GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following paper by A. S. RUSSELL, Esq., Under Secretary, Public Works department, on special duty, with note from the Secretary to Government, Public Works department, No. 566 E., dated 27th August 1884:—

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PUBLIC WORKS—IRRIGATION BRANCH.

Introduction.

1. *Definition of the Branch.*—The irrigation branch of the Public Works department deals with all works of irrigation and internal navigation, and with connected agricultural works, such as river conservancy, river embankments, drainages, &c.

2. *History and Constitution of the Branch.*—The branch was first constituted in the year 1867, when it was made a subordinate branch of the Public Works department by the appointment of a Chief Engineer for Irrigation, and early in 1877 it was made a distinct and independent branch in direct communication with Government. The Chief Engineer for Irrigation—who is also Joint Secretary to Government in the irrigation branch, and in that capacity lays before Government all matters requiring its decision—is the responsible executive head of the branch in all professional matters connected with the special subjects pertaining to the irrigation branch; and, together with the Examiner of Public Works Accounts, who is the head of the accounts branch, exercises control over the officers of the department employed on works of irrigation and navigation, in respect to the expenditure and disbursement of public money, the custody of stores, and the due submission of accounts. The Chief Engineer for Irrigation also prepares the budget estimate and all reports relating to his branch, and it is his special duty to check and examine all designs for irrigation projects, and to lay them before Government, accompanied by a distinct expression of his opinion regarding their merits. He is assisted in his office work by an Assistant Chief Engineer for Irrigation, who is also Under Secretary to Government, and by a suitable office establishment, but no separate and distinct executive establishment is maintained for employment upon irrigation works, owing to the exceedingly scattered nature of such works in the Madras Presidency. The officers and subordinates employed on irrigation works are provided from the one general list of the Public Works department; attend to other public works besides those of irrigation; and as regards their posting and general discipline are under the orders of the Chief Engineer, Public Works department. The cost of the one general establishment is debited, in the first instance, to Provincial Funds, and the irrigation branch is charged with a fixed percentage, on account of the portion of the establishment employed on irrigation works, as a contribution to "Provincial," at the following rates :—

(*a*.) 23 per cent. on expenditure on original works and repairs, excluding expenditure in England and payments for land compensation.

(*b*.) 10 per cent. on the "Direct"* revenue collected in the Public Works department.

(*c*.) 6 per cent. on the gross "indirect" revenue (i.e., revenue realised in the Civil department and credited to the Public Works department) due to Productive Public Works, including the share due to old irrigation, but excluding the enhanced share of land revenue.

It is also under contemplation to make a further charge to "irrigation" on account of establishment, by means of a fixed percentage on the "indirect" revenue due to works not classed as Productive.

3. *Financial Policy of Government in respect to Irrigation Works and its Results in the Madras Presidency.*—Previous to the year 1854, expenditure incurred on irrigation works of all descriptions was treated as ordinary expenditure, and was charged against the general revenues of the year. Under this system the large irrigation works of the Godávery, Kistna, and Cauvery Deltas were begun. After

* See paragraph 5.

1854, as it was recognised that the system of charging the cost of large works, expected to prove remunerative, against the general yearly revenue was a false one, a distinction was made between the expenditure incurred on

(*a*) the maintenance and repair of existing irrigation works, and the construction of the smaller works necessary for the due development of irrigation, which it was decided to charge as formerly against the yearly revenues of the country; and

(*b*) the construction and extension of large irrigation works of permanent public utility, calculated materially to increase the wealth and promote the prosperity of the country, which were to be constructed by means of money raised on loan, and were to be treated as financial concerns by opening for them capital and revenue accounts, so that their exact financial position could at any time be ascertained.

The outbreak of the mutiny prevented the prosecution of the schemes for promoting irrigation by means of money raised on loan, and it was not until 1858 that the Madras Irrigation and Canal Company was formed with a Government guarantee of 5 per cent. This work was financially a failure, and warned by this example and by experience elsewhere of the unsuitability of the agency of private companies in the construction of irrigation works, Government have constructed all other irrigation works in the Madras Presidency by the direct agency of their own officers. This decision was arrived at in 1867, when the policy of guaranteed companies for the construction of irrigation works was finally abandoned in favour of what was then called the "Extraordinary" Public Works policy, whereby large works of irrigation expected to prove remunerative were to be constructed by Government from money borrowed annually by the State, when the ordinary revenues were insufficient for the purpose. The capital expenditure incurred on the large irrigation works of the Godávery, Kistna, Cauvery, and Penner rivers continued up to the year 1879, in accordance with the policy above stated, to be met partly from Loan Funds and partly from ordinary revenue. In 1879, however, the expenditure under the latter head was written back to Loan Funds in the accounts, as if constructed from money raised on loan. The reason why this course became necessary in 1879 was owing to the following cause :—

The understanding on which "Extraordinary" Public Works were originally undertaken was that, if money was available from the general revenue of the country, it was to be made use of, and borrowing was only to be resorted to in case of need. But, as it was found impossible to determine exactly the profit derived from expenditure incurred from Loan Funds, the works having been carried out partly from Loan Funds and partly from ordinary revenue, it was ruled in 1879 that the entire cost of the works, from whatever source the expenditure was met, should be brought together in one account, and that no part of the cost of construction or improvements to such works should thereafter be charged to ordinary revenue.

From 1867, therefore, the distinction between the two classes of works (*a*) and (*b*) has been strictly observed, while practically the cost of the first-named works has, since 1854 to the present time, alone been charged as ordinary expenditure against the general yearly revenue of the country, and those in the latter category have virtually been made with borrowed money, as the expenditure incurred on them from ordinary revenue was comparatively small. The expenditure upon the extension of irrigation may, therefore, be said to have passed through three phases :—

First.—From the establishment of British rule to 1854, when the annual disbursements were comparatively small, and were met from yearly revenue.

Second.—From 1854 to 1867, during which time the experiment of private companies was tried in addition.

Third.—From 1867, the date of the "Extraordinary" Public Works policy, under which all irrigation works were undertaken by the State, and a certain sum was devoted annually to their prosecution.

In 1876-77 the term "Extraordinary" was dropped in favour of that of "Productive;" and very strict rules (which have since that date been reiterated with increased emphasis) were laid down, limiting the outlay of borrowed money to works which were likely to be remunerative, by yielding in the shape of annual income within ten years after completion a sum equal to the interest on the money expended on their construction. In point of fact, from the very commencement, in 1867, of the policy embodied in the Productive Public Works scheme, it was assumed that the works comprised in the category of, and sanctioned as, Productive Public Works, would prove remunerative, and orders on the subject were issued, though it was not until 1876-77 that stringent limitations regarding the certainty of their financial success were insisted upon before works could be so classed. How far this assumption has been realised in the case of the Productive Public Works of the Madras Presidency will be seen from the following figures, exhibiting the total gain or loss to the State from outlay on works originally so classed :—

Statement of Financial Results of Irrigation Works classed as "Productive," in the Madras Presidency up to end of 1882-83.

Systems.	Total estimate including indirect charges.	Total outlay to end of 1882-83.	Total revenue due to works to end of 1882-83.	Charges to end of 1882-83.			Surplus revenue after payment of all charges.	Percentage of surplus revenue on capital outlay.
				Working expenses.	Interest.	Total.		
Productive Public Works.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	
1. Godávery Delta system.	1,30,32,653	1,10,20,241	3,21,40,280	83,09,475	81,74,910	1,64,84,385	1,56,55,895	142·06
2. Kistna do. do.	1,49,00,944	63,30,628	1,49,75,292	46,01,857	48,19,225	94,21,082	55,54,210	87·74
3. Penner Anicut do.	18,94,784	16,65,159	13,61,115	1,51,356	10,74,532	12,25,888	1,35,227	8·12
4. Cauvery Delta do.	18,54,847	11,50,238	1,38,42,450	— 1,85,934	11,60,217	9,74,283	1,28,68,167	1118·74
5. Srivaikuntham Anicut system	14,76,806	13,12,135	6,11,579	2,64,497	5,92,518	8,57,015	— 2,45,436	— 18·71
Total ...	3,31,66,034	2,14,78,401	6,29,30,716	1,31,41,251	1,58,21,402	2,89,62,653	3,39,68,063	158·15

The Madras Irrigation and Canal Company's Canal, which was purchased by Government in 1882, and was classed as a Productive Public Work in the same year, was, as has already been explained, constructed by a private company, and has therefore purposely been excluded from the foregoing statement as embodying the result of a different policy. The enormous loss which this work has entailed upon the State is shown by the following figures :—

Statement showing the financial result of the Kurnool Canal from its commencement up to end of 1882-83.

CAPITAL EXPENDITURE.

	RS.
Amount paid by the Secretary of State to the company for the purchase of the canal ...	1,76,25,050

REVENUE RECEIPTS.

Total irrigation revenue from the commencement of the work to the end of 1882-83	10,73,097
Total navigation and other receipts collected up to 31st March 1883	2,07,764
Total ...	12,80,861

CHARGES.

Total working expenses to end of 1882-83 ...	18,55,385
Total interest charges	135,60,282
Total ...	1,54,15,667
Net loss ...	1,41,34,806

About the year 1881 a new class of works, called Protective Public Works, was instituted, and may be defined as works, which, although not directly remunerative to the extent which would justify their inclusion in the class of Productive Public Works, are calculated to afford a protection against famine, and to guard against a probable future expenditure in relief of the population. A certain proportion of the total sum of $1\frac{1}{2}$ millions sterling annually reserved for "Famine Relief and Insurance" purposes is appropriated for works of this class.

4. *Classification of irrigation of works.*—All works under the charge of the irrigation branch are divided into the three following main heads :—

I. Productive Public Works.
II. Public Works not classed as Productive.
III. Protective Works.

I. *Productive Public Works.*—Productive Public Works are those specially classed under that head, in consideration of their remunerative character. The cost of their construction or material improvement is met from Loan Funds; and their working expenses are met from "Ordinary Revenue," to which head the revenue derived from them is credited. The revenue and expenditure of these works are treated as "Imperial," and are held at the disposal of the Government of India, and applied to the general services of the empire, as distinguished from Provincial Funds, which are held at the disposal of the Local Government, and are appropriated to the exclusive wants of the Presidency. The works in the Madras Presidency classed under this head up to the end of 1883-84 are—

Name of Work.	District.
(1.) Godávery Delta	Godávery.
(2.) Kistna do.	Kistna.
(3.) Kurnool Canal	Kurnool and Cuddapah.
(4.) Penner Anicut	Nellore.
(5.) Sangam Anicut	Nellore.
(6.) Barur Tank	Salem.
(7.) Cauvery Delta	Tanjore.
(8.) Srivaikuntham Anicut	Tinnevelly.

For all these eight works capital and revenue accounts are kept. With the exception of the Sangam Anicut and Barur Tank, which have only recently been commenced, they have all been in operation for some years. The Kurnool Canal was classed under the head of "Productive" in the year 1882, owing to the purchase money paid to the late Madras Irrigation and Canal Company being met from Loan Funds.

II. *Public Works not classed as Productive.*—Public works not classed as Productive are sub-divided into

(*a.*) Irrigation and Navigation Works, for which Capital and Revenue Accounts are kept.

(*b.*) Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.

(*c.*) Agricultural Works.

(*a.*) The following are the works for which capital and revenue accounts are kept, which are again sub-divided into "Imperial" and "Provincial," to which heads the expenditure incurred on them is respectively charged.

Name of Work.	District.	
(1.) Chembrambaukum Tank... ...	Chingleput.	Imperial.
(2.) Palar Anicut	North Arcot.	Imperial.
(3.) Pelandorai Anicut	South Arcot.	Imperial.
(4.) Madras Water-supply and Irrigation Extension Project	Chingleput.	Provincial.
(5.) Buckingham Canal.	Nellore, Chingleput, and South Arcot.	Provincial.

The financial results of all the thirteen works for which capital and revenue accounts are kept are tested as follows :—

(*A.*) By considering the "capital" cost of any work to be simply the sum actually spent on its construction.

(*B.*) By debiting the "revenue" account yearly, with the simple * interest on the capital cost of the works at the commencement of the year and with the working expenses of the year.

(*C.*) By crediting the "revenue" account yearly, with the total receipts, "direct" and "indirect."

The difference between (*B*) and (*C*) for any one year shows the profit or loss for that year, while the difference between (*B*) and (*C*) from the commencement of the works to any date shows the financial position of the works at that date. The rules regarding the debit of the outlay on works, for which capital and revenue accounts are kept, are that all the past outlay on construction and all fresh estimates amounting to more than Rupees 2,500 each for the material improvement of the existing works are charged to "capital"; while all outlay on the maintenance and repairs of the works, together with estimates for their extension and improvement amounting to less than Rupees 2,500 are charged to "revenue."

(*b.*) The expenditure on the irrigation and navigation works for which neither capital nor revenue accounts are kept is met from Imperial Funds. Many of these works are of very considerable importance individually, and for such, under the orders of the Madras Government, a continuous record of expenditure has been ordered to be maintained in a simple form, which will afford all the information necessary for administrative purposes and for the determination of their financial value. The number of important works for which such accounts are kept up to the end of 1883-84 is 59. A complete list of these works will be found in paragraph 22.

. The remaining irrigation works under (*b*) are of small importance individually, though important collectively, and are dealt with in the groups or classes to which they belong, viz. :—

First.—Irrigation works supplied by rivers and streams.
Second.—Groups of rainfed tanks.
Third.—Isolated tanks—rainfed.
Fourth.—Miscellaneous works including spring-channels, ponds, &c.

(*c.*) Agricultural works are those which do not yield revenue, but which are necessary for the safety or prosperity of agriculture. They are divided into the following main heads :—

River conservancy.
River embankments.
Drainages.
Miscellaneous works.

Expenditure on these works is also met from Imperial Funds.

III. *Protective Works.*—Protective works have already been defined in paragraph 2. They are carried out from Famine Relief and Insurance Funds, formed of insurance taxation levied for famine purposes, and treated as imperial. The only work classed under this head up to the end of 1883-84 is the Rushkulya Project in the Ganjam District.

5. *Classification of Revenue of Irrigation Works.*—The revenue derived from the irrigation works of the Presidency is either direct or indirect. The former, properly speaking, represents revenue *separately* assessed for water supplied by the works, and the latter exhibits the increase of land revenue, which would not have been obtained but for the works. In this Presidency, however, where the ryotwari system of tenure prevails, the Government is virtually sole landlord and also proprietor of the water, and its demand for irrigated land is commonly a lump sum, in which no distinction is made between the charge due for the occupancy of the

* Under recent orders from the Government of India, interest on capital is not to be debited to the "revenue" account for works not classed as "Productive."

land and that due for the use of the water. The whole land revenue is therefore assessed and collected in the Revenue department, and is credited to the head "Land Revenue" without any separation between "Land Revenue Ordinary" and "Land Revenue Irrigated." The water-rates or bulk of the irrigation revenue proper are therefore shown under indirect revenue, while the direct revenue comprises only navigation and other miscellaneous receipts collected in the Public Works department. In the single case, however, of the Kurnool Canal, the water rates are credited to direct revenue, as the system in vogue, under the late Madras Irrigation and Canal Company, was continued after the transfer of the canal to Government.

In addition to the anomaly which exists in Madras of showing the great bulk of the irrigation revenue proper as "Indirect Revenue," a further anomaly is caused by the difference between the official year ending 31st March and the agricultural or revenue year ending 30th June. Owing to this difference between the official and revenue years, the "direct" revenue due to irrigation collected in the Public Works department is shown for the official year, while the "indirect" revenue collected in the Civil department is the net ascertained demand for the revenue year. From the irrigation revenue thus ascertained, the portion due in the more ancient irrigation works to the old irrigation which existed prior to the improvements and additions carried out by the British Government, is deducted, and the share of enhanced land revenue, or assessment on waste lands which would not have been brought under cultivation but for the irrigation works executed, is added thereto. It has already been stated that the water-rates on irrigated lands are collected in the Civil department. In order to provide for these collection charges, a fixed percentage is deducted from irrigation. The rate at which this deduction has hitherto been made is 7·2 per cent. on the ascertained demand, but, from the commencement of the official year 1884-85, the rate has been reduced to 5 per cent., which is found to be approximately the actual cost of collection. In the accounts of the Finance department, revenue derived from irrigation and navigation works is shown under the following heads :—

G. Revenue from Productive Public Works—
XXVII—Irrigation and Navigation (Direct Receipts).
XXVIII—Portion of Land Revenue due to Irrigation.

H. Receipts on account of public works not classed as Productive—
XXXI—Irrigation and Navigation.

Irrigation revenue due to works not classed as Productive is not shown separately in these accounts.

6. *Classification of Expenditure on Irrigation Works.*—Expenditure in the irrigation branch is shown under the following heads in the accounts of the Finance department.

N. Productive Public Works (Capital Account).
51. Irrigation and Navigation.
G. Productive Public Works (Revenue Account).
38. Irrigation and Navigation (Working Expenses).
H. Public Works not classed as Productive.
44. Irrigation and Navigation.
F. Famine Relief and Insurance.
34. Protective Works—Irrigation.

In budget estimates and accounts of the Public Works department, the same heads of account are adopted, except that the head of account denoted by H is sub-divided into the following budget heads :—

Imperial.

I. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
II. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.

III. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.
IV. Agricultural works.

Provincial.

V. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
VI. Irrigatian and Navigation Works for which Capital and Revenue Accounts are kept— Revenue Account.

Each budget head is divided into departmental heads as shown below :—

Budget heads.	*Departmental heads.*
1. Productive Public Works—Capital Account. 2. Imperial, Irrigation, and Navigation works for which Capital and Revenue Accounts are kept—Capital Account. 3. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account. 4. Protective Works.	I. Works. II. Establishment. III. Tools and Plant. IV. Suspense Account. V. Less receipts on Capital Account.
5. Productive Public Works—Revenue Account. 6. Imperial, Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account. 7. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.	IA. Extensions and Improvements. IB. Maintenance and Repairs. IC. Compensation. II. Establishment. III. Tools and Plant.
8. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept. 9. Agricultural Works.	Original Works, Repairs, Establishment, Tools and Plant, Profit and Loss, Suspense Account.

Expenditure shown under the above departmental heads is termed "direct" as distinguished from that known as "indirect," which is not shown in the Finance Accounts of the department, but only in the Capital and Revenue Accounts, or the Administrative Accounts as they are otherwise called, in view to the profit or loss on the works being exactly determined. "Indirect charges" are of three kinds—

1. Capitalized abatement of land revenue.
2. Loss by exchange.
3. Leave and pension allowances.

These charges are calculated as shown below :—

Item (1) 25 times the annual assessment of lands occupied by the works.
Item (2) at the current rates of exchange on payments in England, which are shown in the Indian accounts *at par*.
Item (3) at 14 per cent. on establishment charges.

With regard to the old maintenance charges of (1) "Productive Public Works," and (2) "Irrigation and Navigation works for which Capital and Revenue Accounts are kept not classed as Productive," such charges are deducted from the total charges on "Revenue," and are added to the expenditure under the head "Irrigation and Navigation Works, for which neither Capital nor Revenue Accounts are kept."

Description of the Madras Irrigation Works.

7. *Sketch of the Geographical Features and Distribution of Rainfall as affecting Irrigation.*—The two great mountain ranges of the Western and Eastern Ghauts give the key to the configuration of Southern India. The Western Ghauts are generally of considerable elevation. They stretch continuously along the entire line of the West Coast of the Presidency, having but a narrow strip of land between them and the sea, and within the limits of the Madras Presidency not a single river breaks through their barrier and flows towards the Eastern Coast. The Eastern Ghauts are of low elevation, lie entirely within the limits of the Presidency, have for the most part a broad expanse of land between their base and the sea, and run in a south-westerly direction, until they lose themselves in the Neilgherries, and there join the Western Ghauts. Their line is pierced by three great rivers, the Godávery, the Kistna, and the Cauvery, as well as by numerous minor streams, so that they do not perform the part of a watershed. These two mountain ranges, from a physical point of view, divide the Presidency into three portions.

(1) The short and narrow Western Coast.
(2) The long and broad Eastern Coast.
(3) The central tableland lying between the two ranges.

Each of these three divisions has natural features of its own; is under different climatic conditions, which are determined by the monsoons; and practise in the main different methods of irrigation for the cultivation of their wet crops. The principal monsoon, which is known as the south-west monsoon and is general over a large portion of India, breaks with great violence on the western shore of the Presidency, where the high ranges of the Western Ghauts catch almost the entire rainfall, which is accordingly exceedingly heavy along this coast. No irrigation, in the proper sense of the word, is practised in this division, but the abundant rainfall renders every species of wet crop capable of being cultivated. The average annual rainfall in this tract is 127·14 inches.

Along the east coast of the Madras Presidency, the main portion of the annual rainfall is brought by the monsoon known as the north-east monsoon, which is peculiar to the Madras Presidency, and generally brings an abundant supply of rain to all the eastern coast districts from the district of Nellore southwards—the coast districts north of Nellore, and especially those of Ganjam and Vizagapatam, deriving the principal portion of their supply of rain from the south-west monsoon. The eastern coast of the Presidency is also subject to cyclonic rainfall, from the cyclones which take place in the Bay of Bengal, and during the continuance of these cyclonic storms the rainfall is exceptionally heavy. The average annual rainfall in this tract is 34·97 inches. This second division therefore is under different climatic conditions from the rest of the Presidency, and in this tract of country, owing to its physical features, irrigation is more extensively practised and developed than in either of the other two divisions. It possesses the alluvial deltas of the three great rivers already mentioned, which rising in the hilly region under the full influence of the south-west monsoon, drain a very large extent of country and have an almost perennial supply; it has also numerous other rivers, which, though not so constant in their supply, bring down great volumes of water during the time of the periodical rains; and it has a copious, though uncertain, rainfall during the north-east monsoon. As a consequence, this division has (*a*) the important irrigation works of the Godávery, Kistna and Cauvery Deltas, in which from a dam placed across the river, a vast system of canals and distributary channels supply the means of irrigation to a large area of country; (*b*) the smaller, though still very important, systems on the Penner, Palar, Tambrapurni and other rivers, where advantage is taken of the river freshes by means of rapidly discharging channels, to store water in a large chain of tanks or reservoirs; (*c*) the very numerous tanks constructed entirely under the native rulers of Southern India, which, from very ancient times, have stored the heavy local rainfall of the north-east monsoon.

The central plateau derives its rainfall from both monsoons, and may be said to consist of the districts of Kurnool, Cuddapah, Bellary, Anantapur, together with those of Salem and Coimbatore. In this division the country is, generally

speaking, bare; the rainfall light and uncertain, averaging 27·92 inches; the means of irrigation difficult; and the ravages of famine, particularly in the four first-named districts, most frequent. It contains many tracts of fertile country cultivated with dry crops; but, with the exception of the irrigation from the Tungabhadra, an affluent of the Kistna, and from the affluents of the Cauvery in the Coimbatore District, the irrigation in this division is individually unimportant, and consists for the most part of tanks intended to store the local showers which the monsoons bring from either coast.

The rainfall of each district of the Presidency, from 1870 to 1883 inclusive, is shown in the following statement. The general duration of the south-west monsoon, which is commonly called the "six months' monsoon," is from June to September inclusive; while that of the north-east monsoon, which is known as the "three months' monsoon," is from October to December. In the interval between the two monsoons, there is little rain, except such as is occasioned by cyclonic rainfall and local thunder showers.

Statement showing the average Rainfall, in each District of the Madras Presidency, for the Fourteen Years from 1870 to 1883.

Districts.	Dry Season—January to May.	South-west Monsoon—June to September.	North-east Monsoon—October to December.	Total.	Area irrigated.	Gross Revenue—("Land" and "Water").
						RS.
Ganjam	4·71	26·91	11·59	43·21	194,756	5,17,552
Vizagapatam	5·86	23·43	12·40	40·69	47,674	1,54,412
Godávery	3·04	22·32	10·82	36·18	554,455	23,66,295
Kistna	2·99	18·60	11·90	33·49	312,893	13,92,414
Nellore	3·10	10·77	19·40	34·27	215,041	9,91,126
Bellary and Anantapur	3·31	11·94	6·50	21·75	142,756	6,16,088
Kurnool	3·29	18·52	6·14	27·95	49,233	2,41,124
Cuddapah	4·50	13·49	10·33	28·32	197,286	8,95,088
Coimbatore	6·92	9·59	10·98	26·49	98,081	6,60,584
Salem	7·23	16·28	11·57	35·08	97,172	5,08,077
North Arcot	5·31	17·49	14·43	37·23	283,786	13,49,170
Malabar	11·52	97·67	12·01	121·20	...	...
South Canara	9·62	114·07	9·39	133·08	...	...
Chingleput	4·80	16·64	20·65	42·09	366,306	13,22,393
South Arcot	4·78	16·92	18·42	40·12	358,428	17,65,352
Trichinopoly	5·91	12·35	15·91	34·17	178,807	7,71,711
Tanjore	5·43	13·67	23·61	42·71	914,801	40,97,382
Madura	6·07	6·24	12·89	25·20	157,845	6,04,011
Tinnevelly	7·33	3·58	14·62	25·53	217,796	18,32,430
Total ...	...	...	...	...	4,387,116	2,00,85,208

8. *General Sketch of the Irrigation System of the Presidency.*—The uncertainty and great variation in the amount of the annual rainfall, brought by the monsoons, render cultivation precarious and fruitless without the artificial storage and distribution of water, and to meet this ever-recurring difficulty, irrigation works have, from time immemorial, been an absolute necessity of existence in Southern India. The works themselves vary alike in magnitude, in character, and in origin. There are works that yearly irrigate 1,000 square miles; others that do not irrigate 5 acres. Some derive their water from great perennial rivers; others from streams and local drainages, or from the rainfall of half a square mile ponded up in a valley. Some works date from periods, of which there is no historical record; others are the latest outcome of scientific engineering.

Artificial irrigation may be said to be carried out in three ways—first, by utilising the water of rivers; second, by utilising the rain water draining off the land; third, by utilising the subterranean springs and water. These three general methods are in the Madras Presidency sub-divided into the following classes of irrigation works. (1) *River-fed Canal Systems.*—Works drawing their supply from rivers, of which the discharge is at all times of the year, except perhaps for a short period during the hot weather, sufficient without storage to keep up a constant supply of water in the canals for the purposes of irrigation or navigation. Of this type are the great delta systems of the Godávery, Kistna, and Cauvery rivers; the irrigation channels from the Bavani, Amravati, Upper

Cauvery, and other lesser rivers, irrigating long and narrow riparian tracts. In all works of this class the main channels take off directly from a masonry dam, or "anicut" built across the river; and, in the case of the Godávery and Kistna works, the main lines of canal are adapted for navigation as well as irrigation, and form the principal means of communication in the districts which they traverse. (2) *River-fed Systems of Tanks.*—Works drawing their supply from rivers having an uncertain and very variable discharge, which is stored and rendered constantly available for the purposes of irrigation by means of a chain of tanks or reservoirs. Of this type are the systems known as the Penner, Palar, Pelandorai, and Srivaikuntham anicut systems, together with numerous other works of the same character. In all these works main channels leading from an anicut supply a great series of tanks and channels. (3) *Rain-fed Tanks in Groups.*—A succession of reservoirs connected with each other and formed by impounding the drainage from the catchment basin above them, by means of long embankments thrown across valleys, or by short embankments thrown across gorges. Vast numbers of such works exist, and in many districts form very large groups. (4) *Isolated Tanks.*—Reservoirs obtaining a supply from a small river or stream, or from the drainage of the catchment area above them. These works, though not forming nearly so numerous a class as those of the preceding, are in some cases of considerable importance. (5) *Well Irrigation.*—This system of irrigation, though not coming in any way within the special province of the irrigation branch of the Public Works department, forms an indispensable part of the general system of irrigation of Southern India. In addition to the above five classes of irrigation works, there are in the Madras Presidency two works solely intended for internal navigation. These are the salt-water canals of the Eastern and Western Coasts. The first known as the Buckingham Canal connects the Godávery and Kistna systems of navigation with the district of South Arcot by means of a navigable canal 261 miles in length. The second, which is practically a system of connected backwaters, is under the management of the Native States and Local Fund Boards, through whose districts it passes.

