundaleru river.	91st mile ..	Paragraph 55 ..	18,380	
2	..	Improvements to canal, 90 miles 6 furlongs to 92 miles.	90th to 92nd mile.	Do. 55 ..	6,100	
3	..	Outlet at 90 miles 6 furlongs ..	90th mile 6th furlong.	Do. 55 ..	3,450	
4	..	Siding basin at 91 miles ..	91st mile ..	Do. 39 (9).	1,480	
5	..	Bridge at Kistnapatam road crossing ..	91st " ..	Do. 39 (10).	10,250	
6	..	First-class Rest-house at Kistnapatam ..	93rd mile ..	Do. 39 (11).	6,630	
7	..	Diversion to canal, 92 miles to 93 miles 4 furlongs.	92nd to 93rd mile.	Do. 55 ..	13,680	
8	..	Siding basin at Kistnapatam ..	93rd mile ..	Do. 39 (9).	655	
9	..	Improvements to canal, 93 miles 4 furlongs to 95 miles 6 furlongs.	93rd to 95th mile.	Do. 55 ..	7,030	
10	..	Outlet at 95 miles 4 furlongs ..	95th mile 4th furlong.	Do. 55 ..	3,485	
11	..	Flood-gate south bank of Nalatur river ..	Do. do. ..	Do. 55 ..	18,550	
12	..	Improvements to canal, 95 miles 6 furlongs to 97 miles 2 furlongs.	95th to 97th mile.	Do. 54 ..	11,930	
13	..	Flood-gate north bank of Nalatur river ..	95th mile 6th furlong.	Do. 54 ..	18,550	
14	..	Outlet at 95 miles 6 furlongs ..	Do. do. ..	Do. 54 ..	3,485	
15	..	Diversion to canal, 97 miles 2 furlongs to 97 miles 7 furlongs, and new cut to drainage channel.	97th mile ..	Do. 54 ..	6,340	
16	..	Improvements to canal, 97 miles 7 furlongs to 101 miles 1 furlong.	97th to 101st mile.	Do. 54 ..	4,350	
17	..	Diversion to canal, 101 miles 1 furlong to 101 miles 6 furlongs and cutting drainage channel.	101st mile to 6th furlong.	Do. 54 ..	7,300	
18	..	Outlet at 101 miles 6 furlongs ..	101st mile 3rd furlong.	Do. 54 ..	3,590	
19	..	Flood-gate south bank of Kódúr river ..	Do. do. ..	Do. 54 ..	15,540	

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
		NORTHERN CANAL—cont.			RS.	RS.
		Section IV.—From Kistnapatam to Pennér River—cont.				
20	..	Flood-gate north bank of Kodur river ..	101st mile 4th furlong.	Paragraph 53 ..	15,540	
21	..	Outlet at 101 miles 4 furlongs ..	Do. do. ..	Do. 53 ..	3,590	
22	..	Improvements to canal, 101 miles 6 furlongs to 111 miles 3 furlongs and 5 furlongs.	101st to 111th mile.	Do. 53 ..	29,950	
23	..	Toll Office and Establishment sheds at Kodur.	103rd mile ..	Do. 39 (11).	1,400	
24	..	Outlet at 107 miles 3 furlongs ..	107th mile 3rd furlong.	Do. 53 ..	3,590	
25	..	Do. at 108 miles 5 furlongs ..	108th mile 5th furlong.	Do. 53 ..	3,510	
26	..	Siding basin at Mypaud ..	110th mile ..	Do. 39 (9).	1,075	
27	..	Store and office at do. ..	110th " ..	Do. 39 (11).	2,340	
28	..	Outlet at 111 miles 3 furlongs ..	111th mile 3rd furlong.	Do. 53 ..	3,510	
29	..	Flood-gate south bank of Gangapatam river.	111th mile 4th furlong.	Do. 52 ..	20,500	
30	..	Improvements to canal, 111 miles 5 furlongs to 114 miles 2 furlongs.	111th to 114th mile.	Do. 52 ..	12,980	
31	..	Flood-gate north bank of Gangapatam river.	114th mile 5th furlong.	Do. 52 ..	20,500	
32	..	Outlet at 113 miles 2 furlongs ..	113th mile 2nd furlong.	Do. 52 ..	3,510	
33	..	Flood-gate south bank of Pennér river ..	114th mile ..	Do. 52 ..	20,500	
		Add Items of General Abstract Estimate, Nos. 65, 68 and 73.			3,03,270	
					3,09,498	6,12,768
		Section V.—From Pennér River to tail of Commamur Canal in Kistna District.				
1	..	Pennér diversion ..	114th to 117th mile.	Paragraph 51 ..	69,300	
2	..	Flood-gate north bank of Pennér river ..	114th mile 4th furlong.	Do. 51 ..	20,500	
3	..	Training and cross bank of Pennér river ..	Do. do. ..	Do. 51 ..	68,690	
4	..	Second-class Rest-house at Pennér island ..	115th mile ..	Do. 39 (11).	5,715	
5	..	Outlet at 116 miles 7 furlongs ..	116th mile 7th furlong.	Do. 51 ..	3,510	
6	..	Improvements to canal, 116 miles 7 furlongs to 119 miles 3 furlongs.	116th to 119th mile.	Do. 50 ..	11,145	
7	..	Ramatheertham diversion, 119 miles 3 furlongs to 120 miles 1 furlong.	119th to 120th mile.	Do. 50 ..	8,230	
8	..	Siding basin at Ramatheertham ..	120th mile ..	Do. 39 (9).	1,310	
9	..	Outlet at 120 miles ..	120th " ..	Do. 50 ..	3,250	
10	..	Improvements to canal, 120 miles 1 furlong to 122 miles 6 1/2 furlongs.	120th to 122nd mile.	Do. 50 ..	20,000	
11	..	Diversion to canal, 122 miles 6 1/2 furlongs to 123 miles 5 furlongs.	122nd to 123rd mile.	Do. 50 ..	14,030	
12	..	Two outlets at 123 miles 5 furlongs and 123 miles 6 furlongs.	123rd mile 5th and 6th furlong.	Do. 50 ..	6,500	
13	..	Flood-gate south bank of Pyderu river ..	123rd mile 5th furlong.	Do. 49 ..	19,060	
14	..	Diversion to canal, 123 miles 6 furlongs to 126 miles 7 furlongs.	123rd mile to 126th mile.	Do. 49 ..	45,900	
15	..	Flood-gate north bank of Pyderu river ..	123rd mile 6th furlong.	Do. 49 ..	19,060	
16	..	Improvements to canal, 126 miles 7 furlongs to 131 miles 7 furlongs.	126th to 131st mile.	Do. 49 ..	25,900	
17	..	Siding basin at Iskapalle ..	128th mile ..	Do. 39 (9).	1,160	
18	..	Flood-gate south bank of Iskapalle river ..	128th " ..	Do. 49 ..	19,080	
19	..	Do. north bank of do. ..	128th " ..	Do. 49 ..	19,080	
20	..	Diversion to canal, 131 miles 7 furlongs to 132 miles 5 furlongs.	131st to 132nd mile.	Do. 49 ..	9,364	
21	..	Outlet at 133 miles 5 furlongs ..	132nd mile 5th furlong.	Do. 49 ..	3,045	
22	..	Flood-gate south bank of Chippaleru river.	Do. do. ..	Do. 49 ..	18,100	
23	..	Diversion to canal, 132 miles 5 furlongs to 134 miles 3 furlongs.	132nd to 134th mile.	Do. 48 ..	18,690	
24	..	Flood-gate north bank of Chippaleru river.	132nd mile 6th furlong.	Do. 48 ..	18,100	

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
					RS.	RS.
NORTHERN CANAL—cont.						
Section III.—From Dugurápatnam to Kistnapatnam.						
1	..	Diversion to canal, 67 miles, 2 furlongs to 72 miles 2 furlongs.	67th to 72nd mile.	Paragraph 57 ..	55,570	
2	..	Flood-gate north bank of Dugurápatnam river.	67th mile 3rd furlong.	Do. 57 ..	19,030	
3	..	Outlet at 67 miles 3 furlongs.	Do. do. ..	Do. 57 ..	3,660	
4	..	Second-class Rest-house at Dugurápatnam.	69th mile ..	Do. 39 (11).	5,715	
5	..	Stores and office at Dugurápatnam.	69th " ..	Do. ..	2,340	
6	..	Siding basin at do.	69th " ..	Do. 39 (9).	1,090	
7	..	Do. at Thupili.	72nd mile ..	Do. ..	590	
8	..	Outlet at 71 miles 6 furlongs.	71st mile 6th furlong.	Do. 57 ..	3,660	
9	..	Improvements to canal, 72 miles 2 furlongs to 76 miles 3 furlongs.	72nd to 76th mile.	Do. 57 ..	17,200	
10	..	Swarnamukhi diversion and flood-banks ..	76th to 77th " ..	Do. 57 ..	36,700	
11	..	Outlet at 76 miles 5 furlongs.	76th mile 5th furlong.	Do. 57 ..	3,460	
12	..	Flood-gate south bank of Swarnamukhi river.	77th mile ..	Do. 57 ..	20,880	
13	..	Do. north bank of do.	77th " 1st furlong.	Do. 56 ..	20,880	
14	..	Improvements to canal, 77 miles 1 furlong to 80 miles 1 furlong.	77th to 80th mile.	Do. 56 ..	24,200	
15	..	Second-class Rest-house at Siddavaram ..	79th mile ..	Do. 39 (11).	5,715	
16	..	Two siding basins at Siddavaram and Kanoor.	79th and 81st mile	Do. 39 (9).	1,270	
17	..	Diversion to canal, 80 miles 1 furlong to 89 miles 7 furlongs.	80th mile ..	Do. 56 ..	8,400	
18	..	Outlet at 89 miles 6 furlongs.	89th mile 6th furlong.	Do. 56 ..	8,450	
19	..	Flood-gate south bank of Kundaleru river.	90th mile ..	Do. 56 ..	18,040	
		Add Items of General Abstract Estimate Nos. 65, 68, and 73.			2,51,840	
					2,88,409	6,40,249
Section IV.—From Kistnapatnam to Pennér River.						
1	..	Flood-gate north bank of Kundaleru river.	91st mile ..	Paragraph 55 ..	18,380	
2	..	Improvements to canal, 90 miles 6 furlongs to 92 miles.	90th to 92nd mile.	Do. 55 ..	6,100	
3	..	Outlet at 90 miles 6 furlongs.	90th mile 6th furlong.	Do. 55 ..	3,450	
4	..	Siding basin at 91 miles.	91st mile ..	Do. 39 (9).	1,480	
5	..	Bridge at Kistnapatnam road crossing.	91st " ..	Do. 39 (10).	10,250	
6	..	First-class Rest-house at Kistnapatnam.	93rd mile ..	Do. 39 (11).	6,630	
7	..	Diversion to canal, 92 miles to 93 miles 4 furlongs.	92nd to 93rd mile.	Do. 55 ..	13,680	
8	..	Siding basin at Kistnapatnam.	93rd mile ..	Do. 39 (9).	655	
9	..	Improvements to canal, 93 miles 4 furlongs to 95 miles 6 furlongs.	93rd to 95th mile.	Do. 55 ..	7,050	
10	..	Outlet at 95 miles 4 furlongs.	95th mile 4th furlong.	Do. 55 ..	3,485	
11	..	Flood-gate south bank of Nalatur river.	Do. do. ..	Do. 55 ..	18,550	
12	..	Improvements to canal, 95 miles 6 furlongs to 97 miles 2 furlongs.	95th to 97th mile.	Do. 54 ..	11,930	
13	..	Flood-gate north bank of Nalatur river.	95th mile 6th furlong.	Do. 54 ..	18,550	
14	..	Outlet at 95 miles 6 furlongs.	Do. do. ..	Do. 54 ..	3,485	
15	..	Diversion to canal, 97 miles 2 furlongs to 97 miles 7 furlongs, and new cut to drainage channel.	97th mile ..	Do. 54 ..	6,340	
16	..	Improvements to canal, 97 miles 7 furlongs to 101 miles 1 furlong.	97th to 101st mile.	Do. 54 ..	4,350	
17	..	Diversion to canal, 101 miles 1 furlong to 101 miles 6 furlongs and cutting drainage channel.	101st mile to 6th furlong.	Do. 54 ..	7,300	
18	..	Outlet at 101 miles 3 furlongs.	101st mile 3rd furlong.	Do. 54 ..	3,590	
19	..	Flood-gate south bank of Kódúr river.	Do. do. ..	Do. 54 ..	15,540	

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
					RS.	RS.
NORTHERN CANAL—cont.						
Section IV.—From Kistnapatnam to Pennér River—cont.						
20	..	Flood-gate north bank of Kodur river.	101st mile 4th furlong.	Paragraph 53 ..	15,540	
21	..	Outlet at 101 miles 4 furlongs.	Do. do. ..	Do. 53 ..	3,590	
22	..	Improvements to canal, 101 miles 6 furlongs to 111 miles 3 furlongs and 5 furlongs.	101st to 111th mile.	Do. 53 ..	29,950	
23	..	Toll Office and Establishment sheds at Kodur.	103rd mile ..	Do. 39 (11).	1,400	
24	..	Outlet at 107 miles 3 furlongs.	107th mile 3rd furlong.	Do. 53 ..	3,590	
25	..	Do. at 108 miles 5 furlongs.	108th mile 5th furlong.	Do. 53 ..	3,510	
26	..	Siding basin at Mypaud.	110th mile ..	Do. 39 (9).	1,075	
27	..	Store and office at do.	110th " ..	Do. 39 (11).	2,340	
28	..	Outlet at 111 miles 3 furlongs.	111th mile 3rd furlong.	Do. 53 ..	3,510	
29	..	Flood-gate south bank of Gungapatam river.	111th mile 4th furlong.	Do. 52 ..	20,500	
30	..	Improvements to canal, 111 miles 5 furlongs to 114 miles 2 furlongs.	111th to 114th mile.	Do. 52 ..	12,980	
31	..	Flood-gate north bank of Gungapatam river.	114th mile 5th furlong.	Do. 52 ..	20,500	
32	..	Outlet at 113 miles 2 furlongs.	113th mile 2nd furlong.	Do. 52 ..	3,510	
33	..	Flood-gate south bank of Pennér river.	114th mile ..	Do. 52 ..	20,500	
		Add Items of General Abstract Estimate, Nos. 65, 68 and 73.			3,03,270	
					3,09,498	6,12,768
Section V.—From Pennér River to tail of Commamur Canal in Kistna District.						
1	..	Pennér diversion.	114th to 117th mile.	Paragraph 51 ..	69,300	
2	..	Flood-gate north bank of Pennér river.	114th mile 4th furlong.	Do. 51 ..	20,500	
3	..	Training and cross bank of Pennér river.	Do. do. ..	Do. 51 ..	68,690	
4	..	Second-class Rest-house at Pennér island.	115th mile ..	Do. 39 (11).	5,715	
5	..	Outlet at 116 miles 7 furlongs.	116th mile 7th furlong.	Do. 51 ..	3,510	
6	..	Improvements to canal, 116 miles 7 furlongs to 119 miles 3 furlongs.	116th to 119th mile.	Do. 50 ..	11,145	
7	..	Ramatheertham diversion, 119 miles 3 furlongs to 120 miles 1 furlong.	119th to 120th mile.	Do. 50 ..	8,230	
8	..	Siding basin at Ramatheertham.	120th mile ..	Do. 39 (9).	1,310	
9	..	Outlet at 120 miles.	120th " 122nd mile.	Do. 50 ..	3,250	
10	..	Improvements to canal, 120 miles 1 furlong to 122 miles 6 1/2 furlongs.	120th to 122nd mile.	Do. 50 ..	20,000	
11	..	Diversion to canal, 122 miles 6 1/2 furlongs to 123 miles 5 furlongs.	122nd to 123rd mile.	Do. 50 ..	14,030	
12	..	Two outlets at 123 miles 5 furlongs and 123 miles 6 furlongs.	123rd mile 5th and 6th furlong.	Do. 50 ..	6,500	
13	..	Flood-gate south bank of Pyderu river.	123rd mile 5th furlong.	Do. 49 ..	19,060	
14	..	Diversion to canal, 123 miles 6 furlongs to 126 miles 7 furlongs.	123rd mile to 126th mile.	Do. 49 ..	45,900	
15	..	Flood-gate north bank of Pyderu river.	123rd mile 6th furlong.	Do. 49 ..	19,060	
16	..	Improvements to canal, 126 miles 7 furlongs to 131 miles 7 furlongs.	126th to 131st mile.	Do. 49 ..	25,900	
17	..	Siding basin at Iskapalle.	128th mile ..	Do. 39 (9).	1,160	
18	..	Flood-gate south bank of Iskapalle river.	128th " ..	Do. 49 ..	19,080	
19	..	Do. north bank of do.	128th " ..	Do. 49 ..	19,080	
20	..	Diversion to canal, 131 miles 7 furlongs to 132 miles 5 furlongs.	131st to 132nd mile.	Do. 49 ..	9,364	
21	..	Outlet at 132 miles 5 furlongs.	132nd mile 5th furlong.	Do. 49 ..	3,045	
22	..	Flood-gate south bank of Chippaleru river.	Do. do. ..	Do. 49 ..	18,100	
23	..	Diversion to canal, 132 miles 5 furlongs to 134 miles 3 furlongs.	132nd to 134th mile.	Do. 48 ..	18,690	
24	..	Flood-gate north bank of Chippaleru river.	132nd mile 6th furlong.	Do. 48 ..	18,100	