9. *Detailed Description of the more Important Irrigation Works.*—In paragraph 4, giving the classification of irrigation works, all classes of irrigation works were mentioned, while the names of the works for which capital and revenue accounts were detailed. It will now be necessary to return to this classification, in order to describe the irrigation works of the Presidency in order of their importance. The following description of the works will therefore give (I) a detailed account of the works classed as Productive, (II) a briefer account of the works for which capital and revenue accounts are kept, but which are not classed as Productive; and a general description of (III) the works for which a continuous record of expenditure is kept individually; (IV) works for which a continuous record of expenditure is kept collectively; and (V) Public Works classed as "Protective."

10. *The Godávery Delta System.*—This work like those of the Kistna and Cauvery Deltas is one of a type special to the Madras Presidency. In all these delta systems, the river flows along a central ridge formed by the deposit of its own alluvium, while, on each side of this ridge the ground—formed by successive inundations of the river itself—slopes a way from either bank with a gradual fall, and enables an anicut, built at the apex of the natural delta thus formed, to have a working command of water over the whole area comprised within the limits of the delta.

I. Productive Public Works.

The river Godávery, the largest and most important of the rivers traversing the Madras Presidency, rises in the Western Ghauts, and, at the site of the Godávery Anicut, is 898 miles in length; has a drainage basin of 115,570 square miles; and a maximum flood discharge of 1·21 millions cubic feet per second. The anicut was commenced in 1844-45, and commands an alluvial tract of country of 2,020 square miles in area. It is a massive work of masonry, and is built across the sandy bed of the river at a spot 33 miles from the coast, where the river is nearly 4 miles broad, and is divided by three islands into four channels. Of these, the two eastern channels re-unite just below the anicut, and similarly the two western channels. The land included between these two principal branches forms what is known as the central delta, while that on the eastern branch is called the eastern

delta, and that on the western branch the western delta. The irrigation in each of these three natural divisions is distinct, and is supplied by a head sluice and main canal from the anicut. This great work consists of a masonry dam built in separate portions between the islands, the total length of the masonry work being 3,982 yards. The general section of the dam consists of, first, a front curtain wall running along the whole length, resting on wells; second, a horizontal flooring or waste-board 19 feet in breadth; third, a masonry counter-arched fall 28 feet in breadth; fourth, a rough-stone apron in rear formed of massive stones, and extending about 184 feet down stream, so as to protect the rear foundations against the erosive action of the water passing over the dam. The crest of the anicut is 38 feet above mean sea level; 13 feet above level of top of foundations; and the greatest depth of water which has passed over it is 15·25 feet. The delta is fully supplied when 3 feet of water is passing over the anicut crest. On both flanks of the dam, and at the head of the central delta, is a lock for the passage of craft; an under sluice for purposes of scour and clearance; and a head sluice from which takes off the main canal of each delta, and supplies a network of branch and distributary channels, of which the principal ones are adapted for navigation as well as irrigation. The dimensions of the head sluices are as follows:—

Eastern, 13 vents 6′ × 8′
Central, 15 vents 6′ × 8½′
Western, 15 vents 7½′ and varying in width from 5½′ to 6′.

the sills of each sluice being 6 feet below the level of the anicut crest. The capacity of the three main canals is—

	Discharge in cubic feet per second.
Eastern	2,826
Central	1,745
Western	3,945
	8,516

The system is not yet finished, but is expected to be completed by the year 1889—1890, and the completion estimates, amounting to a total of Rupees 1,30,32,653 for direct and indirect charges, have been sanctioned by the Secretary of State as follows:—Direct charges, Rupees 1,10,88,695, indirect charges, Rupees 19,43,958. The length of navigable canals is 458 miles, which will be increased to 502½ miles on completion of the works. The extent of irrigation in 1882-83 was 528,129 acres, which will be extended to 612,000 acres on completion of the works. The net annual income of the system for the year 1882-83 was Rupees 12,11,028, and the surplus revenue, after payment of interest charges, was Rupees 8,45,830. A reference to the statement of paragraph 3, exhibiting the financial result of Productive Public Works up to the end of 1882-83, will show that the works have paid 142·06 per cent. on the total capital outlay, i.e., the system has paid in surplus revenue nearly one-and-a-half times the money expended upon it. On completion of the works in 1889-90, it is estimated that the system will yield a net annual return of 12·7 per cent. on the total capital outlay of Rupees 1,30,32,653. These highly satisfactory financial results do not represent by any means the total profits which have accrued to the State from this most successful work. Directly traceable to the work are the enormous increase in the import and export trade, the rise in land revenue, in population, and in the general prosperity of the district; while as an insurance against famine, the work is invaluable. One instance of this last fact may be cited. During the famine of 1876-77, when every unirrigated district was importing enormous quantities of grain to feed its population, the quantity of grain exported from the Godávery District was valued at £1,740,000.

11. *Kistna Delta System.*—The river Kistna, the second in point of size of the rivers of the Presidency, rises in the Western Ghauts, close to the source of the Godávery. The anicut is built at the natural head of the delta, where the river flows between rocky hills, and is only 1,300 yards wide, or much narrower than its normal width. At the head of the delta, the river is 800 miles long; has a drainage area of 97,050 square miles; and a maximum flood discharge of 736,000 cubic feet per second. The anicut which was commenced in the year 1852 is situated 45 miles from the sea in a direct line, 60 miles by river, and commands a

delta, which is separated into two natural divisions, respectively called the eastern and western divisions, by the river itself, of 2,110 square miles in area. Like the Godávery dam the Kistna Anicut is constructed on a sandy river bed. It consists mainly of a body wall of stone in mortar founded upon a double row of wells. The body wall is 1,238 yards in width from wing to wing; 6 feet wide at top; and has its crest or sill-board 20 feet above the deep bed of the stream, and 15½ feet above the summer level of the river; and is backed on the down stream side by a massive rough stone apron, containing about 400,000 cubic yards of stone, and sloping away down stream for a distance of 257 feet. In this apron, at a distance of 100 feet from the body wall, is a retaining wall having its crest 6 feet lower than that of the body wall. The crest of the anicut is 43 feet above mean sea level; the greatest flood which has passed over it is 20·65 feet; and the depth of water upon it which is considered to furnish a full supply to the delta is 2½ feet. In order therefore to keep the water level considerably above the anicut, towards the end of the cultivating season when the river is low, a rough dry stone wall about 4 feet high is erected on the anicut crest in October or November of each year, and as the river falls in the dry season this stone is utilised in the annual repairs required by the apron of the Anicut, so that the crest is left clear again before the floods of the south-west monsoon in June. On each flank of the anicut are under-sluices, consisting of 15 vents of 6 feet span, with their floor 8½ feet below the crest of the anicut; while, above the anicut, on either bank, are the locks for the passage of craft and the head sluices of the deltaic channels. The eastern head sluice has 15 vents of 6′ × 9′ span, with its floor 5½ feet below the anicut crest; and the western head sluice 15 vents of 6′ × 8′ span, with its floor 6 feet below the crest of the anicut. Both of the head locks are 16 feet wide, and 160 feet long from gate to gate. The system is not expected to be completed till the end of the year 1901-02. The total estimate for direct charges, amounting to Rupees 1,38,99,784, has been sanctioned by the Secretary of State. The estimate for indirect charges, amounting to Rupees 10,01,160, is now awaiting sanction. The navigable canals of the system are connected on the one side with those of the Godávery delta, and on the other side with the Buckingham Canal. In 1882-83 their total length was 278 miles, which will be ultimately increased to 349 miles. The total area effectually irrigated, and net revenue derived, in the year 1882-83, was 261,158 acres and Rupees 5,85,262 respectively as against 287,027 acres and Rupees 7,13,129 in the year preceding, the decrease being due to the very heavy floods of 1882, which caused much damage and entailed large remissions in the delta. On completion of the works the area of irrigation will be increased to 475,000 acres. The surplus revenue of the year, after paying all charges including interest, was Rupees 3,51,945, or 5·57 per cent. on the total capital outlay of Rupees 63,30,628. A large portion of the further expenditure to be incurred on the system consists of works, such as drainage, &c., for the purpose of securing existing irrigation from risk. Expenditure of this description, while adding largely to the capital outlay brings no proportionate increase in revenue, and it is accordingly estimated that the net returns of the system, which have during 1882-83 been 9·92 per cent. will, on completion of the works in 1901-02 be reduced to 8·38 per cent. on the total capital outlay of Rupees 1,49,00,944. As in the case of the Godávery system, this work, while paying a large direct profit to the State, is a safe insurance against famine, and has immensely increased the general prosperity of the district, which is now one of the richest and most thriving in the Presidency, but previous to the construction of the Kistna anicut was one of the poorest, and suffered most severely in the famine of 1833-34.

12. *The Kurnool Canal.*—This work takes off from an anicut, 17 miles above the town of Kurnool, on the river Tungabhadra, which, rising in the hilly country of West Mysore, skirts the dry district of Bellary, and joins the Kistna river in that of Kurnool. In describing (paragraph 3) the financial policy of Government in respect to large works of irrigation, allusion was made to this canal, which was purchased by Government in 1882 from the Madras Irrigation and Canal Company, and from that date has been designated the "Kurnool Canal." The work owes its inception to the policy of introducing into India British capital and enterprise in the construction of irrigation works. So much was anticipated from this policy that, when in

1858 overtures were made to Government to carry out a project, initiated by Sir Arthur Cotton, and then known as the "Tungabhadra Project," by the agency of a private company, the proposal was readily met by Government. The company, known as the Madras Irrigation and Canal Company, was therefore incorporated in 1858, and in 1863 the regular contract deed between the Secretary of State and the company was drawn up, by which a Government guarantee of 5 per cent. was given on a capital of one million sterling for the execution of the work proposed. In 1866 the company was already in financial difficulties, and had spent £937,242 out of a capital raised of £964,521, while the works were still in a very unfinished stage. A second indenture was therefore signed in that year, modifying the original contract in so far as to allow of the company obtaining from Government a sum of £600,000 by means of debentures. By 1872 the original capital of one million sterling, together with the Secretary of State's loan of £600,000, had been wholly exhausted, while the canal still remained unfinished. Mortgage debentures were then issued, but the credit of the company was not sufficiently good to make funds readily forthcoming; and, as the improvement of the financial state of the work was impossible as long as it remained under the company, Government decided to forestall the date of the termination of the contract, and to take the work under their direct control. Terms were accordingly offered to the stock and mortgage debenture holders, which were at once accepted by the former but not by the latter. The matter was therefore referred to the Court of Chancery, and finally in 1882 the Court gave a judgment, authorizing the transfer of the canal to the Secretary of State. The works of the company were accordingly purchased, and were officially transferred in July of that year; and the canal was formed into an ordinary public works division; was placed under an Executive Engineer; and was called the "Kurnool Canal Division."

The anicut supplying the canal is built across the river Tungabhadra at Sunkasala. It is 1,500 yards in length; is founded on rock; has a clear overfall; and is furnished with a set of under-sluices. The highest flood that has yet passed over it is 6·80 feet. The water passes through a head sluice into the canal, which, in the upper portion of its course, has a general cross section of 90′ bottom width, side slopes 2 to 1, depth 8 feet, and capacity of 3,000 cubic feet per second. At the 75th mile the canal passes through the watershed between the Tungabhadra and Penner rivers, crosses the Penner at the 182nd mile, and terminates at the town of Cuddapah (on the Madras Railway) 190 miles from Sunkasala. An anicut at the crossing of the Penner affords the supply necessary for the continuation of the canal to Cuddapah. This anicut is 2,333 feet in length, of which 509 feet are founded on rock, and 1,724 feet on wells sunk in the sand. In addition to this work there are on the canal two other anicuts, two important aqueducts; surplus and cross drainage works; 48 over-bridges; and 42 locks, of which 7 are double and 35 single. The canal was completed in 1871, but navigation was not started until 1880, owing to the embarrassed state of the company's affairs. A telegraph line runs along the canal, and at the end of 1883-84 was in progress of reconstruction by the Telegraph department. When completed, the line will be inspected and maintained by the Telegraph department; and will be worked by the Public Works staff of the canal as a licensed system, so that it will be available for carrying messages for the general public, in addition to those on the service of the canal.

. The works have suffered from numerous accidents, the latest serious ones being the breaching of the Sunkasala Anicut in the year 1882, a few days after the transfer of the canal to Government; and the damages done to the canal by the breaching of a tank in the following year. The extension of irrigation under the canal has been of the most disappointing nature. For the five years, from 1871 to 1876, the irrigated area and revenue averaged 14,700 acres and Rupees 50,650, the charges against revenue being Rs. 1,80,000. The impetus given to irrigation in the years 1876-77 and 1877-78 by the failure of the monsoon rains raised the area shown as irrigated materially, as the following figures will show:—

	ACRES.	RS.
1876-77	90,285	2,47,351
1877-78	50,918	1,49,130

This increase was due to watering dry crops, and soon declined, as the average for the years 1878-79 to 1881-82 was only 20,018 acres and Rupees 73,363. In 1882-83 the area irrigated was 14,903 acres, the revenue from irrigation Rupees 59,255, and the traffic receipts from navigation, Rupees 10,683. The decrease in the irrigated area during 1882-83 was owing to the breach in the anicut, which occurred in July 1882. The financial result for the year was a loss of Rupees 63,708, in addition to the charge for interest on capital. It is as yet early to predict what the future of the work may be now that it has been taken under the management of Government, but the enormous capital outlay sunk upon it, in proportion to the capacity of the canal, absolutely precludes it from ever being a paying concern. It is proposed to complete the distributaries required for the extension of irrigation by the end of 1885-86, and it is anticipated that, at the end of 1886-87, the revenue will be sufficient to meet the cost of maintenance.

. The causes of the financial failure of the work are numerous, and prominent among them are—

First.—Excessive cost of works and faulty execution and design.
Second.—Nature of soil commanded, and circumstances of people.
Third.—Faulty administration on part of the company; unsatisfactory relations between company and the revenue officers; and antagonism between company and the ryots.
Fourth.—Delay in starting navigation.

. The first and second causes of failure are permanent; the third and fourth no longer exist. The enormous cost of the works in relation to the capacity of the canal has already been noticed, and both the anicut and the canal have suffered repeated accidents. The canal flows through a country where irrigation is but little practised, and the people are unused to it; where also the food grains grow perfectly well in ordinary years without being irrigated. The only chance of success for the work was therefore to offer water on the most tempting terms, and to furnish by means of navigation cheap means of transport and access to a profitable mart. Neither condition was complied with. The system of applications for water introduced was absolutely of a nature to deter the ryot from making any application at all, while navigation was delayed for nine years.

13. *The Penner Anicut.*—The river Penner rises in Mysore, has a drainage area of 20,000 square miles, and a total length of 330 miles. Its principal supply is derived from the north-east monsoon, during which it is subject to very heavy floods of short duration, but the upper portion of its basin obtains a fair, though uncertain, supply from the south-west monsoon. The bed of the river has a considerable fall, which in the lower portions of its course is as much as 3 feet per mile. Owing to the character of the river, advantage has heen taken from very ancient times, by means of flood cuts, to utilise the supply brought down by freshes, in filling a very large series of tanks on the southern bank of the river in the neighbourhood of the town of Nellore, and thus the irrigation of this area is carried over the periods when the river itself is dry. The water-supply, however, obtained by this means was very variable, and, in order to improve it and render the irrigation certain, the anicut was commenced in 1853, at a site close to the town of Nellore, and 19 miles from the sea. This work was completed in 1855, but during the extraordinary heavy floods of 1874 was turned at its northern or left flank. The anicut was thereupon repaired and was extended from its original length of 1,581 feet, which is about one-third of the normal width of the river, to a length of 2,039 feet. As existing, the anicut consists of a body wall of this length, founded on a double row of wells; and is backed by a series of rough stone aprons, divided by retaining walls, and having a total fall of 9 feet and total width of 178 feet. The crest of the anicut is 9 feet above the river bed, and 37·47 feet above mean sea-level, while the highest flood which has passed over it is 19·30 feet. It has two sets of under-sluices, and a head sluice and auxiliary head sluice at its southern flank—there being no irrigation under the anicut on the northern bank of the river. The head sluice has 9 vents of 6 feet span and the auxiliary head sluice 6 vents of 10′ × 3½′, while the level of the sills of both head sluices are 8 feet below the anicut crest. From the main canal leading from the

head sluices, two old native channels, which have been extended and improved since the construction of the anicut, convey the river-supply to a great series of tanks, and form the main feeders of the system. From one of these channels, a third principal channel, running midway between the other two, branches off, and is the only entirely new channel of any considerable size constructed by the British Government. The channels of the system generally flow along the watershed, and there is consequently but little cross drainage. The irrigation on the southern bank of the river extends over an area of 150 square miles. The irrigation of the northern bank will be effected by the Sangam anicut, which at the end of 1883-84 was being built across the river, 20 miles above the Penner anicut. In 1882-83 the area irrigated under the Penner anicut was 63,653 acres, and the irrigation revenue derived therefrom Rupees 2,34,957, but of this sum the portion due to the old irrigation, which existed prior to the construction of the anicut, was Rupees 1,20,350. The net revenue due to the work was Rupees 79,989 or 4·8 per cent. on the total capital outlay of Rupees 16,65,159. The complete estimate for this system has not yet been sanctioned. It has however been prepared, is computed to amount to Rupees 18,94,784, including all direct and indirect charges, and will shortly be forwarded to the Government of India.

14. *The Cauvery Delta.*—The river Cauvery rises in the province of Coorg, flows through the Mysore plateau, and through the Madras districts of Coimbatore, Salem, and Trichinopoly, where, together with its tributaries, it feeds a whole succession of irrigating channels, and bifurcates at the head of its delta, 9 miles west of the town of Trichinopoly, the southern branch retaining the name of the parent stream, while the northern branch is known as the Coleroon. About 17 miles below the point of their bifurcation, the two branches very nearly re-unite, forming between them the island of Srirangam. Below this point the Coleroon takes a north-easterly course, skirts the district of Tanjore on its northern border, and reaches the sea with its volume comparatively little diminished. Though there is considerable irrigation from this branch, it has nothing to do with the irrigation of what is classed as the Cauvery Delta proper, to which (as will afterwards be noticed) it affords a great natural drainage channel for the escape of surplus water. The Cauvery branch, on the other hand, runs through the delta, splits up into numerous branches, and covers the delta with a vast net-work of channels, which have from very ancient times been utilized for the purposes of irrigation. Of the numerous offshoots some are lost in the wide expanse of rice-fields, others find their way to the sea, while the branch which retains the name of Cauvery throughout diminishes to an insignificant stream before entering the sea. The Cauvery river, together with its tributaries, is fed by the rains of both monsoons, and has an abundant and constant flow for nine months in the year. At the head of the delta it is 4,400 feet wide, has a drainage area of 27,705 square miles, and a maximum flood discharge of 284,000 cubic feet per second. The total average annual discharge is about 490,000 millions of cubic feet, equivalent to 17·68 inches of discharge from the whole drainage basin. The irrigation of the Tanjore Delta dates to a very remote period, and in order clearly to understand the system as it now exists, and the requirements which have still to be attended to, it will be necessary to show briefly the development of the system up to the present time. Under the old native régime, channels, sometimes supplied by head sluices, were first cut from the main river, and, by means of an infinite number of smaller channels of distribution, afforded a supply of water for the purposes of irrigation. Not only was the main river thus utilized, but the numerous deltaic branches from it (in all of which the water surface was, in the normal state of the river, generally higher than the level of the surrounding country) were also similarly laid under contribution, and, hand in hand, with this process of utilising the waters in moderate floods, necessarily grew up a vast system of embankments, whereby the waters during extreme floods were prevented from spreading over the country and damaging the crops. Thus in progress of time, there grew up over the whole area of the delta an extremely artificial condition of things, the cardinal points of which were (1) the supply of abundance of water, by means of taking up the natural drainage lines for irrigation; and (2) the protection, by means of a system of embankments, of the irrigated area thus formed from the effects of floods. The principal masonry

work undertaken during the native period is that known as the Grand Anicut, built in the eleventh century, and situated just below the island of Srirangam, where (as has already been mentioned) the Cauvery and Coleroon come into close contact with each other. At this point the bed of the Coleroon is nine or ten feet lower than that of the Cauvery, and the Grand Anicut was therefore built across a natural outlet of the Cauvery to prevent its water being wholly drained off into the Coleroon. About the year 1800 the Tanjore District was ceded to the British, and in 1804 it was found that the Coleroon branch, from its more rapid fall and more direct course to the sea, was draining off, at its head, the main portion of the water-supply of the river above the point of its bifurcation; while the Cauvery branch was silting up at its head. It thus became very evident that, if effective measures were not taken to rectify, by artificial means, the natural differences between the two branches, the inevitable issue must be the annihilation of the Cauvery branch as an irrigating stream, and, as a consequence, the total collapse of the delta irrigation. From 1804—1829 an incessant struggle was maintained against the increasing tendency of the Cauvery branch to silt up at its head, and efforts were made to force a larger supply of water into the branch. These efforts were ineffectual. The bed of the Cauvery branch continued to rise, the supply to diminish, and the area under cultivation to fall off. In 1830, under-sluices were built in the Grand Anicut, together with other similar works and waste weirs at eligible sites in the left bank of the Cauvery, in order to endeavour to clear from its bed the accumulations of sand. These works were beneficial, but did not check in any way the evil resulting from the unequal distribution of the volume between the two main streams. In 1836, under the advice of Sir Arthur Cotton, the Upper Coleroon Anicut was built across the head of the Coleroon branch, and was completely successful in its object of throwing into the Cauvery branch a fair distribution of the water-supply, by the simple expedient of placing the crest of the anicut at such a height as to ensure, in the average state of the river, a proper distribution of the entire volume of the main stream between the two branches during the irrigating season. Simultaneously with the Upper Coleroon Anicut, and supplementary to it, was constructed the Lower Coleroon Anicut, 70 miles lower down the river, in order to provide for the irrigation of the irrigated lands of the South Arcot District, and for those of the north-east portion of the Tanjore District, whose supply would of course be much reduced by the construction of the Upper Anicut. As the irrigation under the Lower Coleroon Anicut, and the expenditure incurred thereon, are not included in that of the Cauvery Delta system, and the work is separately classed as one for which a continuous record of expenditure is kept (*vide* paragraph 22), no further mention will here be made to it. The next important work undertaken was in 1845, when a regulating dam was built across the head of the Cauvery branch to counteract the effects of the Upper Coleroon Anicut, which, it was found, was throwing into the Cauvery branch a body of water far larger than was safe or was required. Finally, in 1848, the construction of a regulating dam to the first principal offshoot from the Cauvery branch was begun; and subsequently regulating dams were provided for the other principal branches, thus completing the general system of regulation and control of the water required for the delta irrigation.

The development of the delta system having thus been traced, it only remains to describe briefly the principal works. The total area of the delta is 1,402,880 acres (2,192 square miles), of which 900,000 acres are irrigated. The irrigation in the delta is fully supplied when the river stands 5·7 feet on the Cauvery regulating dam, which represents a discharge of 12,330 cubic feet per second. The Upper Coleroon Anicut is built across the head of the Coleroon, the body wall is 2,789 feet in length, and is founded on a double row of wells. The anicut is provided with under-sluices, and a bridge, six feet between parapet walls, is built across it. The Cauvery regulating dam is practically a continuation of the anicut, is built across the Cauvery branch at its head, and is 1950 feet in length from wing to wing. The highest flood ever known in the river rose to 13·20 above the floor of this dam. Below these works, lower down the delta, are numerous surplus works and the regulating works of the principal branch channels from the Cauvery. The sketch already given of the development of the delta irrigation will have made it plain that a peculiarity of the system is that the natural drainage channels

have been taken up for the purpose of irrigation, and that the numerous deltaic channels of the Cauvery take the place of the artificial canals in the Godávari and Kistna Deltas, and merely require sluices built across their heads to be made available as irrigating channels. The total length of the Cauvery branch from the head of the delta to the sea is 95 miles. At its head, the branch is 2,000 feet wide, and continues that width for 14½ miles, where the Vennar river, its first principal branch, takes off. The Vennar has a regulating dam at its head, and is itself divided into five main branches. Returning to the main river, 2¾ miles below the Vennar, is the Grand Anicut. This very ancient work is 1,080 feet long, and consists of rough blocks of granite built in a serpentine form, having over it a bridge of 32 arches of 32 feet span following the wavy line of the anicut. The crest of the work is 7 feet above the bed of the Cauvery branch. The Grand Anicut is provided with 10 sluices, 3 feet broad, with their sills 10 feet below the crest of the work, which pass the surplus water of the Cauvery into the Coleroon. Besides the Grand Anicut, there are other surplus works passing into the Coleroon branch all the water which cannot be disposed of by the Cauvery branch and its irrigating channels. Further down the Cauvery branch, 9½ miles below the Grand Anicut and 26¾ miles from the head of the delta, the Kodamurti river—the second principal branch of the Cauvery—takes off; while 20 miles lower down is the Arasillar, or third principal branch; and 14 miles lower down, the Verasholen, or last principal branch. All these three main branches have also regulating dams at their head, and supply a vast number of branch and distributary channels. This concludes the description of the delta irrigation under the Cauvery branch. As before stated, there is no irrigation from the Coleroon within the delta proper, but that branch plays a most important part in the delta system, by providing a great natural drainage channel for the surplus waters of the Cauvery branch. Before quitting the subject of the delta irrigation, it will be necessary to notice two important requirements which yet remain to be attended to. First among these is the complete system of head works necessary in order to have the supply of the Vennar, and other branches from the Cauvery, under complete control, and thus to prevent the repeated damages which, for many years, the delta has been liable to during heavy floods in the river. The floods generally occur in the north-east monsoon, and, together with the very heavy local rainfall which often occurs at that time of the year in the Tanjore District, fills the Cauvery branch and its offshoots to overflowing, and consequently bursts the delta embankments. The subject is now being systematically taken up. The construction of head sluices to the Cauvery and Vennar rivers, at a site immediately below the Grand Anicut, is now in progress; and various other works—including alterations to the Grand Anicut, which will enable that work to discharge 85,000 cubic feet of water per second—will shortly be undertaken. The second requirement is a complete survey of the delta. No proper survey of the delta has yet been made, and comparatively little is therefore known of the vast system of minor channels within its limits. Regulators are required at the heads of many of the smaller irrigation channels, but the construction of these works is necessarily delayed until the completion of the survey, which will show accurately how the irrigation is distributed over the several channels. The survey is now in progress.

The total amount of the estimates sanctioned for this system, up to the end of 1883-84, is Rupees 18,54,847.

The area effectually irrigated, and the revenue derived therefrom, for 1882-83 was—

	ACRES.	RS.
First crop	895,719	26,55,600
Second crop	1,08,298	2,53,780
		29,09,380

Of the gross irrigation revenue of Rupees 29,09,380, the portion due to the old irrigation, which existed prior to the improvements and additions made by the British Government, was Rupees 23,43,214. The surplus revenue due to the new works after meeting all charges was, in 1882-83, Rupees 5,80,975, or 50·51 per cent. on the total capital outlay of Rupees 11,50,238; while, as will be seen from the statement in paragraph 3, the total surplus revenue, up to end of 1882-83, was Rupees 1,28,68,167, being 1118·8 per cent. on the capital outlay, or more

than eleven times the total outlay on capital account. It will thus be abundantly clear that the work as a financial investment has been extraordinarily successful.

15. *The Srivaikuntham Anicut.*—The Srivaikuntham Anicut is the last of eight anicuts on the river Tambrapurni, in the Tinnevelly District, and is situated 16 miles from the sea. The river rises in the Western Ghauts, and, though comparatively a small stream, derives its importance from the fact that it receives a supply from both monsoons. At the site of the Srivaikuntham Anicut the drainage are of the river is 1,739 square miles, and the maximum flood discharge 118,673 cubic feet per second. The average annual discharge of the river is 60,304 millions cubic feet, equivalent to 14·9 inches of discharge from the whole catchment basin but in the year 1877, when the freshes of the north-east monsoon were extraordinarily heavy, the total annual discharge of the river reached the high figure of 121,295 millions cubic feet, equivalent to 30 inches from the whole catchment basin. The seven anicuts in the Tambrapurni above the Srivaikuntham Anicut are of old native construction, and it was principally owing to the great success of these works that the Srivaikuntham Anicut was projected. This work was begun in 1867. The system is of a simple character, and may be briefly described. From either flank of the anicut, which is 1,380 feet in length between the wings, two main channels, 21 miles in length and supplied with head sluices, are taken off, and supply a large series of tanks which existed before the Srivaikuntham Anicut was built, and before its construction were very inadequately supplied. Besides filling these tanks, the main channels irrigate directly a considerable area of land. The height of the anicut crest above mean sea level is 37·40 feet, while the sills of the head sluices of the main channels are 6 feet below the crest of the anicut. The highest flood which has yet passed over the anicut rose to 11¾ feet over its crest. The works from their very commencement have had numerous accidents, and to this cause must mainly be attributable the slow extension of irrigation under them, and their want of financial success up to the present date. The damages to the works have been due to the breaching of the river embankments, during the very sudden and heavy floods to which the Tambrapurni is liable; and to the breaching of tanks, caused by heavy upland floods. They have now been provided against by completing the river embankments, throwing back the north flood-bank of the river below the anicut, and by affording adequate means of surplus for the cross drainage from the tanks lying above those of the Srivaikuntham Anicut system. The system will not be finally completed till the year 1885-86. The completion estimates amounting to Rupees 14,76,806, of which Rupees 13,61,520 represents the direct and Rupees 1,15,286 the indirect charges, have been sanctioned by the Secretary of State. During the year 1882-83 the area effectively irrigated and the revenue derived therefrom was—

	ACRES.	RS.
First crop	19,546	4,13,450
Second crop	17,647	58,291
		1,71,741

while the ultimate area of irrigation—which it is estimated will be reached in 1886-87, the year after the completion of the works—is acres 25,000, all of which will be double cropped. The net revenue from the system in 1882-83 was Rupees 73,018, while the actual return from the work, after paying all charges including interest charges, was Rupees 23,768, or 1·81 per cent. on the total capital outlay of Rupees 13,12,135. After completion of the works in the year 1886-87, it is anticipated that the net yearly revenue will be increased to Rupees 1,10,902, or 7½ per cent. on the total capital outlay of Rupees 14,76,806.

16. *The Works in progress at the Sangam Anicut and Barur Tank.*—As has already been stated (paragraph 13), the Sangam Anicut will extend irrigation to the northern bank of the Pennér. From the anicut, a main channel, leading from a head sluice on the north bank of the river, will supply two large existing reservoirs, known as the Kanigiri and Duvur Tanks, from the former of which the irrigation channels will be taken off, and thus advantage will be taken of the intermittent character of the river supply. The area to be commanded by the anicut will be 220 square miles. This tract of country already contains many tanks, and is

partially irrigated by cuts from the river. The construction of the anicut will render certain the existing irrigation, and will largely increase it as follows:—

	ACRES.
Present irrigation	44,053
Estimated increase	49,947
Total ...	94,000

The site of the anicut is about 38 miles from the sea, and 20 miles above the Pennér Anicut at Nellore. When finished, it will be 4,290 feet in length, or nearly three times the length of the Pennér Anicut; and will have its crest 7 feet above the deep bed of the river, or 105 feet above mean sea level. The head sluice (which is now finished) has 21 vents of 6 feet span, and is designed to carry 4,800 cubic feet of water per second (when the water in the river is flush with the anicut crest), which will be distributed in the following proportions to the reservoirs which it supplies:—

	Cubic feet per second.
Kanigiri Tank	4,576·5
Duvur Tank	223·5

The present capacity of the Kanigiri Tank is to be greatly enlarged, and the total capacity of the two reservoirs will ultimately be—

	Millions cubic feet.
Kanigiri Tank	6,419
Duvur Tank	1,043
Total ...	7,462

When finished, the Kanigiri Tank will be the largest reservoir in the Presidency. It is estimated that the works will be completed about the year 1889-90. At the end of 1883-84 very considerable progress had been made in their construction, as the whole of the wells required for the anicut had been sunk, the south wing of the anicut and the head sluice had been finished, and a large amount of work on the anicut and other works had reached an advanced stage of progress. The estimate for the work amounts to Rupees 35,69,049, of which Rupees 28,96,437 is for Direct charges and Rupees 6,72,612 for Indirect charges, and was sanctioned by the Secretary of State in February 1881. At the end of 1883-84 the total outlay against Direct charges was Rupees 13,48,624. It is anticipated that on completion of the works, about 1889-90, the annual revenue will amount to Rupees 2,38,000. The estimate of annual working expenses is Rupees 50,255, and the net revenue will therefore be Rupees 1,87,745 or 5·26 per cent. on the total Capital outlay of Rupees 35,69,049.

. *Barur Tank.*—This work is situated in the Salem District, and was commenced as a Famine Relief-work in August 1877, at a time when the district was suffering severely from the effects of famine. The normal value of the work then done was estimated at Rupees 67,185, in addition to which a sum of Rupees 13,172 was paid for land compensation, making a total expenditure of Rupees 80,357 on the work. In 1883 the project was sanctioned as a Productive Public Work by the Secretary of State, and was put in hand towards the close of the year. The scheme is one for the improvement of several existing tanks (of which the Barur Tank is by far the largest) by building an anicut across the Ponnair River. This river rises in the Mysore plateau, and drains an area of 2,082 square miles, in which are situated numerous tanks. The extent of free catchment basin may be put down at 1,080 square miles. The supply afforded by the river is ample, and from the anicut, a supply channel, 7½ miles in length, provided with a head sluice leads to the Barur Tank. The project also provides for the enlargement of this tank, and for two distributary channels from it, which will supply a number of smaller tanks. The work will bring under irrigation an area of 5,430 acres, in addition to 1,457 acres already supplied by the tanks. The total storage capacity of the tanks, when completed, will be 16½ millions cubic yards, of which the Barur Tank will alone store 11½ millions cubic yards. The total estimate for the project is Rupees 3,33,793, of which Rupees 3,20,000 is for Direct charges, and Rupees

13,793 for Indirect charges. In addition to the expenditure of Rupees 80,357 incurred on the work prior to its sanction as a Productive Public Work, a further expenditure of Rupees 7,298 was incurred in the year 1883-84. The work done to the end of 1883-84 consisted mainly of earthwork to the supply channel, construction of waste weir on the Barur Tank, collection of materials, and preparation of foundations for the head works. The project will be finally completed in the year 1886-87, and the net revenue which the work is estimated to yield is Rupees 21,448, or 6·4 per cent. on the total Capital outlay of Rupees 3,33,793.

Works for which Capital and Revenue Accounts are kept, but which are not classed as "Productive."

17. *The Chembrambaukum Tank.*—The Chembrambaukum Tank is a large reservoir about 14 miles from Madras, and is formed by an embankment 7,100 yards in length, connecting high ground on one side with a rocky spur on the other. It is provided with 8 irrigation sluices, and with 3 masonry weirs aggregating 1,192 feet in length, while its capacity is 2,799 millions cubic feet, and the area of its water spread 8·95 square miles. The tank is an old native work, and the improvements undertaken by the British Government consist mainly of the extension of its capacity, and the increase of its water supply. The chief sources of its supply are from anicuts across the Cortelliar and Cooum Rivers. The catchment basin of the tank is about 400 square miles, in which area are 320 tanks, but the supply from this gathering ground is in some years exceedingly scanty. The sanctioned estimate for the work is Rupees 7,36,958, of which Rupees 6,55,310 represent the Direct and Rupees 81,648 the Indirect charges. In 1882-83 the area effectively irrigated and revenue derived was—

	ACRES.	Revenue. RS.	Average Rate per Acre.
First crop	12,763	39,338	3·08
Second crop	3,216	8,294	2·77
Total ...		47,632	

The surplus revenue of the year, after paying all charges including interest was Rupees 8,319, or 1·12 per cent. on the total Capital outlay of Rupees 7,36,589.

18. *The Palar Anicut.*—The Palar Anicut was originally designed to give an improved supply to old native channels feeding a very large series of existing tanks. The work was commenced in 1855 and was finished in 1857. The river, which is very uncertain in its supply, rises in the Mysore plateau, and at the site of the anicut, has a drainage area of 3,974 square miles, and maximum flood discharge of 25,000 cubic feet per second. The anicut is situated in the North Arcot District and commands 201 tanks, of which 127 are on the northern bank of the river and 74 on the southern bank. It was breached in 1874 but was subsequently restored. As existing, the anicut is 2,634 feet in length between the wings, and has under-sluices at either flank. On the north bank of the river three head-sluices supply the principal channels, one of which feeds the Kaveripak Tank, one of the largest reservoirs in the Presidency; and, on the south bank, is one head-sluice supplying numerous channels and tanks. The system is still incomplete, and the work remaining to be done consists principally of improvements to the channels and head-sluices, and the construction of new head-sluices and other masonry works. The area effectively irrigated, and the revenue derived, in the year 1882-83 was—

	ACRES.	RS.	Average Rate per Acre.
First crop	66,571	1,72,074	2·60
Second crop	20,584	45,290	2·20
Total ...		2,17,364	

The surplus revenue of the year, after paying all charges including interest was Rupees 4,581 or 0·27 per cent. on the Capital outlay of Rupees 16,80,965. The completion estimates for the system, amounting to Rupees 19,93,893, of which Rupees 18,94,915 represents the Direct charges, and Rupees 98,978 the Indirect

charges, were submitted to the Government of India in June 1884. They anticipate that, on completion of the works about the year 1886-87, the ultimate area of irrigation will be Acres 68,000 for first crop, and Acres 34,000 for second crop, yielding a net revenue of Rupees 93,720, or 4·7 per cent. on the total Capital outlay, and that the present deficit of Rupees 7,89,416 will not be cleared off until the year 1928.

19. *The Pelandorai Anicut.*—The Pelandorai Anicut is built across the Vellaur River, and affords a river supply to twelve tanks (which existed prior to the construction of the anicut) on the southern bank of the river in the South Arcot District. The anicut was commenced in 1870, but was not completed till 1876. In 1877 it was breached and was accordingly repaired by 1879. In the year 1880 it was again breached, and the head-sluice was carried away by an extraordinary flood which swept two feet over the wings. It was again restored and was in working order by 1882. To these two very serious accidents, occurring within the short period of four years after the construction of the anicut, must be attributed the very slow extension of irrigation, and the very unfavourable financial position of the work. The accidents were due to an under-estimate of the maximum flood discharge of the river, which, as ascertained after the great flood of 1880, reaches the high figure of 85,000 cubic feet per second at the site of the anicut, from a catchment basin of 1,600 square miles. The completion estimates of the system, amounting to Rupees 4,48,246, of which Rupees 4,05,000 is for Direct and Rupees 42,246 for Indirect charges, were sanctioned at the beginning of the official year 1884-85. Against this sanction, the total outlay to the end of 1883-84 was Rupees 3,90,213, and the only works now remaining to be done are the increase to the storage capacity of four tanks from a total capacity of 62·3 millions cubic feet to 174·0 millions cubic feet. The ultimate area of irrigation is 15,728 acres, but in 1882, Acres 3,560 only were irrigated under the system (which is the largest area yet irrigated) and yielded a gross revenue of Rupees 8,596. The net receipts of the year were Rupees 5,270, while the total charges, including interest, debited to the "Revenue" account, were Rupees 56,191 leaving a loss of Rupees 56,191 as the financial result of the year. As irrigation under the works is not at present popular with the ryots, it is anticipated that the full ultimate area of irrigation (Acres 15,728) will not be reached till 1899-1900, when a return of 8·1 per cent. on the total Capital outlay will be received. On this assumption of the growth of cultivation under the work, the interest charges will exceed the net revenue till 1891-92 and the balance of interest charges will not be paid off till 1914-15.

20. *The Madras Water-supply and Irrigation Extension Project.*—This project, which is a combined work affording a water-supply to the city of Madras, and irrigating an area of about 7,500 acres, was virtually completed about the year 1870-71. The work may be briefly described. From an anicut across the river Kortalayur, a stream with a drainage area of 837 square miles, a head sluice, and supply channel eight miles in length, lead the water to a reserve reservoir, known as the Cholaveram Tank. From thence the water is conveyed to the main reservoir, known as the Red Hills Tank, which has four irrigating sluices for the supply of the irrigation under it, and one sluice for the water-supply of the Town of Madras. The two tanks were old native works, but were enlarged from a total capacity of 644 millions cubic feet to a total capacity of 3,523 millions cubic feet, of which the Red Hills Tank alone occupies 2,753 millions cubic feet. The works have suffered some serious accidents since their construction, and have not been a financial success. According to the arrangements concluded with the Municipality of the Town of Madras, that body pay Rupee 1 for every 1,000 cubic yards of water supplied. The average annual consumption of water by the Municipality may be taken as 143 millions cubic feet. A reserve supply is, in bad seasons, maintained in the Red Hills Tank for the water-supply of the Town of Madras, by arranging that, when the water in the tank falls 6 above the bed of the Municipal supply channel, or 38·31 above M.S.L., all irrigation under the tank is stopped. The total

sanctioned estimate for the work is Rupees 18,54,463, of which Rupees 15,62,239 represent the Direct, and Rupees 2,85,224 the Indirect, charges. The total estimated amount of the Capital outlay has recently been divided as follows:—

	RS.
Imperial ordinary	7,78,874
Provincial	10,75,589

which approximately represents the value of the water used for purposes of irrigation and town supply respectively. In 1882-83 the area of first and second crop effectively irrigated was Acres 10,420, and the revenue derived therefrom Rupees 24,135. The receipts by the sale of water to the Town of Madras were Rupees 32,314, and the total financial result of the year was a loss of Rupees 23,579.

21. *The Buckingham Canal.*—This is a salt water canal—tidal to a great extent wherever the river bars are open—extending for 261 miles along the east coast of the Presidency, from Pedda Ganjam in the Kistna District to Merkanum in the South Arcot District. At Pedda Ganjam, it communicates with the fresh water, high level, canals of the Kistna Delta system, and thence with the Godávari system, and opens up traffic with the seaport of Cocanada, making a total length of mainline of navigable canal of 462 miles. The canal runs within three miles of the sea-coast throughout its entire length, and in many portions is within half mile of the sea. The excavation of the canal was begun as long ago as 1801, but, previous to the famine of 1876—1878, the expenditure incurred on it was only Rupees 5,49,078. During the famine, an expenditure of Rupees 29,24,924 was incurred on the work, of which Rupees 21,93,584 represented the normal value of work done and was accordingly debited to the Canal, thus bringing up the total expenditure for works up to Rupees 27,42,662. The completion estimates of the system have lately been sanctioned, and amount to Rupees 92,94,954, of which Rupees 86,12,000 represent the Direct charges, and Rupees 6,79,954 the Indirect charges. Against this sanction, the total direct expenditure on Capital account was only Rupees 50,12,722 to the end of 1883-84, so that it will be apparent that much yet remains to be done. With a view to expedite the completion of the canal, grants-in-aid from "Protective" Funds are given by the Government of India. The principal work required to complete the canal is (1) the isolation of the canal into "reaches" between rivers, by means of flood-gates, so as to allow the cross drainage free vent to the sea; (2) the deepening and widening of the canal to its full section of 20 feet bottom width, side slopes 4 to 1, depth 3 feet below level of lowest recorded tide in each "reach"; and (3) provision of locks, bridges, and boat basins, together with an extensive wharf at the city of Madras. The principal commodities carried by the canal are salt, firewood, and food-grains. In paragraph 30 will be found the particulars of traffic for the official year 1882-83, during which year traffic was much impeded from various causes. Until the completion estimates have been more fully worked out, and the canal has been protected from the damages to which it is now liable from river-floods, it cannot be considered a safe line of communication. It is expected that the works will be completed by the year 1893-94. The prospects of the canal are favourable. In times of famine it will be invaluable, enabling the produce of the Godávari and Kistna Deltas to be distributed through the districts of Nellore, Chingleput, and South Arcot. Its value as a cheap means of transport is already recognised, and has attracted much attention from the mercantile community, and should the Singareni Coal fields in Hyderabad be opened up, a short line of railway to the canal will enable cheap coal to be procured in Madras, to compete with the patent fuel and English Coal now consumed by the Railway Companies.

22. III. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT INDIVIDUALLY.—*The works for which individually a continuous record of expenditure is kept.* These works number 59 in all, and are distributed over nine districts. The following list exhibits the names of all the works so classed and the districts in which they are situated, together with the particulars of irrigation for each work or system for the year 1882-83:—

Statement showing the area irrigated and revenue derived from works for which a continuous record of expenditure is maintained individually for 1882-83.

District.	Names of works.	Total area irrigated 1st crop.	Total revenue from irrigation.
			RS.
Vizagapatam.	Six anicuts on the Sarada river...	11,764	27,784
	Four anicuts on the Varaha do. ...	5,533	14,636
	Total ...	17,297	42,420
Kurnool ...	Cumbum tank	4,952	39,568
Chingleput	Kortalayar river—Vallur tank ...	4,856	6,591
	Madurantakum tank	5,372	14,099
	Total ...	10,228	20,690
North Arcot.	Cheyar anicut	17,455	62,029
	Poiney do.	19,988	66,531
	Total ...	3,71,443	1,28,560
Salem ...	Barur tank (since classed as productive public works) ...	286	1,166
	Pennugoondapuram tank ...	205	744
	Total ...	491	1,910
Tanjore ...	Lower Coleroon anicut	22,860	66,689
South Arcot.	Coleroon Lower anicut—		
	Rajahavoikal	21,455	64,313
	Vadavar	11,462	39,234
	Khansaib canal	11,608	30,680
	Veeranam tank	38,214	1,09,416
	Vellar river—Shatatope anicut ...	25,360	67,876
South Arcot (*contd*).	Manimuttanaddy —		RS.
	Vridachalam anicut	5,074	16,839
	Mehmatur do.	3,018	11,381
	Myorenuddy-Katumyloor anicut.	249	1,080
	Gadilam river—Tiruvadi do....	5,575	22,958
	Do. Vanamadavy do....	690	2,729
	Do. Tiruvandipuram ... anicut.	1,643	8,797
	Kullur river—Vikravandy do....	1,244	2,839
	Ponniar—Tirukoilur do....	16,339	53,219
	Total ...	141,929	4,31,361
Coimbatore	Bhavani river—		
	Kodnelly anicut. { Todpalli channel ...	13,672	97,557
	{ Arkankottai do. ...	3,945	25,969
	Kalingaroyen anicut	10,912	97,374
	Amaravati river (twenty-two channels)	25,645	1,39,379
Tinnevelly.	Tambrapurni river—		
	Ariyanayakapuram anicut ...	5,124	64,413
	Bhalavur do. ...	8,405	93,800
	Suttamully do.	6,163	62,194
	Marudur do. ...	17,100	1,84,041
	Kodamilalaghyan do. ...	2,855	15,642
	Nathiyuni do. ...	2,486	19,608
	Kamiadiyen do. ...	11,177	1,57,810
	Total ...	53,310	5,97,508
	Grand Total ...	3,42,684	16,88,985

The most important of these works are the Lower Coleroon anicut, the Poiney and Cheyar anicuts, and the irrigation under the Bhavani, Amravati, and Tambrapurni rivers.

. *The Lower Coleroon Anicut.*—The reasons that rendered the construction of this work necessary have already been given in paragraph 14. From the north flank of the anicut two large channels take off for the supply of the irrigation in the South Arcot district. One of these channels feeds the great Veeranam tank—the largest existing reservoir in the Presidency, having an embankment 12 miles in length and a capacity of 5,400 millions of cubic feet. From the south flank of the anicut another large channel feeds a number of branch channels in the Tanjore district.

The Poiney and Cheyar anicuts are built across rivers of that name, and feed a series of tanks. The irrigation under the Bhavani and Amravati rivers (which both rise in a rainy tract of country and have a constant supply of water) is entirely direct. Channels taking off from masonry dams, convey water to the fields, and irrigate long strips of land on either bank of the river, lying in the river valley, and running nearly parallel to the river's course. The irrigation under the Tambrapurni is effected by means of tanks supplied by channels, into which the river water is diverted by seven masonry anicuts of very ancient date. The irrigation under this system is exceedingly valuable and is much sought after.

23. IV. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT COLLECTIVELY.—*Works for which no individual record of expenditure is maintained, but which are accounted for collectively.*—Works of this class comprise all works other than those of the first three classes of paragraph 9 (of which detailed mention has already been made in the foregoing paragraphs 10—22 inclusive) and works classed as "Protective." They consist almost entirely of tanks, which are scattered, in great numbers, throughout the districts of the East coast and the central tableland (*vide* paragraph 7). These tanks are formed in numerous ways, according to the nature of the ground they occupy. The majority are constructed by damming up the natural drainage lines flowing through valleys, by means of embankments sufficiently long to close the gorge of the valley. The reservoir thus formed is provided with masonry sluices

for the supply of the irrigation under it, and with masonry surplus weirs, which act as a safety valve to the tank during floods. The old surplus weirs constructed by the natives are generally provided on their crest with a row of masonry pillars, 3 or 4 feet high, placed about 3 feet apart, and are locally termed "calingulas." Towards the close of the rainy season, when the chief floods of the monsoon are over, these "calingulas" are closed by damming up the spaces between the pillars with turf, straw, and earth, so as to enable the tank to retain an extra supply of water in order to carry on irrigation during the dry season. The majority of tanks in the Presidency run in groups, and descending steppes of land are occupied by a succession of reservoirs, the higher feeding the lower from its surplus supply, and the whole group forming one connected scheme of irrigation. According to the latest returns, the total number of Government tanks in the Presidency is 31,648, and it can therefore be readily imagined that the labour involved in keeping up the embankments of these tanks to a proper margin of safety, so as to guard against their breaching during the heavy rains of the monsoons, and the inspection, repair, and restoration of the very numerous masonry works attached to them, are such as to tax very severely the resources of the Irrigation Branch. For administrative purposes (as will hereafter be noticed in paragraph 26) a distinction has recently been made between (1) tanks irrigating an area of 200 acres and upwards, and (2) tanks irrigating an area below 200 acres. The following statement shows the numbers of works of each class, together with their irrigated area and revenue during 1882-83, in each district of the Presidency :—

Districts.	Tanks irrigating above 200 acres.			Tanks irrigating below 200 acres.			Grand Total.		
	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total irrigation revenue.
			RS.			RS.			RS.
Ganjam	215	82,476	1,30,345	2,654	112,280	1,35,759	2,869	1,95,026	2,66,104
Vizagapatam	24	11,614	21,691	420	18,763	52,526	444	30,377	74,217
Godávari	110	32,326	44,801	1,205	31,146	31,681	1,315	63,472	76,482
Kistna	190	22,274	57,636	248	16,231	44,183	438	38,505	1,01,819
Nellore	209	118,200	4,10,874	563	33,188	1,02,562	772	1,51,388	5,13,436
Cuddapah	156	53,916	2,41,341	2,950	133,893	4,31,761	3,106	1,87,809	6,73,102
Kurnool	46	14,980	57,311	671	23,875	78,832	717	38,855	1,36,143
Bellary	131	28,963	1,60,586	898	24,347	70,225	1,029	53,310	2,30,811
Anantapur	101	39,106	1,39,838	1,495	50,340	1,59,162	1,596	89,446	2,99,000
Chingleput	545	188,433	4,89,298	2,090	126,933	2,75,318	2,635	3,15,366	7,64,616
North Arcot	171	59,034	2,10,814	3,906	141,611	5,01,770	4,077	2,00,645	7,12,584
South Arcot	246	72,068	2,31,325	2,849	141,045	4,22,462	3,095	2,13,113	6,53,787
Salem	78	21,435	1,02,840	3,194	75,246	2,50,833	3,272	96,681	3,53,673
Coimbatore	69	33,097	1,58,568	242	10,810	41,501	311	43,907	2,00,069
Tanjore	52	17,283	32,524	607	28,973	54,033	659	46,256	86,557
Trichinopoly	148	67,572	2,25,720	1,134	64,049	1,68,630	1,282	1,31,621	3,94,350
Madura	207	89,298	2,45,801	1,911	68,547	1,29,415	2,118	1,57,845	3,75,216
Tinnevelly	174	76,059	4,34,471	1,739	68,881	3,70,804	1,913	1,44,940	8,05,275
Total ...	2,872	1,028,134	33,95,784	28,776	1,170,158	33,21,457	31,648	2,198,292	67,17,241

In addition to the works included in this statement, there are large numbers of private tanks and zemindari tanks, with which the Irrigation Branch have no concern.

24. V. PROTECTIVE PUBLIC WORKS—*Protective Public Works.*—The only work yet classed under this head is that known as the Rushkuliya Project. The work was sanctioned by the Secretary of State in 1883, and the preliminary operations for commencing work were undertaken towards the close of the official year 1883-84. The project consists in utilising the waters of the rivers Mahanadi and Rushkuliya, in the Ganjam district, by means of canals to be used both for irrigation and navigation. These rivers unite at the town of Aska, and flow into the sea at Ganjam, and, as they do not rise in the Western Ghauts, are liable to be affected by the failure of the south-west monsoon rains. In order to supplement their supply, two large reservoirs will be formed above them, the reservoir for the Mahanadi having a capacity of 2,457 millions cubic feet, and that for the Rushkuliya 2,160 millions cubic feet. From an anicut on the right bank of the Mahanadi, a channel, $19\frac{3}{4}$ miles long, and provided with a head sluice, will lead to the

Rushkuliya river. This channel will irrigate 12,000 acres, will be made navigable throughout, and will be provided with a double tail lock. Where it ends in the Rushkuliya river, an anicut will be built, and from the right bank of the Rushkuliya, a second canal, $63\frac{1}{4}$ miles long, and navigable for the first $44\frac{1}{4}$ miles of its length, will irrigate a further extent of 108,000 acres. The works will be completed about the year 1894-95, and the full area of 120,000 acres is expected to be cultivated about the year 1897-98. The total sanctioned estimate is Rupees 28,60,239, of which Rupees 26,01,386 are for direct charges and Rupees 2,58,853 for indirect charges, and the net revenue anticipated, on completion of the works, is Rupees 1,44,312, or 5·1 per cent. on the total capital outlay.

25. *Important works projected.*—Many projects of more or less magnitude have been, at various times, proposed and partially investigated. Only one of these schemes will here be mentioned, viz., the Periyar Project, which has been fully worked out, and has been sent to the Government of India for sanction. The Periyar Project is one for the extension of irrigation in the Madura district, which, from its physical configuration, receives a very scanty and uncertain supply of rain from the south-west monsoon, and has but one river of any size running through it. This result is due to the fact that the range of hills on the northern border of the district, separating it from Travancore, rise up very abruptly from the plains of Madura, while on the Travancore side they stretch away towards the sea with a long and gentle fall. The district has, at various periods of its history, suffered severely from scarcity, while from time immemorial, its scanty rainfall has been stored in a multitude of tanks, with which it is literally dotted from end to end. Its one river, the Vaigai (which has a very uncertain flow), supplies a large number of tanks, by which it is drained nearly dry on its progress *eastwards* to the sea. To remedy this state of things, the Periyar Project was planned. The scheme provides for the diversion of the waters of the Periyar—a river rising in Travancore territory, in a region of heavy annual rainfall, and flowing towards the *West* Coast—into the valley of the Vaigai river by (1) a dam closing the valley of the Periyar, and thereby storing 13,300 million cubic feet of water; (2) a tunnel through the water-shed ridge between the two valleys, for the purpose of drawing off the water from the reservoir thus formed; and (3) the necessary regulating works for passing the water thus diverted into the tanks now inadequately supplied by the Vaigai river. The dam (which will be a work of great magnitude) will be 155 feet in height, constructed of concrete throughout. The complete estimate for the work amounts to Rupees 64,41,463. The work is expected to be of the most remunerative character, and has been recommended for sanction as a Productive Public Work. The full ultimate area to be brought under irrigation is estimated at acres 101,000 and the net annual revenue therefrom Rupees 5,74,600, or 8·92 per cent. on the total capital outlay.