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for Section.
		NORTHERN CANAL—cont.			RS.	RS.
25		Section V.—From Pennar River to tail of Commamur Canal in Kistna District—cont.				
26		Two outlets at 132 miles 6 furlongs	132nd mile 6th furlong.	Paragraph 48	6,090	
27		Improvements to canal, 134 miles 3 furlongs to 150 miles 5 furlongs.	134th to 150th mile.	Do. 48	33,100	
28		Siding basin at Tumalapenta	139th mile 2nd furlong.	Do. 39 (9)	900	
29		Second-class Rest-house at Tumalapenta	Do. do.	Do. 39 (11)	5,715	
30		Siding basin at Chenugariptiem	145th mile	Do. 39 (9)	3,180	
31		First-class inspection bungalow at Ramapatam.	149th mile 2nd furlong.	Do. 39 (11)	3,004	
32		Office and store at do.	Do. do.	Do. 39	2,340	
33		Toll Office, &c., at do.	Do. do.	Do. 39	1,300	
34		Siding basin at do.	Do. do.	Do. 39 (9)	2,590	
35		Two outlets at 150 miles 5 furlongs	150th mile 5th furlong.	Do. 48	5,640	
36		Flood-gate south bank of Elekeru river	Do. do.	Do. 48	13,720	
37		Improvements to canal, 151 miles to 159 miles 7 furlongs.	151st to 159th mile.	Do. 47	21,530	
38		Flood-gate north bank of Elekeru river	151st mile	Do. 47	13,720	
39		Outlet at 151 miles	151st "	Do. 47	2,820	
40		Two siding basins at Chackicheria and Karedu.	154th and 159th miles.	Do. 39 (9)	1,310	
41		Manneru southern diversion	159th to 160th mile.	Do. 47	2,937	
42		Outlet at 159 miles 7 furlongs	159th mile 7th furlong.	Do. 47	2,990	
43		Flood-gate south bank of Manneru river	160th mile	Do. 47	20,240	
44		Manneru right flood bank	Do. do.	Do. 46	2,118	
45		Do. left do.	Do. do.	Do. 46	6,525	
46		Do. north diversion	160th "	Do. 46	6,250	
47		Flood-gate north bank of Manneru river	160th mile to 160th mile 6th furlong.	Do. 46	20,240	
48		Outlet at 160 miles	160th mile	Do. 46	2,990	
49		Improvements to canal, 160 miles 6 furlongs to 168 miles 2 furlongs.	160th to 168th mile.	Do. 45	31,860	
50		Second-class Rest-house at Oollapolliem	163rd mile	Do. 39 (11)	5,715	
51		Siding basin at Oollapolliem	163rd "	Do. 39 (9)	1,115	
52		Outlet at 164 miles 5 furlongs	164th mile 5th furlong.	Do. 45	3,055	
53		Siding basin at Pakala	166th mile	Do. 39 (9)	615	
54		Outlet at 168 miles	168th "	Do. 45	3,055	
55		Flood-gate south bank at Paleru river	168th "	Do. 45	18,440	
56		Paleru right flood bank	167th to 168th mile.	Do. 46	6,180	
57		Duplicate cut and improvements to canal, 168 miles 2 furlongs to 169 miles 3 furlongs.	168th to 169th mile.	Do. 45	14,100	
58		Flood-gate north bank of Paleru river	168th mile 2nd furlong.	Do. 45	18,440	
59		Do. south bank of Moosee river	169th mile 3rd furlong.	Do. 45	18,440	
60		Do. north bank of do.	Do. do.	Do. 45	18,440	
61		Outlet at 169 miles 3 furlongs	Do. do.	Do. 45	3,055	
62		Moosee left flood bank and Enagalur diversion to Moosee.	Do. do.	Do. 45	14,960	
63		Improvements to canal, 169 miles 3 furlongs to 177 miles.	172nd mile	Do. 44	15,800	
64		Siding basin at Manneru	169th to 177th mile.	Do. 39 (9)	2,135	
65		Bridge at Ethamukkala	172nd mile	Do. 39 (10)	10,250	
66		Siding basin at do.	173rd mile	Do. 39 (9)	2,410	
67		Thonderu diversion, 177 miles to 177 miles 7 furlongs.	173rd "	Do. 44	11,150	
68		Improvements to canal 177 miles 7 furlongs to 183 miles 1 furlong.	177th mile			
69		First-class inspection bungalow at Kothapatam.	178th to 183rd mile.	Paragraphs 43 and 44	23,900	
70		Stores and office at Kothapatam	179th mile	Paragraph 39 (11)	6,630	
71		Bridge at do.	179th "	Do. 39 (11)	2,340	
72		Basin at do. both sides	179th "	Do. 39 (10)	10,250	
73		Road dam at do.	179th "	Do. 39 (9)	8,150	
74		Siding basin at Mottumala	179th "	Do. 39 (10)	3,600	
		Outlet at 183 miles 2 furlongs	183rd mile	Do. 39 (9)	605	
			182nd mile 2nd furlong.	Do. 44	3,170	

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work	Position.	Reference to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
		NORTHERN CANAL—cont.			RS.	RS.
		Section V.—From Pennar River to tail of Commamur Canal in Kistna District—cont.				
75		Flood-gate south bank of Madigoundi river.	183rd mile 2nd furlong.	Paragraph 44	21,460	
76		Improvements to canal, 183 miles 3 furlongs to 186 miles 6 furlongs.	183rd to 186th mile.	Do. 43	41,220	
77		Flood-gate north bank of Madigoundi river.	183rd mile 3rd furlong.	Do. 43	21,460	
78		Siding basin at Patapadu	185th mile	Do. 39 (9)	515	
79		Gundlacamma right flood-bank	186th mile 6th furlong.	Do. 43	3,400	
80		Flood-gate south bank of Gundlacamma river.	Do. do.	Do. 43	21,720	
81		Improvements to canal, 187 miles to 190 miles 3½ furlongs.	187th to 190th mile.	Do. 43	13,380	
82		Gundlacamma left flood-bank	187th mile	Do. 43	11,850	
83		Flood-gate north of bank of do.	187th "	Do. 42	21,720	
84		Siding basin at Devarampadu	188th mile	Do. 39 (9)	590	
85		Diversion at Kanooparthi, 190 miles 3½ furlongs to 191 miles 4 furlongs.	190th to 191st mile.	Do. 42	11,630	
86		Second-class Rest-house at Kanooparthi	191st mile	Do. 39 (11)	5,715	
87		Siding basin at Kanooparthi	191st "	Do. 39 (9)	1,115	
88		Two outlets at 191 miles	191st "	Do. 42	6,780	
89		Flood-bank at Kanooparthi	191st to 192nd mile.	Do. 42	1,970	
90		Improvements to canal, 191 miles 4 furlongs to 194 miles 7½ furlongs.	191st to 194th mile.	Do. 42	24,800	
91		Toll Office and Establishment sheds at Pedda Ganjam.	195th mile	Do. 39 (11)	2,004	
92		Siding basin at Pedda Ganjam	196th "	Do. 39 (9)	430	
93		Flood-gate at do.	196th mile	Do. 42	18,300	
94		Improvements to canal, 194 miles 7½ furlongs to 196 miles 3 furlongs.	194th to 196th mile.	Do. 42	3,100	
		Add Items of General Abstract Estimate, Nos. 65, 68, 69 and 73.			11,25,667	
					13,25,229	24,50,896
		Section VI.—Junction Canal from Buckingham Canal to Commamur Canal, Kistna District.				
1		Drainage cut	195th mile	Paragraph 41	3,830	
2		Under tunnel	195th "	Do. 41	14,000	
3		Inlet and outlet at the crossing of the Pedda Ganjam Creek.	195th "	Do. 41	2,770	
					20,600	
					20,674	41,274
		Add Item of General Abstract Estimate, No. 73.				47,38,397
		Tools and Plant and Machinery (General Abstract Estimate, Item No. 71.)				56,103
		Total, Northern Canal				47,94,500
		SOUTHERN CANAL.				
		Section I.—From St. Mary's Bridge at Madras to Sadras Canal Lock.				
1		Lock at Adyar river left bank		Paragraph 63	61,280	
		Add Items of General Abstract Estimate, Nos. 65, 68-A, 69-A, and 73.			6,51,957	7,03,237
		Section II.—From Sadras Canal Lock to Palar River.				
1		Improvements to canal from Adyar river to 8 miles 4 furlongs.	0 to 8th mile	Paragraph 64	50,700	
2		Lock at Adyar river right bank	1st mile	Do. 64	42,750	
3		Two siding basins at Guindy Bridge and at lattice girder bridge, &c.	1st and 3rd miles.	Do. 39 (9)	4,045	
4		Toll Office and Establishment sheds at Palavakkam.	5th mile	Do. 39 (11)	925	

84
84
28

Summary of Estimates for improving reaches of Buckingham Canal, &c.—cont.

Number on Index Map and General Abstract Estimate.	Sheet Number of Index Map.	Description of Work.	Position.	References to Report.	Amount of Estimate as sanctioned in detail by the Madras Government.	Total for each Section.
		Southern Canal—cont.			RS.	RS.
		Section II.—From Sadras Canal Lock to Pálar River—cont.				
5	..	Siding basin at Neelankarai ..	5th mile ..	Paragraph 39 (9).	1,250	
6	..	Diversion to canal, 8 miles 4 furlongs to 15 miles 1 furlong.	8th to 15th mile.	Do. 64 ..	55,200	
7	..	Two siding basins at Vanienchavady, 12 miles and 13 miles.	12th to 13th mile.	Do. 39 (9).	1,800	
8	..	Flood-gate north bank of Covelong backwater.	15th mile 1st furlong.	Do. 64 ..	14,800	
9	..	Diversion to canal, 15 miles 2 furlongs to 31 miles 2 furlongs.	15th to 31st mile.	Do. 65 ..	1,69,300	
10	..	Flood-gate south of Covelong backwater ..	15th mile to 2nd furlong.	Do. 65 ..	14,800	
11	..	Second-class Rest-house at Covelong ..	16th mile 3rd furlong.	Do. 39 (11).	5,715	
12	..	Six siding basins at 16 miles 3 furlongs, 18 miles, 20 miles 4 furlongs, 23 miles 4 furlongs, 28 miles 4 furlongs, and 30 miles 1 furlong.	16th mile 3rd furlong, 18th mile, 20th mile 4th furlong, 23rd mile 4th furlong, 28th mile 4th furlong, and 30th mile 1st furlong.	Do. 39 (9).	9,625	
13	..	Flood-gate north of Edayur backwater ..	31st mile 2nd furlong.	Do. 65 ..	14,800	
14	..	Diversion to canal, 31 miles 4 furlongs to 32 miles 3 furlongs.	31st to 32nd mile.	Do. 66 ..	7,430	
15	..	Flood-gate south bank of Edayur backwater	31st mile 4th furlong.	Do. 66 ..	14,800	
16	..	Siding basin at Konatur, 32 miles 2 furlongs	32nd mile 2nd furlong.	Do. 39 (9).	1,695	
17	..	Improvements to canal, 32 miles 3 furlongs to 36 miles 3 furlongs.	32nd to 36th mile.	Do. 66 ..	14,875	
18	..	Siding basin at Sadras ..	35th mile ..	Do. 39 (9).	2,670	
19	..	Flood-gate north of Pudupatnam drain near Sadras.	36th mile 3rd furlong.	Do. 66 ..	15,130	
20	..	Improvements to canal, diversion and flood bank to Pálar river.	36th to 41st mile.	Do. 66 ..	92,280	
21	..	Flood-gate south bank of Pudupatnam drain	36th mile 5th furlong.	Do. 66 ..	15,130	
22	..	Siding basin at Pudupatnam ..	37th mile ..	Do. 39 (9).	3,375	
23	..	Flood-gate left bank, Pálar river ..	39th ..	Do. 66 ..	18,950	
23-A.	..	Five outlet sluices ..	13th, 18th, 30th, 33rd and 36th miles.	Do. 66 ..	14,700	
		Add Items of General Abstract Estimate, Nos. 65, 68, 68-A, and 73.			5,86,745	
		Section III.—From Pálar River to Merkanam.			78,608	6,65,353
1	..	Flood-gate, Pálar river, right bank ..	40th mile ..	Paragraph 66 ..	18,620	
2	..	Second-class Rest-house at Panayur ..	54th ..	Do. 39 (11).	5,715	
3	..	Toll Office and Establishment sheds at Alambarai.	58th ..	Do. 39 (11).	640	
4	..	Store and Office at Alambarai ..	58th ..	Do. 39 (11).	2,340	
		Add Items of General Abstract Estimate, Nos. 65, 68 and 73.			27,315	
		Tools and Plant and Machinery, Item No. 71.			1,86,450	
		Total, Southern Canal ..				2,13,765
		Grand Total, Northern and Southern Canals.				10,245
						15,92,600
						63,87,100

CHEPAUK,
December 1882.(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.APPENDIX B.
Statement showing the Expenditure incurred up to 31st March 1883 and to be incurred on different Sections of the Buckingham Canal.

No.	Sections of Canal.	Expenditure up to the commencement of Famine.	Total Famine Expenditure.	Deduct Excess over Normal Rates debited to Famine.	Net Ordinary Expenditure.	Expenditure subsequent to Famine up to 31st March 1882.	Total of Columns 3, 6, and 7.	Further Expenditure to be incurred including the probable Outlay in 1882-83.	Total of Columns 8 and 9.
		3	4	5	6	7	8	9	10
		RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
1	Southern Canal.								
1	From St. Mary's Bridge at Madras to Junction Canal Lock ..	16,002	7,12,497	1,29,395	5,83,102	48,053	6,47,157	56,080	7,03,237
2	From Sadras Canal Lock to Pálar River ..	48,836	39,719	15,591	24,128	361	73,325	5,92,028	6,65,353
3	From Pálar River to Merkanam ..	..	32,633	15,016	17,617	1,65,793	1,83,410	30,355	2,13,765
		64,838	7,84,849	1,60,002	6,24,847	2,14,207	9,03,892	6,78,463	15,82,355
	Northern Canal.								
1	From St. Mary's Bridge at Madras to Pulicat ..	..	..	..	..	1,452	1,452	4,32,960	4,34,412
2	From Pulicat to Dugurápatnam ..	..	..	..	..	7,673	2,50,973	4,07,825	6,58,798
3	From Dugurápatnam to Kistnapatnam ..	..	..	..	..	..	2,85,782	2,54,467	5,40,249
4	From Kistnapatnam to Pennér River ..	..	..	..	..	..	3,07,990	3,04,778	6,12,768
5	From Pennér River to tail of Commamur Canal ..	..	..	..	..	..	13,16,422	11,34,474	24,50,896
6	Junction Canal from Buckingham Canal to Commamur Canal ..	..	..	..	..	..	20,674	20,600	41,274
		4,84,240	21,40,080	5,71,073	15,69,007	1,30,046	21,83,293	25,55,104	47,38,397
	Total ..	5,49,078	29,24,929	7,31,075	21,93,854	3,44,253	30,87,185	32,33,567	63,20,752
	Tools and Plant and Machinery provided for in the General Abstract Estimate ..	..	..	..	..	..	..	..	66,348
	Grand Total ..	..	..	..	..	..	..	..	63,87,100

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.814
29
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APPENDIX C.

Statement showing the Arrivals at and Departures from the Madras Basin of Boats, with their Tonnage, for the period 1st July 1878 to 30th June 1882.

Directions.	HALF-YEAR ENDING 31st DECEMBER 1878.		HALF-YEAR ENDING 30th JUNE 1879.		HALF-YEAR ENDING 31st DECEMBER 1879.		HALF-YEAR ENDING 30th JUNE 1880.		HALF-YEAR ENDING 31st DECEMBER 1880.		HALF-YEAR ENDING 30th JUNE 1881.		HALF-YEAR ENDING 31st DECEMBER 1881.		HALF-YEAR ENDING 30th JUNE 1882.	
	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.	Number of Boats.	Tons.
Inwards from A Section ..	3,199	19,880	2,681	14,946	4,019	25,494	1,467	9,333	3,762	26,440	3,890	26,638	3,842	21,841	3,100	15,968
Do. from C do. ..	6,561	81,836	7,125	78,645	5,396	66,406	5,653	70,208	7,657	116,755	5,338	96,075	6,856	96,753	5,070	59,341
Total ..	9,760	101,716	9,806	93,591	9,415	91,900	7,120	79,538	11,419	143,195	9,228	122,613	10,698	118,594	8,170	75,309
Outwards into A Section ..	1,438	7,893	1,629	9,059	780	3,954	277	2,405	2,208	17,087	3,975	26,247	3,828	21,061	3,153	16,639
Do. into C do. ..	959	6,754	1,121	11,463	2,036	24,667	5,591	67,679	7,701	117,591	5,768	62,357	6,918	98,474	5,072	58,018
Total ..	2,397	14,617	2,750	20,522	2,766	28,611	5,868	70,084	9,909	134,628	9,738	88,604	10,746	120,035	8,225	74,657
Grand Total ..	12,157	116,333	12,556	114,113	12,181	120,511	12,988	149,622	21,328	277,823	18,961	211,217	21,444	238,629	16,395	149,966

CHEPAUK,
15th September 1882.