ADMINISTRATION OF IRRIGATION AND NAVIGATION WORKS.

26. *Conservancy of Irrigation Works.*—In general, the entire maintenance of the irrigation works for which capital and revenue accounts are kept rests with the Irrigation Branch of the Public Works Department. In the Kaveri Delta, however, which (as has already been noticed) is a very ancient system of irrigation, the Irrigation Branch only deals with the maintenance and repair of all masonry works and embankments, and the annual silt clearances required, on channels that irrigate the lands of two villages or more, the villagers themselves undertaking all the necessary repairs on the smaller channels. On all irrigation works other than those for which capital and revenue accounts are kept, the upkeep of the works also devolves, in most cases, upon the Irrigation Branch; but, in some of the more ancient river channels, the works are maintained entirely by the villagers concerned; and, on other channels, the villagers supply customary labour, or "kudimaramat," by which agency, in former times, the State maintained the great majority of its irrigation works. The old ordinance of "kudimaramat," or unpaid labour of the ryots, has long ago died out on the numerous tanks throughout the Presidency, and is only now in force on channels, where the ryot sees it is entirely to his own interest to execute himself any little repairs that may be necessary,

in the interests of irrigation, from time to time. The reason is not difficult to seek. On channels, clearances of silt are all the repairs that are usually required, and are absolutely necessary, at short intervals, to enable the ryot to get any water at all. Hence he readily contributes his free labour on works of this class. The case of tanks is very different. Their irrigation will go on until the final moment when the tank bursts, and, there being therefore no immediate and pressing need for the ryot to exert himself, the small repairs—which done at the right time would prove of incalculable benefit, and which no one but he is on the spot to do—are, year after year, left undone, until they become so considerable that, the tank either breaches, or, they attract the notice of the Government officers, and are repaired in the usual course by the Irrigation Branch. Owing to the disuse of this custom of "kudimaramat," and to the fact that the vast numbers of the tanks scattered throughout the country absolutely preclude the possibility of their proper upkeep, or even of their inspection, by the officers of the Irrigation Branch, much attention has been lately attracted to the important question of their restoration in the present, and their permanent and efficient upkeep in the future. Before mentioning the arrangements that are at present in force regarding these works, it may be as well to notice, once for all, a common and somewhat widespread misapprehension that exists regarding them. It is *not* the case that the tanks have rapidly deteriorated of late years. The deterioration of the works has been gradual and inevitable, because a tank *must*, from its very nature, gradually silt up and therefore deteriorate as years go by, and the time has now come when a large number of the tanks of this Presidency—works, without exception, of old construction—have reached a stage which renders their deterioration apparent to all observers owing to the great curtailment of their irrigating capacity.

As already stated in paragraph 23, the number of Government tanks in this Presidency is 31,648. These works are scattered over a vast extent of country, and, as experience has demonstrated that it is absolutely impossible for the Irrigation branch to attend properly to the upkeep of so great a number of works, three main principles of concerted action have been decided on, in view to the present upkeep and restoration of the works and their future maintenance:—

First.—A special Public Works Department establishment to be employed in grouping the works, and estimating for their requirements, the actual work required being afterwards done by the ordinary Public Works establishment.

Second.—The Irrigation branch to be relieved of the duty of maintaining all tanks considered not to need any professional supervision. These tanks to be denominated "Minor"—in contradistinction to those retained by the Irrigation branch, and designated as "Imperial,"—and to be maintained by the Revenue Department.

Third.—That, until the result of the investigations of the special establishment are known, it will be impossible to decide definitely what works should be respectively classed as "Imperial" and "Minor:" but that, for the present, all works irrigating 200 acres or upwards to be classed as "Imperial," and works irrigating under 200 acres as "Minor," and this classification into "Imperial" and "Minor" to be finally revised on completion of investigations for each river basin.

This is the state at which matters now stand with regard to the upkeep and restoration of the tanks of the Presidency. For some two years past works classed as "Imperial" have been maintained by the Irrigation branch, works classed as "Minor" by the Revenue Department, while the special establishment is now at work.

27. *Regulation and Distribution of Water on Irrigation Works.*—No uniform system exists for the regulation and distribution of water required for irrigation. In the Godávari and Kistna Deltas the control and distribution of the water from the time it enters the canal to its exit from the village sluice is in the hands of the Public Works Department, who are in possession, from day to day, of information as to the state of the supply at all the principal regulating works. Once discharged

from the village sluice the field distribution rests with the ryots themselves. On the Pénner Anicut system, the regulation of the water-supply among the several channels is in the hands of the Public Works Department, while the distribution from the tanks rests with the ryots. On the Kurnool Canal the regulation and distribution of the water-supply is entirely in the hands of the Public Works Department. In the Kaveri Delta system the sluices built across the heads of the various offtakes from the river are managed by the Public Works Department, while the regulation of the distributary channels rests generally with the peasant proprietors of the soil, locally termed the "Mirassidars." Where the channels irrigate many villages, there is a well recognised custom, defined generally in a written document, settling the days and hours during which each village is to take water, and similar rules lay down each man's turn within the village. An establishment, paid and appointed by the "Mirassidars," manages the distribution of water to the fields. On all the large systems, such as the Palar Anicut, &c., where a series of tanks is fed from an anicut, the regulation of the water at the head works is in the hands of the Public Works Department, while the distribution from the tanks rests entirely with the ryots. On the channel systems of irrigation various rules apply; on some, the regulation of the supply from the river is managed by the Public Works Department, while the distribution of water from the channel itself is controlled by the Revenue Officers; on others, the entire control is in the hands of the ryots, and no Revenue Officer or Public Works Officer interferes with them. On the Tambrapurni Channels above the Srivaikuntham Anicut, the Public Works Department controls the supply entering the upper channels and passing the weirs, but have no authority to check waste of water on the channels, or to see that it is fairly distributed, and each ryot therefore practically takes as much water as he likes. On the Srivaikuntham Anicut system itself, the regulation and distribution is in the hands of the Public Works Department. Finally, to complete this sketch of the regulation and distribution of water throughout the Presidency, it only remains to add that the disposal of water stored in tanks rests entirely with the ryots interested, who regulate the sluices, distribute the supply, and manage for themselves every detail.

28. *Revenue due to Irrigation.*—Reference was made in paragraph 5 to the system which prevails in this Presidency with regard to the assessment of irrigated land. Except in the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment is consolidated, and the shares due respectively to "Land" and "Water" can only be approximately determined. Until 1880 no information existed on this head, but, as it was absolutely required in order to determine the financial position of works of irrigation, an approximation has since been made of the "revenue due to irrigation" as distinguished from the total revenue derived from irrigated land, for (1) all Productive Public Works, and (2) Irrigation and Navigation Works, for which Capital and Revenue accounts are kept, not classed as "Productive" from the commencement of the works up to date; similar information for (3) the works for which individually a continuous record of expenditure is kept is still under preparation. For the year 1882-83 the information for this class of works has already been prepared, as well as for (4) all other Irrigation and Navigation works for which Capital and Revenue accounts are not kept, but it is not considered necessary that the accounts should be prepared for previous years in the case of this last class of works. For the determination of the share due to irrigation resulting from the disintegration of consolidated assessments, elaborate rules have been framed. Briefly in the case of single wet crop the rules are (*a*) where assessments have been revised by the Settlement Department, the consolidated assessments are resolved into Land and Irrigation revenue respectively, by assigning to "Land" the amount proper to dry lands of the same class and sort in each village, and the remainder to "Water;" (*b*) where settlements have not been revised the average dry rate of the village, or where that is not available of the tálooks, or where that cannot be determined of the district, is applied to the total area irrigated. The product is then assigned to "Land" and the remainder to "Water." With regard to double-crop lands, the charge for the two crops is consolidated—the charge for second-crop being essentially in the nature of a water-rate. Everywhere but in Tinnevelly, the normal charge for double-crop land is one and half

times the charge for single-crop land of the same class and sort, and it therefore follows that one-third of the consolidated double-crop assessment represents the normal second-crop charge for the Presidency generally. In Tinnevelly, the normal charge for double-crop land is one and two-thirds that for single-crop, and the normal second-crop charge in Tinnevelly is therefore two-fifths of the consolidated double-crop assessment. The additional charge for second-crop assigned to "Water" is therefore two-fifths of the entire assessment in the Tinnevelly District, and one-third in all other districts, while the remainder is assigned to "Land," in the same manner as for single-crop land.

29. *Water-rates.*—In the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment on irrigated lands are not consolidated, but a separate water-rate is levied on the area irrigated. The following are the water-rates now in force:—

—	Godávari and Kistna Deltas.	Kurnool Canal.
	Rs.	Rs.
Single wet crop per acre	4	4
Second wet crop per acre	4	3
If compounded for both crops for not less than five years	6½	6
Single dry crop	2	1
Second dry crop on irrigated lands if not compounded	2	1
Garden crop	8	6
Garden crop if compounded for not than less five years	6½	...
Crops requiring frequent floodings	...	3

On the Kurnool Canal, with a view to stimulate the ryots to extend their wet cultivation by converting their lands from dry into wet, certain concessions are allowed on the above rates as follows:—A reduction at 50 per cent. for the first five years, and at 25 per cent. for the second five years, is made, in the case of lands which have not been cultivated within the last ten years. For blocks of 50 acres and upwards of unoccupied lands taken up for irrigated cultivation, water is supplied, without restriction as to crops, free of charge for five years, and at half rates for another five years.

30. *Management of Traffic and Tolls and License Fees on Navigable lands.*—The navigable canals in this Presidency under the charge of the Public Works Department are:—

—	Present Lengths.	Ultimate Lengths.
	Miles.	Miles.
Godávari Canals	458	502½
Kistna Canals	278	349
Buckingham Canal	261	261
Kurnool Canal	190	190
Total	1,187	1,302½

The circumstances of the Godávari and Kistna Canals are most favourable for navigation, as there are few locks, owing to the gently sloping nature of the country permitting the main lines to be carried on without such accessories to navigation. On these canals, as well as on the Buckingham Canal, private boats carry all the traffic. The late Madras Irrigation and Canal Company, when they had charge of the Kurnool Canal, assumed the function of carriers; but, after the transfer of the canal to Government, the boats were let out to private individuals, who now conduct the traffic on the canal, which was also, from July 1883, brought under the same navigation rules as the three other canals. Prior to this date, there were no rules authorized by Government on the Kurnool Canal, the rules for navigation formerly in force under the Company being in vogue.

Boats are licensed to ply on these canals on payment of an annual fee, and those not holding licenses are required to pay tolls for each trip. Prior to July 1883, separate licenses were issued for the Godávari and Kistna Canals, and for each section of the Buckingham Canal, but, with a view to remove obstacles and stimulate traffic, the system of using separate licenses was abolished in 1883, although it

involved a reduction of revenue, and the following rates of license fees and tolls are now in force :—

License Fees.

Cargo boats	Rs.	2½ a ton of 50 cubic feet.
Passenger boats not bound to carry all castes, and charges for freight not limited	„	5 do.
Passenger boats bound to carry all castes, and to charge for freight not more than 2 pies per mile per passenger in the general cabin, and 3 pies per mile per passenger in the fore or aft cabin, including one cooly load of baggage	„	3 do.
Steamers	„	5 do.
Pleasure boats	„	1 per boat.

Tolls.

Cargo or passenger boat	„	½ per ton of 50 cubic feet.
Steamer	„	1 do.
Pleasure boats	„	3 per boat.
Timber raft	„	½ per 100 square feet.
Bamboo raft	„	¼ do.

A license entitles the vessel to use any, or all, the canals without any other payment whatever. A toll once paid clears the vessel over all the canals, and in any direction, for a period of six weeks, and rafts for one month. Each passenger is allowed a space of 7½ square feet. The extreme dimensions of any vessel allowed to navigate the canals are 90 feet in length, 13 feet breadth over all, fixed fittings 6½ feet high over water level, and draught 2 feet. Rafts are not allowed to exceed 90′ × 12′ × 2.

Toll stations are established at the head locks of each section of the Godávari and Kistna Deltas, at all tidal locks, at the Ellore lock, and at four stations on the Buckingham Canal. A wharfage fee of 1 anna per ton on the registered tonnage on each boat loading or unloading, is charged at the authorized wharfs, but at present the only wharfage station is at Madras.

Executive Engineers, and officers authorized by them, are vested with the power of suspending the license of any vessel for overloading, wrong mooring, not carrying lights, not producing licenses, or for any other infringement of the rules prescribed for navigation as follows :—

15 days for the first offence,
30 days for the second offence
60 days for the third offence

in the same year. For a fourth offence the license may be cancelled. The following statement shows the statistics of traffic for the past two years on the four canals :—

Particulasr.	Godávari.		Kistna.		Buckingham Canal.		Kurnool Canal.	
	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.
Laden boats, number of trips.	19,000	20,520	7,627	7,566	24,982	*17,494	...	...
Empty boats, do. ...	15,025	17,096	4,472	4,220	2,817	7,87,166	...	...
Passenger boats, do ...	21,678	22,448	8,043	9,867	7,970	24,127	...	...
Tonnage	234,564	262,530	110,202	114,710	337,992	17,983	2,773	3,234
Ton-mileage	6,465,893	7,343,834	3,085,411	3,399,929	4,961,087	50,424	...	...
Value of goods, Rs.	1,42,00,998	1,26,17,048	91,04,133	92,03,167	1,00,35,339	98,23,228	3,27,500	7,08,867
Number of passengers ...	422,783	946,813	221,069	451,172	98,802	56,664	...	...
Tolls and License fees † Rs.	57,439	48,472	36,435	22,916	99,758	35,421	10,683	4,592

On the Kurnool Canal the traffic is worked by Government boats let out on hire.

31. STATISTICS. *Financial position of all Irrigation Works for which Capital and Revenue Accounts are kept.*—In paragraph 3, the financial position of each of the Productive Public Works in operation up to the end of 1882-83 was given. The following statement shows the financial position of each of the works for which capital and revenue accounts are kept, but which are no tclassed as Productive up to the end of 1882-83.

* The decrease in traffic on the Buckingham Canal in the year 1883-84 was due to the decrease in the salt traffic.
† The decrease in the receipts from tolls and license fees during the year 1883-84 was due to the reduction in the scale of fees from 1st July 1883.

Statement of Financial Results of Irrigation Works for which Capital and Revenue Accounts are kept, not classed as Productive up to end of 1882-83.

Systems.	Total Estimate including Indirect Charges.	Total Outlay to end of 1882-83.	Revenue due to work's to end of 1882-83.	Charges to end of 1882-83.			Total Deficit after payment of all Charges.	Percentage of Deficit on Capital Outlay.
				Working Expenses.	Interest.	Total.		
1	2	3	4	5	6	7	8	9
PUBLIC WORKS NOT CLASSED AS PRODUCTIVE.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
Imperial.								
Chembrambakam Tank	7,24,648	7,36,589	2,95,835	30,163	2,86,128	3,16,291	20,456	2·78
Pálár Anicut system	19,93,893	16,80,965	13,23,351	7,41,596	13,71,171	21,12,767	7,89,416	46·96
Pelandorai do.	4,48,246	3,87,028	23,767	2,19,635	99,205	3,18,840	2,95,073	76·24
Total Imperial ...	31,66,787	28,04,582	16,42,953	9,91,394	17,56,504	27,47,898	11,04,945	39·40
Provincial.								
Buckingham Canal	92,91,954	53,74,499	18,42,232	13,13,810	18,90,504	32,04,314	13,62,082	25·34
Madras Water-Supply and Irrigation Extension Project	18,25,615	17,09,997	1,21,628	1,27,480	8,40,719	9,68,199	8,46,571	49·50
Total Provincial ...	1,11,17,569	70,84,496	19,63,860	14,41,290	27,31,223	41,72,513	22,08,653	31·17
Grand Total ...	1,42,84,356	98,89,078	36,06,813	24,32,684	44,87,727	69,20,411	33,13,598	33·50

The following general statement shows the financial position of all imperial works for which capital and revenue accounts are kept, from the years 1879-80 to 1882-83.

—	Capital Expenditure (Direct and Indirect) to end of year.			Revenue (Direct and Indirect.)	Maintenance Charges (Direct and Indirect.)	Net Revenue.	Percentage of Net Revenue or Capital Outlay to end of year.
	Productive Public Works.	Public Works for which Capital and Revenue Accounts are kept.	Total.				
	RS.	RS.	RS.	RS.	RS.	RS.	RS.
1879-80	2,04,42,429	23,73,646	2,28,16,075	38,07,921	11,12,151	26,95,770	11·81
1880-81	2,07,57,153	28,38,935	2,35,96,088	41,05,459	13,99,482	27,05,977	11·47
1881-82	2,09,95,698	29,24,961	2,39,20,659	36,30,105	11,55,884	24,74,211	10·34
1882-83	3,91,03,451	28,04,582	4,19,08,033	35,02,255	9,11,729	25,90,526	6·18

The very large decrease in the percentage of net revenue on capital outlay in 1882-83 was entirely due to the purchase by Government in that year of the Kurnool Canal from the late Madras Irrigation and Canal Company, and to its classification as a Productive Public Work.

32. *Area irrigated and revenue derived from all classes of Irrigation Works during the year* 1882-83.—In paragraph 7, together with the table exhibiting figures of rainfall, were shown by districts the figures of irrigated area and gross revenue ("land" and "water") derived from all classes of irrigation works for the year 1882-83; in paragraphs 10—21 inclusive, were given the figures of irrigated area and irrigation revenue of each of the works for which capital and revenue accounts are kept for 1882-83; in paragraph 23, similar information was given for each of the works for which a continuous record of expenditure is kept individually, while, in paragraph 24, was given a statement by districts showing the irrigated area and irrigation revenue of all the remaining works. The following general statement shows the total irrigated area of first crop and total revenue derived from irrigation, for each class of works, during the year 1882-83, the latest year for which the information is available :—

—	Area.	Revenue.
	ACRES.	RS.
Works for which Capital and Revenue Accounts are kept—		
I. Productive Public Works	1,756,344	57,59,623
II. Works not classed as Productive	89,796	2,95,357
Works for which neither Capital nor Revenue Accounts are kept—		
III. Works for which a continuous record of expenditure is kept individually ...	342,684	16,88,985
Works for which a continuous record of IV. "Imperial" Works ...	1,028,134	33,95,784
expenditure is kept collectively. V. "Minor" Works	1,170,185	33,21,457
Total ...	4,387,116	1,44,61,206

33. *Percentage of Irrigation under works of each class and incidence of revenue per acre irrigated.*—The total area of Acres 4,387,116, as shown in the preceding paragraph, taken up for first crop irrigation during the year 1882-83 was 20·43 per cent. on the total cultivated area of the Presidency. Of the total area of first crop irrigation, Acres 871,533, or nearly 19·87 per cent., were irrigated for a second crop also. The total area occupied for irrigation was divided as follows among the works of the several classes :—

40·03 per cent. under Productive Public Works,
2·04 per cent. under Irrigation and Navigation Works for which capital and revenue accounts are kept, but not classed as Productive,
7·81 under works for which individually a continuous record of expenditure is kept,
23·45 per cent. under the "Imperial" Works retained under the charge of Public Works Department, and
26·67 per cent. under the "Minor" Works under the charge of Collectors.

The incidence of irrigation revenue per acre for each class of works is as follows :—

	Average Irrigation Revenue per Acre.
Works for which Capital and Revenue Accounts are kept—	
I. Productive Public Works	3·27
II. Public Works not classed as Productive	3·28
Works for which neither Capital nor Revenue Accounts are kept—	
III. Works for which a continuous record of expenditure is maintained individually	4·93
IV. "Imperial" Works	3·30
V. "Minor" Works	2·83

The incidence of irrigation revenue per acre on the works of Classes I and II, and on the more important works of Class III is shown in the following table :—

—	Area irrigated.	Average Irrigation Revenue per Acre.
Productive Public Works—		
Godávari Delta	504,213	3·09
Kistna do.	261,158	3·19
Penner Anicut	63,653	3·69
Kurnool Canal	14,903	3·32
Cauvery Delta	892,871	3·25
Srivaikuntham Anicut	19,546	8·79
Total ...	1,756,344	...
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	12,763	3·78
Palar Anicut	66,212	3·28
Palandorai Anicut	3,386	2·54
Madras Water-Supply and Irrigation Extension Project	7,435	2·84
Works for which individually a continuous record of expenditure is kept—		
Lower Coleroon Anicut	105,599	2·94
Tambrapurni river above Srivaikuntham Anicut	53,310	11·21
Bhavani River	28,529	7·04
Amaravati River	25,645	5·43

From the above it will be noticed that the irrigation under the Tambrapurni river above the Srivaikuntham anicut, under the Srivaikuntham anicut, and on the

Bhavani and Amaravati rivers, is proportionately more valuable than that on the other systems.

33. *Incidence of Expenditure on all works for which Capital and Revenue Accounts are kept.*—The following statement exhibits the capital expenditure per acre irrigated from the commencement of the works up to the end of 1882-83, and the maintenance charges debited to revenue during the year 1882-83, for all works for which capital and revenue accounts are kept :—

Statement showing the Average Cost of construction and maintenance of works for which Capital and Revenue Accounts are kept.

—	Average Expenditure per Acre.	
	Capital Account to end of 1882-83.	Revenue Account during 1882-83.
Productive Public Works—		
Godávari Delta	18·23	0·64
Kistna do.	22·50	1·06
Penner Anicut	22·45	0·72
Kurnool Canal	1189·36	8·95
Cauvery Delta	1·17	0·35
Srivaikuntham Anicut	63·34	1·48
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	48·92	0·32
Palar Anicut	24·94	0·63
Pelandorai Anicut	104·41	13·79
Madras Water-Supply and Irrigation Extension Project	198·11	2·20

From this statement it will be seen that the capital cost of the Kurnool Canal, in proportion to its irrigated area, far exceeds that of any other work, while the capital expenditure on the Pelandorai anicut and Madras water-supply works is disproportionately high as compared with the remaining works. With the exception of the expenditure incurred on repairs to the Pelandorai anicut during 1882-83, when the breached portions of the anicut was restored, the year 1882-83 approximately represents the normal cost of working expenses of these systems, and the statement therefore shows that the only work on which the cost of maintenance is abnormally high is the Kurnool Canal. Hitherto, also owing to the serious accidents, the works have received, the maintenance charges of the Pelandorai anicut have been abnormally high, and have averaged Rupees 9·74 per acre from the construction of the works in 1875-76 up to the end of 1882-83. In the year 1899, when the full area of irrigation will be in operation, it is estimated that the maintenance charges of this system will be reduced to about 12 annas per acre.

34. GENERAL. *Legislative enactments affecting the Irrigation Branch.*—At the present time, the Act known as "The River Conservancy Bill" is the only legislative enactment affecting irrigation, which has passed the Madras Legislative Council. As long ago as 1856, a draft enactment was instituted to provide for the safety of life and property, during river-floods, by means of a Bill enabling the officers of Government to attend properly to the conservancy of the great rivers of the Presidency, but it was only in March 1884 that the Bill, after being under consideration for several years, was finally amended and passed by the Madras Legislative Council, and only now awaits the sanction of the Supreme Government to become law. The principal object of the Bill is to give the officers of Government full power to prevent and prohibit the damage, which is at present inflicted on both private and public property, by the unauthorized action of private individuals, in forming and removing constructions within river-beds. Formerly, no officer of Government could in any way check the action of individuals in such matters, without rendering himself liable to a suit for damages, and much public money was accordingly spent on works designed to counteract the evil effect of private or unauthorized interference with the river-beds. The Act provides for the appointment of officers to be styled "Conservators of Rivers," who have power

to prohibit cultivation within river-beds; to direct the removal of all constructions, plantations, &c., which they deem to be an obstruction to the course of the river; and to take any measures which appear to them to be necessary for the safety of life or property, in connection with any river to which the Act has been applied.

35. *Further Legislation proposed.*—An important Bill now under consideration is that known as the "Madras Irrigation Act," which was originally drafted in 1883, was circulated to the Governments of Bengal, Bombay, and the North-West Provinces, for opinion on certain points, and has lately been referred to a Committee. The object of the Bill is to make provision for the construction, maintenance, and regulation of canals, for the supply of water therefrom, and for the levy of rates for the water so supplied. It will empower canal officers to duly inspect and regulate the water-supply; to remove obstructions; to execute repairs where the owner of a "water-course" fails to execute the repairs required of him by the Bill, and to charge the cost of such repairs to the owner; to settle disputes as to rights and liabilities of persons interested in a "water-course;" and to take into custody persons causing wilful damage to canals, or interfering, without proper authority, with the supply or flow of water.

ORDER—dated 26th January 1885, No. 210, Public.

Recorded.

(True Extract.)

R. S. BENSON,
Ag. Under Secy. to Govt.

To the Public Works department, Irrigation branch.

Exd. J. Wright.

Govt. of {1885} Madras.

PUBLIC.

Issued

Recd. *Encl.*

G.O., 26th January 1885, No. 210.

JANUARY.

Manual of the Administration.

Recording a paper on Irrigation.

GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following paper by A. S. RUSSELL, Esq., Under Secretary, Public Works department, on special duty, with note from the Secretary to Government, Public Works department, No. 566 E., dated 27th August 1884 :—

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2. History and constitution of the branch.
3. Financial policy of Government in respect to irrigation works, and its results in the Madras Presidency.
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5. Classification of revenue on irrigation works.
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Description of the Madras Irrigation Works.

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PUBLIC WORKS—IRRIGATION BRANCH.

Introduction.

1. *Definition of the Branch.*—The irrigation branch of the Public Works department deals with all works of irrigation and internal navigation, and with connected agricultural works, such as river conservancy, river embankments, drainages, &c.

2. *History and Constitution of the Branch.*—The branch was first constituted in the year 1867, when it was made a subordinate branch of the Public Works department by the appointment of a Chief Engineer for Irrigation, and early in 1877 it was made a distinct and independent branch in direct communication with Government. The Chief Engineer for Irrigation—who is also Joint Secretary to Government in the irrigation branch, and in that capacity lays before Government all matters requiring its decision—is the responsible executive head of the branch in all professional matters connected with the special subjects pertaining to the irrigation branch; and, together with the Examiner of Public Works Accounts, who is the head of the accounts branch, exercises control over the officers of the department employed on works of irrigation and navigation, in respect to the expenditure and disbursement of public money, the custody of stores, and the due submission of accounts. The Chief Engineer for Irrigation also prepares the budget estimate and all reports relating to his branch, and it is his special duty to check and examine all designs for irrigation projects, and to lay them before Government, accompanied by a distinct expression of his opinion regarding their merits. He is assisted in his office work by an Assistant Chief Engineer for Irrigation, who is also Under Secretary to Government, and by a suitable office establishment, but no separate and distinct executive establishment is maintained for employment upon irrigation works, owing to the exceedingly scattered nature of such works in the Madras Presidency. The officers and subordinates employed on irrigation works are provided from the one general list of the Public Works department; attend to other public works besides those of irrigation; and as regards their posting and general discipline are under the orders of the Chief Engineer, Public Works department. The cost of the one general establishment is debited, in the first instance, to Provincial Funds, and the irrigation branch is charged with a fixed percentage, on account of the portion of the establishment employed on irrigation works, as a contribution to "Provincial," at the following rates :—

(*a*.) 23 per cent. on expenditure on original works and repairs, excluding expenditure in England and payments for land compensation.

(*b*.) 10 per cent. on the "Direct"* revenue collected in the Public Works department.