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

APPENDIX D.

Statement showing the Number, Tonnage, and Description of Boats licensed for each Section of the Buckingham Canal for the Year 1881.

UNCOVERED CARGO BOATS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
Particulars.	1 Ton.	2 Tons.	3 Tons.	4 Tons.	5 Tons.	6 Tons.	7 Tons.	8 Tons.	9 Tons.	10 Tons.	11 Tons.	12 Tons.	13 Tons.	14 Tons.	15 Tons.	16 Tons.	17 Tons.	18 Tons.	19 Tons.	20 Tons.	21 Tons.	22 Tons.	23 Tons.	24 Tons.	25 Tons.	26 Tons.	27 Tons.	28 Tons.	29 Tons.	30 Tons.	31 Tons.	32 Tons.	33 Tons.	Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
Government Boats ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	

Statement showing the Number, Tonnage, and Description of Boats licensed for each Section, &c.—ont.

Particulars.	COVERED CARGO, PASSENGERS AND RADARI BOATS.																			Total Tons.
	1 Ton.	2 Tons.	3 Tons.	4 Tons.	5 Tons.	6 Tons.	7 Tons.	8 Tons.	9 Tons.	10 Tons.	11 Tons.	12 Tons.	13 Tons.	14 Tons.	15 Tons.	16 Tons.	17 Tons.	18 Tons.	19 Tons.	
Government Boats ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Private Boats ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Boats compounded for the whole ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
A or Madras Section ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
B or Madras do. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C or Pulicat do. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
D or Kistnapatnam Section ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
E or Ramapatnam do. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
F or Kottapatnam do. ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total Number of Boats ..	7	33	62	106	94	61	41	35	27	20	12	14	13	7	6	3	1	..	..	533
Total Tonnage ..	7	66	156	424	470	366	287	250	243	200	132	168	169	98	90	48	17	..	..	3,240

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30

Statement showing the Number, Tonnage, and Description of Boats Licensed for each Section, &c.—contd.

Particulars.	Deck and Dinghy Boats—cont.						Fishing Boats.						Various Other Boats.					Total Number of all kinds of Boats.	Total Tonnage of Boats.
	13 Tons.	14 Tons.	15 Tons.	16 Tons.	17 Tons.	18 Tons.	1 Ton.	2 Tons.	3 Tons.	4 Tons.	5 Tons.	6 Tons.	1 Ton.	2 Tons.	3 Tons.	4 Tons.	Total.		
Government Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	114	114
Private Boats	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	81	81
Boats comprised for the year	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
A or Sadras Section	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	44	348
B or Madras do.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	125	457
C or Pulicat do.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	44	237
D or Kistnapatam Section	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	11	767
E or Ramapatam do.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	35	7,816
F or Kottapatam do.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	39	380
Total Number of Boats	3	2	2	4	1	2	108	42	3	1	..	..	1	1	..	..	2	48	291
Total Tonnage	39	28	60	16	51	36	108	42	3	1	..	..	1	1	..	..	32	1,128	10,215

CHEPAUK,
15th September 1882.(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

APPENDIX E.

THE BUCKINGHAM CANAL.

Ootacamund, September 22, 1879.

The following Revised Rules for the regulation of the navigation of the Buckingham Canal, passed by the Madras Government with such alterations as appeared necessary, are, under the provisions of Section 23 of Act I of 1870, hereby published for general information:—

I.—The Buckingham Canal includes the following lines of navigation, extending from south of the Pálár river in the District of Chingleput to the junction of the tidal and fresh-water canals in the Kistna District near Pedda Ganjam, together passing over a continuous distance of about 256 miles, viz:—

1st.—The Sadras Canal extending from 12 miles south of the right bank of the Pálár river to Palavakkam, distance about 50 miles.

2nd.—The Madras Canal extending from Palavakkam to the Shadayankuppam Lock, distance about 16 miles.

3rd.—The Pulicat Canal extending from the Shadayankuppam Lock to near Raidur-ravoo, distance about 48 miles.

4th.—The Kistnapatam Canal extending from near Raiduravoo to near Kodoor, distance about 48 miles.

5th.—The Ramapatam Canal extending from near Kodoor to Ramapatam, distance about 48 miles.

6th.—The Kottapatam Canal extending from Ramapatam to the junction with the Commamur fresh-water canal in the Kistna District, distance about 46 miles.

II.—These lines of navigation include also such portions of all navigable estuaries, backwaters, rivers, and channels, whether salt or fresh, connected with each such line as have been artificially formed, deepened, or protected; except all those minor channels which have been excavated as feeders to the main line of canal for purposes connected with the Salt and Wood Departments; they shall be each and severally distinct lines of navigation as defined in Section I of Act I of 1870 (The Canals and Ferries Act), the provisions of which shall apply to each of these distinct lines of navigation separately, and they shall be denominated sections of the Buckingham Canal as follows:—

1st.—A or the Sadras Section.

2nd.—B or the Madras Section.

3rd.—C or the Pulicat Section.

4th.—D or the Kistnapatam Section.

5th.—E or the Ramapatam Section.

6th.—F or the Kottapatam Section.

III.—From and after the 8th day of October 1879, no vessel, but those hereinafter excepted, shall be allowed on, or to use any of the abovementioned distinct lines of navigation without—

(1st) The payment of an annual license fee at the rates specified in the Schedule A annexed for the use of any one of the abovementioned distinct lines of navigation.

Exception (1)—Vessels possessing licenses for the navigation of the canals of the Godáviri or Kistna District will not be required to pay a license fee for the use of any section of the Buckingham Canal.

Exception (2)—The Pulicat fishermen (with boats under 2 tons each) should be free to fish in the backwater without the obligation to take out a license.

(2nd) The payment of a toll at the rates specified in the Schedule B annexed for passing from any one to any other of the abovementioned distinct lines of navigation for which the owner does not hold a license.

Exception (1)—Boats leaving their section will not be liable to toll when returning empty within two months.

Exception (2)—Boats licensed for the Kistna and Godáviri plying through the length of the canal to Madras will pay 4 annas per ton on the outward journey, but on returning full or empty, they will pass free at any toll-bar at which they had paid toll within one month.

Exception (3)—Boat-owners have the option of compounding for a year's tolls at Rs. 10 per ton.

Exception (4)—Boats licensed for the whole canal will not pay tolls.

Exception (5)—Boats returning into their own sections with a cargo after an absence from it of ten clear days, or if returning empty after an absence from it of two months, must pay tolls.

IV.—The Executive Engineer of the canal will issue licenses (in the Form C annexed) personally or by Agents authorized by him in writing for the purpose, at such times and places as he may notify in the *Fort St. George Gazette* and in the Official Gazette of the district in which the line of navigation, for which licenses are to be issued is situated. The vessels to be licensed must be brought at the time specified in the notification to the places where licenses are to be issued to be measured and registered and to have the necessary distinguishing marks put on them.

V.—These marks will show by letter the section of the canal to which the vessel belongs and which it is licensed to navigate. They will show the registered number of the vessel, and the tonnage, or the number of passengers the vessel is licensed to carry. They shall be put on under the direction of the Executive Engineer at the cost of the owner of the vessel, who will be held responsible that they are not defaced or obliterated, and that they are renewed from time to time as required. Yachts, pleasure-boats, and other vessels not intended to ply for hire, may be marked as the owner desires, provided the figures are clearly legible.

VI.—Applications for licenses shall be made in the Form D annexed, at any time before the 8th October for the current calendar year, and in the months of October, November or December for the ensuing calendar year. Printed forms of applications for licenses will be issued by the Executive Engineer of the Canal at his Office in Madras and by the Toll Superintendents of the Canal at the Toll Offices at Palavakkam, Shadayankuppam Lock, Raiduravoo, Kodoor, Ramapatam, and Pedda Ganjam.

VII.—The maximum dimensions of vessels brought on the canal hereafter will be limited to 90 feet in length, 13 feet beam, and 2½ feet draught; vessels of greater length and beam that may be now on the canal will be allowed to remain upon it at the owner's risk until they are worn out or renewed, but the draught of water will be limited in all cases to 2½ feet, which draught will be marked by a painted band or water-line round the outside of the hull, provided that the painted band or water-line thus arrived at shall not allow less free-board than 12 inches; or, in other words, be less than 12 inches below the lowest point in the gunwale; and no vessel shall be laden so as entirely to submerge this painted band. The height of fixed fittings, such as the roofs of boats, mast partners, funnel sockets, &c., shall be limited to 6½ feet above the deep load-line. The height of piled cargo, such as firewood, cotton, leaves, &c., will be limited to the same dimensions and in a similar manner.

VIII.—The gross tonnage of all vessels will be obtained by the following rule:—

$$\frac{L \times B \times D}{50}$$

L being equal to the length of the vessel, measured at half the midship depth, from the afterpart of the stem to the forepart of the stern post.

B is equal to the sum of five widths taken from the inner side of the planking to one side of the rib on the other side, at equal distances of one-sixth of the above length, divided by 6.

D is the midship depth taken from the upper surface of the limber strake (the bottom plank next the keelson, or the centre bottom plank when there is no keelson) to the under surface of the deck planking in decked vessels, or to the top of the upper strake or gunwale in open vessels.

The net or registered tonnage will be for—

Steamers, the gross tonnage less one-third; and for
Other vessels, the gross tonnage less 15 per cent.;

but the carrying capacity of any vessel to the load-line painted round the hull as laid down in Rule VII will be actually tested by weight on the owner of the vessel or his Agent bringing it to the Basin at Madras and making written application to the Executive Engineer to have it so tested, and the result arrived at by such testing shall be the registered tonnage of the vessel and be painted on it and adopted as the registered tonnage of the vessel, with effect retrospective to the commencement of the license under which the vessel is plying, i.e., all excess license fees and tolls collected from the commencement of the calendar year for which the vessel is licensed will be refunded, and *vice versa*. In the case of a vessel being tested which is found to have had its tonnage correctly or under-estimated by the method of measurement in this rule, the boat-owner or his agent who applies for the testing will pay a fee for testing of eight annas per ton of the tonnage arrived at by the testing. The cost of testing shall be borne by the Government when it is carried out on the order of the officer in charge of the canal, and in such case its effect shall not be retrospective.

IX.—Vessels adopted to carry passengers, i.e., having a covered space for their protection, may be registered as passenger vessels and will then be licensed to carry one passenger for every 5 square feet of deck surface under cover to be measured as follows:—Length, from stem to stern at the deck level; breadth, the sum of five widths taken at equal distances of one-sixth the length and divided by 6; then length and breadth divided by 5 will give the number of passengers a vessel will be licensed to carry, including 40 lb. of luggage for each passenger. When passenger vessels carry cargo as well as passengers, the quantity of cargo allowable will be the registered tonnage less 400 lb. for each passenger on board.

First-class passenger vessels (such as budgerows) plying for hire and not carrying cargo will be licensed at the commencement of the year at the option of the owners, either like other vessels by a license fee of Rs. 2 per ton for one section and tolls at 4 annas per ton, or by a license fee at Rs. 4 per ton for the whole Buckingham Canal for the year. In the calculation of the tonnage of such boats the free-board will be taken as at 18 inches and the load-line marked accordingly, the tonnage being determined by testing. The minimum fee for licensing a budgerow for the whole canal shall be Rs. 15.

Vessels, the private property of individuals, making use of the canals, but not carrying passengers or goods or plying for hire, will be licensed for a calendar year for the whole Buckingham Canal on payment of a fee of Rs. 15.

X.—Rafts will be permitted to navigate the several sections of the Buckingham Canal on payment of a fee of Rs. 15. on payment when entering each such section of the toll prescribed in Schedule B annexed; no raft exceeding 90' x 13' x 2' will be allowed on the canal.

XI.—If a vessel after the issue of a license be enlarged, it shall not again use the canal until it has been re-measured and re-licensed. The new license will be granted on surrender of the old license and on payment of the prescribed fee per ton on the difference between the old and new tonnage.

XII.—No person who has taken out a license for the navigation of any section of the canal shall have claim to compensation on account of any impediment to navigation that may occur from any cause whatever.

XIII.—Sea-going vessels brought into rivers and backwaters for shelter, for repair, or for any other purpose except to ply for hire must anchor or lay up outside the fairway of canal traffic which will be defined by the Canal Officers; such vessels will not be allowed to enter on the main line of the canal for the purpose of proceeding from one river or backwater to another river or backwater or for any other purpose except in accordance with the rules prescribed for the use of the canal.

XIV.—The Executive Engineer in charge of the canal for the time being is authorized to enforce these rules, to collect tolls and license fees, to remove obstructions to navigation, and to direct prosecutions under the provisions of Sections 7, 8, 9, 10, 12, and 25 of Act No. I of 1870.

BYE-LAWS.

I.—No vessel shall moor on the towing path side of the canal when there is only one towing path, nor on the windward side when there are two towing paths, except when actually loading or unloading, or with the special permission of the Canal Officers.

II.—No cargo shall be loaded or unloaded, and no passengers shall be shipped or landed at any lock or masonry work other than the quays or wharfs specially provided for the purpose.

III.—No vessel shall be repaired or fitted on the main line of the canal without the written permission of the Executive Engineer or other officer authorised to give such permission on the Executive Engineer's behalf.

IV.—No vessels shall be moored in a lock channel defined as such by notice-boards erected for the purpose by the Canal Officers.

V.—Vessels when moored in main line of the canal shall be made fast stem and stern to the banks in single tier, and there must be a person always in charge of each vessel; vessels when thus moored must, between sunset and sunrise, show a clear bright light not less than 4 feet above the water-level and visible all round the vessel.

VI.—When vessels, other than steamers, going under sail in opposite directions, meet, the vessel going with the wind shall give way, while the vessel going against the wind shall hold on its course.

VII.—Vessels not under sail shall give way to vessels under sail, and steamers shall in all cases give way to other vessels.

VIII.—When vessels not under sail, including steamers, meet, those going north should keep to the east, and those going south should keep to the west.

IX.—When a vessel passes another vessel going in the same direction, it should keep to the leeward of vessels under sail, and on the opposite side of the towing line of vessels not under sail.

X.—Vessels when not moored must, between sunset and sunrise, carry lights as follows:—

Steamers, three lights—

1st.—A clear white light not less than 9 feet above water and in the centre line of the vessel.

2nd.—A bull's-eye bright red light on the port (left) side.

3rd.—A bull's-eye bright green light on the star-board (right) side.

The bull's-eye lights to be not less than 8 inches diameter and not less than 4 feet above water.

Vessels other than steamers must carry a clear white light at the fore end not less than 4 feet above water.

Passenger-boats must, in addition to the above lights, carry a light in each cabin or compartment for passengers.

XI.—The maximum speed of steamers will be limited to 10 miles an hour by day and to 5 miles an hour by night, reduced to 4 miles an hour when within half a mile of a lock, or vessels ahead coming in an opposite direction. The steam whistle shall be blown when speed is reduced on the abovementioned occasions and when nearing a vessel going ahead in the same direction, or when approaching any sharp bend in the canal. Steamers passing through portions of the canal under repair or through portions of the canal that cannot stand a high speed shall reduce speed at those places to the limit fixed by the Canal Officers on notice-boards erected for this purpose.

XII.—Every vessel shall have its license always on board, and it shall be produced for examination by the Executive Engineer or by any officer authorised by the Executive Engineer to demand an inspection of it.

XIII.—Every vessel plying for hire is liable to be inspected at any time or place by the Executive Engineer or by officers authorized by him to inspect vessels, and the Executive Engineer may withdraw the license of any vessel found to be from any cause unfit for use, and to withhold the license until the vessel is made serviceable.

XIV.—The Executive Engineer may suspend the license of any vessel for any period not exceeding three months, or levy a fine not exceeding 5 rupees in each case, for any infringement of these rules or bye-laws.

THE BUCKINGHAM CANAL, MADRAS.

SCHEDULE A.

LICENSE FEES

Description of Vessel.

Rate per Ton
of Registered
Tonnage per
Annum.

RS. A. P.

For every ship, steamer, boat, barge, or vessel of any description, except those specified in the latter part of Rule IX (for the licenses for the whole canal), propelled in any manner and used for any purpose except fishing or pleasure 2 0 0

For every fishing or pleasure boat 0 4 0

Fractions of tons will be counted as one ton, and the minimum charge for any vessel will be one rupee.

Licenses will be issued on payment of the above fees for the use of any distinct line of navigation included in the Buckingham Canal.

A license will not be granted to the same vessel for the use of more than one line of navigation on the canal, except in the instances of the two classes of vessels specified in the latter part of Rule IX.

Vessels licensed in any month of one year must pay the annual fee for the whole of that year.

Licensed vessels will have to pay no other dues of any sort for the use throughout the year of the section of the canal for which the license is granted.

The fee for a duplicate license will be two rupees.

THE BUCKINGHAM CANAL, MADRAS.

SCHEDULE B.

SCHEDULE OF TOLLS.

Tolls.

Description of Vessel.

Rate per Ton
of Registered
Tonnage.
RS. A. P.

For every ship, steamer, barge, boat, or vessel of any description and propelled in any manner entering any of the distinct lines of navigation or sections of the canal other than the section in which it is licensed, and which it can use free of tolls 0 4 0

Rate per
Square Yard.
RS. A. P.

For every raft of floating timber, bamboos, or other floating substance 0 1 0

THE BUCKINGHAM CANAL, MADRAS.

FORM C.

License No. of 1879.

of the Buckingham Canal

This vessel is licensed to use the section during the calendar year 1879 free of further charge.

Registered No.

Name of owner.

Residence of owner.

Class of vessel (a).

Extreme length.

Do. breadth.

Do. depth.

Draught of water.

Licensed to carry

Do. do.

Fee paid.

License issued by

tons cargo.
passengers.

on the day of 1879.
Executive Engineer.

(a) Here enter steamer, budgerow, cargo-boat, passenger-boat, fishing-boat, or pleasure-boat as the case may be.

THE BUCKINGHAM CANAL, MADRAS.

FORM D.

APPLICATION FOR LICENSE.

I (or we) the undersigned (1) district of (3) hereby apply for license to
in the place (4) on the (5) section of the Buckingham Canal during
the year 1879.

Signature.

Date

(1) Here enter name or names of owners.

(2) Place of residence.

(3) Name of district in which residing.

(4) Description of boat and purpose for which it is to be used, such as passenger-boat, cargo-boat, budgerow, &c.

(5) Section of the canal for which a license is required, i.e., the

A or Sadras Section,
B or Madras Section,
C or Pulicat Section,
D or Kistnapatam Section,
E or Ramapatam Section,
F or Kottapatam Section.

R. H. SANKEY, Colonel, R.E.,
Secretary to Government, P.W.D.

14TH MARCH 1883, No. 841 W., PUBLIC WORKS.

GOVERNMENT OF MADRAS.
PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

No. 106.

READ—the following papers:—

Report by the Executive Engineer, Buckingham Canal Division.

No. 106-A.

Note by the Chief Engineer, Public Works Department.

The history, constructive details, financial position, &c., of this work have been dealt with at such length in the accompanying Report that little more than a brief résumé of the points will suffice in submitting the project for the consideration of Government.

2. The work now known as the Buckingham Canal, extending along the coast 66 miles south and 195 miles north of Madras (where it unites with the Kistna and Godavari Canal Systems), had its commencement as early as 1801.

3. Mr. Heefke, with Mr. Basil Cochrane as security, obtained the first concession for excavating 11 miles of channel (which was then known as Lord Clive's Canal) between Madras and Ennore, but Mr. Cochrane, obtaining subsequently entire control, finished this portion in 1806, and afterwards extended the communication to Pulicat 25 miles. This gentleman remained sole proprietor of the work for 45 years, when his rights were bought out by Government. Throughout this period the work was generally known as "Cochrane's Canal," a term which, in spite of the lapse of time and two subsequent changes of title, first, to "East Coast Canal," and then later on, to the "Buckingham Canal," still adheres to the first portion.

To maintain a sufficient height of water in the canal, which otherwise, when the Ennore bar was open, would have reduced the height of water in the Cooum river at Madras, the Shadayankupam lock was built in 1854 at $7\frac{1}{2}$ miles north of Madras; and subsequently, the channel was extended as far as Dugarápatnam, 69 miles north. About the same time the canal was pushed south from Madras 40 miles to the Pálár river.

The ultimate objects in view at this period were to reach Kistnapatam backwater, 21 miles north of Dugarápatnam, thus affording a terminus for Nellore; and as regards the southern branch of the canal, to make for Merkanam, and ultimately the French territory (Pondicherry).

That much wider views of the ultimate extension of the work obtained is clear from all the reports of the time, but want of funds and difficulties connected with the disposal of the cross drainage (every river along the coast passing the channel on its way to the sea) interfered with the actual progress of the work.

Captain Chambers, Mr. Kennedy, Mr. Fraser and other able officers designed extensions of the work north and south, and it was probably as much due to the fact

that these designs were in readiness as to anything else that on the occurrence of the late severe famine the further prosecution of the work was resolved on.

Under the orders of His Grace the Duke of Buckingham large gangs of work-people from the famine-stricken districts of Bellary, Kurnool, and Cuddapah were marched down to the coast, and worked along the whole line, partly in improving the then existing channel, partly in excavating the new canal extending from Dugarázpatnam to Pedda Ganjam, the junction of the Kistna System (a length of 126 miles in all), was put in hand to the north, and a further length from the Pálár river south. At one time it is reported that no less than 100,000 men, women, and children were so employed.

The whole line in its present length may thus be said to have reached a certain stage of completion with the termination of the famine.

The circumstances which have directly led to the necessity for the present large completion estimate may now be briefly noticed.

From the shallowness of the several backwaters along the coast, out of the connection of which no doubt arose the original conception of the canal, flat-bottomed boats, with only trifling draft, were at first used; owing to this the several connecting cuts or channels were given very little depth, say 12, or at most 15 inches.

In many places the backwaters were necessarily much deeper than this, and so also the canals in places, but these were at least the ruling depths.

This view of the requirements and capacity of the work is clearly shown by the trifling outlay which, down to 1856, had taken place in its construction, which did not exceed Rs. 1,400 per mile.

Some of the highest engineering authorities of the time considered that for the development of an inland coast trade it would not only suffice thus, as it were, to "scratch" out a shallow channel, but that it would be quite a mistake to attempt anything more.

This view in itself was by no means illogical, as, in addition to providing for the small class of boats there in use, it certainly met in a way the difficulties arising out of silt-bearing floods which, in crossing the line of canal all along the coast, would always tend to fill up the channel.

To re-excavate, even along a considerable length, a channel to only 12 or 15 inches might be periodically faced, and few or no works of flood protection would be essential.

This view, like all others, dependent on arguments derived from small beginnings, had of necessity to yield as traffic increased, and a larger class of boats began to be built and used on the canal.

It thus came to be recognized that if the work was to meet in any adequate way the strain thrown upon it, a depth of not less than 3 feet everywhere at low water must be secured; and although, as will be observed from an examination of the present Report, this has led to greatly enhanced outlay, the conclusions on which it is based appear to be irresistible.

Whereas merely clearing a shallow trough through backwaters might have well suited the requirements of the small flat-bottomed skiffs at first used, it has year by year become more clear that if a canal with sole 3 feet below low water were to be maintained, the first necessity would be to exclude the land floods which usually accompany cyclones on the coast, and which in many places have been shown to rise to no less than 10 or 11 feet above mean sea level.

Such floods, owing to the flatness of the littoral tract, take some time to vent themselves, and after two or three days they have, in many places, been shown not only to bring in silt sufficient to fill up the canal, but even to raise the bed above mean sea level. The enormous recurring outlay required by the re-excavation of the silt thus poured into the unprotected channel has proved that it would in the end be far cheaper to isolate and protect from flood invasion all the several reaches of the canal between the different drainages as they cross the line.

The necessity of constructing high isolating side embankments, flood gates, and the training of the several rivers near the coast have, thus one and all, followed as a matter of necessity.

The trifling outlay which, as before shown, was found to suffice with shallow boats and a small trade has thus gradually progressed from a capital outlay of Rs. 1,400 per mile in 1856 to nearly—

Rs. 3,500	per mile at end of 1875-76,
" 8,500	" " of 1877-78,
" 12,000	" " of 1881-82.

[This omits the excess over normal rates due to famine, which amounted in the aggregate to Rs. 7,31,075.]

As shown by the completion estimates herewith sent up, amounting with all past outlay to Rs. 63,87,100, the ultimate cost for a fully completed first-class canal, 261 miles in length, will be a little under Rs. 24,500 per mile.

The returns show that all classes of boats employed on the canal have increased in a very marked manner, notwithstanding what is now admitted to have been a vexatious and deterrent method of levying license fees and tolls.

In 1879 there were in all 723 boats with a gross burden of 6,287 tons. By 1882 these had increased to 1,055 boats aggregating 10,551 tons.

In 1875 the receipts from tolls, &c., were Rs. 51,113, and the total collections had increased to—

Rs. 1,09,808	in 1880,
" 1,16,527	in 1881,
" 1,00,037	in 1882.

The falling off in the last year was due to certain changes in regard to the tolls not necessary to particularize.

As further illustrating the vitality of the trade which in the present imperfect condition of the work exists, it may be mentioned that no less than 241,207 tons passed through the locks north and south of Madras during 1881.

It is now fully recognized that the system on which the tolls have been levied acts as a direct impediment to trade, and on the report of a Committee which has lately taken the whole subject into consideration, Government has decided on modifications which, though reducing the actual receipts for the present, will, it is certain, have a very beneficial effect in stimulating traffic.

Sufficient, it is hoped, has been adduced to show the growing commercial value of a work which, while being admirably adapted to all the physical conditions of the coast, suits in every way the native habits as a mode of conveyance for passengers and goods, opens a field of new and diverse employment to the inhabitants of the littoral tract, and affords a high way of limitless capacity at a cost of certainly not over one quarter of that of a railway.

Among other benefits indirectly touched on in the Report is the value which may yet attach to the large tracts of land which hitherto from having been open to invasion of tidal water will eventually be reclaimed by the works, and may, like others of a similar character, be turned to the best account as casuarina plantations, the success of which as an industry is now so well established along the older portions of the canal.

As a means of bringing the coal from the Singareni field in Hyderabad at a price which will admit of successful competition with patent fuel and English coal at Madras, the Railway authorities have lately expressed themselves to be very sanguine.

But the main advantage and importance of the work is its probable use during the prevalence of famine. As linking the great delta systems of the Godávari and Kistna with Madras and the country to the south, and thus affording a means, whether the sea-board be closed or not, of depositing grain at any point along the whole line ready for transport into the interior, its value must be held to be incalculable. It is on these grounds that the claims of this work to be classed as "Protective" have been urged on the attention of the Government of India, and, it is hoped, that this view may be fully maintained and recognized.

As shown in Appendix B to the Report, the actual capital amount expended on the work from its commencement down to 31st March 1882 has been Rs. 30,87,185.

As the outlay in the current year will be nearly Rs. 1,36,000, the capital outlay for the completion of the work during 1883-84 and subsequent years will amount to Rs. 31,63,915.

From experience of past working, it is thought that, with temporary increase to the present permanent staff, the expenditure in subsequent years might fairly be raised to three lakhs per annum on original works over and above the amounts needed for repairs and maintenance.

The annual outlay under the latter head, which has for the period, April 1879 to March 1883, on an average amounted to Rs. 99,000, will necessarily, as the works now estimated for advance towards completion, diminish sensibly till, as anticipated by the present Executive Engineer, the whole maintenance of the 261 miles of canal will not exceed Rs. 40,000 per annum (exclusive of establishment), a charge which will be fully covered by the revenue derived from tolls and license fees.

To provide, then, the requisite ways and means for completion of the work, yearly contributions of one lakh from Provincial (which also bears the full maintenance charges) and two lakhs from Imperial under Protective would, it is thought, best meet the requirements of the case, and would, under all the circumstances of the case, appear to provide in a fair and equitable manner for the incidence of the charges.

(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.

8th March 1883.

No. 107.

ORDER—dated 14th March 1883, No. 841 W., Public Works.

Ordered that the plans and estimates for the Buckingham Canal Project be forwarded to the Government of India.

(Here enter No. 842 W., dated 14th March 1883.)

(True Extract.)

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

To the Superintending Engineer, Fifth Circle.
" Chief Engineer for Irrigation.
" Examiner, Public Works Accounts.
" Board of Revenue.

Exd. A. F. Goodall.
Spare Copies

814
369

BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of (1883) Madras.

PUBLIC WORKS.

Dated March, 14th.

Recd.

Encl.

G.O., 14th March 1883, No. 841 W.

MARCH.
Nos. 106-107.

Buckingham Canal Project
*The plans, estimates, &c., for the —, ordered
to be forwarded to the Government of India.*

814
37

From the Committee convened in accordance with Proceedings of Madras Government, No. 612 I., of the 5th August 1882, to the Chief Engineer for Irrigation, dated Camp, Ellore, 12th October 1882.

We have the honor to report that having met at Pedda Ganjam we have discussed the matters referred for our consideration regarding the modifications of the Navigation Rules for the canal system of the East Coast.

2. As regards the first point to which our attention was directed, we have agreed that tolls cannot be entirely abolished, but that tolls should be charged on the basis of time rather than on that of distance or direction of journey. This would admit of the number of toll stations at present existing being considerably reduced.

3. We consider it necessary to maintain a system of tolls in the interests of the public, for although annual licenses are simpler and less harassing to frequent users of the canals, yet the occasional use of the canals of a system should not necessitate the taking out of a whole year's license.

4. We think that if tolls are kept within reasonable limits as to rate and frequency of collection, boats which otherwise would confine themselves to the one system for which they were licensed would make occasional use of the canals of other systems to the general advantage of the public.

5. We therefore recommend the retention of tolls, but on a modified system.

6. Our proposals are that tolls shall be paid at the rate of one-fourth the annual license fee for each separate system, and that a toll once paid at any station of a system shall clear the vessel through all the canals of that system and in any direction for a period of six weeks.

7. We have fixed upon this period as that which would suffice for a through return trip for the greatest distance on the main line, and we have fixed the amount so that it shall be to the advantage of users of the canals for more than six months to take out a license.

8. It will be seen that tolls under this system are practically short licenses.

9. In considering the positions for toll stations, we have thought it advisable to place them as far as possible where there is a natural stop, not at places where artificial bars have to be placed across clear reaches of the canals at which all traffic is stopped, whether toll has to be taken or not.

10. We propose therefore that the only toll stations shall be the head locks of each section of the deltas, all tidal locks, the Ellore Lock, the Western Tammileru Aqueduct on the Kistna Ellore Canal, where the Godavari and Kistna Systems join, and the following places on the Buckingham Canal:—

- (1.) Pedda Ganjam, where the Kistna and Buckingham Canal Systems join.
- (2.) Kandleru River.—We propose this place, because a toll station intermediate between Pedda Ganjam and Shadayankupam Lock is required, so that boats working on the canal between these places can obtain toll tickets without being compelled to proceed for that purpose to either extremity of this long reach of 188 miles.
- (3.) Shadayankupam Lock (north of Madras).
- (4.) Adyar Southern Lock (south of Madras).

11. The toll stations on the three systems will be reduced from a present number of 47 to 20.

12. We propose that the period for which a toll ticket remains current shall in the case of *rafts* be only one month, as it is very necessary that they should not be allowed to linger in the canal to the inconvenience of the general traffic.

13. Under the rules for *rafts* sanctioned in G.O., No. 384, of the 8th May 1882, a fresh toll was charged at the end of three weeks, or when the raft changed its direction. We propose that as in the case of boats a toll once paid shall clear a raft throughout the system and in any direction, but that the toll should in consideration of the much greater length of canal which will be thus opened out by one payment be double the present Godavari and Kistna rates. This however will be a very considerable reduction on the present Buckingham Canal rates. The proposed rates form but a small proportion of the value of *rafts*, and hence will not be oppressive.

14. Points 2 and 3 mentioned in paragraph 5 of the Government Order as specially referred to us are so intimately connected that it is necessary to consider them together.

15. For through traffic it is essential that there shall be only one unit of measurement, and we consider the unit should be that formerly in use in the deltas, and still in use on the Buckingham Canal, viz., 50 cubic feet, which may for convenience be called a ton.

16. We consider that having fixed a measure of capacity and provided for uniformity in the system of measurement, it is unnecessary that any attempt should be made to reconcile this with the *weight* carrying capacity of various builds of boats.

17. As regards the rates of license fees having reverted to the previous unit we propose for the Godavari system to revert also to the previous rate of Rs. 2 per 50 cubic feet in the case of cargo boats.

18. In the case of the Kistna we consider it equitable to fix a rate somewhat higher than that in use with the old unit (Re. 1), because the main line of the system has recently been much improved and connected with the Buckingham Canal. We therefore propose a fee of Rs. 1½ per 50 cubic feet.

19. Hitherto the rate for licenses for the whole of the Buckingham Canal has been nearly five times the Godavari rate, and nearly seven times the Kistna rate, the mileage on the Buckingham Canal being not so much as that of the Kistna system and about ½ths of that of the Godavari. The result has been that boats working on the Buckingham Canal have found it to their advantage to work under the present very complicated system of tolls rather than to take out licenses.

20. Considering that the Buckingham Canal serves a great extent of country, and has a more important terminus than any in either the Godavari or Kistna systems, we consider it advisable to recommend a rate of Rs. 3 per 50 cubic feet for the amount of annual license fee.

21. In order to encourage through traffic we propose a considerable reduction on the total license fees of the three systems separately when boats take out through licenses. The rate for these through licenses for cargo boats we would fix at Rs. 5 per 50 cubic feet.

22. As regards passenger vessels we find that the type of boats in use in the deltas differs so much from those in use on the Buckingham Canal that it is necessary to classify them.

23. For the Godavari and Kistna systems, having reverted to the former unit of measurement, we propose, as in the case of cargo boats, to revert to the former rate.

24. For the Buckingham Canal the proposed rates for the corresponding classes of boats have been made the same as in the deltas.

25. In the case of passenger boats we have however proposed one important modification of present rules, viz., that the space to be allowed for a passenger be increased from 5 to 7½ square feet. This we believe to be advisable in the interests of the public, as with five square feet boats carrying their full number are known to be

inconveniently crowded for long journeys. With through communication made cheaper and simpler it is hoped that the numbers undertaking long journeys may be increased.