(*c*.) 6 per cent. on the gross "indirect" revenue (i.e., revenue realised in the Civil department and credited to the Public Works department) due to Productive Public Works, including the share due to old irrigation, but excluding the enhanced share of land revenue.

It is also under contemplation to make a further charge to "irrigation" on account of establishment, by means of a fixed percentage on the "indirect" revenue due to works not classed as Productive.

3. *Financial Policy of Government in respect to Irrigation Works and its Results in the Madras Presidency.*—Previous to the year 1854, expenditure incurred on irrigation works of all descriptions was treated as ordinary expenditure, and was charged against the general revenues of the year. Under this system the large irrigation works of the Godávery, Kistna, and Cauvery Deltas were begun. After

* See paragraph 5.

1854, as it was recognised that the system of charging the cost of large works, expected to prove remunerative, against the general yearly revenue was a false one, a distinction was made between the expenditure incurred on

(*a*) the maintenance and repair of existing irrigation works, and the construction of the smaller works necessary for the due development of irrigation, which it was decided to charge as formerly against the yearly revenues of the country; and

(*b*) the construction and extension of large irrigation works of permanent public utility, calculated materially to increase the wealth and promote the prosperity of the country, which were to be constructed by means of money raised on loan, and were to be treated as financial concerns by opening for them capital and revenue accounts, so that their exact financial position could at any time be ascertained.

The outbreak of the mutiny prevented the prosecution of the schemes for promoting irrigation by means of money raised on loan, and it was not until 1858 that the Madras Irrigation and Canal Company was formed with a Government guarantee of 5 per cent. This work was financially a failure, and warned by this example and by experience elsewhere of the unsuitability of the agency of private companies in the construction of irrigation works, Government have constructed all other irrigation works in the Madras Presidency by the direct agency of their own officers. This decision was arrived at in 1867, when the policy of guaranteed companies for the construction of irrigation works was finally abandoned in favour of what was then called the "Extraordinary" Public Works policy, whereby large works of irrigation expected to prove remunerative were to be constructed by Government from money borrowed annually by the State, when the ordinary revenues were insufficient for the purpose. The capital expenditure incurred on the large irrigation works of the Godávery, Kistna, Cauvery, and Penner rivers continued up to the year 1879, in accordance with the policy above stated, to be met partly from Loan Funds and partly from ordinary revenue. In 1879, however, the expenditure under the latter head was written back to Loan Funds in the accounts, as if constructed from money raised on loan. The reason why this course became necessary in 1879 was owing to the following cause :—

The understanding on which "Extraordinary" Public Works were originally undertaken was that, if money was available from the general revenue of the country, it was to be made use of, and borrowing was only to be resorted to in case of need. But, as it was found impossible to determine exactly the profit derived from expenditure incurred from Loan Funds, the works having been carried out partly from Loan Funds and partly from ordinary revenue, it was ruled in 1879 that the entire cost of the works, from whatever source the expenditure was met, should be brought together in one account, and that no part of the cost of construction or improvements to such works should thereafter be charged to ordinary revenue.

From 1867, therefore, the distinction between the two classes of works (*a*) and (*b*) has been strictly observed, while practically the cost of the first-named works has, since 1854 to the present time, alone been charged as ordinary expenditure against the general yearly revenue of the country, and those in the latter category have virtually been made with borrowed money, as the expenditure incurred on them from ordinary revenue was comparatively small. The expenditure upon the extension of irrigation may, therefore, be said to have passed through three phases :—

First.—From the establishment of British rule to 1854, when the annual disbursements were comparatively small, and were met from yearly revenue.

Second.—From 1854 to 1867, during which time the experiment of private companies was tried in addition.

Third.—From 1867, the date of the "Extraordinary" Public Works policy, under which all irrigation works were undertaken by the State, and a certain sum was devoted annually to their prosecution.

In 1876-77 the term "Extraordinary" was dropped in favour of that of "Productive;" and very strict rules (which have since that date been reiterated with increased emphasis) were laid down, limiting the outlay of borrowed money to works which were likely to be remunerative, by yielding in the shape of annual income within ten years after completion a sum equal to the interest on the money expended on their construction. As a point of fact, from the very commencement, in 1867, of the policy embodied in the Productive Public Works scheme, it was assumed that the works comprised in the category of, and sanctioned as, Productive Public Works, would prove remunerative, and orders on the subject were issued, though it was not until 1876-77 that stringent limitations regarding the certainty of their financial success were insisted upon before works could be so classed. How far this assumption has been realised in the case of the Productive Public Works of the Madras Presidency will be seen from the following figures, exhibiting the total gain or loss to the State from outlay on works originally so classed :—

Statement of Financial Results of Irrig. Works classed as "Productive," in the Madras Presidency to end of 1882-83.

Systems.	Total estimate including indirect charges.	To out to en 188	Total revenue due to works to end of 1882-83.	Charges to end of 1882-83.			Surplus revenue after payment of all charges.	Percentage of surplus revenue on capital outlay.
				Working expenses.	Interest.	Total.		
Productive Public Works.	RS.	R	RS.	RS.	RS.	RS.	RS.	
1. Godávery Delta system.	1,30,32,653	1,10	3,21,40,280	83,09,475	81,74,910	1,64,84,385	1,56,55,895	142·06
2. Kistna do. do.	1,49,00,944	63	1,49,75,292	46,01,857	48,19,225	94,21,082	55,54,210	87·74
3. Penner Anicut do.	18,94,784	16	13,61,115	1,51,356	10,74,532	12,25,888	1,35,227	8·12
4. Cauvery Delta do.	18,54,847	11	1,38,42,450	— 1,85,934	11,60,217	9,74,283	1,28,68,167	1118·74
5. Srivaikuntham Anicut system	14,76,806	13	6,11,579	2,64,497	5,92,518	8,57,015	— 2,45,436	—18·71
Total ...	3,31,66,034	2,14	6,29,30,716	1,31,41,251	1,58,21,402	2,89,62,653	3,39,68,063	158·15

The Madras Irrigation and Canal Company's Canal, which was purchased by Government in 1882, and was classed as a Productive Public Work in the same year, was, as has already been explained, constructed by a private company, and has therefore purposely been excluded from the foregoing statement as embodying the result of a different policy. The enormous loss which this work has entailed upon the State is shown by the following figures :—

Statement showing the financial result of the Kurnool Canal from its commencement to end of 1882-83.

CAPITAL EXPENDITURE.

	RS.
Amount paid by the Secretary of State to the company for the purchase of the canal ...	1,76,25,050

REVENUE RECEIPTS.

Total irrigation revenue from the commencement of the work to the end of 1882-83	10,73,097
Total navigation and other receipts collected up to 31st March 1883	2,07,764
Total ...	12,80,861

CHARGES.

Total working expenses to end of 1882-83 ...	18,55,385
Total interest charges	135,60,282
Total ...	1,54,15,667
Net loss ...	1,41,34,806

About the year 1881 a new class of works, called Protective Public Works, was instituted, and may be defined as works, which, although not directly remunerative to the extent which would justify their inclusion in the class of Productive Public Works, are calculated to afford a protection against famine, and to guard against a probable future expenditure in relief of the population. A certain proportion of the total sum of 1½ millions sterling annually reserved for "Famine Relief and Insurance" purposes is appropriated for works of this class.

4. *Classification of irrigation of works.*—All works under the charge of the irrigation branch are divided into the three following main heads :—

I. Productive Public Works.
II. Public Works not classed as Productive.
III. Protective Works.

I. *Productive Public Works.*—Productive Public Works are those specially classed under that head, in consideration of their remunerative character. The cost of their construction or material improvement is met from Loan Funds; and their working expenses are met from "Ordinary Revenue," to which head the revenue derived from them is credited. The revenue and expenditure of these works are treated as "Imperial," and are held at the disposal of the Government of India, and applied to the general services of the empire, as distinguished from Provincial Funds, which are held at the disposal of the Local Government, and are appropriated to the exclusive wants of the Presidency. The works in the Madras Presidency classed under this head up to the end of 1883-84 are—

Name of Work.	District.
(1.) Godávery Delta	Godávery.
(2.) Kistna do.	Kistna.
(3.) Kurnool Canal	Kurnool and Cuddapah.
(4.) Penner Anicut	Nellore.
(5.) Sangam Anicut	Nellore.
(6.) Barur Tank	Salem.
(7.) Cauvery Delta	Tanjore.
(8.) Srivaikuntham Anicut ...	Tinnevelly.

For all these eight works capital and revenue accounts are kept. With the exception of the Sangam Anicut and Barur Tank, which have only recently been commenced, they have all been in operation for some years. The Kurnool Canal was classed under the head of "Productive" in the year 1882, owing to the purchase money paid to the late Madras Irrigation and Canal Company being met from Loan Funds.

II. *Public Works not classed as Productive.*—Public works not classed as Productive are sub-divided into

(*a.*) Irrigation and Navigation Works, for which Capital and Revenue Accounts are kept.

(*b.*) Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.

(*c.*) Agricultural Works.

(*a.*) The following are the works for which capital and revenue accounts are kept, which are again sub-divided into "Imperial" and "Provincial," to which heads the expenditure incurred on them is respectively charged.

Name of Work.	District.	
(1.) Chembrambaukum Tank... ...	Chingleput.	Imperial.
(2.) Palar Anicut	North Arcot.	Imperial.
(3.) Pelandorai Anicut	South Arcot.	Imperial.
(4.) Madras Water-supply and Irrigation Extension Project	Chingleput.	Provincial.
(5.) Buckingham Canal.	Nellore, Chingleput, and South Arcot.	Provincial.

The financial results of all the thirteen works for which capital and revenue accounts are kept are tested as follows :—

(*A.*) By considering the "capital" cost of any work to be simply the sum actually spent on its construction.

(*B.*) By debiting the "revenue" account yearly, with the simple * interest on the capital cost of the works at the commencement of the year and with the working expenses of the year.

(*C.*) By crediting the "revenue" account yearly, with the total receipts, "direct" and "indirect."

The difference between (*B*) and (*C*) for any one year shows the profit or loss for that year, while the difference between (*B*) and (*C*) from the commencement of the works to any date shows the financial position of the works at that date. The rules regarding the debit of the outlay on works, for which capital and revenue accounts are kept, are that all the past outlay on construction and all fresh estimates amounting to more than Rupees 2,500 each for the material improvement of the existing works are charged to "capital"; while all outlay on the maintenance and repairs of the works, together with estimates for their extension and improvement amounting to less than Rupees 2,500 are charged to "revenue."

(*b.*) The expenditure on the irrigation and navigation works for which neither capital nor revenue accounts are kept is met from Imperial Funds. Many of these works are of very considerable importance individually, and for such, under the orders of the Madras Government, a continuous record of expenditure has been ordered to be maintained in a simple form, which will afford all the information necessary for administrative purposes and for the determination of their financial value. The number of important works for which such accounts are kept up to the end of 1883-84 is 59. A complete list of these works will be found in paragraph 22.

The remaining irrigation works under (*b*) are of small importance individually, though important collectively, and are dealt with in the groups or classes to which they belong, viz. :—

First.—Irrigation works supplied by rivers and streams.
Second.—Groups of rainfed tanks.
Third.—Isolated tanks—rainfed.
Fourth.—Miscellaneous works including spring-channels, ponds, &c.

(*c.*) Agricultural works are those which do not yield revenue, but which are necessary for the safety or prosperity of agriculture. They are divided into the following main heads :—

River conservancy.
River embankments.
Drainages.
Miscellaneous works.

Expenditure on these works is also met from Imperial Funds.

III. *Protective Works.*—Protective works have already been defined in paragraph 2. They are carried out from Famine Relief and Insurance Funds, formed of insurance taxation levied for famine purposes, and treated as imperial. The only work classed under this head up to the end of 1883-84 is the Rushkulya Project in the Ganjam District.

5. *Classification of Revenue of Irrigation Works.*—The revenue derived from the irrigation works of the Presidency is either direct or indirect. The former, properly speaking, represents revenue *separately* assessed for water supplied by the works, and the latter exhibits the increase of land revenue, which would not have been obtained but for the works. In this Presidency, however, where the ryotwari system of tenure prevails, the Government is virtually sole landlord and also proprietor of the water, and its demand for irrigated land is commonly a lump sum, in which no distinction is made between the charge due for the occupancy of the

* Under recent orders from the Government of India, interest on capital is not to be debited to the "revenue" account for works not classed as "Productive."

land and that due for the use of the water. The whole land revenue is therefore assessed and collected in the Revenue department, and is credited to the head "Land Revenue" without any separation between "Land Revenue Ordinary" and "Land Revenue Irrigated." The water-rates or bulk of the irrigation revenue proper are therefore shown under indirect revenue, while the direct revenue comprises only navigation and other miscellaneous receipts collected in the Public Works department. In the single case, however, of the Kurnool Canal, the water rates are credited to direct revenue, as the system in vogue, under the late Madras Irrigation and Canal Company, was continued after the transfer of the canal to Government.

In addition to the anomaly which exists in Madras of showing the great bulk of the irrigation revenue proper as "Indirect Revenue," a further anomaly is caused by the difference between the official year ending 31st March and the agricultural or revenue year ending 30th June. Owing to this difference between the official and revenue years, the "direct" revenue due to irrigation collected in the Public Works department is shown for the official year, while the "indirect" revenue collected in the Civil department is the net ascertained demand for the revenue year. From the irrigation revenue thus ascertained, the portion due in the more ancient irrigation works to the old irrigation which existed prior to the improvements and additions carried out by the British Government, is deducted, and the share of enhanced land revenue, or assessment on waste lands which would not have been brought under cultivation but for the irrigation works executed, is added thereto. It has already been stated that the water-rates on irrigated lands are collected in the Civil department. In order to provide for these collection charges, a fixed percentage is deducted from irrigation. The rate at which this deduction has hitherto been made is 7·2 per cent. on the ascertained demand, but, from the commencement of the official year 1884-85, the rate has been reduced to 5 per cent., which is found to be approximately the actual cost of collection. In the accounts of the Finance department, revenue derived from irrigation and navigation works is shown under the following heads :—

G. Revenue from Productive Public Works—
XXVII—Irrigation and Navigation (Direct Receipts).
XXVIII—Portion of Land Revenue due to Irrigation.

H. Receipts on account of public works not classed as Productive—
XXXI—Irrigation and Navigation.

Irrigation revenue due to works not classed as Productive is not shown separately in these accounts.

6. *Classification of Expenditure on Irrigation Works.*—Expenditure in the irrigation branch is shown under the following heads in the accounts of the Finance department.

N. Productive Public Works (Capital Account).
51. Irrigation and Navigation.
G. Productive Public Works (Revenue Account).
38. Irrigation and Navigation (Working Expenses).
H. Public Works not classed as Productive.
44. Irrigation and Navigation.
F. Famine Relief and Insurance.
34. Protective Works—Irrigation.

In budget estimates and accounts of the Public Works department, the same heads of account are adopted, except that the head of account denoted by H is sub-divided into the following budget heads :—

Imperial.

I. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
II. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.

III. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.
IV. Agricultural works.

Provincial.

V. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
VI. Irrigatian and Navigation Works for which Capital and Revenue Accounts are kept— Revenue Account.

Each budget head is divided into departmental heads as shown below :—

Budget heads.	*Departmental heads.*
1. Productive Public Works—Capital Account. 2. Imperial, Irrigation, and Navigation works for which Capital and Revenue Accounts are kept—Capital Account. 3. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account. 4. Protective Works.	I. Works. II. Establishment. III. Tools and Plant. IV. Suspense Account. V. Less receipts on Capital Account.
5. Productive Public Works—Revenue Account. 6. Imperial, Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account. 7. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.	IA. Extensions and Improvements. IB. Maintenance and Repairs. IC. Compensation. II. Establishment. III. Tools and Plant.
8. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept. 9. Agricultural Works.	Original Works, Repairs, Establishment, Tools and Plant, Profit and Loss, Suspense Account.

Expenditure shown under the above departmental heads is termed "direct" as distinguished from that known as "indirect," which is not shown in the Finance Accounts of the department, but only in the Capital and Revenue Accounts, or the Administrative Accounts as they are otherwise called, in view to the profit or loss on the works being exactly determined. "Indirect charges" are of three kinds—

1. Capitalized abatement of land revenue.
2. Loss by exchange.
3. Leave and pension allowances.

These charges are calculated as shown below :—

Item (1) 25 times the annual assessment of lands occupied by the works.
Item (2) at the current rates of exchange on payments in England, which are shown in the Indian accounts *at par*.
Item (3) at 14 per cent. on establishment charges.

With regard to the old maintenance charges of (1) "Productive Public Works," and (2) "Irrigation and Navigation works for which Capital and Revenue Accounts are kept not classed as Productive," such charges are deducted from the total charges on "Revenue," and are added to the expenditure under the head "Irrigation and Navigation Works, for which neither Capital nor Revenue Accounts are kept."

Description of the Madras Irrigation Works.

7. *Sketch of the Geographical Features and Distribution of Rainfall as affecting Irrigation.*—The two great mountain ranges of the Western and Eastern Ghauts give the key to the configuration of Southern India. The Western Ghauts are generally of considerable elevation. They stretch continuously along the entire line of the West Coast of the Presidency, having but a narrow strip of land between them and the sea, and within the limits of the Madras Presidency not a single river breaks through their barrier and flows towards the Eastern Coast. The Eastern Ghauts are of low elevation, lie entirely within the limits of the Presidency, have for the most part a broad expanse of land between their base and the sea, and run in a south-westerly direction, until they lose themselves in the Neilgherries, and there join the Western Ghauts. Their line is pierced by three great rivers, the Godávery, the Kistna, and the Cauvery, as well as by numerous minor streams, so that they do not perform the part of a watershed. These two mountain ranges, from a physical point of view, divide the Presidency into three portions.

(1) The short and narrow Western Coast.
(2) The long and broad Eastern Coast.
(3) The central tableland lying between the two ranges.

Each of these three divisions has natural features of its own; is under different climatic conditions, which are determined by the monsoons; and practise in the main different methods of irrigation for the cultivation of their wet crops. The principal monsoon, which is known as the south-west monsoon and is general over a large portion of India, breaks with great violence on the western shore of the Presidency, where the high ranges of the Western Ghauts catch almost the entire rainfall, which is accordingly exceedingly heavy along this coast. No irrigation, in the proper sense of the word, is practised in this division, but the abundant rainfall renders every species of wet crop capable of being cultivated. The average annual rainfall in this tract is 127·14 inches.

Along the east coast of the Madras Presidency, the main portion of the annual rainfall is brought by the monsoon known as the north-east monsoon, which is peculiar to the Madras Presidency, and generally brings an abundant supply of rain to all the eastern coast districts from the district of Nellore southwards—the coast districts north of Nellore, and especially those of Ganjam and Vizagapatam, deriving the principal portion of their supply of rain from the south-west monsoon. The eastern coast of the Presidency is also subject to cyclonic rainfall, from the cyclones which take place in the Bay of Bengal, and during the continuance of these cyclonic storms the rainfall is exceptionally heavy. The average annual rainfall in this tract is 34·97 inches. This second division therefore is under different climatic conditions from the rest of the Presidency, and in this tract of country, owing to its physical features, irrigation is more extensively practised and developed than in either of the other two divisions. It possesses the alluvial deltas of the three great rivers already mentioned, which rising in the hilly region under the full influence of the south-west monsoon, drain a very large extent of country and have an almost perennial supply; it has also numerous other rivers, which, though not so constant in their supply, bring down great volumes of water during the time of the periodical rains; and it has a copious, though uncertain, rainfall during the north-east monsoon. As a consequence, this division has (*a*) the important irrigation works of the Godávery, Kistna and Cauvery Deltas, in which from a dam placed across the river, a vast system of canals and distributary channels supply the means of irrigation to a large area of country; (*b*) the smaller, though still very important, systems on the Penner, Palar, Tambrapurni and other rivers, where advantage is taken of the river freshes by means of rapidly discharging channels, to store water in a large chain of tanks or reservoirs; (*c*) the very numerous tanks constructed entirely under the native rulers of Southern India, which, from very ancient times, have stored the heavy local rainfall of the north-east monsoon.

The central plateau derives its rainfall from both monsoons, and may be said to consist of the districts of Kurnool, Cuddapah, Bellary, Anantapur, together with those of Salem and Coimbatore. In this division the country is, generally

speaking, bare; the rainfall light and uncertain, averaging 27·92 inches; the means of irrigation difficult; and the ravages of famine, particularly in the four first-named districts, most frequent. It contains many tracts of fertile country cultivated with dry crops; but, with the exception of the irrigation from the Tungabhadra, an affluent of the Kistna, and from the affluents of the Cauvery in the Coimbatore District, the irrigation in this division is individually unimportant, and consists for the most part of tanks intended to store the local showers which the monsoons bring from either coast.

The rainfall of each district of the Presidency, from 1870 to 1883 inclusive, is shown in the following statement. The general duration of the south-west monsoon, which is commonly called the "six months' monsoon," is from June to September inclusive; while that of the north-east monsoon, which is known as the "three months' monsoon," is from October to December. In the interval between the two monsoons, there is little rain, except such as is occasioned by cyclonic rainfall and local thunder showers.

Statement showing the average Rainfall, in each District of the Madras Presidency, for the Fourteen Years from 1870 to 1883.

Districts.	Dry Season—January to May.	South-west Monsoon—June to September.	North-east Monsoon—October to December.	Total.	Area irrigated.	Gross Revenue—("Land" and "Water").
						Rs.
Ganjam	4·71	26·91	11·59	43·21	194,756	5,17,552
Vizagapatam	5·86	23·43	12·40	40·69	47,674	1,54,412
Godávery	3·04	22·32	10·82	36·18	554,455	23,66,295
Kistna	2·99	18·60	11·90	33·49	312,893	13,92,414
Nellore	3·10	10·77	19·40	34·27	215,041	9,91,126
Bellary and Anantapur	3·31	11·94	6·50	21·75	142,756	6,16,088
Kurnool	3·29	18·52	6·14	27·95	49,233	2,41,124
Cuddapah	4·50	13·49	10·33	28·32	197,286	8,95,088
Coimbatore	6·92	9·59	10·98	26·49	98,081	6,60,584
Salem	7·23	16·28	11·57	35·08	97,172	5,08,077
North Arcot	5·31	17·49	14·43	37·23	283,786	13,49,170
Malabar	11·52	97·67	12·01	121·20	...	...
South Canara	9·62	114·07	9·39	133·08	...	...
Chingleput	4·80	16·64	20·65	42·09	366,306	13,22,393
South Arcot	4·78	16·92	18·42	40·12	358,428	17,65,352
Trichinopoly	5·91	12·35	15·91	34·17	178,807	7,71,711
Tanjore	5·43	13·67	23·61	42·71	914,801	40,97,382
Madura	6·07	6·24	12·89	25·20	157,845	6,04,011
Tinnevelly	7·33	3·58	14·62	25·53	217,796	18,32,430
Total ...	...	...	...	...	4,387,116	2,00,85,208

8. *General Sketch of the Irrigation System of the Presidency.*—The uncertainty and great variation in the amount of the annual rainfall, brought by the monsoons, render cultivation precarious and fruitless without the artificial storage and distribution of water, and to meet this ever-recurring difficulty, irrigation works have, from time immemorial, been an absolute necessity of existence in Southern India. The works themselves vary alike in magnitude, in character, and in origin. There are works that yearly irrigate 1,000 square miles; others that do not irrigate 5 acres. Some derive their water from great perennial rivers; others from streams and local drainages, or from the rainfall of half a square mile ponded up in a valley. Some works date from periods, of which there is no historical record; others are the latest outcome of scientific engineering.

Artificial irrigation may be said to be carried out in three ways—first, by utilising the water of rivers; second, by utilising the rain water draining off the land; third, by utilising the subterranean springs and water. These three general methods are in the Madras Presidency sub-divided into the following classes of irrigation works. (1) *River-fed Canal Systems.*—Works drawing their supply from rivers, of which the discharge is at all times of the year, except perhaps for a short period during the hot weather, sufficient without storage to keep up a constant supply of water in the canals for the purposes of irrigation or navigation. Of this type are the great delta systems of the Godávery, Kistna, and Cauvery rivers; the irrigation channels from the Bavani, Amravati, Upper

Cauvery, and other lesser rivers, irrigating long and narrow riparian tracts. In all works of this class the main channels take off directly from a masonry dam, or "anicut" built across the river; and, in the case of the Godávery and Kistna works, the main lines of canal are adapted for navigation as well as irrigation, and form the principal means of communication in the districts which they traverse. (2) *River-fed Systems of Tanks.*—Works drawing their supply from rivers having an uncertain and very variable discharge, which is stored and rendered constantly available for the purposes of irrigation by means of a chain of tanks or reservoirs. Of this type are the systems known as the Penner, Palar, Pelandorai, and Srivaikuntham anicut systems, together with numerous other works of the same character. In all these works main channels leading from an anicut supply a great series of tanks and channels. (3) *Rain-fed Tanks in Groups.*—A succession of reservoirs connected with each other and formed by impounding the drainage from the catchment basin above them, by means of long embankments thrown across valleys, or by short embankments thrown across gorges. Vast numbers of such works exist, and in many districts form very large groups. (4) *Isolated Tanks.*—Reservoirs obtaining a supply from a small river or stream, or from the drainage of the catchment area above them. These works, though not forming nearly so numerous a class as those of the preceding, are in some cases of considerable importance. (5) *Well Irrigation.*—This system of irrigation, though not coming in any way within the special province of the irrigation branch of the Public Works department, forms an indispensable part of the general system of irrigation of Southern India. In addition to the above five classes of irrigation works, there are in the Madras Presidency two works solely intended for internal navigation. These are the salt-water canals of the Eastern and Western Coasts. The first known as the Buckingham Canal connects the Godávery and Kistna systems of navigation with the district of South Arcot by means of a navigable canal 261 miles in length. The second, which is practically a system of connected backwaters, is under the management of the Native States and Local Fund Boards, through whose districts it passes.

9. *Detailed Description of the more Important Irrigation Works.*—In paragraph 4, giving the classification of irrigation works, all classes of irrigation works were mentioned, while the names of the works for which capital and revenue accounts were detailed. It will now be necessary to return to this classification, in order to describe the irrigation works of the Presidency in order of their importance. The following description of the works will therefore give (I) a detailed account of the works classed as Productive, (II) a briefer account of the works for which capital and revenue accounts are kept, but which are not classed as Productive; and a general description of (III) the works for which a continuous record of expenditure is kept individually; (IV) works for which a continuous record of expenditure is kept collectively; and (V) Public Works classed as "Protective."

10. *The Godávery Delta System.*—This work like those of the Kistna and Cauvery Deltas is one of a type special to the Madras Presidency. In all these delta systems, the river flows along a central ridge formed by the deposit of its own alluvium, while, on each side of this ridge the ground—formed by successive inundations of the river itself—slopes a way from either bank with a gradual fall, and enables an anicut, built at the apex of the natural delta thus formed, to have a working command of water over the whole area comprised within the limits of the delta.