26. We also propose that passenger boats should be allowed to take out through licenses at reduced rates.

27. Special provision has been made for a modification of the rule regarding the number of passengers, on the occasion of festivals near Madras, to suit the circumstances of the local traffic at those times.

28. We propose that the revenue derived from through licenses should be credited to each system on the following proportions:—

Cargo Boats.						RS.
Amount of through license	...	...	...	...	...	5
Godavari System	...	...	...	...	...	1 8 0
Kistna do.	...	...	...	...	...	1 4 0
Buckingham Canal System	...	...	...	...	...	2 4 0
						5
Passenger Boats.						RS.
(a) and (c) classes, through license	...	...	...	...	...	10
Godavari System	...	...	...	...	...	3 0 0
Kistna do.	...	...	...	...	...	2 8 0
Buckingham Canal System	...	...	...	...	...	4 8 0
						10
(b) and (d) classes, through license	...	...	...	...	...	7
Godavari System	...	...	...	...	...	2 4 0
Kistna do.	...	...	...	...	...	1 8 0
Buckingham Canal System	...	...	...	...	...	3 4 0
						7

As the proposed through license for steamers is Rs. 10 per 50 cubic feet, the amount to be credited to each system will be the same as in the case of (a) and (c) passenger boats.

29. In the case of steamers we propose that they shall, as heretofore, pay double the rates for cargo boats, both for licenses and for tolls.

30. Instead of keeping the existing division of rules and bye-laws, which as at present arranged is inconvenient and occasionally misleading, we propose that all the regulations shall be embodied into one set of rules, and that these should be applicable to all the three systems.

31. We have accordingly prepared the draft of a set of rules embodying our present proposals and such of the old rules and bye-laws as it is advisable still to maintain, and submit them herewith for approval. We believe that these rules will be found more concise than the old ones, and more easily intelligible by those whom they affect.

32. We have drawn out and appended to these rules license and toll ticket forms adapted to the new rules.

33. As the Buckingham Canal has been placed under Madras Act I of 1870 ("The Canals and Ferry Act"), whereas the canals of the delta systems have not been brought under that Act, there may probably be differences in their management which would be inadvisable and likely to lead to complications when attempting to work the three systems as one combined whole. We think all should be under the same rules. We are strongly of opinion, however, that the Delta Canal Officers should not be made Magistrates, as their work is important and always heavy. In the deltas there has been no practical difficulty in enforcing the navigation rules, because the numerous locks in both systems have enabled boats transgressing to be at once punished by stoppage.

34. We also desire to bring to notice that the Buckingham Canal is at present worked under the direct orders of the Chief Engineer, Public Works Department,

814
38

and the Delta Canals under the orders of the Chief Engineer for Irrigation. We would invite attention, if the navigation of the three systems is to be worked as a whole, to the advisability of ensuring uniformity of orders.

35. If the new rules are to be brought into force for the next calendar year, which seems very advisable, we are of opinion that the orders of Government should be received by the 30th November *at the latest*.

We have the honor to be,
Sir,

Your most obedient servants,

(Signed) J. W. RUNDALL,
Superintending Engineer.

(„) G. T. WALCH,
Offg. Superintending Engineer.

(„) W. S. OTTMANN,
Honorary Assist. Engr., P.W.D.

Draft of Revised Navigation Rules for the Godavari, Kistna, and Buckingham Canals.

Reference to present Rules.

Delta Rules I.
Buckingham Canal Rules III.

Delta Rules II.
Buckingham Canal Rules III.

Delta Rules III.
Buckingham Canal Rules III.

New Rule.

Delta Rules V.
Buckingham Canal Rules VIII.

SYSTEMS.

I. GENERAL.

1. No vessel or raft will be allowed to enter or make use of any canal unless the owner shall have previously taken out a license, or unless toll shall have been paid as hereinafter provided.

II. LICENSES.

2. Licenses will be issued for vessels for a calendar year only, and will entitle the vessel to navigate the canals of the system for which the license is issued from date of issue to 31st December following. The owner of a vessel desiring to obtain a license shall apply in person or by letter to an officer empowered to issue licenses, viz., the Executive Engineer of the division or officer authorized in writing by him. The owner shall give to the licensing officer the information required to fill up the license as shown in the license form.

3. Every vessel licensed for the conveyance of cargo shall pay a license fee as follows:—

For the Godavari System Rs. 2 per ton of 50 cubic feet.

For the Kistna System „ 1½ do.

For the Buckingham Canal „ 3 do.

N.B.—Godavari System Licenses and Toll Tickets hold good as far as the Western Tammilern Aqueduct on the Kistna Ellore Canal.

4. The annual license fees payable on cargo vessels for the three systems separately can be compounded for one through license available over all the three systems at the rate of Rs. 5 per ton. A boat which has already taken out a license for either of the three systems will not be permitted to compound for that calendar year.

5. The gross tonnage of all vessels will be obtained by the following rule:—

$$\frac{L \times B \times D}{50}$$

L being the length between the stern and fore post at half the midship depth.

B being one-sixth of the sum of five widths taken at equal distances along the above length. The width to be measured from the rib on one side to the planking (skin) on the other side.

D being the depth measured amidship from the top of the keelson, or of the centre plank, to the underside of the deck planking, or to the top of the gunwale in open or passenger vessels.

The net or registered tonnage on which the fee will be charged will be—

For steamers, the gross tonnage less one-third.

For other vessels, the gross tonnage less 15 per cent.

Fractions of a ton above the half will be charged as one ton.

6. On payment of the license fee according to the rates fixed, a license will be issued which will entitle the vessel to the use of all the canals of the system named in the license without any other payment whatever. If a vessel after the issue of a license be enlarged, it shall not ply again until it has been remeasured, and a new license taken out. This will be granted on surrender of the previous license and on payment of the prescribed rate per ton for the difference between the old and new tonnage. The penalty for using on the canals an enlarged vessel without a new license being taken out will be the forfeiture of the license fee previously paid.

7. The license number with the distinguishing letter * of the system must be painted conspicuously in English figures, not less than four inches in height, on each bow of the vessel.

The tonnage of the vessel must be similarly marked in English figures on each side of the sternpost.

These marks must be put on the vessel before it commences to use the canals at the expense of the owner, who will be responsible that they are not defaced or obliterated.

8. License will be issued to vessels adapted for the conveyance of passengers under the following conditions and at the following rates.

Such vessels will be measured for tonnage under Rule V, and they will be permitted to carry one passenger for every 7½ square feet of covered space. The covered space will be calculated from the following measurements:—

Length, over all of covered space.
Breadth, the mean of three widths taken at equal distances.

Passenger boats will be divided into the following classes:—

(a) Boats of the “Rahaddari” or transit boat type, taking a license which leaves optional to the owner the fares to be charged and the caste of the passengers to be carried.

(b) Boats of the “Rahaddari” or transit boat type, taking a license by the acceptance of which the owner

Delta Rule V.
Buckingham Canal Rules, none.

Delta Rules VI.
Buckingham Canal Rules IV and V.

Delta Rules VII.
Buckingham Canal Rules IX.

814
39

undertakes to convey all passengers for whom there is room according to the rules, irrespective of caste, and at rates not exceeding the following maxima, viz., in the general cabin 2 pies per mile per passenger including one cooly head load of luggage; in the separate fore or aft cabins, for every $7\frac{1}{2}$ square feet of cabin, 3 pies per mile per passenger, including one cooly head load of luggage. Any passenger wishing to reserve a separate cabin for his exclusive use will be entitled to do so on paying the full hire for the whole cabin.

A whole boat of this class shall not be hired out to one individual, except by permission of the Executive Engineer or officer authorised by him to issue licenses.

(c) Boats of the budgerow type, plying for hire, but not carrying cargo, the rate of fare and the passengers to be carried being optional with the owner.

(d) Boats of the "top boat" type, having a covered space for the protection of passengers, taking a license by the acceptance of which the owner undertakes to convey all passengers for whom there is room according to the rules, irrespective of caste, and at rates not exceeding 2 pies per mile per passenger, including one cooly head load of luggage.

During festivals in the neighbourhood of Madras, the rule limiting the number of passengers to be carried by this class of boat may, on application, be temporarily suspended by the Executive Engineer in charge of the division, or officer duly authorized by him to issue licenses.

The license fees for passenger boats will be as follows for each system:—

(a) Class, Rs. 4 per ton.
(b) " " 3 "
(c) " " 4 "
(d) " " 3 "

9. The annual license fees payable on passenger boats can be compounded for one through license available over all the three systems at the following rates:—

(a) Class, Rs. 10 per ton.
(b) " " 7 "
(c) " " 10 "
(d) " " 7 "

10. The number of the license issued for a passenger vessel must be painted on the bows in the manner prescribed for cargo vessels. The tonnage of the vessel and the number of passengers which she is licensed to carry must be painted conspicuously on the stern of the vessel or on the afterpart of the cabin. The number of passengers will be preceded by the letter P.

New Rule.

Delta Rules VIII.
Buckingham Canal Rules IV and V.

Delta Rules IX.
Buckingham Canal Rules IX.

Delta Rules X.
Buckingham Canal Rules, part of IX.

Delta Rules XI.
Buckingham Canal Rules, none.

Delta Rules XV (8).
Buckingham Canal Rules, Schedule A.

Delta Rules XII.
Buckingham Canal Rules XII.

Delta Rules XIV.
Buckingham Canal Rules III (2nd).

Delta Rules XIV (4).
Buckingham Canal, Schedule B.

Delta Rules XV (9).
Buckingham Canal Rules, Schedule B.

New Rule.

Delta Rules XIV.

11. Passenger vessels may carry cargo as well as passengers, subject to the following conditions:—

- (1) That vessels of the types (b) and (d) must convey passengers, when required to do so, in preference to cargo.
- (2) That the quantity of cargo be not greater than the registered tonnage less 400 lb. for each passenger on board.

12. Vessels, the private property of individuals, making use of the canals, but not carrying goods or passengers, or plying for hire, will be licensed to use the canals of a system on payment of a fee of Rs. 12 for the calendar year.

13. Pleasure boats used for rowing on the canals, but not carrying goods or passengers, will be licensed to use the canals of a system on payment of a fee of Re. 1 for the calendar year.

14. All fees payable by steamers will be double those of ordinary cargo boats.

The number of the license and tonnage must be painted on steamers in the manner prescribed for cargo boats.

15. No person who has taken out a license for the navigation of the canals shall have any claim to compensation, in consequence of the closure of all or of any of the canals for repairs, or because of insufficiency of water, or on account of any other impediment to navigation.

III. TOLLS.

16. Vessels not holding a license will be allowed to navigate the canals on payment of the hereinafter stated tolls and on the following conditions.

The rates of toll per ton will be—

Cargo and Passenger Boats.	AS.
Godavari System ...	8
Kistna " ...	6
Buckingham Canal ...	12

Steamers.	RS.
Godavari System ...	1
Kistna " ...	0 $\frac{1}{2}$
Buckingham Canal ...	1 $\frac{1}{2}$

Private Boats referred to in Rule XII.

For each boat, for each system, Rs. 3.

A toll once paid at any toll station of a system will clear the vessel over all the canals of that system and in any direction for a period of six weeks, except in the case of rafts, which must either be removed from the canals within one month from the date of the toll ticket, or again pay toll.

The toll stations in the Godavari and Kistna Systems will be—

The head lock of each section* of delta.

	All tidal locks.
	The Ellore Lock.
* Godavari Sections.	The Western Tam-
Eastern.	mileru Aqueduct on the
Central.	Kistna Ellore Canal.
Western.	The toll stations on
Kistna Sections.	the Buckingham Canal
Eastern.	will be as follows:—
Western.	

1. Pedda Ganjam.
2. Kandleru River.
3. Shadayankupam Lock.
4. Adyar Southern Lock.

814
410

Delta Rules XIII.
Buckingham Canal Rules, Schedule B.

New Rule.

Delta Rules XIII (1).

Delta Bye-law 18.
Buckingham Canal Rule VII.

Buckingham Canal Rule VII.

Delta Bye-law No. 9.
Buckingham Canal Rule X.

Buckingham Canal Rules VII.

Delta Bye-law 1.
Buckingham Canal Bye-law 1.

Delta Bye-law 2.
Buckingham Canal Bye-law 2.

New Rule.

Delta Bye-law 3.
Buckingham Canal Bye-law III.

To determine the tonnage for tolls vessels will be measured under Rule V.

A list of the toll stations for each system will be affixed to a notice board at each toll station in that system.

17. Rafts shall pay tolls at the following rates:—

Logs of timber, rough or squared, as.
for each unit of 100 square feet. 8
Bamboos for each unit of 100
square feet ... 4

Rafts of timber and bamboos mixed will be charged at the rate for timber.

All fractions of the unit will be charged for as a full unit.

IV. REGULATIONS.

18. The extreme dimensions of any vessel allowed to navigate the canals will be 90 feet in length and 13 feet in breadth over all.

Boats built before the 31st December 1880, which exceed the above dimensions, may receive a special license at the discretion of the Executive Engineer of the division.

No boat drawing more than 3½ feet will be admitted into any lock.

To suit the conditions of masonry works on the southern sections of the Buckingham Canal, the height of fixed fittings such as the roofs of boats, steps of masts, funnel sockets, &c., shall be there limited to 6½ feet above water level. A similar limit shall be applied to piled cargo.

19. No raft of larger dimensions than 90 feet in length, by 12 feet in breadth, or of more than 2' draught will be allowed on the canals. Rafts exceeding these dimensions will be stopped until they are reduced and a fresh toll paid on the then measurement under Rule XVI.

20. Boats carrying cargo must have a free board of not less than 9 inches; boats carrying passengers must have a free board of not less than 1 foot.

21. No vessel or raft shall moor on the towing-path side if there be only one tow-path, or on the windward side of a canal if there be two tow-paths, except when actually loading or unloading.

22. No cargo shall be loaded or unloaded and no passengers be shipped or landed at any lock, or on any masonry work other than the quays or wharfs specially provided for the purpose.

23. No goods shall be stacked on any tow-path or on the canal side of any tow-path under any circumstances, nor shall they be stacked on canal lands without special permission of the canal officers.

24. No vessel shall be repaired in any canal at any time, without the written permission on the Divisional Executive Engineer, and then only at the place and during the time named in the written permission. Materials used in the repair of vessels will, unless removed from the canal before, or at the time of, the vessels departure, be confiscated, and any expense incurred in their removal must be paid by the owner of the vessel under penalty of suspension of license until it be paid.

Delta Bye-law 4.
Buckingham Canal Bye-law IV.

Delta Bye-law 5.
Buckingham Canal Bye-law V.

Delta Rules, part of Bye-law 12.
Buckingham Canal Rules, part of Bye-law X.

Canal Rules XIII (5).
Do. Bye-law 12.

Delta Bye-law 12.
Buckingham Canal Bye-law X.

Canal Rule XV (3).

Delta Bye-law 13.
Buckingham Canal Bye-law X.

Delta Bye-law 6.
Buckingham Canal Bye-laws VI, VII, and VIII.

New Rule.

Delta Bye-law 14.
Buckingham Canal Bye-law XIII.

Delta Bye-law 8.

Delta Bye-law 11.

25. At any lock, or other masonry work, no vessel or raft shall moor within the limits fixed by notice boards.

26. Every vessel when moored in any canal shall have its masts down, shall be made fast stem and stern to the bank and in a single line.

Every vessel when thus moored shall be in charge of at least one man, and must between sunset and sunrise exhibit a clear bright light, at not less than 4' above the water level, visible all round.

Rafts when moored must be securely fastened to the canal bank at both ends, and between sunset and sunrise must exhibit a clear light at each outer corner.

27. Vessels when moving must between sunset and sunrise exhibit the following lights:—
All boats one clear bright light at the fore-end, fixed not less than 4 feet above the water.

Steamers, three lights as follows:—One clear white light on the upper deck abaft the funnel, a bull's-eye bright red light on the post (left) side, a bull's-eye bright green light on the star-board (right) side.

The bull's-eye to be not less than 8 inches in diameter. The lights to be so placed and fitted that both may be visible only from a point ahead of the vessel, and so as not to be obscured by any of the fittings, cargo, or passengers. Subject to these provisions the lights may be placed on the front or on top of the cabin, at the sides of the vessel near the bow, or on supports specially provided for the purpose.

Passenger boats must, in addition to the outside light, keep at least one bright light in the general cabin.

28. When vessels meet on the Godavari and Kistna Canals, those going with the current shall give way. In the Buckingham Canal vessels going north shall give way. Vessels under sail shall give way to vessels being towed, and steamers shall give way to all boats.

29. The licenses of cargo boats in an unsafe condition may be suspended by any officer authorized to issue licenses until the vessels be put into a proper state of repair.

30. All passenger vessels shall, whenever it may appear to him to be advisable, be inspected by the Executive Engineer in charge of the Division, or other officer duly authorized by him. The licenses of such as are not maintained in a proper state of repair and cleanliness shall be withdrawn until the vessels are fit for use by the public.

31. No person unless duly authorized shall interfere with the locks or any part of their machinery.

32. Any passenger vessel apparently overloaded must, when required by the Executive Engineer, or by an officer duly authorized by him, by the Superintendent or Assistant Superintendent of Police, or by a Magistrate, stop at

Delta Bye-law 10.
Buckingham Canal Bye-law XII.

Delta Bye-law 10.
Buckingham Canal, Schedule A.

Delta Rule XV (1).