I. Productive Public Works.

The river Godávery, the largest and most important of the rivers traversing the Madras Presidency, rises in the Western Ghauts, and, at the site of the Godávery Anicut, is 898 miles in length; has a drainage basin of 115,570 square miles; and a maximum flood discharge of 1·21 millions cubic feet per second. The anicut was commenced in 1844-45, and commands an alluvial tract of country of 2,020 square miles in area. It is a massive work of masonry, and is built across the sandy bed of the river at a spot 33 miles from the coast, where the river is nearly 4 miles broad, and is divided by three islands into four channels. Of these, the two eastern channels re-unite just below the anicut, and similarly the two western channels. The land included between these two principal branches forms what is known as the central delta, while that on the eastern branch is called the eastern

delta, and that on the western branch the western delta. The irrigation in each of these three natural divisions is distinct, and is supplied by a head sluice and main canal from the anicut. This great work consists of a masonry dam built in separate portions between the islands, the total length of the masonry work being 3,982 yards. The general section of the dam consists of, first, a front curtain wall running along the whole length, resting on wells; second, a horizontal flooring or waste-board 19 feet in breadth; third, a masonry counter-arched fall 28 feet in breadth; fourth, a rough-stone apron in rear formed of massive stones, and extending about 184 feet down stream, so as to protect the rear foundations against the erosive action of the water passing over the dam. The crest of the anicut is 38 feet above mean sea level; 13 feet above level of top of foundations; and the greatest depth of water which has passed over it is 15·25 feet. The delta is fully supplied when 3 feet of water is passing over the anicut crest. On both flanks of the dam, and at the head of the central delta, is a lock for the passage of craft; an under sluice for purposes of scour and clearance; and a head sluice from which takes off the main canal of each delta, and supplies a network of branch and distributary channels, of which the principal ones are adapted for navigation as well as irrigation. The dimensions of the head sluices are as follows:—

Eastern, 13 vents 6′ × 8′
Central, 15 vents 6′ × 8½′
Western, 15 vents 7½′ and varying in width from 5½′ to 6′.

the sills of each sluice being 6 feet below the level of the anicut crest. The capacity of the three main canals is—

	Discharge in cubic feet per second.
Eastern	2,826
Central	1,745
Western	3,945
	8,516

The system is not yet finished, but is expected to be completed by the year 1889—1890, and the completion estimate, amounting to a total of Rupees 1,30,32,653 for direct and indirect charges, have been sanctioned by the Secretary of State as follows:—Direct charges, Rupees 1,10,88,695, indirect charges, Rupees 19,43,958. The length of navigable canals is 458 miles, which will be increased to 502½ miles on completion of the works. The extent of irrigation in 1882-83 was 528,129 acres, which will be extended to 612,000 acres on completion of the works. The net annual income of the system for the year 1882-83 was Rupees 12,11,028, and the surplus revenue, after payment of interest charges, was Rupees 8,45,830. A reference to the statement of paragraph 3, exhibiting the financial result of Productive Public Works up to the end of 1882-83, will show that the works have paid 142·06 per cent. on the total capital outlay, i.e., the system has paid in surplus revenue nearly one-and-a-half times the money expended upon it. On completion of the works in 1889-90, it is estimated that the system will yield a net annual return of 12·7 per cent. on the total capital outlay of Rupees 1,30,32,653. These highly satisfactory financial results do not represent by any means the total profits which have accrued to the State from this most successful work. Directly traceable to the work are the enormous increase in the import and export trade, the rise in land revenue, in population, and in the general prosperity of the district; while as an insurance against famine, the work is invaluable. One instance of this last fact may be cited. During the famine of 1876-77, when every unirrigated district was importing enormous quantities of grain to feed its population, the quantity of grain exported from the Godávery District was valued at £1,740,000.

11. *Kistna Delta System.*—The river Kistna, the second in point of size of the rivers of the Presidency, rises in the Western Ghauts, close to the source of the Godávery. The anicut is built at the natural head of the delta, where the river flows between rocky hills, and is only 1,300 yards wide, or much narrower than its normal width. At the head of the delta, the river is 800 miles long; has a drainage area of 97,050 square miles; and a maximum flood discharge of 736,000 cubic feet per second. The anicut which was commenced in the year 1852 is situated 45 miles from the sea in a direct line, 60 miles by river, and commands a

delta, which is separated into two natural divisions, respectively called the eastern and western divisions, by the river itself, of 2,110 square miles in area. Like the Godávery dam the Kistna Anicut is constructed on a sandy river bed. It consists mainly of a body wall of stone in mortar founded upon a double row of wells. The body wall is 1,238 yards in width from wing to wing; 6 feet wide at top; and has its crest or sill-board 20 feet above the deep bed of the stream, and 15½ feet above the summer level of the river; and is backed on the down stream side by a massive rough stone apron, containing about 400,000 cubic yards of stone, and sloping away down stream for a distance of 257 feet. In this apron, at a distance of 100 feet from the body wall, is a retaining wall having its crest 6 feet lower than that of the body wall. The crest of the anicut is 43 feet above mean sea level; the greatest flood which has passed over it is 20·65 feet; and the depth of water upon it which is considered to furnish a full supply to the delta is 2½ feet. In order therefore to keep the water level considerably above the anicut, towards the end of the cultivating season when the river is low, a rough dry stone wall about 4 feet high is erected on the anicut crest in October or November of each year, and as the river falls in the dry season this stone is utilised in the annual repairs required by the apron of the Anicut, so that the crest is left clear again before the floods of the south-west monsoon in June. On each flank of the anicut are under-sluices, consisting of 15 vents of 6 feet span, with their floor 8½ feet below the crest of the anicut; while, above the anicut, on either bank, are the locks for the passage of craft and the head sluices of the deltaic channels. The eastern head sluice has 15 vents of 6′ × 9′ span, with its floor 5½ feet below the anicut crest; and the western head sluice 15 vents of 6′ × 8′ span, with its floor 6 feet below the crest of the anicut. Both of the head locks are 16 feet wide, and 160 feet long from gate to gate. The system is not expected to be completed till the end of the year 1901-02. The total estimate for direct charges, amounting to Rupees 1,38,99,784, has been sanctioned by the Secretary of State. The estimate for indirect charges, amounting to Rupees 10,01,160, is now awaiting sanction. The navigable canals of the system are connected on the one side with those of the Godávery delta, and on the other side with the Buckingham Canal. In 1882-83 their total length was 278 miles, which will be ultimately increased to 349 miles. The total area effectually irrigated, and net revenue derived, in the year 1882-83, was 261,158 acres and Rupees 5,85,262 respectively as against 287,027 acres and Rupees 7,13,129 in the year preceding, the decrease being due to the very heavy floods of 1882, which caused much damage and entailed large remissions in the delta. On completion of the works the area of irrigation will be increased to 475,000 acres. The surplus revenue of the year, after paying all charges including interest, was Rupees 3,51,945, or 5·57 per cent. on the total capital outlay of Rupees 63,30,628. A large portion of the further expenditure to be incurred on the system consists of works, such as drainage, &c., for the purpose of securing existing irrigation from risk. Expenditure of this description, while adding largely to the capital outlay brings no proportionate increase in revenue, and it is accordingly estimated that the net returns of the system, which have during 1882-83 been 9·92 per cent. will, on completion of the works in 1901-02 be reduced to 8·38 per cent. on the total capital outlay of Rupees 1,49,00,944. As in the case of the Godávery system, this work, while paying a large direct profit to the State, is a safe insurance against famine, and has immensely increased the general prosperity of the district, which is now one of the richest and most thriving in the Presidency, but previous to the construction of the Kistna anicut was one of the poorest, and suffered most severely in the famine of 1833-34.

12. *The Kurnool Canal.*—This work takes off from an anicut, 17 miles above the town of Kurnool, on the river Tungabhadra, which, rising in the hilly country of West Mysore, skirts the dry district of Bellary, and joins the Kistna river in that of Kurnool. In describing (paragraph 3) the financial policy of Government in respect to large works of irrigation, allusion was made to this canal, which was purchased by Government in 1882 from the Madras Irrigation and Canal Company, and from that date has been designated the "Kurnool Canal." The work owes its inception to the policy of introducing into India British capital and enterprise in the construction of irrigation works. So much was anticipated from this policy that, when in

1858 overtures were made to Government to carry out a project, initiated by Sir Arthur Cotton, and then known as the "Tungabhadra Project," by the agency of a private company, the proposal was readily met by Government. The company, known as the Madras Irrigation and Canal Company, was therefore incorporated in 1858, and in 1863 the regular contract deed between the Secretary of State and the company was drawn up, by which a Government guarantee of 5 per cent. was given on a capital of one million sterling for the execution of the work proposed. In 1866 the company was already in financial difficulties, and had spent £937,242 out of a capital raised of £964,521, while the works were still in a very unfinished stage. A second indenture was therefore signed in that year, modifying the original contract in so far as to allow of the company obtaining from Government a sum of £600,000 by means of debentures. By 1872 the original capital of one million sterling, together with the Secretary of State's loan of £600,000, had been wholly exhausted, while the canal still remained unfinished. Mortgage debentures were then issued, but the credit of the company was not sufficiently good to make funds readily forthcoming; and, as the improvement of the financial state of the work was impossible as long as it remained under the company, Government decided to forestall the date of the termination of the contract, and to take the work under their direct control. Terms were accordingly offered to the stock and mortgage debenture holders, which were at once accepted by the former but not by the latter. The matter was therefore referred to the Court of Chancery, and finally in 1882 the Court gave a judgment, authorizing the transfer of the canal to the Secretary of State. The works of the company were accordingly purchased, and were officially transferred in July of that year; and the canal was formed into an ordinary public works division; was placed under an Executive Engineer; and was called the "Kurnool Canal Division."

The anicut supplying the canal is built across the river Tungabhadra at Sunkasala. It is 1,500 yards in length; is founded on rock; has a clear overfall; and is furnished with a set of under-sluices. The highest flood that has yet passed over it is 6·80 feet. The water passes through a head sluice into the canal, which, in the upper portion of its course, has a general cross section of 90′ bottom width, side slopes 2 to 1, depth 8 feet, and capacity of 3,000 cubic feet per second. At the 75th mile the canal passes through the watershed between the Tungabhadra and Penner rivers, crosses the Penner at the 182nd mile, and terminates at the town of Cuddapah (on the Madras Railway) 190 miles from Sunkasala. An anicut at the crossing of the Penner affords the supply necessary for the continuation of the canal to Cuddapah. This anicut is 2,333 feet in length, of which 509 feet are founded on rock, and 1,724 feet on wells sunk in the sand. In addition to this work there are on the canal two other anicuts, two important aqueducts; surplus and cross drainage works; 48 over-bridges; and 42 locks, of which 7 are double and 35 single. The canal was completed in 1871, but navigation was not started until 1880, owing to the embarrassed state of the company's affairs. A telegraph line runs along the canal, and at the end of 1883-84 was in progress of reconstruction by the Telegraph department. When completed, the line will be inspected and maintained by the Telegraph department; and will be worked by the Public Works staff of the canal as a licensed system, so that it will be available for carrying messages for the general public, in addition to those on the service of the canal.

. The works have suffered from numerous accidents, the latest serious ones being the breaching of the Sunkasala Anicut in the year 1882, a few days after the transfer of the canal to Government; and the damages done to the canal by the breaching of a tank in the following year. The extension of irrigation under the canal has been of the most disappointing nature. For the five years, from 1871 to 1876, the irrigated area and revenue averaged 14,700 acres and Rupees 50,650, the charges against revenue being Rs. 1,80,000. The impetus given to irrigation in the years 1876-77 and 1877-78 by the failure of the monsoon rains raised the area shown as irrigated materially, as the following figures will show :—

	ACRES.	RS.
1876-77	90,285	2,47,351
1877-78	50,918	1,49,130

This increase was due to watering dry crops, and soon declined, as the average for the years 1878-79 to 1881-82 was only 20,018 acres and Rupees 73,363. In 1882-83 the area irrigated was 14,903 acres, the revenue from irrigation Rupees 59,255, and the traffic receipts from navigation, Rupees 10,683. The decrease in the irrigated area during 1882-83 was owing to the breach in the anicut, which occurred in July 1882. The financial result for the year was a loss of Rupees 63,708, in addition to the charge for interest on capital. It is as yet early to predict what the future of the work may be now that it has been taken under the management of Government, but the enormous capital outlay sunk upon it, in proportion to the capacity of the canal, absolutely precludes it from ever being a paying concern. It is proposed to complete the distributaries required for the extension of irrigation by the end of 1885-86, and it is anticipated that, at the end of 1886-87, the revenue will be sufficient to meet the cost of maintenance.

. The causes of the financial failure of the work are numerous, and prominent among them are—

First.—Excessive cost of works and faulty execution and design.
Second.—Nature of soil commanded, and circumstances of people.
Third.—Faulty administration on part of the company; unsatisfactory relations between company and the revenue officers; and antagonism between company and the ryots.
Fourth.—Delay in starting navigation.

. The first and second causes of failure are permanent; the third and fourth no longer exist. The enormous cost of the works in relation to the capacity of the canal has already been noticed, and both the anicut and the canal have suffered repeated accidents. The canal flows through a country where irrigation is but little practised, and the people are unused to it; where also the food grains grow perfectly well in ordinary years without being irrigated. The only chance of success for the work was therefore to offer water on the most tempting terms, and to furnish by means of navigation cheap means of transport and access to a profitable mart. Neither condition was complied with. The system of applications for water introduced was absolutely of a nature to deter the ryot from making any application at all, while navigation was delayed for nine years.

13. *The Penner Anicut.*—The river Penner rises in Mysore, has a drainage area of 20,000 square miles, and a total length of 330 miles. Its principal supply is derived from the north-east monsoon, during which it is subject to very heavy floods of short duration, but the upper portion of its basin obtains a fair, though uncertain, supply from the south-west monsoon. The bed of the river has a considerable fall, which in the lower portions of its course is as much as 3 feet per mile. Owing to the character of the river, advantage has been taken from very ancient times, by means of flood cuts, to utilise the supply brought down by freshes, in filling a very large series of tanks on the southern bank of the river in the neighbourhood of the town of Nellore, and thus the irrigation of this area is carried over the periods when the river itself is dry. The water-supply, however, obtained by this means was very variable, and, in order to improve it and render the irrigation certain, the anicut was commenced in 1853, at a site close to the town of Nellore, and 19 miles from the sea. This work was completed in 1855, but during the extraordinary heavy floods of 1874 was turned at its northern or left flank. The anicut was thereupon repaired and was extended from its original length of 1,581 feet, which is about one-third of the normal width of the river, to a length of 2,039 feet. As existing, the anicut consists of a body wall of this length, founded on a double row of wells; and is backed by a series of rough stone aprons, divided by retaining walls, and having a total fall of 9 feet and total width of 178 feet. The crest of the anicut is 9 feet above the river bed, and 37·47 feet above mean sea-level, while the highest flood which has passed over it is 19·30 feet. It has two sets of under-sluices, and a head sluice and auxiliary head sluice at its southern flank—there being no irrigation under the anicut on the northern bank of the river. The head sluice has 9 vents of 6 feet span and the auxiliary head sluice 6 vents of $10' \times 3\frac{1}{2}'$, while the level of the sills of both head sluices are 8 feet below the anicut crest. From the main canal leading from the

head sluices, two old native channels, which have been extended and improved since the construction of the anicut, convey the river-supply to a great series of tanks, and form the main feeders of the system. From one of these channels, a third principal channel, running midway between the other two, branches off, and is the only entirely new channel of any considerable size constructed by the British Government. The channels of the system generally flow along the watershed, and there is consequently but little cross drainage. The irrigation on the southern bank of the river extends over an area of 150 square miles. The irrigation of the northern bank will be effected by the Sangam anicut, which at the end of 1883-84 was being built across the river, 20 miles above the Penner anicut. In 1882-83 the area irrigated under the Penner anicut was 63,653 acres, and the irrigation revenue derived therefrom Rupees 2,34,957, but of this sum the portion due to the old irrigation, which existed prior to the construction of the anicut, was Rupees 1,20,350. The net revenue due to the work was Rupees 79,989 or 4·8 per cent. on the total capital outlay of Rupees 16,65,159. The complete estimate for this system has not yet been sanctioned. It has however been prepared, is computed to amount to Rupees 18,94,784, including all direct and indirect charges, and will shortly be forwarded to the Government of India.

14. *The Cauvery Delta.*—The river Cauvery rises in the province of Coorg, flows through the Mysore plateau, and through the Madras districts of Coimbatore, Salem, and Trichinopoly, where, together with its tributaries, it feeds a whole succession of irrigating channels, and bifurcates at the head of its delta, 9 miles west of the town of Trichinopoly, the southern branch retaining the name of the parent stream, while the northern branch is known as the Coleroon. About 17 miles below the point of their bifurcation, the two branches very nearly re-unite, forming between them the island of Srirangam. Below this point the Coleroon takes a north-easterly course, skirts the district of Tanjore on its northern border, and reaches the sea with its volume comparatively little diminished. Though there is considerable irrigation from this branch, it has nothing to do with the irrigation of what is classed as the Cauvery Delta proper, to which (as will afterwards be noticed) it affords a great natural drainage channel for the escape of surplus water. The Cauvery branch, on the other hand, runs through the delta, splits up into numerous branches, and covers the delta with a vast net-work of channels, which have from very ancient times been utilized for the purposes of irrigation. Of the numerous offshoots some are lost in the wide expanse of rice-fields, others find their way to the sea, while the branch which retains the name of Cauvery throughout diminishes to an insignificant stream before entering the sea. The Cauvery river, together with its tributaries, is fed by the rains of both monsoons, and has an abundant and constant flow for nine months in the year. At the head of the delta it is 4,400 feet wide, has a drainage area of 27,705 square miles, and a maximum flood discharge of 284,000 cubic feet per second. The total average annual discharge is about 490,000 millions of cubic feet, equivalent to 17·68 inches of discharge from the whole drainage basin. The irrigation of the Tanjore Delta dates to a very remote period, and in order clearly to understand the system as it now exists, and the requirements which have still to be attended to, it will be necessary to show briefly the development of the system up to the present time. Under the old native régime, channels, sometimes supplied by head sluices, were first cut from the main river, and, by means of an infinite number of smaller channels of distribution, afforded a supply of water for the purposes of irrigation. Not only was the main river thus utilized, but the numerous deltaic branches from it (in all of which the water surface was, in the normal state of the river, generally higher than the level of the surrounding country) were also similarly laid under contribution, and, hand in hand, with this process of utilising the waters in moderate floods, necessarily grew up a vast system of embankments, whereby the waters during extreme floods were prevented from spreading over the country and damaging the crops. Thus in progress of time, there grew up over the whole area of the delta an extremely artificial condition of things, the cardinal points of which were (1) the supply of abundance of water, by means of taking up the natural drainage lines for irrigation; and (2) the protection, by means of a system of embankments, of the irrigated area thus formed from the effects of floods. The principal masonry

work undertaken during the native period is that known as the Grand Anicut, built in the eleventh century, and situated just below the island of Srirangam, where (as has already been mentioned) the Cauvery and Coleroon come into close contact with each other. At this point the bed of the Coleroon is nine or ten feet lower than that of the Cauvery, and the Grand Anicut was therefore built across a natural outlet of the Cauvery to prevent its water being wholly drained off into the Coleroon. About the year 1800 the Tanjore District was ceded to the British, and in 1804 it was found that the Coleroon branch, from its more rapid fall and more direct course to the sea, was draining off, at its head, the main portion of the water-supply of the river above the point of its bifurcation; while the Cauvery branch was silting up at its head. It thus became very evident that, if effective measures were not taken to rectify, by artificial means, the natural differences between the two branches, the inevitable issue must be the annihilation of the Cauvery branch as an irrigating stream, and, as a consequence, the total collapse of the delta irrigation. From 1804—1829 an incessant struggle was maintained against the increasing tendency of the Cauvery branch to silt up at its head, and efforts were made to force a larger supply of water into the branch. These efforts were ineffectual. The bed of the Cauvery branch continued to rise, the supply to diminish, and the area under cultivation to fall off. In 1830, under-sluices were built in the Grand Anicut, together with other similar works and waste weirs at eligible sites in the left bank of the Cauvery, in order to endeavour to clear from its bed the accumulations of sand. These works were beneficial, but did not check in any way the evil resulting from the unequal distribution of the volume between the two main streams. In 1836, under the advice of Sir Arthur Cotton, the Upper Coleroon Anicut was built across the head of the Coleroon branch, and was completely successful in its object of throwing into the Cauvery branch a fair distribution of the water-supply, by the simple expedient of placing the crest of the anicut at such a height as to ensure, in the average state of the river, a proper distribution of the entire volume of the main stream between the two branches during the irrigating season. Simultaneously with the Upper Coleroon Anicut, and supplementary to it, was constructed the Lower Coleroon Anicut, 70 miles lower down the river, in order to provide for the irrigation of the irrigated lands of the South Arcot District, and for those of the north-east portion of the Tanjore District, whose supply would of course be much reduced by the construction of the Upper Anicut. As the irrigation under the Lower Coleroon Anicut, and the expenditure incurred thereon, are not included in that of the Cauvery Delta system, and the work is separately classed as one for which a continuous record of expenditure is kept (*vide* paragraph 22), no further mention will here be made to it. The next important work undertaken was in 1845, when a regulating dam was built across the head of the Cauvery branch to counteract the effects of the Upper Coleroon Anicut, which, it was found, was throwing into the Cauvery branch a body of water far larger than was safe or was required. Finally, in 1848, the construction of a regulating dam to the first principal offshoot from the Cauvery branch was begun; and subsequently regulating dams were provided for the other principal branches, thus completing the general system of regulation and control of the water required for the delta irrigation.

The development of the delta system having thus been traced, it only remains to describe briefly the principal works. The total area of the delta is 1,402,880 acres (2,192 square miles), of which 900,000 acres are irrigated. The irrigation in the delta is fully supplied when the river stands 5·7 feet on the Cauvery regulating dam, which represents a discharge of 12,330 cubic feet per second. The Upper Coleroon Anicut is built across the head of the Coleroon, the body wall is 2,789 feet in length, and is founded on a double row of wells. The anicut is provided with under-sluices, and a bridge, six feet between parapet walls, is built across it. The Cauvery regulating dam is practically a continuation of the anicut, is built across the Cauvery branch at its head, and is 1950 feet in length from wing to wing. The highest flood ever known in the river rose to 13·20 above the floor of this dam. Below these works, lower down the delta, are numerous surplus works and the regulating works of the principal branch channels from the Cauvery. The sketch already given of the development of the delta irrigation will have made it plain that a peculiarity of the system is that the natural drainage channels

have been taken up for the purpose of irrigation, and that the numerous deltaic channels of the Cauvery take the place of the artificial canals in the Godávari and Kistna Deltas, and merely require sluices built across their heads to be made available as irrigating channels. The total length of the Cauvery branch from the head of the delta to the sea is 95 miles. At its head, the branch is 2,000 feet wide, and continues that width for 14½ miles, where the Vennar river, its first principal branch, takes off. The Vennar has a regulating dam at its head, and is itself divided into five main branches. Returning to the main river, 2¾ miles below the Vennar, is the Grand Anicut. This very ancient work is 1,080 feet long, and consists of rough blocks of granite built in a serpentine form, having over it a bridge of 32 arches of 32 feet span following the wavy line of the anicut. The crest of the work is 7 feet above the bed of the Cauvery branch. The Grand Anicut is provided with 10 sluices, 3 feet broad, with their sills 10 feet below the crest of the work, which pass the surplus water of the Cauvery into the Coleroon. Besides the Grand Anicut, there are other surplus works passing into the Coleroon branch all the water which cannot be disposed of by the Cauvery branch and its irrigating channels. Further down the Cauvery branch, 9½ miles below the Grand Anicut and 26¾ miles from the head of the delta, the Kodamurti river—the second principal branch of the Cauvery—takes off; while 20 miles lower down is the Arasillar, or third principal branch; and 14 miles lower down, the Verasholen, or last principal branch. All these three main branches have also regulating dams at their head, and supply a vast number of branch and distributary channels. This concludes the description of the delta irrigation under the Cauvery branch. As before stated, there is no irrigation from the Coleroon within the delta proper, but that branch plays a most important part in the delta system, by providing a great natural drainage channel for the surplus waters of the Cauvery branch. Before quitting the subject of the delta irrigation, it will be necessary to notice two important requirements which yet remain to be attended to. First among these is the complete system of head works necessary in order to have the supply of the Vennar, and other branches from the Cauvery, under complete control, and thus to prevent the repeated damages which, for many years, the delta has been liable to during heavy floods in the river. The floods generally occur in the north-east monsoon, and, together with the very heavy local rainfall which often occurs at that time of the year in the Tanjore District, fills the Cauvery branch and its offshoots to overflowing, and consequently bursts the delta embankments. The subject is now being systematically taken up. The construction of head sluices to the Cauvery and Vennar rivers, at a site immediately below the Grand Anicut, is now in progress; and various other works—including alterations to the Grand Anicut, which will enable that work to discharge 85,000 cubic feet of water per second—will shortly be undertaken. The second requirement is a complete survey of the delta. No proper survey of the delta has yet been made, and comparatively little is therefore known of the vast system of minor channels within its limits. Regulators are required at the heads of many of the smaller irrigation channels, but the construction of these works is necessarily delayed until the completion of the survey, which will show accurately how the irrigation is distributed over the several channels. The survey is now in progress.

The total amount of the estimates sanctioned for this system, up to the end of 1883-84, is Rupees 18,54,847.

The area effectually irrigated, and the revenue derived therefrom, for 1882-83 was—

	Acres.	Rs.
First crop	895,719	26,55,600
Second crop	1,08,298	2,53,780
		29,09,380

Of the gross irrigation revenue of Rupees 29,09,380, the portion due to the old irrigation, which existed prior to the improvements and additions made by the British Government, was Rupees 23,43,214. The surplus revenue due to the new works after meeting all charges was, in 1882-83, Rupees 5,80,975, or 50·51 per cent. on the total capital outlay of Rupees 11,50,238; while, as will be seen from the statement in paragraph 3, the total surplus revenue, up to end of 1882-83, was Rupees 1,28,68,167, being 1118·8 per cent. on the capital outlay, or more

than eleven times the total outlay on capital account. It will thus be abundantly clear that the work as a financial investment has been extraordinarily successful.

15. *The Srivaikuntham Anicut.*—The Srivaikuntham Anicut is the last of eight anicuts on the river Tambrapurni, in the Tinnevelly District, and is situated 16 miles from the sea. The river rises in the Western Ghauts, and, though comparatively a small stream, derives its importance from the fact that it receives a supply from both monsoons. At the site of the Srivaikuntham Anicut the drainage are of the river is 1,739 square miles, and the maximum flood discharge 118,673 cubic feet per second. The average annual discharge of the river is 60,304 millions cubic feet, equivalent to 14·9 inches of discharge from the whole catchment basin but in the year 1877, when the freshes of the north-east monsoon were extraordinarily heavy, the total annual discharge of the river reached the high figure of 121,295 millions cubic feet, equivalent to 30 inches from the whole catchment basin. The seven anicuts in the Tambrapurni above the Srivaikuntham Anicut are of old native construction, and it was principally owing to the great success of these works that the Srivaikuntham Anicut was projected. This work was begun in 1867. The system is of a simple character, and may be briefly described. From either flank of the anicut, which is 1,380 feet in length between the wings, two main channels, 21 miles in length and supplied with head sluices, are taken off, and supply a large series of tanks which existed before the Srivaikuntham Anicut was built, and before its construction were very inadequately supplied. Besides filling these tanks, the main channels irrigate directly a considerable area of land. The height of the anicut crest above mean sea level is 37·40 feet, while the sills of the head sluices of the main channels are 6 feet below the crest of the anicut. The highest flood which has yet passed over the anicut rose to 11¾ feet over its crest. The works from their very commencement have had numerous accidents, and to this cause must mainly be attributable the slow extension of irrigation under them, and their want of financial success up to the present date. The damages to the works have been due to the breaching of the river embankments, during the very sudden and heavy floods to which the Tambrapurni is liable; and to the breaching of tanks, caused by heavy upland floods. They have now been provided against by completing the river embankments, throwing back the north flood-bank of the river below the anicut, and by affording adequate means of surplus for the cross drainage from the tanks lying above those of the Srivaikuntham Anicut system. The system will not be finally completed till the year 1885-86. The completion estimates amounting to Rupees 14,76,806, of which Rupees 13,61,520 represents the direct and Rupees 1,15,286 the indirect charges, have been sanctioned by the Secretary of State. During the year 1882-83 the area effectively irrigated and the revenue derived therefrom was—

	Acres.	Rs.
First crop	19,546	4,13,450
Second crop	17,647	58,291
		1,71,741

while the ultimate area of irrigation—which it is estimated will be reached in 1886-87, the year after the completion of the works—is acres 25,000, all of which will be double cropped. The net revenue from the system in 1882-83 was Rupees 73,018, while the actual return from the work, after paying all charges including interest charges, was Rupees 23,768, or 1·81 per cent. on the total capital outlay of Rupees 13,12,135. After completion of the works in the year 1886-87, it is anticipated that the net yearly revenue will be increased to Rupees 1,10,902, or 7½ per cent. on the total capital outlay of Rupees 14,76,806.

16. *The Works in progress at the Sangam Anicut and Barur Tank.*—As has already been stated (paragraph 13), the Sangam Anicut will extend irrigation to the northern bank of the Pennér. From the anicut, a main channel, leading from a head sluice on the north bank of the river, will supply two large existing reservoirs, known as the Kanigiri and Duvur Tanks, from the former of which the irrigation channels will be taken off, and thus advantage will be taken of the intermittent character of the river supply. The area to be commanded by the anicut will be 220 square miles. This tract of country already contains many tanks, and is

partially irrigated by cuts from the river. The construction of the anicut will render certain the existing irrigation, and will largely increase it as follows:—

	ACRES.
Present irrigation	44,053
Estimated increase	49,947
Total ...	94,000

The site of the anicut is about 38 miles from the sea, and 20 miles above the Pennér Anicut at Nellore. When finished, it will be 4,290 feet in length, or nearly three times the length of the Pennér Anicut; and will have its crest 7 feet above the deep bed of the river, or 105 feet above mean sea level. The head sluice (which is now finished) has 21 vents of 6 feet span, and is designed to carry 4,800 cubic feet of water per second (when the water in the river is flush with the anicut crest), which will be distributed in the following proportions to the reservoirs which it supplies:—

	Cubic feet per second.
Kanigiri Tank	4,576·5
Duvur Tank	223·5

The present capacity of the Kanigiri Tank is to be greatly enlarged, and the total capacity of the two reservoirs will ultimately be—

	Millions cubic feet.
Kanigiri Tank	6,419
Duvur Tank	1,043
Total ...	7,462

When finished, the Kanigiri Tank will be the largest reservoir in the Presidency. It is estimated that the works will be completed about the year 1889-90. At the end of 1883-84 very considerable progress had been made in their construction, as the whole of the wells required for the anicut had been sunk, the south wing of the anicut and the head sluice had been finished, and a large amount of work on the anicut and other works had reached an advanced stage of progress. The estimate for the work amounts to Rupees 35,69,049, of which Rupees 28,96,437 is for Direct charges and Rupees 6,72,612 for Indirect charges, and was sanctioned by the Secretary of State in February 1881. At the end of 1883-84 the total outlay against Direct charges was Rupees 13,48,624. It is anticipated that on completion of the works, about 1889-90, the annual revenue will amount to Rupees 2,38,000. The estimate of annual working expenses is Rupees 50,255, and the net revenue will therefore be Rupees 1,87,745 or 5·26 per cent. on the total Capital outlay of Rupees 35,69,049.

. *Barur Tank.*—This work is situated in the Salem District, and was commenced as a Famine Relief-work in August 1877, at a time when the district was suffering severely from the effects of famine. The normal value of the work then done was estimated at Rupees 67,185, in addition to which a sum of Rupees 13,172 was paid for land compensation, making a total expenditure of Rupees 80,357 on the work. In 1883 the project was sanctioned as a Productive Public Work by the Secretary of State, and was put in hand towards the close of the year. The scheme is one for the improvement of several existing tanks (of which the Barur Tank is by far the largest) by building an anicut across the Ponnair River. This river rises in the Mysore plateau, and drains an area of 2,082 square miles, in which are situated numerous tanks. The extent of free catchment basin may be put down at 1,080 square miles. The supply afforded by the river is ample, and from the anicut, a supply channel, 7½ miles in length, provided with a head sluice leads to the Barur Tank. The project also provides for the enlargement of this tank, and for two distributary channels from it, which will supply a number of smaller tanks. The work will bring under irrigation an area of 5,430 acres, in addition to 1,457 acres already supplied by the tanks. The total storage capacity of the tanks, when completed, will be 16½ millions cubic yards, of which the Barur Tank will alone store 11¼ millions cubic yards. The total estimate for the project is Rupees 3,33,793, of which Rupees 3,20,000 is for Direct charges, and Rupees

13,793 for Indirect charges. In addition to the expenditure of Rupees 80,357 incurred on the work prior to its sanction as a Productive Public Work, a further expenditure of Rupees 7,298 was incurred in the year 1883-84. The work done to the end of 1883-84 consisted mainly of earthwork to the supply channel, construction of waste weir on the Barur Tank, collection of materials, and preparation of foundations for the head works. The project will be finally completed in the year 1886-87, and the net revenue which the work is estimated to yield is Rupees 21,448, or 6·4 per cent. on the total Capital outlay of Rupees 3,33,793.

17. *The Chembrambaukum Tank.*—The Chembrambaukum Tank is a large reservoir about 14 miles from Madras, and is formed by an embankment 7,100 yards in length, connecting high ground on one side with a rocky spur on the other. It is provided with 8 irrigation sluices, and with 3 masonry weirs aggregating 1,192 feet in length, while its capacity is 2,799 millions cubic feet, and the area of its water spread 8·95 square miles. The tank is an old native work, and the improvements undertaken by the British Government consist mainly of the extension of its capacity, and the increase of its water supply. The chief sources of its supply are from anicuts across the Cortelliar and Cooum Rivers. The catchment basin of the tank is about 400 square miles, in which area are 320 tanks, but the supply from this gathering ground is in some years exceedingly scanty. The sanctioned estimate for the work is Rupees 7,36,958, of which Rupees 6,55,310 represent the Direct and Rupees 81,648 the Indirect charges. In 1882-83 the area effectively irrigated and revenue derived was—

Works for which Capital and Revenue Accounts are kept, but which are not classed as "Productive."

	ACRES.	Revenue. RS.	Average Rate per Acre.
First crop	12,763	39,338	3·08
Second crop	3,216	8,294	2·77
Total ...		47,632	

The surplus revenue of the year, after paying all charges including interest was Rupees 8,319, or 1·12 per cent. on the total Capital outlay of Rupees 7,36,589.

18. *The Palar Anicut.*—The Palar Anicut was originally designed to give an improved supply to old native channels feeding a very large series of existing tanks. The work was commenced in 1855 and was finished in 1857. The river, which is very uncertain in its supply, rises in the Mysore plateau, and at the site of the anicut, has a drainage area of 3,974 square miles, and maximum flood discharge of 25,000 cubic feet per second. The anicut is situated in the North Arcot District and commands 201 tanks, of which 127 are on the northern bank of the river and 74 on the southern bank. It was breached in 1874 but was subsequently restored. As existing, the anicut is 2,634 feet in length between the wings, and has under-sluices at either flank. On the north bank of the river three head-sluices supply the principal channels, one of which feeds the Kaveripak Tank, one of the largest reservoirs in the Presidency; and, on the south bank, is one head-sluice supplying numerous channels and tanks. The system is still incomplete, and the work remaining to be done consists principally of improvements to the channels and head-sluices, and the construction of new head-sluices and other masonry works. The area effectively irrigated, and the revenue derived, in the year 1882-83 was—

	ACRES.	RS.	Average Rate per Acre.
First crop	66,571	1,72,074	2·60
Second crop	20,584	45,290	2·20
Total ...	2,17,364		

The surplus revenue of the year, after paying all charges including interest was Rupees 4,581 or 0·27 per cent. on the Capital outlay of Rupees 16,80,965. The completion estimates for the system, amounting to Rupees 19,93,893, of which Rupees 18,94,915 represents the Direct charges, and Rupees 98,978 the Indirect

charges, were submitted to the Government of India in June 1884. They anticipate that, on completion of the works about the year 1886-87, the ultimate area of irrigation will be Acres 68,000 for first crop, and Acres 34,000 for second crop, yielding a net revenue of Rupees 93,720, or 4·7 per cent. on the total Capital outlay, and that the present deficit of Rupees 7,89,416 will not be cleared off until the year 1928.

19. *The Pelandorai Anicut.*—The Pelandorai Anicut is built across the Vellaur River, and affords a river supply to twelve tanks (which existed prior to the construction of the anicut) on the southern bank of the river in the South Arcot District. The anicut was commenced in 1870, but was not completed till 1876. In 1877 it was breached and was accordingly repaired by 1879. In the year 1880 it was again breached, and the head-sluice was carried away by an extraordinary flood which swept two feet over the wings. It was again restored and was in working order by 1882. To these two very serious accidents, occurring within the short period of four years after the construction of the anicut, must be attributed the very slow extension of irrigation, and the very unfavourable financial position of the work. The accidents were due to an under-estimate of the maximum flood discharge of the river, which, as ascertained after the great flood of 1880, reaches the high figure of 85,000 cubic feet per second at the site of the anicut, from a catchment basin of 1,600 square miles. The completion estimates of the system, amounting to Rupees 4,48,246, of which Rupees 4,05,000 is for Direct and Rupees 42,246 for Indirect charges, were sanctioned at the beginning of the official year 1884-85. Against this sanction, the total outlay to the end of 1883-84 was Rupees 3,90,213, and the only works now remaining to be done are the increase to the storage capacity of four tanks from a total capacity of 62·3 millions cubic feet to 174·0 millions cubic feet. The ultimate area of irrigation is 15,728 acres, but in 1882, Acres 3,560 only were irrigated under the system (which is the largest area yet irrigated) and yielded a gross revenue of Rupees 8,596. The net receipts of the year were Rupees 5,270, while the total charges, including interest, debited to the "Revenue" account, were Rupees 56,191 leaving a loss of Rupees 56,191 as the financial result of the year. As irrigation under the works is not at present popular with the ryots, it is anticipated that the full ultimate area of irrigation (Acres 15,728) will not be reached till 1899-1900, when a return of 8·1 per cent. on the total Capital outlay will be received. On this assumption of the growth of cultivation under the work, the interest charges will exceed the net revenue till 1891-92 and the balance of interest charges will not be paid off till 1914-15.

20. *The Madras Water-supply and Irrigation Extension Project.*—This project, which is a combined work affording a water-supply to the city of Madras, and irrigating an area of about 7,500 acres, was virtually completed about the year 1870-71. The work may be briefly described. From an anicut across the river Kortalayur, a stream with a drainage area of 837 square miles, a head sluice, and supply channel eight miles in length, lead the water to a reserve reservoir, known as the Cholaveram Tank. From thence the water is conveyed to the main reservoir, known as the Red Hills Tank, which has four irrigating sluices for the supply of the irrigation under it, and one sluice for the water-supply of the Town of Madras. The two tanks were old native works, but were enlarged from a total capacity of 644 millions cubic feet to a total capacity of 3,523 millions cubic feet, of which the Red Hills Tank alone occupies 2,753 millions cubic feet. The works have suffered some serious accidents since their construction, and have not been a financial success. According to the arrangements concluded with the Municipality of the Town of Madras, that body pay Rupee 1 for every 1,000 cubic yards of water supplied. The average annual consumption of water by the Municipality may be taken as 143 millions cubic feet. A reserve supply is, in bad seasons, maintained in the Red Hills Tank for the water-supply of the Town of Madras, by arranging that, when the water in the tank falls 6 above the bed of the Municipal supply channel, or 38·31 above M.S.L., all irrigation under the tank is stopped. The total

sanctioned estimate for the work is Rupees 18,54,463, of which Rupees 15,62,239 represent the Direct, and Rupees 2,85,224 the Indirect, charges. The total estimated amount of the Capital outlay has recently been divided as follows:—

	Rs.
Imperial ordinary	7,78,874
Provincial	10,75,589

which approximately represents the value of the water used for purposes of irrigation and town supply respectively. In 1882-83 the area of first and second crop effectively irrigated was Acres 10,420, and the revenue derived therefrom Rupees 24,135. The receipts by the sale of water to the Town of Madras were Rupees 32,314, and the total financial result of the year was a loss of Rupees 23,579.

21. *The Buckingham Canal.*—This is a salt water canal—tidal to a great extent wherever the river bars are open—extending for 261 miles along the east coast of the Presidency, from Pedda Ganjam in the Kistna District to Merkanum in the South Arcot District. At Pedda Ganjam, it communicates with the fresh water, high level, canals of the Kistna Delta system, and thence with the Godávari system, and opens up traffic with the seaport of Cocanada, making a total length of mainline of navigable canal of 462 miles. The canal runs within three miles of the sea-coast throughout its entire length, and in many portions is within half mile of the sea. The excavation of the canal was begun as long ago as 1801, but, previous to the famine of 1876—1878, the expenditure incurred on it was only Rupees 5,49,078. During the famine, an expenditure of Rupees 29,24,924 was incurred on the work, of which Rupees 21,93,584 represented the normal value of work done and was accordingly debited to the Canal, thus bringing up the total expenditure for works up to Rupees 27,42,662. The completion estimates of the system have lately been sanctioned, and amount to Rupees 92,94,954, of which Rupees 86,12,000 represent the Direct charges, and Rupees 6,79,954 the Indirect charges. Against this sanction, the total direct expenditure on Capital account was only Rupees 50,12,722 to the end of 1883-84, so that it will be apparent that much yet remains to be done. With a view to expedite the completion of the canal, grants-in-aid from "Protective" Funds are given by the Government of India. The principal work required to complete the canal is (1) the isolation of the canal into "reaches" between rivers, by means of flood-gates, so as to allow the cross drainage free vent to the sea; (2) the deepening and widening of the canal to its full section of 20 feet bottom width, side slopes 4 to 1, depth 3 feet below level of lowest recorded tide in each "reach"; and (3) provision of locks, bridges, and boat basins, together with an extensive wharf at the city of Madras. The principal commodities carried by the canal are salt, firewood, and food-grains. In paragraph 30 will be found the particulars of traffic for the official year 1882-83, during which year traffic was much impeded from various causes. Until the completion estimates have been more fully worked out, and the canal has been protected from the damages to which it is now liable from river-floods, it cannot be considered a safe line of communication. It is expected that the works will be completed by the year 1893-94. The prospects of the canal are favourable. In times of famine it will be invaluable, enabling the produce of the Godávari and Kistna Deltas to be distributed through the districts of Nellore, Chingleput, and South Arcot. Its value as a cheap means of transport is already recognised, and has attracted much attention from the mercantile community, and should the Singareni Coal fields in Hyderabad be opened up, a short line of railway to the canal will enable cheap coal to be procured in Madras, to compete with the patent fuel and English Coal now consumed by the Railway Companies.

22. III. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT INDIVIDUALLY.—*The works for which individually a continuous record of expenditure is kept.* These works number 59 in all, and are distributed over nine districts. The following list exhibits the names of all the works so classed and the districts in which they are situated, together with the particulars of irrigation for each work or system for the year 1882-83:—

Statement showing the area irrigated and revenue derived from works for which a continuous record of expenditure is maintained individually for 1882-83.

District.	Names of works.	Total area irrigated 1st crop.	Total revenue from irrigation.
			Rs.
Vizagapatam.	Six anicuts on the Sarada river...	11,764	27,784
	Four anicuts on the Varaha do. ...	5,533	14,636
	Total ...	17,297	42,420
Kurnool ...	Cumbum tank	4,952	39,568
Chingleput	Kortalayar river—Vallur tank ...	4,856	6,591
	Madurantakum tank	5,372	14,099
	Total ...	10,228	20,690
North Arcot.	Cheyar anicut	17,455	62,029
	Poiney do.	19,988	66,531
	Total ...	3,71,443	1,28,560
Salem ...	Barur tank (since classed as productive public works) ...	286	1,166
	Pennugoondapuram tank ...	205	744
	Total ...	491	1,910
Tanjore ...	Lower Coleroon anicut	22,860	66,689
South Arcot.	Coleroon Lower anicut—		
	Rajahavoikal	21,455	64,313
	Vadavar	11,462	39,234
	Khansaib canal	17,608	30,680
	Veeranam tank	38,214	1,09,416
	Vellar river—Shatatope anicut ...	25,360	67,876
South Arcot (*contd*).	Manimuttanaddy —		
	Vridachalam anicut	5,074	16,839
	Mehnatur do.	3,018	11,381
	Myorenuddy-Katumyloor anicut.	249	1,080
	Gadilam river—Tiruvadi do....	5,575	22,958
	Do. Vanamadavy do....	690	2,729
	Do. Tiruvandipuram ... anicut.	1,643	8,797
	Kullur river—Vikravandy do....	1,244	2,839
	Ponniar—Tirukoilur do....	16,339	53,219
	Total ...	141,929	4,31,361
Coimbatore	Bhavani river—		
	Kodnelly { Todpalli channel ...	13,672	97,557
	anicut. { Arkankottai do. ...	3,945	25,969
	Kalingaroyen anicut	10,912	97,374
	Amaravati river (twenty-two channels)	25,645	1,39,379
Tinnevelly.	Tambrapurni river—		
	Ariyanayakapuram anicut ...	5,124	64,413
	Bhalavur do. ...	8,405	93,800
	Suttamully do.	6,163	62,194
	Marudur do. ...	17,100	1,84,041
	Kodamilalaghyan do. ...	2,855	15,642
	Nathiyuni do. ...	2,486	19,608
	Kamiadiyen do. ...	11,177	1,57,810
	Total ...	53,310	5,97,508
	Grand Total ...	3,42,684	16,88,985

The most important of these works are the Lower Coleroon anicut, the Poiney and Cheyar anicuts, and the irrigation under the Bhavani, Amravati, and Tambrapurni rivers.

The Lower Coleroon Anicut.—The reasons that rendered the construction of this work necessary have already been given in paragraph 14. From the north flank of the anicut two large channels take off for the supply of the irrigation in the South Arcot district. One of these channels feeds the great Veeranam tank—the largest existing reservoir in the Presidency, having an embankment 12 miles in length and a capacity of 5,400 millions of cubic feet. From the south flank of the anicut another large channel feeds a number of branch channels in the Tanjore district.

The Poiney and Cheyar anicuts are built across rivers of that name, and feed a series of tanks. The irrigation under the Bhavani and Amravati rivers (which both rise in a rainy tract of country and have a constant supply of water) is entirely direct. Channels taking off from masonry dams, convey water to the fields, and irrigate long strips of land on either bank of the river, lying in the river valley, and running nearly parallel to the river's course. The irrigation under the Tambrapurni is effected by means of tanks supplied by channels, into which the river water is diverted by seven masonry anicuts of very ancient date. The irrigation under this system is exceedingly valuable and is much sought after.

23. IV. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT COLLECTIVELY.—*Works for which no individual record of expenditure is maintained, but which are accounted for collectively.*—Works of this class comprise all works other than those of the first three classes of paragraph 9 (of which detailed mention has already been made in the foregoing paragraphs 10—22 inclusive) and works classed as "Protective." They consist almost entirely of tanks, which are scattered, in great numbers, throughout the districts of the East coast and the central tableland (*vide* paragraph 7). These tanks are formed in numerous ways, according to the nature of the ground they occupy. The majority are constructed by damming up the natural drainage lines flowing through valleys, by means of embankments sufficiently long to close the gorge of the valley. The reservoir thus formed is provided with masonry sluices

for the supply of the irrigation under it, and with masonry surplus weirs, which act as a safety valve to the tank during floods. The old surplus weirs constructed by the natives are generally provided on their crest with a row of masonry pillars, 3 or 4 feet high, placed about 3 feet apart, and are locally termed "calingulas." Towards the close of the rainy season, when the chief floods of the monsoon are over, these "calingulas" are closed by damming up the spaces between the pillars with turf, straw, and earth, so as to enable the tank to retain an extra supply of water in order to carry on irrigation during the dry season. The majority of tanks in the Presidency run in groups, and descending steppes of land are occupied by a succession of reservoirs, the higher feeding the lower from its surplus supply, and the whole group forming one connected scheme of irrigation. According to the latest returns, the total number of Government tanks in the Presidency is 31,648, and it can therefore be readily imagined that the labour involved in keeping up the embankments of these tanks to a proper margin of safety, so as to guard against their breaching during the heavy rains of the monsoons, and the inspection, repair, and restoration of the very numerous masonry works attached to them, are such as to tax very severely the resources of the Irrigation Branch. For administrative purposes (as will hereafter be noticed in paragraph 26) a distinction has recently been made between (1) tanks irrigating an area of 200 acres and upwards, and (2) tanks irrigating an area below 200 acres. The following statement shows the numbers of works of each class, together with their irrigated area and revenue during 1882-83, in each district of the Presidency:—

Districts.	Tanks irrigating above 200 acres.			Tanks irrigating below 200 acres.			Grand Total.		
	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total irrigation revenue.
			Rs.			Rs.			Rs.
Ganjam	215	82,476	1,30,345	2,654	112,280	1,35,759	2,869	1,95,026	2,66,104
Vizagapatam	24	11,614	21,691	420	18,763	52,526	444	30,377	74,217
Godâvari	110	32,326	44,801	1,205	31,146	31,681	1,315	63,472	76,482
Kistna	190	22,274	57,636	248	16,231	44,183	438	38,505	1,01,819
Nellore	209	118,200	4,10,874	563	33,188	1,02,562	772	1,51,388	5,13,436
Cuddapah	156	53,916	2,41,341	2,950	133,893	4,31,761	3,106	1,87,809	6,73,102
Kurnool	46	14,980	57,311	671	23,875	78,832	717	38,855	1,36,143
Bellary	131	28,963	1,60,586	898	24,347	70,225	1,029	53,310	2,30,811
Anantapur	101	39,106	1,39,838	1,495	50,340	1,59,162	1,596	89,446	2,99,000
Chingleput	545	188,433	4,89,298	2,090	126,933	2,75,318	2,635	3,15,366	7,64,616
North Arcot	171	59,034	2,10,814	3,906	141,611	5,01,770	4,077	2,00,645	7,12,584
South Arcot	246	72,068	2,31,325	2,849	141,045	4,22,462	3,095	2,13,113	6,53,787
Salem	78	21,435	1,02,840	3,194	75,246	2,50,833	3,272	96,681	3,53,673
Coimbatore	69	33,097	1,58,568	242	10,810	41,501	311	43,907	2,00,069
Tanjore	52	17,283	32,524	607	28,973	54,033	659	46,256	86,557
Trichinopoly	148	67,572	2,25,720	1,134	64,049	1,68,630	1,282	1,31,621	3,94,350
Madura	207	89,298	2,45,801	1,911	68,547	1,29,415	2,118	1,57,845	3,75,216
Tinnevelly	174	76,059	4,34,471	1,739	68,881	3,70,804	1,913	1,44,940	8,05,275
Total ...	2,872	1,028,134	33,95,784	28,776	1,170,158	33,21,457	31,648	2,198,292	67,17,241

In addition to the works included in this statement, there are large numbers of private tanks and zemindari tanks, with which the Irrigation Branch have no concern.

24. V. PROTECTIVE PUBLIC WORKS—*Protective Public Works.*—The only work yet classed under this head is that known as the Rushkuliya Project. The work was sanctioned by the Secretary of State in 1883, and the preliminary operations for commencing work were undertaken towards the close of the official year 1883-84. The project consists in utilising the waters of the rivers Mahanadi and Rushkuliya, in the Ganjam district, by means of canals to be used both for irrigation and navigation. These rivers unite at the town of Aska, and flow into the sea at Ganjam, and, as they do not rise in the Western Ghauts, are liable to be affected by the failure of the south-west monsoon rains. In order to supplement their supply, two large reservoirs will be formed above them, the reservoir for the Mahanadi having a capacity of 2,457 millions cubic feet, and that for the Rushkuliya 2,160 millions cubic feet. From an anicut on the right bank of the Mahanadi, a channel, $19\frac{3}{4}$ miles long, and provided with a head sluice, will lead to the

Rushkuliya river. This channel will irrigate 12,000 acres, will be made navigable throughout, and will be provided with a double tail lock. Where it ends in the Rushkuliya river, an anicut will be built, and from the right bank of the Rushkuliya, a second canal, 63¼ miles long, and navigable for the first 44¼ miles of its length, will irrigate a further extent of 108,000 acres. The works will be completed about the year 1894-95, and the full area of 120,000 acres is expected to be cultivated about the year 1897-98. The total sanctioned estimate is Rupees 28,60,239, of which Rupees 26,01,386 are for direct charges and Rupees 2,58,853 for indirect charges, and the net revenue anticipated, on completion of the works, is Rupees 1,44,312, or 5·1 per cent. on the total capital outlay.

25. *Important works projected.*—Many projects of more or less magnitude have been, at various times, proposed and partially investigated. Only one of these schemes will here be mentioned, viz., the Periyar Project, which has been fully worked out, and has been sent to the Government of India for sanction. The Periyar Project is one for the extension of irrigation in the Madura district, which, from its physical configuration, receives a very scanty and uncertain supply of rain from the south-west monsoon, and has but one river of any size running through it. This result is due to the fact that the range of hills on the northern border of the district, separating it from Travancore, rise up very abruptly from the plains of Madura, while on the Travancore side they stretch away towards the sea with a long and gentle fall. The district has, at various periods of its history, suffered severely from scarcity, while from time immemorial, its scanty rainfall has been stored in a multitude of tanks, with which it is literally dotted from end to end. Its one river, the Vaigai (which has a very uncertain flow), supplies a large number of tanks, by which it is drained nearly dry on its progress *eastwards* to the sea. To remedy this state of things, the Periyar Project was planned. The scheme provides for the diversion of the waters of the Periyar—a river rising in Travancore territory, in a region of heavy annual rainfall, and flowing towards the *West* Coast—into the valley of the Vaigai river by (1) a dam closing the valley of the Periyar, and thereby storing 13,300 million cubic feet of water; (2) a tunnel through the water-shed ridge between the two valleys, for the purpose of drawing off the water from the reservoir thus formed; and (3) the necessary regulating works for passing the water thus diverted into the tanks now inadequately supplied by the Vaigai river. The dam (which will be a work of great magnitude) will be 155 feet in height, constructed of concrete throughout. The complete estimate for the work amounts to Rupees 64,41,463. The work is expected to be of the most remunerative character, and has been recommended for sanction as a Productive Public Work. The full ultimate area to be brought under irrigation is estimated at acres 101,000 and the net annual revenue therefrom Rupees 5,74,600, or 8·92 per cent. on the total capital outlay.

ADMINISTRATION OF IRRIGATION AND NAVIGATION WORKS.

26. *Conservancy of Irrigation Works.*—In general, the entire maintenance of the irrigation works for which capital and revenue accounts are kept rests with the Irrigation Branch of the Public Works Department. In the Kaveri Delta, however, which (as has already been noticed) is a very ancient system of irrigation, the Irrigation Branch only deals with the maintenance and repair of all masonry works and embankments, and the annual silt clearances required, on channels that irrigate the lands of two villages or more, the villagers themselves undertaking all the necessary repairs on the smaller channels. On all irrigation works other than those for which capital and revenue accounts are kept, the upkeep of the works also devolves, in most cases, upon the Irrigation Branch; but, in some of the more ancient river channels, the works are maintained entirely by the villagers concerned; and, on other channels, the villagers supply customary labour, or "kudimaramat," by which agency, in former times, the State maintained the great majority of its irrigation works. The old ordinance of "kudimaramat," or unpaid labour of the ryots, has long ago died out on the numerous tanks throughout the Presidency, and is only now in force on channels, where the ryot sees it is entirely to his own interest to execute himself any little repairs that may be necessary,

in the interests of irrigation, from time to time. The reason is not difficult to seek. On channels, clearances of silt are all the repairs that are usually required, and are absolutely necessary, at short intervals, to enable the ryot to get any water at all. Hence he readily contributes his free labour on works of this class. The case of tanks is very different. Their irrigation will go on until the final moment when the tank bursts, and, there being therefore no immediate and pressing need for the ryot to exert himself, the small repairs—which done at the right time would prove of incalculable benefit, and which no one but he is on the spot to do—are, year after year, left undone, until they become so considerable that, the tank either breaches, or, they attract the notice of the Government officers, and are repaired in the usual course by the Irrigation Branch. Owing to the disuse of this custom of "kudimaramat," and to the fact that the vast numbers of the tanks scattered throughout the country absolutely preclude the possibility of their proper upkeep, or even of their inspection, by the officers of the Irrigation Branch, much attention has been lately attracted to the important question of their restoration in the present, and their permanent and efficient upkeep in the future. Before mentioning the arrangements that are at present in force regarding these works, it may be as well to notice, once for all, a common and somewhat widespread misapprehension that exists regarding them. It is *not* the case that the tanks have rapidly deteriorated of late years. The deterioration of the works has been gradual and inevitable, because a tank *must*, from its very nature, gradually silt up and therefore deteriorate as years go by, and the time has now come when a large number of the tanks of this Presidency—works, without exception, of old construction—have reached a stage which renders their deterioration apparent to all observers owing to the great curtailment of their irrigating capacity.