Delta Rules XV (4).
Buckingham Canal Bye-law XI.

Delta Rules XV (7).
Buckingham Canal Bye-law XI.

Delta Rules XV (11).
Do. XVI.

Buckingham Canal Rule XIII.

Buckingham Canal Rules III.

Delta Bye-law 19.

any place to have the number of its passengers counted and its cargo examined.

33. Every vessel and raft must have its license or toll ticket always on board. These shall be produced when called for by any Lock or Toll Superintendent or other duly authorized officer.

34. In the case of a license or toll ticket being lost, and a duplicate copy being required, the fee for its issue will be Rs. 2.

35. All steamers using the canals shall be inspected by the Executive Engineer or officer authorized by him, who will see that the machinery is in fair working order, that the boilers are provided with proper gauges, and are apparently in safe working order. The Executive Engineer or other officer will issue an inspection certificate in the form appended, which will hold good for six months.

No steamer shall travel at a greater speed than 8 miles per hour by day-light and 5 miles per hour at night.

Steamers shall reduce their speed to three miles an hour when they come within half a mile of a lock, and shall then whistle to give notice of their approach to the lock establishment. Steamers must be warped into and out of locks, and will not be allowed to use their propellers until quite clear of the locks.

Steamers shall whistle when within a 100 yards of any boat, and reduce speed to 5 miles an hour.

36. Any vessel or raft damaging the works of the canal or any Government property on them shall have its license or toll ticket taken away and shall not be allowed to use the canals until the cost of repairing the damage has been estimated and the amount has been paid. A pass shall be given by the officer suspending the license to enable the vessel to proceed to its destination.

37. Sea-going vessels brought into rivers and backwards for shelter, for repair, or for any other purpose except to ply for hire, shall anchor or lay up outside the fair way of canal traffic, which will be defined by the canal officers; such vessels will not be allowed to enter the main line of the canals for the purpose of proceeding from one river or backwater to another river or backwater, or for any other purpose, except in accordance with the rules prescribed for the use of the canals.

38. All boats used solely for fishing purposes which have to pass through any portion of the Buckingham Canal must be registered, but will not be charged any fee.

39. Officers in charge of canals are empowered summarily to remove vessels which may have sunk in a canal waterway of any system, or rafts which have been in the canals for more than one month, and shall have failed to pay on demand the fresh toll leviable under Rule XVI, and to recover cost of removal afterwards.

Vessels sunk, abandoned, or left for more than three days without a man in charge will be dealt with as follows:—

(a.) If the vessel be licensed a notice will be sent by post, by the officer in charge of the canal, to the registered owner requiring him to remove the vessel within 15 days. Failing such removal the vessel will be sold by auction after giving not less than 15 days' notice of intended sale in the District Gazette.

(b.) In the case of unlicensed vessels a notice will be published in the District Gazette requiring the removal of the vessel within 15 days, and stating that if not so removed the vessel will be sold by auction. Such sale may be fixed to take place on any date not prior to 30 days from the date of the publication of the notice to remove. Vessels removed under this rule lie at the owner's risk.

Owners applying to recover possession of vessels or rafts referred to in this bye-law must, before their removal will be permitted, pay all expenses which may have been incurred.

The sale-proceeds of a vessel sold under this bye-law will be available to meet all expenses incurred in the removal and sale of such vessel, and to repair all damage which may have resulted to the canal from its being sunk or abandoned therein. Any balance remaining will be paid to the owner if claimed within three months from the date of the sale; otherwise such balance will be carried to the credit of Government.

40. Executive Engineers in charge of sections of the deltas and of the Buckingham Canal and other officers duly authorized by them will have power to suspend the license of any vessel on account of the infringement of any of the rules and regulations for periods not exceeding—

15 days for a first offence,
30 days for a second offence in the same calendar year,
60 days for a third offence in the same calendar year,

and for a fourth offence in the same calendar year the license may be cancelled.

Vessels plying under a toll ticket may be punished by the suspension of the toll ticket for 15 days for a first offence, and by the withdrawal of the toll ticket for a second offence.

41. Superintending Engineers will exercise the same powers as Executive Engineers in respect of any of these rules.

(Signed) J. W. RUNDALL,
President for Committee.

Delta Bye-law 15.
Buckingham Canal Bye-law XIV.

Delta Bye-law 16.

12th October 1882.

814
42

Delta Bye-law 10.
Buckingham Canal Bye-law XII.

Delta Bye-law 10.
Buckingham Canal, Schedule A.

Delta Rule XV (1).

Delta Rules XV (4).
Buckingham Canal Bye-law XI.

Delta Rules XV (7).
Buckingham Canal Bye-law XI.

Delta Rules XV (11).
Do. XVI.

Buckingham Canal Rule XIII.

Buckingham Canal Rules III.

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Steamers shall reduce their speed to three miles an hour when they come within half a mile of a lock, and shall then whistle to give notice of their approach to the lock establishment. Steamers must be warped into and out of locks, and will not be allowed to use their propellers until quite clear of the locks.

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The sale-proceeds of a vessel sold under this bye-law will be available to meet all expenses incurred in the removal and sale of such vessel, and to repair all damage which may have resulted to the canal from its being sunk or abandoned therein. Any balance remaining will be paid to the owner if claimed within three months from the date of the sale; otherwise such balance will be carried to the credit of Government.

40. Executive Engineers in charge of sections of the deltas and of the Buckingham Canal and other officers duly authorized by them will have power to suspend the license of any vessel on account of the infringement of any of the rules and regulations for periods not exceeding—

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30 days for a second offence in the same calendar year,

60 days for a third offence in the same calendar year,

and for a fourth offence in the same calendar year the license may be cancelled.

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Delta Bye-law 16.

12th October 1882.

814
42

Delta Bye-law 10.
Buckingham Canal Bye-law XII.

Delta Bye-law 10.
Buckingham Canal, Schedule A.

Delta Rule XV (1).

Delta Rules XV (4).
Buckingham Canal Bye-law XI.

Delta Rules XV (7).
Buckingham Canal Bye-law XI.

Delta Rules XV (11).
Do. XVI.

Buckingham Canal Rule XIII.

Buckingham Canal Rules III.

Delta Bye-law 19.

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Owners applying to recover possession of vessels or rafts referred to in this bye-law must, before their removal will be permitted, pay all expenses which may have been incurred.

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Vessels plying under a toll ticket may be punished by the suspension of the toll ticket for 15 days for a first offence, and by the withdrawal of the toll ticket for a second offence.

41. Superintending Engineers will exercise the same powers as Executive Engineers in respect of any of these rules.

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President for Committee.

Delta Bye-law 15.
Buckingham Canal Bye-law XIV.

Delta Bye-law 16.

12th October 1882.

814
42

Memorandum regarding the different Forms of Licenses.

It is proposed that the license and toll tickets shall be on different colored paper for each system—

Godavari	...	...	...	...	...	White.
Kistna	...	...	...	...	...	Red.
Buckingham Canal	...	...	...	...	...	Blue.

Through licenses will be printed on green paper.

When a license is taken out, a copy of the navigation rules in the vernacular is to be given to every boat-owner who has not already got one.

When printed for issue, the license forms and tickets will have a counterfoil separated from the original by perforations.

All license forms and toll ticket should be printed on good stout paper.

12th October 1882.

(Signed) J. W. RUNDALL.

System

TOLL TICKET FOR RAFT.
తెప్ప పన్ను చీటి.

No.	Dimensions		Length	feet.	Breadth	feet.	Superficial Area	square feet.	Description of Raft	Amount of Toll paid.	Rupees	Annas
నెం	కోలు	పొడుగు	చతురం కొల్ల	అడుగులు.								
తెప్ప వివరం												
ఇచ్చిన పన్ను మొత్తం.												
Issued at												
చీటియచ్చిన స్థలం												
Date of issue												
చీటియచ్చిన తారీఖు												
This ticket will hold good for one month only.												

Toll Superintendent.

This ticket is issued subject to the Navigation Rules sanctioned in S. O. No. dated

814
43

System

TOLL TICKET FOR RAFT.
తెప్ప పన్ను చీటి.

No.	Dimensions		Length	feet.	Breadth	feet.	Superficial Area	square feet.	Description of Raft	Amount of Toll paid.	Rupees	Annas
నెం	కోలు	పొడుగు	చతురం కొల్ల	అడుగులు.								
తెప్ప వివరం												
ఇచ్చిన పన్ను మొత్తం.												
Issued at												
చీటియచ్చిన స్థలం												
Date of issue												
చీటియచ్చిన తారీఖు												
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Toll Superintendent.

This ticket is issued subject to the Navigation Rules sanctioned in S. O. No. dated

తెల్లపూడుగు 90 అడుగులు, వెడల్పు 12 అడుగులు, 2 అడుగుల పీచుతో శ్రేణినికంపై
మెక్కువగావుండకూడదు.

పన్ను రేఖ.

అణులు.

Rafts not to exceed 90 feet in length, 12 in breadth, 2 feet in draught.

RATES OF TOLL.		annas.
Logs of timber, rough or squared, per unit of 100 square feet.....	8	
Bamboos per unit of 100 square feet.....	4	
Fractions of the unit will be charged for as a full unit.		
Rafts of timber and bamboos mixed will be charged for at the rate for timber.		

License for Passenger Vessel, Class (A) or (C), for 18

System
Owner's name
Vessel built at

No. of License
Residence
in the year

Maximum number of passengers
Fares to be charged and caste of passengers to be carried, *optional*. ; less one for every 400 lb. of cargo carried.

EXTREME DIMENSIONS OVER ALL.		DIMENSIONS FOR TONNAGE.				Gross Tonnage.	Deduction of 15 per Cent.	Net Tonnage for License.	License Fee paid.	Date of Issue.	Place of Issue.
Length.	Breadth.	L.	B.	D.	Cubic Feet.				RS. A.		
FEET.	FEET.	FT. IN.	FT. IN.	FT. IN.							

Signature of Licensing Officer.

This License is issued subject to the Navigation Rules sanctioned in G.O., No. dated

License for Passenger Vessel, Class (B) or (D), for 18

System
Owner's name
Vessel built at

No. of License
Residence
in the year

Maximum number of passengers ...

{ In the general cabin
In the fore cabin
In the aft cabin

Total No.

less

one for every 400 lb. of cargo carried.
The holder of this license is required to convey all passengers, for whom there may be room, irrespective of caste, at rates for each passenger (including one cooly headload of luggage) not exceeding 2 pies in the general cabin, and 3 pies in the separate fore and aft cabins, per mile.

EXTREME DIMENSIONS OVER ALL.		DIMENSIONS FOR TONNAGE.				Gross Tonnage.	Deduction of 15 per Cent.	Net Tonnage for License.	License Fee paid.	Date of Issue.	Place of Issue.
Length.	Breadth.	L.	B.	D.	Cubic Feet.				RS. A.		
FEET.	FEET.	FT. IN.	FT. IN.	FT. IN.							

Signature of Licensing Officer.

This License is issued subject to the Navigation Rules sanctioned in G.O., No. dated

Cargo Boat License for 18
No. of License

System
Name of owner
Residence of owner
Boat built at

in the year

EXTREME DIMENSIONS OVER ALL.		DIMENSIONS FOR TONNAGE.				Gross Tonnage.	Deduction of 15 per Cent.	Net Tonnage for License.	License Fee paid.	Date of Issue.	Place of Issue.
Length.	Breadth.	L.	B.	D.	Cubic Feet.						
FEET.	FEET.	FT. IN.	FT. IN.	FT. IN.					RS. A.		

NOTE.—This License is issued subject to the Navigation Rules sanctioned in G.O., No. dated

Signature of Licensing Officer.

Private Boat License for 18

No. of License

in the year

System
Name of owner
Residence of owner
Boat built at
Description of boat
Amount of license fee paid Rs.
Date of issue
Place of issue

Signature of Licensing Officer.

N.B.—The License fee for private boats not carrying goods or passengers is Rs. 12 per cent. The fee on pleasure boats used for rowing is Re. 1.
This License is issued subject to the Navigation Rules sanctioned in G.O., No. dated

License for Steam Vessel for 18

Residence
in the year

No. of license
Owner's name
Vessel built at
Description of propeller
Do. of engines
Do. of boiler
Maximum pressure of steam

EXTREME DIMENSIONS OVER ALL.		MEASUREMENTS FOR TONNAGE.				Gross Tonnage.	Deduction of one-third.	Net Tonnage.	License Fee paid.	Date of Issue.	Place of Issue.
Length.	Breadth.	L.	B.	D.	Cubic Feet.						
FEET.	FEET.	FT. IN.	FT. IN.	FT. IN.					RS. A.		

This License is issued subject to the Navigation Rules sanctioned in G.O., No. dated

Signature of Licensing Officer.

Inspection Certificate.

This vessel has been inspected under Navigation Rule No. 35, and is passed for navigation of the canals for a period of six months from this date

Signature of Inspecting Officer.

Station
Date
Certificate renewed on

Signature of Inspecting Officer.

Toll Ticket.

No.

System
Name of owner

EXTREME DIMENSIONS OVER ALL.		MEASUREMENTS FOR TONNAGE.				Gross Tonnage.	Deduction.	Net Tonnage.	Toll paid.	Date of Issue.	Place of Issue.
Length.	Breadth.	L.	B.	D.	Cubic Feet.						
FEET.	FEET.	FT. IN.	FT. IN.	FT. IN.					RS. A.		

Signature of Issuing Officer.

This ticket is issued subject to the Navigation Rules sanctioned in G.O., No. dated
, and will hold good for *six weeks only*.
This ticket is to be surrendered on renewal.

No. 117 L.

Memorandum by the Chief Engineer for Irrigation.

Submitted to Government.

2. The first line of navigable canal opened on the Eastern Coast of the Madras Presidency was the Cochrane's Canal from Madras to the Ennore backwater, and from the Ennore backwater to Pulicat Lake. The work was completed in 1806 on contract, the terms being the exclusive possession of the canal by the contractor for forty-five years, with right to levy toll on all goods carried upon it at certain rates laid down. In 1837 the canal came into the possession of Government, who fixed a rather elaborate system of tolls. The annual receipts from tolls at this time were about Rs. 32,000. In the year 1855 the East Coast Canal to the south of Madras from the Adyar to the Pálár was commenced; this portion of the line was opened to traffic in 1857, and a separate system of tolls was adopted on it.

The extension of the Northern Canal was commenced in the year 1854, and was pushed on from time to time until, in the year 1875, it reached the Kistnapatam backwater, 90 miles to the north of Madras. This was the limit in the year 1876 immediately before the famine. The annual receipts were then—

	RS.
In the Northern Section	39,869
" Southern "	5,720

In 1877, when it was necessary to find work for thousands of starving people, the connection of the northern and southern sections of the canal through Madras, which had been planned many years before, was undertaken, and the northern extension from Kistnapatam to Pedda Ganjam to join the Kistna Delta Canals being also pushed on vigorously under the government of the Duke of Buckingham, the canal was opened throughout, in 1878, from the Pálár, 47 miles south of Madras, to Pedda Ganjam, 196 miles north, under the name of the Buckingham Canal.

In 1879 the navigation rules for this canal now in force were introduced, under which the canal was divided into six sections. Copy of these rules is attached. Generally speaking they imposed a license fee of Rs. 2 per ton for all boats, except fishing and pleasure boats, the license clearing the boat for one section only. On entering any other section, the boat had to pay a toll of four annas a ton, or boat-owners were allowed to compound for a year's tolls throughout the canal for Rs. 10 a ton.

The navigation receipts have been as follows:—

	RS.
1880	...
1881	...
	1,09,805
	1,20,056

2. The Godáviri Delta Canals navigation commenced in the year 1853, the ancient having been completed in 1852. The navigation was started under the auspices of Government officers, but before long the natives were out of leading strings and took up the navigation with a will, so that in 1863-64, ten years after the navigation commenced, the number of boats on the Delta Canal was 1,200, and the annual receipts amounted to Rs. 24,493. On first opening the navigation no tolls were charged, as was noticed in 1859 by the then Governor, Sir Charles Trevelyan, in a minute on the Godáviri irrigation and navigation. He says: "The canals are all toll-free, for it has been wisely determined that it is better to take the Government dues in a consolidated form on the crops than to harass and mulct the people by exactions which cannot be confined to those demanded on behalf of the public." In November 1863, however, a license fee of one rupee per ton was charged.

As the canals have been extended, the navigation rules have been, from time to time, revised, and the license fees raised, and toll stations have been instituted generally at the head and tail locks of each canal, so that boats are not compelled to take out licenses for the year, but may, if it suits their convenience, pay by the trip. Up to 1882 the rates for license fees were generally speaking (taking 50 cubic feet to represent a ton)—

Cargo boats	...	2 rupees per ton.
Passenger boats—		
First class	...	4 "
Second class	...	3 "
Rafts, timber	...	4 annas per 100 square feet.
" bamboos, &c.	...	2 "

The measurement of boats was, up to that time, much the same in the Godáviri and Buckingham Canals, and the unit of measurement, 50 cubic feet to a ton, was the same, but in 1882 revised rules for the Godáviri and Kistna Canals were sanctioned by Government, in which the unit of measurement was altered to a ton of 75 cubic feet, and, as in the Buckingham Canal 50 cubic feet were still continued the unit, there arose difficulties in the case of through traffic, which have brought to notice the necessity for introducing rules of general applicability.

In introducing new rules for navigation in the Delta Canals, the rule has been laid down that navigation should be made to pay, that is, not only should the receipts cover the working expenses, but also interest on the original cost of works constructed solely in the interests of navigation. In a system of canals which combine irrigation and navigation there is, of course, great difficulty in apportioning the share of cost, but under instructions that have been issued from this office, this has been settled, and the yearly accounts show the maintenance charges and interest compared with the receipts. The accounts of last year, ending 31st December 1881, show the following results:—

	RS.
Maintenance charges	55,106
Interest	24,504
Total	79,610
Receipts	55,670

that is, the receipts more than covered the working expenses, but were insufficient to meet the charge for interest. It was contemplated that, as the canals approached completion, the maintenance charges would become lighter, and the receipts would increase until they were sufficient to cover all charges. It is, however, to be noticed that, when the Godáviri completion estimates were submitted to the Government of India, all that was claimed for navigation receipts was that they should cover maintenance charges.

3. The Kistna Delta Canal navigation, which was opened a few years later than the Godáviri, was started in the same way, and has been generally under the same rules, but as in the Kistna Delta the canals are less advanced than in the Godáviri, the license fees charged are less per ton than in the Godáviri. In the last revised rules, 1882, cargo boats were charged 2½ rupees against 3½ rupees a ton in the Godáviri.

The accounts of last year ending 31st December 1881 show the following results:—

	RS.
Maintenance charge	60,330
Interest	8,054
Total	68,384
Receipts	21,788

but the maintenance charges were much higher than they should have been, in consequence of damage caused by floods.

4. The length of navigable canal now open is—

	MILES.
In the Godáviri Delta	458
" Kistna "	278
" Buckingham Canal	243
Total	979

The through line from Pálár south of Madras to the port of Cocanada in the mouth of Godáviri is—

	MILES.
In Godáviri	78
" Kistna "	110
" Buckingham Canal	243
Total	431

When the Delta Canals are completed there will be the following lengths of canals navigable:—

	MILES.
In Godáviri	502½
„ Kistna	349

while the Buckingham Canal may possibly be extended southwards to near Point Calimere, a distance of 156 miles from the Pálár.

5. Under the rules as they at present stand, it will be seen that there are considerable obstacles in the way of through navigation. The rates of license fee for each system of canals are now certainly not oppressive in the deltas, but 10 rupees a ton per annum for the use of 243 miles of the Buckingham Canal seems very heavy. Supposing a boat to ply between Madras and Cocanada continually, and to take out licenses for all canals, it would pay—

Buckingham Canal	10 rupees per ton of 50 cubic feet.
Kistna Canals	2½ „ „ of 75 „
Godáviri Canals	3½ „ „ of 75 „

or a license might be taken out for one section, and tolls paid at entering each other section, which would clear the boat for one trip. In any case, at each toll station on the through journey, 5 on the Buckingham Canal, 3 on the Kistna, and 2 on the Godáviri, the boat would be stopped to exhibit its license, and a door would be opened for "exactions which cannot be confined to those demanded on behalf of the public." Taking into account the very incomplete state of the Buckingham Canal, and the difficulty which is at times experienced in navigating it, the high rate of license fees, and the interruptions to traffic caused by the frequent toll stations, it is surprising that navigation has extended as it has. It must also be noticed that the Kistna Canals are closed for repairs for three months yearly, and the through traffic is necessarily interrupted for that time.

6. The Committee appointed by Government in G.O., No. 612 I., dated 5th August 1882, was instructed to take the following points specially into consideration:—

- (1) The abolition, as far as possible, of tolls;
- (2) The license fees to be charged for the canals throughout;
- (3) The measurement of boats with reference to the adoption of one unit of measurement;

and in their report now submitted they have embodied their proposals attaching a revised set of rules to be applicable to all the canals on the East Coast if their proposals are approved.

7. The Committee originally appointed consisted of Mr. Rundall, Superintending Engineer, Second Circle; Mr. Walsh, Officiating Superintending Engineer, First Circle, and Major Drake-Brockman; but in consequence of the latter officer having taken leave before the Committee could meet, Mr. Ottmann, Honorary Assistant Engineer, who was acting for him, was appointed in his place. Mr. Ottmann has submitted a separate memorandum calling attention to some additions, which on further consideration he suggests should be made to the rules proposed by the Committee, and these will be considered further on. The whole of the papers were on the return of Major Drake-Brockman from leave sent for his consideration, and he has stated his concurrence generally with the Committee's views.

8. Regarding the first point referred to them, the Committee consider that tolls cannot be entirely abolished, but that to allow of the occasional use of the canals without taking out a license, toll stations must be maintained at the head locks of each section of the deltas, all tidal locks, at Ellore near the junction of the Godáviri and Kistna Canals, and four places on the Buckingham Canal, for the public convenience, thus reducing the number of toll stations from 47 to 20. To these proposals I agree on the understanding that the toll stations are maintained for the public convenience only, that no obstructions such as now exist in the shape of a chain drawn across the canal shall be allowed, and that the toll-taker has no authority to stop any boat or call for the production of its license unless there is some apparent infringement of

the rules. A subordinate in the position of a Lock Superintendent or toll-keeper should never be allowed the powers of an Inspecting Officer. It apparently was contemplated by Mr. Ottmann that, at the proposed toll stations on the Buckingham Canal, all licenses would be produced for examination as at present, and in his memorandum he specially notices that some examination of the boats will be necessary, while the canal remains as at present one open reach from Shadayankupam Lock to Pedda Ganjam. There is of course an opening for boats to ply in this reach without licenses to get in by paying a toll and remain at work for an indefinite period, but this will be impossible when flood-gates are constructed at several places, and meanwhile I consider that the Division and Sub-division officers should, as Inspecting Officers, pay special attention to the subject, and endeavor to prevent evasions of fees. Under no circumstances would I allow the toll-keepers to have any thing to do with this duty; they should be restricted to issuing toll tickets when called upon to do so. It is better to risk some loss than to harass the traffic. As to the amount of toll I shall have to make some remarks further on.

9. The Committee recommend that one unit of measurement should be adopted for all canals, and that the ton should consist of 50 cubic feet. It is only lately, in August 1881, that, on the recommendation of Colonel Mullins, a ton of 75 cubic feet was introduced into the Godáviri and Kistna Canals. The reasons for this change are given in the note printed with G.O., No. 484 I., dated 3rd August 1881, and I am unwilling to propose any radical alterations, but I quite agree with the Committee that to avoid confusion there must be only one unit of measurement, and I consider it quite unnecessary to make any attempt to reconcile the weight of cargo with the cubic space it occupies. For some years a ton has been considered to be 50 cubic feet, and I would retain this measurement, charging license fees by this unit, and only providing in the rules for a certain safe free board in all cases.

10. The Committee next proceed to give the rates at which they propose to fix license fees and tolls, and here they follow the system at present in force to some extent. They propose a separate license fee for each system, and a compound rate for all these systems, but they do not propose to retain the present plan of charging a separate fee for each section of the Buckingham Canal. Passenger boats of both classes are dealt with in the same way as cargo boats, also steamers. I am prepared here to go a great deal further than the Committee. What I desire to see is one demand to clear all the canals. I would remove all obstacles in the way of navigation that I possibly could, believing that the interests of Government will be best served by improving the communications, stimulating consumption, and consequently extending production.

The argument that, if 2 rupees is charged for carriage of 100 miles, more should be charged for carriage of 300 miles is not here I think applicable. In the case of the Godáviri and Kistna Delta Canals, the irrigation gives a splendid return on the expenditure without any receipts from navigation, and the Buckingham Canal has been carried out as a Protective Public Work, and a return is to be looked for, from free and extended use of it. I consider that all that should be looked for is that the navigation receipts should cover the working expenses, by which I mean the cost of the navigation establishments and of maintenance of navigation works, and this I believe will soon be the case on all three of the existing systems. It must be remembered that the canals of two of these systems are still in a very incomplete state, and it should not be expected that as soon as a canal is opened it will pay its way.

11. The following statement shows at a glance the present rates of license fees, those proposed by the Committee, and those which I propose, and I have endeavored to make a comparison in statements appended between the actual receipts of last year, those to be expected if the Committee's rates are introduced, and if the rates I propose are adopted. The receipts should, I think, be credited to the system to which the boat belongs; that is, a Kistna boat might be licensed in the Buckingham Canal, but the license fees would be credited to the Kistna system. I do not look for an immediate return, but I do expect that the opening of the canal to traffic in this way will eventually prove remunerative to Government, and I allow that it will be practicable to raise these rates at some future time:—

314
B.C.
H.T.

Cargo Boats.	Present Rates per Ton of 50 Cubic Feet.	Rates proposed by Committee.	Rates proposed by Chief Engineer for Irrigation.
	RS.	Rs. per Ton of 50 C. Feet.	Rs. per Ton of 50 C. Feet.
Godávári	2½	2	
Kistna	1½	1½	
Buckingham Canal ...	2 per section, 10 for whole canal.	3 } 5	2½
<i>Passenger Boats, 1st Class.</i>			
Godávári	4½	4	
Kistna	4½	4	
Buckingham Canal ...	2 per section, 4 for whole canal.	4 } 10	5
<i>Passenger Boats, 2nd Class.</i>			
Godávári	3½	3	
Kistna	3½	3	
Buckingham Canal ...	2 per section, 4 for whole canal.	3 } 7	3
<i>Steamers.</i>			
Godávári	5	4	
Kistna	5	3	
Buckingham Canal ...	As cargo on passenger boats.	6 } 10	5
<i>Rafts, Timber.</i>			
Godávári	4 annas per 100 square feet each canal.	8 annas per 100 sq. feet.	8 annas per 100 sq. feet.
Kistna	Do. ...	Do. ...	Do. do.
Buckingham Canal ...	1 anna per sq. yard...	Do. ...	Do. do.
<i>Rafts, Bamboo.</i>			
Godávári	2 annas per 100 sq. feet.	4 annas per 100 sq. feet.	4 annas per 100 sq. feet.
Kistna	Do. ...	Do. ...	Do. do.
Buckingham Canal ...	1 anna per sq. yard...	Do. ...	Do. do.
<i>Tolls for Vessels.</i>			
Godávári	4 annas per ton each canal.	8 annas per ton per system.	8 annas per ton per system.
Kistna	Do. ...	6 do. ...	Do. do.
Buckingham Canal ...	4 annas per ton each section of canal.	12 do. ...	Do. do.
<i>Tolls for Steamers.</i>			
Godávári	Same as vessels ...	1 rupee per ton per system.	1 rupee per ton per system.
Kistna	...	12 annas do. ...	Do. do.
Buckingham Canal ...	...	1½ rupees do. ...	Do. do.

If my recommendations are approved, revised rules and bye-laws, which shall be applicable to all canals, will be drawn up. I agree with the Committee in considering that the navigation must be worked in the same way on all three systems, but I see the difficulty that there will be in enforcing the rules by stoppage of license on the Buckingham Canal where the open reach is so long, and I think it will be necessary, until the proposed improvements to the canal are carried out, to continue to the Buckingham Canal Divisional Officer the powers of a First-class Magistrate.

12. As regards the difficulty referred to by the Committee in consequence of the Delta Canals being under the orders of the Chief Engineer for Irrigation, and the

Buckingham Canal under those of the Chief Engineer, Department Public Works, I may state my opinion that the Buckingham Canal should be under the Chief Engineer for Irrigation. It would tend to uniformity, and I am disposed to think that all water works should be in charge of the Irrigation Branch. I say this without expressing any personal feelings in the matter.

13. The Committee ask for early orders, so that the new rules may be introduced on the 1st January 1882. This opens another question, viz., whether it is necessary that the navigation rates should continue to relate to the calendar year. The arrangement necessitates the figures in the accounts being shown for receipts in the calendar year, and for charges in the official year, and as I have lately recommended that the revenue year should be made to correspond with the official year, so I now recommend that the navigation year should be made to correspond with the official year. The change may occasion trifling inconvenience at first, but there are, I believe, no insuperable difficulties in the way.

14. In preparing revised rules I propose to take into consideration the addition proposed by Mr. Ottmann to be made to Section I.

CHEPAUK,
6th November 1882.

(Signed) J. O. HASTED, Col. R.E.,
Chief Engineer for Irrigation.

To the Joint Secretary to Government, Public Works Department, Irrigation Branch.

STATEMENT showing the Navigation Receipts and Charges of the Godávári, Kistna, and Buckingham Canals.

Year.	Receipts.	Year.	Maintenance Charges.	Balance.	Interest.
<i>Godávári Canal.</i>					
	RS.		RS.	RS.	RS.
1876	39,952	1875-76	37,713	2,239	23,372
1877	44,742	1876-77	37,959	6,783	25,154
1878	53,386	1877-78	43,855	9,531	27,125
1879	63,348	1878-79	40,582	22,766	28,128
1880	51,315	1879-80	47,307	3,908	28,994
1881	55,670	1880-81	55,106	564	24,504
<i>Kistna Canals.</i>					
	RS.		RS.	RS.	RS.
1876	18,377	1875-76	31,963	— 13,586	300
1877	14,876	1876-77	29,584	— 14,708	308
1878	16,396	1877-78	25,262	— 8,866	373
1879	23,294	1878-79	34,653	— 11,359	2,916
1880	23,834	1879-80	35,980	— 12,146	5,807
1881	21,788	1880-81	60,330	— 38,542	8,054
<i>Buckingham Canal.</i>					
	RS.		RS.	RS.	RS.
1880	1,09,805	1879-80	82,519	27,286	...
1881	1,20,056	1880-81	1,56,734	— 36,678	...

The maintenance charges on the Kistna and Buckingham Canals during 1880-81 were unusually high, owing to the damages caused by extraordinary floods and cyclone. The increase in the interest charges to the Kistna Canals is owing to the cost of the locks recently constructed on the Commamur Canal having been included in the amount on which interest was calculated.

STATEMENT showing the Estimated Receipts from Navigation at the Rates now in force compared with those proposed by the Committee and the Chief Engineer for Irrigation.

	Actual Collection for 1881.			Estimated Collection at the Rates now in force.			Estimated Collection at the Rates proposed by the Committee.			Estimated Collection at the Rates proposed by the Chief Engineer for Irrigation.		
	Tons.	Rate.	Amount.	Tons.	Rate.	Amount.	Tons.	Rate.	Amount.	Tons.	Rate.	Amount.
<i>Godavari Canals.</i>												
Cargo boats	21,530	2	41,935	14,354	2	50,239	16,148	2	32,296	21,530	2	53,825
Do. by compounding	1,913	3	5,702	1,275	5	6,375	1,435	3	4,305	1,913	3	5,739
Passenger boat, 2nd class							1,486	2	3,470			
Do. by compounding	21	5	105	14	7	105	21	4	84	21	5	105
Steamers	10,319	1	2,579	6,880	1	1,720	10,319	1	6,160			1,000
Tolls			4,999			4,985			9,970			9,970
Rafts			358			358			358			358
Miscellaneous Revenue												
Total			55,670			68,782			71,708			70,997
<i>Kistna Canals.</i>												
Cargo boats	14,957	1	14,972	9,971	2	24,927	11,218	1	16,827	14,957	2	37,392
Do. by compounding	793	3	2,379	529	5	2,645	506	3	1,518	793	3	2,379
Passenger boat, 2nd class									1,486	2		
Do. by compounding									3,470			
Tolls	10,996	1	2,749	7,331	1	1,833	10,996	1	4,123			1,000
Rafts			1,484			1,484			2,968			2,968
Miscellaneous			204			204			204			204
Total			21,758			31,093			42,764			43,943
<i>Buckingham Canals.</i>												
Cargo boats	6,352	2	12,704				4,764	3	14,292	6,352	2	15,880
Do. by compounding							10,710	2	21,097			
Passenger boats, 2nd class	3,240	2	6,480				2,435	3	7,305	3,240	3	9,720
Do. by compounding									1,486	2		
Tolls									3,470			1,500
Rafts			95,667						750			75
Miscellaneous			100						5,104			5,104
Total			1,26,055						54,343			32,279

Memorandum by the Executive Engineer, Buckingham Canal, replying to questions put by the Chief Engineer, Public Works Department.

(1.) What the annual maintenance charges may, on completion of the work, amount to?

The allotment for maintenance during the current year is—

	RS.
For Southern Canal, 61 miles, at Rs. 110	6,710
„ Northern „ 207 „ at „ 275	56,925
	63,635
Minor repairs to masonry works	5,000
	68,635

The allotment hitherto made for the Southern Canal has been found sufficient, and I think when the canal reaches have been remodelled throughout, the whole canal will be put into a condition that as regards the cost of maintenance, will compare favorably with the present condition of the Southern Canal. The immunity the Southern Canal enjoys from inordinate silting, results from the drainage flowing into the several still-ages in numerous small drainages, and not in a concentrated form through large streams or rivers which carry down large quantities of silt, and backing into the water reaches of the Northern Canal, form large shoals at their entrances and for considerable distances upwards from their mouths. I consider therefore that when the improvements to the canal have been effected that no greater expenditure per mile will

be necessary for its maintenance than has been found requisite for the Southern Canal even in its present unimproved condition. For the 266 miles therefrom an allotment of Rs. 30,000 should prove sufficient, but taking into account the number of river crossings on the Northern Canal that are liable to obstruction, a sum of Rs. 10,000 may be added, bringing the sum total to Rs. 40,000.

(2.) What at the end of the remaining eight or nine years required for completion of the works under the lately revised Estimate the sums levied for licenses and tolls under the revised scale should, making due allowance for all reasonable increase, amount to?

With regard to this subject it may not be out of place, to give here a few particulars regarding the progress of navigation on the Buckingham Canal, and show the effect that the raising of tolls thereon of late years has had upon its development.

Prior to the assumption in October 1879, of the duty of levying tolls upon or issuing licenses for boats that were plying on the canal, the Collector of the Chingleput District was accustomed to levy, under the orders of the Board of Revenue, a toll of four annas per ton upon every cargo boat, and four annas per trip on every passenger boat passed through the Shadayankupam Lock towards Madras. No tolls were levied on boats entering Madras from the southward. The receipts from these aggregated respectively in 1875, 1876, 1877 and 1878 Rs. 51,113, 39,869, 23,110, and 47,130. The falling off in 1876, 1877 may be attributed to the famine. The receipts from the licenses issued to boats on the Southern Canal amounted to an average collection of Rs. 1,400. In October 1879 this system was abolished, and licenses and tolls began to be levied under the new Navigation Rules which still continue in force.

The collections in 1880, 1881 and up to November 1882 amounted to Rs. 1,09,803, 1,16,527, and 1,00,037, respectively, or to more than twice the amount previously collected. Instead, however, of the number of boats decreasing, consequent upon the multiplying of toll stations and the introduction of a more complicated system of tolls under the rules, the number has actually progressively increased as is shown from the table hereto appended:—

Years.	UNCOVERED CARGO BOATS.		COVERED CARGO, PASSENGER AND RADARI BOATS.		DECK AND DINGHIE BOATS.		FISHING BOATS.		MISCELLANEOUS BOATS.		TOTAL.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
1879												
1880												
1881	252	3,974	282	1,919	4	70	144	232	41	92	723	6,287
1882	359	6,206	468	3,567	19	315	90	110	46	80	992	10,278
	379	6,352	533	3,240	29	367	155	* 211	32	45	1,128	10,215
	377	6,394	554	3,522	22	283	62	* 152	40	200	1,055	10,551

The establishment of tolling stations does not appear therefore to have had a prejudicial effect upon the number of boats that use the canal. The brunt of paying the tolls comes upon the well-to-do merchants who hire the boats for carrying their goods to market, and this they can always afford to do without difficulty, and the boat-owner who builds his boat to earn a livelihood is in no way affected. The principle, however, of abolishing toll stations, and removing the powers from petty subordinates of extorting more than they are authorized to collect is a correct one, and should if possible be carried out. But the retention of two tolling stations on the canal, say, at Shadayankupam and another at Adyar Lock, would not be objectionable, as these stations would from their proximity to the headquarters of the division be open to frequent check and scrutiny. I would recommend, therefore, as a direct means of simplifying the method of collection of revenue that a modification of the original system of collections, viz., 4 annas per ton on all boats, be established. The number of boats that passed through the locks at Shadayankupam and the Adyar during 1881 amounted to 241,207 tons, which at 4 annas per ton would give 60,000 and odd rupees. This added to the expected revenue from Licenses as per statement

* These do not pay tolls nor fees.

814
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49

given by the Chief Engineer for Irrigation would bring up the receipts of the Buckingham Canal to about 93,000 rupees.

The charge under the establishment proposed under this scheme in the accompanying table would be 11,500 rupees, which added to the amount required for maintenance would bring the sum total of charges to Rs. 51,500.

BUCKINGHAM CANAL.

TABLE showing the Establishment proposed for Toll Offices, Locks and Flood-gates.

Locality.	ESTABLISHMENT.		Average Salary per Month.	Amount per Annum.	Total.
	No.	Nature of Appointment.			
Toll Office at Shadayankupam.	1	Clerk, IV Class, 2nd Grade	RS. 35	RS.	
	1	Do. 3rd	25		
	1	Clerk, V Class, 1st Grade	17½		
	1	Do. 2nd	12½		
	2	Peons at Rs. 7 each	14		
			104	1,248	
Lock at Shadayankupam.	1	Head Lascar	8		
	4	Lascars at Rs. 7 each	28		
			36	432	
Junction Canal Lock at Adyar.	1	Head Lascar	7		
	4	Lascars at Rs. 6 each	24		
			31	372	
Sadras Canal Lock at Adyar.	1	Head Lascar	7		
	4	Lascars at Rs. 6 each	24		
			31	372	
Toll Office at Adyar Lock.	1	Clerk, IV Class, 3rd Grade	25		
	1	Clerk, V Class, 1st Grade	17½		
	2	Peons at Rs. 7 each	14		
	2	Lascars at Rs. 6 each	12		
			68½	822	
47 Flood-gates, 2 Lascars at each.	94	Lascars at Rs. 6 each	564	6,768	
Basin at Madras	1	Clerk, IV Class, 2nd Grade	35		
	3	Peons at Rs. 6 each	18		
			53	636	
Division Office at Madras.	1	Clerk, IV Class, 3rd Grade	25		
	1	Clerk, V Class, 1st Grade	17½		
	2	Peons at Rs. 6 each	12		
			54½	654	
		Contingencies		196	
		Total			11,500

CHRAPPAK,
16th December 1882.

(Signed) R. R. E. DRAKE-BROCKMAN, Major, R.E.,
Executive Engineer, Buckingham Canal.

Note by the Chief Engineer, Public Works Department.

It having been brought under the notice of Government that hindrance to the traffic between Madras and the northern deltas was caused by the navigation rules of the Buckingham Canal differing from those applicable to the Godavari and Kistna deltas, and to the possible abuses from the through traffic being called upon to pay frequent tolls, the following Committee was, under G.O., of 5th August 1882, No. 612 I., appointed to consider and report on the matter, viz.:—

J. W. Rundall, Esq., Superintending Engineer, Second Circle, President.
G. T. Walch, Esq., Officiating Superintending Engineer, First Circle, } Members.
Major Drake-Brockman, Executive Engineer, Buckingham Canal, }

2. The points to which the attention of the Committee was specially drawn were—

- (1) The abolition, as far as possible, of tolls.
- (2) The license fees to be charged for the canals throughout.
- (3) The measurement of the boats with reference to the adoption of one unit of measurement.

3. Major Drake-Brockman being absent on leave, his place was taken on the Committee by his *locum tenens*, Mr. Ottmann, Honorary Assistant Engineer; but as will be observed from the printed collection now submitted, the Executive Engineer has had every opportunity for expressing his opinion.

4. The accompanying papers are in themselves so full and complete that, it will be needless to do more than summarize the conclusions arrived at by the Committee, and those of the Chief Engineer for Irrigation, who has noted at length on the case.

5. On the first point referred to them the Committee consider that although tolls cannot be entirely abolished, the number of existing stations may with advantage be reduced from 47 to 20. To allow of the occasional use of the canals without taking out a license, toll stations must, they consider, be maintained at the head locks of each section of the deltas, at all tidal locks, at Ellore near the junction of the Godavari and Kistna Canals, and at four places (viz., Pedda Ganjam, Kundaleru, Shadayankupam, and Adyar) on the Buckingham Canal.

6. In regard to the second point the Committee propose a very considerable reduction on the license fees, especially on the Buckingham Canal, which are nearly five times those for the corresponding lengths of the Godavari Canals.

7. By paragraph 28 the proposed through rates, and the proportions in which the revenue should be credited to each system should, they consider, be as follows:—

Cargo Boats.

	RS.	A.	P.
Amount of through licenses	1	8	0
Godavari system	1	4	0
Kistna	2	4	0
Buckingham Canal	5	0	0

Passenger Boats.

(a) and (c) classes, through license	10	0	0
Godavari system	3	0	0
Kistna	2	8	0
Buckingham Canal	4	8	0
(b) and (d) classes, through license	10	0	0
Godavari system	7	0	0
Kistna	2	4	0
Buckingham Canal	1	8	0
	3	4	0
	7	0	0

8. On the third point the Committee definitely recommend that the unit hitherto adopted for the Buckingham Canal, viz., that 50 cubic feet should represent

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a registered ton, instead of 75 cubic feet, as not long since introduced on the Godavari and Kistna Deltas.

9. The Chief Engineer for Irrigation accepts the Committee's recommendation on the first head, with the proviso that no obstruction such as a chain drawn across the canal (as at present) shall be allowed at the tolling stations; also that the toll-taker shall have no authority to stop any boat for the production of its license unless there is some evident infringement of the rules. He would confine all such action to the Inspecting Officers alone, considering it better to risk some loss than harass traffic.

10. Under the second head Colonel Hasted, while agreeing to the general principles, is prepared to go much further than the Committee by making one demand for license to clear all the canals, and by otherwise removing all possible obstacles to navigation, believing that the interests of Government would best be served by improving the communications, stimulating consumption, and extending production. All he considers that should be looked for is that, the navigation receipts should cover the working expenses when the canals have been completed and brought into normal condition, excluding interest charge on capital outlay.

11. The scales of license fees as suggested by Colonel Hasted (see paragraph 11 of his Note) for cargo boats, passenger boats, and steamers, are just one-half those recommended by the Committee, while for rafts the scale is the same.

12. In the matter of tolls, he would substitute the uniform rate of 8 annas per ton for boats, and one rupee per ton for steamers for each system, in lieu of the Committee's rather heavier rates, and the existing ones on the Buckingham Canal, which are acknowledged to be both heavy and vexatious.

13. Major Drake-Brockman, to whom the question of licenses and tolls was referred, chiefly in view to show what would be the probable financial effect of the suggestions made by the Committee, and by the Chief Engineer for Irrigation, has recorded his opinion in a memorandum of the 16th December.

14. The main point brought prominently into view by this officer, is the large outlay now required for the maintenance of the Buckingham Canal in its present incomplete condition, and the sensible reduction which must occur when the improvement works, which have been estimated for and are being carried out, shall have been completed. The total future annual charge for the 266 miles open, he considers, should not exceed Rs. 40,000.

15. While showing what the collection from tolls has been during the past four years, he has taken no credit for future increase, which, when the trade has been freed from the present harassing system of tolls, may reasonably be expected to show itself. The growth of the revenue in the last few years does not, it is thought, prove that tolls are acceptable to boat-owners or others engaged in trade, so much as that the vitality of the traffic is so great that, the revenue has increased in a very marked manner in spite of all obstacles.

16. In addition to the license fees proposed by the Chief Engineer for Irrigation, Major Drake-Brockman would establish only two toll stations, viz., at the Adyar lock, the head of the southern branch, and at Shadayankupam, the southern extremity of the north branch of the Buckingham Canal.

17. With a toll of 4 annas per ton on the whole outward and inward traffic passing the locks (aggregating 241,207 tons) he calculates on a revenue from this source only of Rs. 60,000 per annum.

18. The plan, though apparently simple, would have the objection that the rate charged on boats plying near the extremities of the canals would be unduly heavy, while others might escape all tolls, e.g., a boat making three outward trips would pass the toll station six times, and pay $1\frac{1}{2}$ rupees per ton, which is certainly very heavy, while any boat plying within the full length of the canal beyond the toll station, would pay nothing.

19. Colonel Hasted, on a further reference made to him regarding the cost of establishment, gives the following for his scheme:—

Toll Stations.	Establishment.	Pay.		Total.
		RS.	RS.	
Shadayankupam Lock	1 Superintendent	15	}	41
	2 Lascars at Rs. 7	14		
	2 Do. at „ 6	12		
Adyar Lock	1 Superintendent	15	}	41
	2 Lascars at Rs. 7	14		
	2 Do. at „ 6	12		
Pedda Ganjam Lock	1 Superintendent	15	}	21
	1 Lascar	6		
Kundaleru	1 Superintendent	15	}	21
	1 Lascar	6		
Wharf at Madras	1 Superintendent	50	}	79½
	1 Clerk	17½		
	2 Lascars at Rs. 6	12		
Total per Mensem		...	...	258
Total per Annum		...	...	3,096

20. Assuming the maintenance charges at Rs. 40,000, the amount estimated by Major Drake-Brockman, allowing for contingencies, establishment and maintenance, would not exceed Rs. 45,000 per annum when the canal shall have been completed.

21. As even with the present imperfectly developed traffic the license fees and tolls would on Colonel Hasted's scale amount as shown to over Rs. 32,000 per annum, it would only need a wharfage charge of about 1 anna a ton levied at Madras, to bring receipts and disbursements into equilibrium.

22. A wharf is now being constructed near the basin at Madras, and it may be desirable to build another to south of the Adyar lock. A charge such as that indicated at both places would be in every way reasonable, and it certainly would be necessary to prevent all discharge of cargo excepting at the selected places.

23. On the whole, therefore, the proposals put forward by the Chief Engineer for Irrigation, supplemented by the small wharfage charge which he himself has suggested, would, it is thought, prove most suitable.

24. It is of the utmost moment that a work which holds out such promise of success in ordinary years, and of proving itself of inestimable value during famine, should be freed in its infancy from all needless trammels.

25. Among other points which have incidentally entered into the questions raised, is one regarding the branch of this department, by which in future the work should be controlled.

26. Reasons have hitherto existed, needless here to state, which have made it advisable to retain the control in the general branch of the department. These, however, do not now exist in the same force as formerly, and certainly if in future complete uniformity of management is to be introduced for all the canals as forming part of a general system, it would be desirable to transfer the management of the Buckingham Canal to the Irrigation Branch.

27. Another point has reference to the period covered by the annual returns, which hitherto has been the calendar and not the official year. There seems no reason why the latter should not now be reverted to as being in every way the most convenient. Should the above approve themselves to Government, orders might issue at a sufficiently early date to admit of the introduction of the new system in its entirety from the 1st April next.

MADRAS,
26th January 1883.

(Signed) R. H. SANKEY, Colonel, R.E.,
Chief Engineer, P.W.D.

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Buildings and Roads.
Civil Works.

No. 139.

READ—the following paper :—

From the Committee convened in Proceedings, Madras Government, No. 612 I., of 5th August 1882, dated 12th October 1882.

Memorandum by the Chief Engineer for Irrigation, dated 6th November 1882, No. 117 I.

" " Executive Engineer, Buckingham Canal Division, dated 16th December 1882.

" " Chief Engineer, Public Works Department, dated 26th January 1883.

No. 140.

ORDER—dated 20th February 1883, No. 562 W., Public Works.

The Government accept the recommendations of the Committee, with the modifications suggested by the Chief Engineer for Irrigation, and the Chief Engineer, Public Works Department.

2. The Chief Engineer for Irrigation will submit, in time to admit of their introduction by the 1st April 1883, a revised draft of the rules for publication in the *Fort St. George Gazette* and communication to officers concerned.

3. The official, instead of the calendar, year will in future be adopted in regard to the preparation of navigation returns, &c., and from 1st April next all matters relating to the Buckingham Canal will be dealt with in the Irrigation Branch.

(True Extract.)

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

To the Chief Engineer for Irrigation.
" Superintending Engineer, First Circle.
" " " Second "
" " " Third "
" Board of Revenue.
" Revenue Department.

" *Supg. Engineer Fifth Circle.*

Ed. A. F. Goodall.
Spare Copies

★
BUILDINGS AND ROADS.
CIVIL WORKS.

Govt. of (1883) Madras.
PUBLIC WORKS.

Dated February, 20th.

Recd.

Encl.

G.O., 20th Feb. 1883, No. 562 W.

FEBRUARY.
Nos. 139-140.

Navigation Rules

Revised — for the Canal System of the
East Coast.

The disposal of establishment
questions raised in this
note must I think await
return by E. F. of the
Distribution Statement.
He might be asked by
wire to return it as
soon as possible.

8/4 M.
2-84
S.W.

The Statement came
in this afternoon - and
was sent up to you.

R.S.
1-2-84.

The Statement
was sent up to you.

1/4 J

Please ascertain, &

1/4 J

1/4 J

1/4 J

To C. A. W.

The statement
will probably come
in by Monday, the 22nd
instant.

R.H.

22-2-84

To A.W.

The papers have
since been sent up
to you.

R.H.

25-2-84

C.A.W.

814/10/84

It might be well to
alter the proposed scale
for Buckingham Canal in
accordance with E. D.'s report
herein. The modification is
very slight. — C.A.

25-2-84

Subsequently ordered
to stand over. The
distribution list being
issued unaltered.

R.H.

25-2-84

No 814
S. W. Department.

Proceedings of the Madras Government,
Under date the March 25. 1884

Read the following:—

814
56

Note by the Ag. Chief Engineer for
Irrigation—

A.E. No 6 Bd of Jan'y 18. 1884

The proposals of the
Chief Engineer for Irrigation
for the future supervision
of the Buckingham Canal
are approved.

It is hoped that
the changes will result
in a much more vigorous
prosecution of this very
important work.

An Assistant Engineer
will be allotted to
the Division as soon
as possible.

RS
20/3/84

W
20.3.84



W. 25/3
S.E. v. circle 2/3
C.E. for Sprague
Ex. S.W. Nichols

RS
Circ. 20/3/84 R. 24/3/84

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Govt. of (1883) Madrid

PUBLIC WORKS



25th March 4th 8/4/80

Buckingham Canal

The proposals of
the Corps for the
future supervision
of the ———— proposed
with ———— and ————

W.C. 25/3
13.2
4/4