As already stated in paragraph 23, the number of Government tanks in this Presidency is 31,648. These works are scattered over a vast extent of country, and, as experience has demonstrated that it is absolutely impossible for the Irrigation branch to attend properly to the upkeep of so great a number of works, three main principles of concerted action have been decided on, in view to the present upkeep and restoration of the works and their future maintenance:—

First.—A special Public Works Department establishment to be employed in grouping the works, and estimating for their requirements, the actual work required being afterwards done by the ordinary Public Works establishment.

Second.—The Irrigation branch to be relieved of the duty of maintaining all tanks considered not to need any professional supervision. These tanks to be denominated "Minor"—in contradistinction to those retained by the Irrigation branch, and designated as "Imperial,"—and to be maintained by the Revenue Department.

Third.—That, until the result of the investigations of the special establishment are known, it will be impossible to decide definitely what works should be respectively classed as "Imperial" and "Minor:" but that, for the present, all works irrigating 200 acres or upwards to be classed as "Imperial," and works irrigating under 200 acres as "Minor," and this classification into "Imperial" and "Minor" to be finally revised on completion of investigations for each river basin.

This is the state at which matters now stand with regard to the upkeep and restoration of the tanks of the Presidency. For some two years past works classed as "Imperial" have been maintained by the Irrigation branch, works classed as "Minor" by the Revenue Department, while the special establishment is now at work.

27. *Regulation and Distribution of Water on Irrigation Works.*—No uniform system exists for the regulation and distribution of water required for irrigation. In the Godávari and Kistna Deltas the control and distribution of the water from the time it enters the canal to its exit from the village sluice is in the hands of the Public Works Department, who are in possession, from day to day, of information as to the state of the supply at all the principal regulating works. Once discharged

from the village sluice the field distribution rests with the ryots themselves. On the Pénner Anicut system, the regulation of the water-supply among the several channels is in the hands of the Public Works Department, while the distribution from the tanks rests with the ryots. On the Kurnool Canal the regulation and distribution of the water-supply is entirely in the hands of the Public Works Department. In the Kaveri Delta system the sluices built across the heads of the various offtakes from the river are managed by the Public Works Department, while the regulation of the distributary channels rests generally with the peasant proprietors of the soil, locally termed the "Mirassidars." Where the channels irrigate many villages, there is a well recognised custom, defined generally in a written document, settling the days and hours during which each village is to take water, and similar rules lay down each man's turn within the village. An establishment, paid and appointed by the "Mirassidars," manages the distribution of water to the fields. On all the large systems, such as the Palar Anicut, &c., where a series of tanks is fed from an anicut, the regulation of the water at the head works is in the hands of the Public Works Department, while the distribution from the tanks rests entirely with the ryots. On the channel systems of irrigation various rules apply; on some, the regulation of the supply from the river is managed by the Public Works Department, while the distribution of water from the channel itself is controlled by the Revenue Officers; on others, the entire control is in the hands of the ryots, and no Revenue Officer or Public Works Officer interferes with them. On the Tambrapurni Channels above the Srivaikuntham Anicut, the Public Works Department controls the supply entering the upper channels and passing the weirs, but have no authority to check waste of water on the channels, or to see that it is fairly distributed, and each ryot therefore practically takes as much water as he likes. On the Srivaikuntham Anicut system itself, the regulation and distribution is in the hands of the Public Works Department. Finally, to complete this sketch of the regulation and distribution of water throughout the Presidency, it only remains to add that the disposal of water stored in tanks rests entirely with the ryots interested, who regulate the sluices, distribute the supply, and manage for themselves every detail.

28. *Revenue due to Irrigation.*—Reference was made in paragraph 5 to the system which prevails in this Presidency with regard to the assessment of irrigated land. Except in the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment is consolidated, and the shares due respectively to "Land" and "Water" can only be approximately determined. Until 1880 no information existed on this head, but, as it was absolutely required in order to determine the financial position of works of irrigation, an approximation has since been made of the "revenue due to irrigation" as distinguished from the total revenue derived from irrigated land, for (1) all Productive Public Works, and (2) Irrigation and Navigation Works, for which Capital and Revenue accounts are kept, not classed as "Productive" from the commencement of the works up to date; similar information for (3) the works for which individually a continuous record of expenditure is kept is still under preparation. For the year 1882-83 the information for this class of works has already been prepared, as well as for (4) all other Irrigation and Navigation works for which Capital and Revenue accounts are not kept, but it is not considered necessary that the accounts should be prepared for previous years in the case of this last class of works. For the determination of the share due to irrigation resulting from the disintegration of consolidated assessments, elaborate rules have been framed. Briefly in the case of single wet crop the rules are (*a*) where assessments have been revised by the Settlement Department, the consolidated assessments are resolved into Land and Irrigation revenue respectively, by assigning to "Land" the amount proper to dry lands of the same class and sort in each village, and the remainder to "Water;" (*b*) where settlements have not been revised the average dry rate of the village, or where that is not available of the tálooks, or where that cannot be determined of the district, is applied to the total area irrigated. The product is then assigned to "Land" and the remainder to "Water." With regard to double-crop lands, the charge for the two crops is consolidated—the charge for second-crop being essentially in the nature of a water-rate. Everywhere but in Tinnevelly, the normal charge for double-crop land is one and half

times the charge for single-crop land of the same class and sort, and it therefore follows that one-third of the consolidated double-crop assessment represents the normal second-crop charge for the Presidency generally. In Tinnevelly, the normal charge for double-crop land is one and two-thirds that for single-crop, and the normal second-crop charge in Tinnevelly is therefore two-fifths of the consolidated double-crop assessment. The additional charge for second-crop assigned to "Water" is therefore two-fifths of the entire assessment in the Tinnevelly District, and one-third in all other districts, while the remainder is assigned to "Land," in the same manner as for single-crop land.

29. *Water-rates.*—In the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment on irrigated lands are not consolidated, but a separate water-rate is levied on the area irrigated. The following are the water-rates now in force:—

—	Godávari and Kistna Deltas.	Kurnool Canal.
	Rs.	Rs.
Single wet crop per acre	4	4
Second wet crop per acre	4	3
If compounded for both crops for not less than five years	6½	6
Single dry crop	2	1
Second dry crop on irrigated lands if not compounded	2	1
Garden crop	8	6
Garden crop if compounded for not than less five years	6½	...
Crops requiring frequent floodings	...	3

On the Kurnool Canal, with a view to stimulate the ryots to extend their wet cultivation by converting their lands from dry into wet, certain concessions are allowed on the above rates as follows:—A reduction at 50 per cent. for the first five years, and at 25 per cent. for the second five years, is made, in the case of lands which have not been cultivated within the last ten years. For blocks of 50 acres and upwards of unoccupied lands taken up for irrigated cultivation, water is supplied, without restriction as to crops, free of charge for five years, and at half rates for another five years.

30. *Management of Traffic and Tolls and License Fees on Navigable lands.*—The navigable canals in this Presidency under the charge of the Public Works Department are:—

—	Present Lengths.	Ultimate Lengths.
	MILES.	MILES.
Godávari Canals	458	502½
Kistna Canals	278	349
Buckingham Canal	261	261
Kurnool Canal	190	190
Total	1,187	1,302½

The circumstances of the Godávari and Kistna Canals are most favourable for navigation, as there are few locks, owing to the gently sloping nature of the country permitting the main lines to be carried on without such accessories to navigation. On these canals, as well as on the Buckingham Canal, private boats carry all the traffic. The late Madras Irrigation and Canal Company, when they had charge of the Kurnool Canal, assumed the function of carriers; but, after the transfer of the canal to Government, the boats were let out to private individuals, who now conduct the traffic on the canal, which was also, from July 1883, brought under the same navigation rules as the three other canals. Prior to this date, there were no rules authorized by Government on the Kurnool Canal, the rules for navigation formerly in force under the Company being in vogue.

Boats are licensed to ply on these canals on payment of an annual fee, and those not holding licenses are required to pay tolls for each trip. Prior to July 1883, separate licenses were issued for the Godávari and Kistna Canals, and for each section of the Buckingham Canal, but, with a view to remove obstacles and stimulate traffic, the system of using separate licenses was abolished in 1883, although it

involved a reduction of revenue, and the following rates of license fees and tolls are now in force :—

License Fees.

Cargo boats	Rs.	2½ a ton of 50 cubic feet.
Passenger boats not bound to carry all castes, and charges for freight not limited	„	5 do.
Passenger boats bound to carry all castes, and to charge for freight not more than 2 pies per mile per passenger in the general cabin, and 3 pies per mile per passenger in the fore or aft cabin, including one cooly load of baggage	„	3 do.
Steamers	„	5 do.
Pleasure boats	„	1 per boat.

Tolls.

Cargo or passenger boat	„	½ per ton of 50 cubic feet.
Steamer	„	1 do.
Pleasure boats	„	3 per boat.
Timber raft	„	½ per 100 square feet.
Bamboo raft	„	¼ do.

A license entitles the vessel to use any, or all, the canals without any other payment whatever. A toll once paid clears the vessel over all the canals, and in any direction, for a period of six weeks, and rafts for one month. Each passenger is allowed a space of 7½ square feet. The extreme dimensions of any vessel allowed to navigate the canals are 90 feet in length, 13 feet breadth over all, fixed fittings 6½ feet high over water level, and draught 2 feet. Rafts are not allowed to exceed 90′ × 12′ × 2.

Toll stations are established at the head locks of each section of the Godávari and Kistna Deltas, at all tidal locks, at the Ellore lock, and at four stations on the Buckingham Canal. A wharfage fee of 1 anna per ton on the registered tonnage on each boat loading or unloading, is charged at the authorized wharfs, but at present the only wharfage station is at Madras.

Executive Engineers, and officers authorized by them, are vested with the power of suspending the license of any vessel for overloading, wrong mooring, not carrying lights, not producing licenses, or for any other infringement of the rules prescribed for navigation as follows :—

15 days for the first offence,
30 days for the second offence
60 days for the third offence

in the same year. For a fourth offence the license may be cancelled. The following statement shows the statistics of traffic for the past two years on the four canals :—

Particulasr.	Godávari.		Kistna.		Buckingham Canal.		Kurnool Canal.	
	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.
Laden boats, number of trips.	19,000	20,520	7,627	7,566	24,982	*17,494	...	...
Empty boats, do. ...	15,025	17,096	4,472	4,220	2,817	7,87,166	...	...
Passenger boats, do ...	21,678	22,448	8,043	9,867	7,970	24,127	...	...
Tonnage	234,564	262,530	110,202	114,710	337,992	17,983	2,773	3,234
Ton-mileage	6,465,893	7,343,834	3,085,411	3,399,929	4,961,087	50,424	...	...
Value of goods, Rs.	1,42,00,998	1,26,17,048	91,04,133	92,03,167	1,00,35,339	98,23,228	3,27,500	7,08,867
Number of passengers ...	422,783	946,813	221,069	451,172	98,802	56,664	...	...
Tolls and License fees † Rs.	57,439	48,472	36,435	22,916	99,758	35,421	10,683	4,592

On the Kurnool Canal the traffic is worked by Government boats let out on hire.

31. STATISTICS. *Financial position of all Irrigation Works for which Capital and Revenue Accounts are kept.*—In paragraph 3, the financial position of each of the Productive Public Works in operation up to the end of 1882-83 was given. The following statement shows the financial position of each of the works for which capital and revenue accounts are kept, but which are no tclassed as Productive up to the end of 1882-83.

* The decrease in traffic on the Buckingham Canal in the year 1883-84 was due to the decrease in the salt traffic.
† The decrease in the receipts from tolls and license fees during the year 1883-84 was due to the reduction in the scale of fees from 1st July 1883.

Statement of Financial Results of Irrigation Works for which Capital and Revenue Accounts are kept, not classed as Productive up to end of 1882-83.

Systems.	Total Estimate including Indirect Charges.	Total Outlay to end of 1882-83.	Total Revenue due to work's to end of 1882-83.	Charges to end of 1882-83.			Total Deficit after payment of all Charges.	Percentage of Deficit on Capital Outlay.
				Working Expenses.	Interest.	Total.		
1	2	3	4	5	6	7	8	9
PUBLIC WORKS NOT CLASSED AS PRODUCTIVE.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Imperial.								
Chembrambakam Tank	7,24,648	7,36,589	2,95,835	30,163	2,86,128	3,16,291	20,456	2·78
Pálár Anicut system	19,93,893	16,80,935	13,23,351	7,41,596	13,71,171	21,12,767	7,89,416	46·96
Pelandorai do.	4,48,246	3,87,028	23,767	2,19,635	99,205	3,18,840	2,95,073	76·24
Total Imperial ...	31,66,787	28,04,582	16,42,953	9,91,394	17,56,504	27,47,898	11,04,945	39·40
Provincial.								
Buckingham Canal	92,91,954	53,74,499	18,42,232	13,13,810	18,90,504	32,04,314	13,62,082	25·34
Madras Water-Supply and Irrigation Extension Project	18,25,615	17,09,997	1,21,628	1,27,480	8,40,719	9,68,199	8,46,571	49·50
Total Provincial ...	1,11,17,569	70,84,496	19,63,860	14,41,290	27,31,223	41,72,513	22,08,653	31·17
Grand Total ...	1,42,84,356	98,89,078	36,06,813	24,32,684	44,87,727	69,20,411	33,13,598	33·50

The following general statement shows the financial position of all imperial works for which capital and revenue accounts are kept, from the years 1879-80 to 1882-83.

—	Capital Expenditure (Direct and Indirect) to end of year.			Revenue (Direct and Indirect.)	Maintenance Charges (Direct and Indirect.)	Net Revenue.	Percentage of Net Revenue or Capital Outlay to end of year.
	Productive Public Works.	Public Works for which Capital and Revenue Accounts are kept.	Total.				
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1879-80	2,04,42,429	23,73,646	2,28,16,075	38,07,921	11,12,151	26,95,770	11·81
1880-81	2,07,57,153	28,38,935	2,35,96,088	41,05,459	13,99,482	27,05,977	11·47
1881-82	2,09,95,698	29,24,961	2,39,20,659	36,30,105	11,55,884	24,74,211	10·34
1882-83	3,91,03,451	28,04,582	4,19,08,033	35,02,255	9,11,729	25,90,526	6·18

The very large decrease in the percentage of net revenue on capital outlay in 1882-83 was entirely due to the purchase by Government in that year of the Kurnool Canal from the late Madras Irrigation and Canal Company, and to its classification as a Productive Public Work.

32. *Area irrigated and revenue derived from all classes of Irrigation Works during the year* 1882-83.—In paragraph 7, together with the table exhibiting figures of rainfall, were shown by districts the figures of irrigated area and gross revenue ("land" and "water") derived from all classes of irrigation works for the year 1882-83 ; in paragraphs 10—21 inclusive, were given the figures of irrigated area and irrigation revenue of each of the works for which capital and revenue accounts are kept for 1882-83 ; in paragraph 23, similar information was given for each of the works for which a continuous record of expenditure is kept individually, while, in paragraph 24, was given a statement by districts showing the irrigated area and irrigation revenue of all the remaining works. The following general statement shows the total irrigated area of first crop and total revenue derived from irrigation, for each class of works, during the year 1882-83, the latest year for which the information is available :—

—	Area.	Revenue.
	ACRES.	RS.
Works for which Capital and Revenue Accounts are kept—		
I. Productive Public Works	1,756,344	57,59,623
II. Works not classed as Productive	89,796	2,95,357
Works for which neither Capital nor Revenue Accounts are kept—		
III. Works for which a continuous record of expenditure is kept individually ...	342,684	16,88,985
Works for which a continuous record of expenditure is kept collectively. IV. "Imperial" Works ...	1,028,134	33,95,784
Works for which a continuous record of expenditure is kept collectively. V. "Minor" Works	1,170,185	33,21,457
Total ...	4,387,116	1,44,61,206

33. *Percentage of Irrigation under works of each class and incidence of revenue per acre irrigated.*—The total area of Acres 4,387,116, as shown in the preceding paragraph, taken up for first crop irrigation during the year 1882-83 was 20·43 per cent. on the total cultivated area of the Presidency. Of the total area of first crop irrigation, Acres 871,533, or nearly 19·87 per cent., were irrigated for a second crop also. The total area occupied for irrigation was divided as follows among the works of the several classes :—

40·03 per cent. under Productive Public Works,
2·04 per cent. under Irrigation and Navigation Works for which capital and revenue accounts are kept, but not classed as Productive,
7·81 under works for which individually a continuous record of expenditure is kept,
23·45 per cent. under the "Imperial" Works retained under the charge of Public Works Department, and
26·67 per cent. under the "Minor" Works under the charge of Collectors.

The incidence of irrigation revenue per acre for each class of works is as follows :—

—	Average Irrigation Revenue per Acre.
Works for which Capital and Revenue Accounts are kept—	
I. Productive Public Works	3·27
II. Public Works not classed as Productive	3·28
Works for which neither Capital nor Revenue Accounts are kept—	
III. Works for which a continuous record of expenditure is maintained individually	4·93
IV. "Imperial" Works	3·30
V. "Minor" Works	2·83

The incidence of irrigation revenue per acre on the works of Classes I and II, and on the more important works of Class III is shown in the following table :—

—	Area irrigated.	Average Irrigation Revenue per Acre.
Productive Public Works—		
Godávari Delta	504,213	3·09
Kistna do.	261,158	3·19
Penner Anicut	63,653	3·69
Kurnool Canal	14,903	3·32
Cauvery Delta	892,871	3·25
Srivaikuntham Anicut	19,546	8·79
Total ...	1,756,344	...
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	12,763	3·78
Palar Anicut	66,212	3·28
Palandorai Anicut	3,386	2·54
Madras Water-Supply and Irrigation Extension Project	7,435	2·84
Works for which individually a continuous record of expenditure is kept—		
Lower Coleroon Anicut	105,599	2·94
Tambrapurni river above Srivaikuntham Anicut	53,310	11·21
Bhavani River	28,529	7·04
Amaravati River	25,645	5·43

From the above it will be noticed that the irrigation under the Tambrapurni river above the Srivaikuntham anicut, under the Srivaikuntham anicut, and on the

Bhavani and Amaravati rivers, is proportionately more valuable than that on the other systems.

33. *Incidence of Expenditure on all works for which Capital and Revenue Accounts are kept.*—The following statement exhibits the capital expenditure per acre irrigated from the commencement of the works up to the end of 1882-83, and the maintenance charges debited to revenue during the year 1882-83, for all works for which capital and revenue accounts are kept :—

Statement showing the Average Cost of construction and maintenance of works for which Capital and Revenue Accounts are kept.

—	Average Expenditure per Acre.	
	Capital Account to end of 1882-83.	Revenue Account during 1882-83.
Productive Public Works—		
Godávari Delta	18·23	0·64
Kistna do.	22·50	1·06
Penner Anicut	22·45	0·72
Kurnool Canal	1189·36	8·95
Cauvery Delta	1·17	0·35
Srivaikuntham Anicut	63·34	1·48
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	48·92	0·32
Palar Anicut	24·94	0·63
Pelandorai Anicut	104·41	13·79
Madras Water-Supply and Irrigation Extension Project	198·11	2·20

From this statement it will be seen that the capital cost of the Kurnool Canal, in proportion to its irrigated area, far exceeds that of any other work, while the capital expenditure on the Pelandorai anicut and Madras water-supply works is disproportionately high as compared with the remaining works. With the exception of the expenditure incurred on repairs to the Pelandorai anicut during 1882-83, when the breached portions of the anicut was restored, the year 1882-83 approximately represents the normal cost of working expenses of these systems, and the statement therefore shows that the only work on which the cost of maintenance is abnormally high is the Kurnool Canal. Hitherto, also owing to the serious accidents, the works have received, the maintenance charges of the Pelandorai anicut have been abnormally high, and have averaged Rupees 9·74 per acre from the construction of the works in 1875-76 up to the end of 1882-83. In the year 1899, when the full area of irrigation will be in operation, it is estimated that the maintenance charges of this system will be reduced to about 12 annas per acre.

34. GENERAL. *Legislative enactments affecting the Irrigation Branch.*—At the present time, the Act known as "The River Conservancy Bill" is the only legislative enactment affecting irrigation, which has passed the Madras Legislative Council. As long ago as 1856, a draft enactment was instituted to provide for the safety of life and property, during river-floods, by means of a Bill enabling the officers of Government to attend properly to the conservancy of the great rivers of the Presidency, but it was only in March 1884 that the Bill, after being under consideration for several years, was finally amended and passed by the Madras Legislative Council, and only now awaits the sanction of the Supreme Government to become law. The principal object of the Bill is to give the officers of Government full power to prevent and prohibit the damage, which is at present inflicted on both private and public property, by the unauthorized action of private individuals, in forming and removing constructions within river-beds. Formerly, no officer of Government could in any way check the action of individuals in such matters, without rendering himself liable to a suit for damages, and much public money was accordingly spent on works designed to counteract the evil effect of private or unauthorized interference with the river-beds. The Act provides for the appointment of officers to be styled "Conservators of Rivers," who have power

to prohibit cultivation within river-beds; to direct the removal of all constructions, plantations, &c., which they deem to be an obstruction to the course of the river; and to take any measures which appear to them to be necessary for the safety of life or property, in connection with any river to which the Act has been applied.

35. *Further Legislation proposed.*—An important Bill now under consideration is that known as the "Madras Irrigation Act," which was originally drafted in 1883, was circulated to the Governments of Bengal, Bombay, and the North-West Provinces, for opinion on certain points, and has lately been referred to a Committee. The object of the Bill is to make provision for the construction, maintenance, and regulation of canals, for the supply of water therefrom, and for the levy of rates for the water so supplied. It will empower canal officers to duly inspect and regulate the water-supply; to remove obstructions; to execute repairs where the owner of a "water-course" fails to execute the repairs required of him by the Bill, and to charge the cost of such repairs to the owner; to settle disputes as to rights and liabilities of persons interested in a "water-course;" and to take into custody persons causing wilful damage to canals, or interfering, without proper authority, with the supply or flow of water.

ORDER—dated 26th January 1885, No. 210, Public.

Recorded.

(True Extract.)

R. S. BENSON,
Ag. Under Secy. to Govt.

To the Public Works department, Irrigation branch.

Exd. J. Wright.

Govt. of {1885} Madras.

PUBLIC.

Issued

Recd. *Encl.*

G.O., 26th January 1885, No. 210.

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JANUARY.

Manual of the Administration.

Recording a paper on Irrigation.

GOVERNMENT OF MADRAS.

PUBLIC DEPARTMENT.

READ—the following paper by A. S. RUSSELL, Esq., Under Secretary, Public Works department, on special duty; with note from the Secretary to Government, Public Works department, No. 566 E., dated 27th August 1884:—

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2. History and constitution of the branch.
3. Financial policy of Government in respect to irrigation works, and its results in the Madras Presidency.
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5. Classification of revenue on irrigation works.
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PUBLIC WORKS—IRRIGATION BRANCH.

INTRODUCTION.

1. *Definition of the Branch.*—The irrigation branch of the Public Works department deals with all works of irrigation and internal navigation, and with connected agricultural works, such as river conservancy, river embankments, drainages, &c.

2. *History and Constitution of the Branch.*—The branch was first constituted in the year 1867, when it was made a subordinate branch of the Public Works department by the appointment of a Chief Engineer for Irrigation, and early in 1877 it was made a distinct and independent branch in direct communication with Government. The Chief Engineer for Irrigation—who is also Joint Secretary to Government in the irrigation branch, and in that capacity lays before Government all matters requiring its decision—is the responsible executive head of the branch in all professional matters connected with the special subjects pertaining to the irrigation branch; and, together with the Examiner of Public Works Accounts, who is the head of the accounts branch, exercises control over the officers of the department employed on works of irrigation and navigation, in respect to the expenditure and disbursement of public money, the custody of stores, and the due submission of accounts. The Chief Engineer for Irrigation also prepares the budget estimate and all reports relating to his branch, and it is his special duty to check and examine all designs for irrigation projects, and to lay them before Government, accompanied by a distinct expression of his opinion regarding their merits. He is assisted in his office work by an Assistant Chief Engineer for Irrigation, who is also Under Secretary to Government, and by a suitable office establishment, but no separate and distinct executive establishment is maintained for employment upon irrigation works, owing to the exceedingly scattered nature of such works in the Madras Presidency. The officers and subordinates employed on irrigation works are provided from the one general list of the Public Works department; attend to other public works besides those of irrigation; and as regards their posting and general discipline are under the orders of the Chief Engineer, Public Works department. The cost of the one general establishment is debited, in the first instance, to Provincial Funds, and the irrigation branch is charged with a fixed percentage, on account of the portion of the establishment employed on irrigation works, as a contribution to "Provincial," at the following rates :—

(*a*.) 23 per cent. on expenditure on original works and repairs, excluding expenditure in England and payments for land compensation.

(*b*.) 10 per cent. on the "Direct"* revenue collected in the Public Works department.

(*c*.) 6 per cent. on the gross "indirect" revenue (i.e., revenue realised in the Civil department and credited to the Public Works department) due to Productive Public Works, including the share due to old irrigation, but excluding the enhanced share of land revenue.

It is also under contemplation to make a further charge to "irrigation" on account of establishment, by means of a fixed percentage on the "indirect" revenue due to works not classed as Productive.

3. *Financial Policy of Government in respect to Irrigation Works and its Results in the Madras Presidency.*—Previous to the year 1854, expenditure incurred on irrigation works of all descriptions was treated as ordinary expenditure, and was charged against the general revenues of the year. Under this system the large irrigation works of the Godávery, Kistna, and Cauvery Deltas were begun. After

* See paragraph 5.

1854, as it was recognised that the system of charging the cost of large works, expected to prove remunerative, against the general yearly revenue was a false one, a distinction was made between the expenditure incurred on

(*a*) the maintenance and repair of existing irrigation works, and the construction of the smaller works necessary for the due development of irrigation, which it was decided to charge as formerly against the yearly revenues of the country; and

(*b*) the construction and extension of large irrigation works of permanent public utility, calculated materially to increase the wealth and promote the prosperity of the country, which were to be constructed by means of money raised on loan, and were to be treated as financial concerns by opening for them capital and revenue accounts, so that their exact financial position could at any time be ascertained.

The outbreak of the mutiny prevented the prosecution of the schemes for promoting irrigation by means of money raised on loan, and it was not until 1858 that the Madras Irrigation and Canal Company was formed with a Government guarantee of 5 per cent. This work was financially a failure, and warned by this example and by experience elsewhere of the unsuitability of the agency of private companies in the construction of irrigation works, Government have constructed all other irrigation works in the Madras Presidency by the direct agency of their own officers. This decision was arrived at in 1867, when the policy of guaranteed companies for the construction of irrigation works was finally abandoned in favour of what was then called the "Extraordinary" Public Works policy, whereby large works of irrigation expected to prove remunerative were to be constructed by Government from money borrowed annually by the State, when the ordinary revenues were insufficient for the purpose. The capital expenditure incurred on the large irrigation works of the Godávery, Kistna, Cauvery, and Penner rivers continued up to the year 1879, in accordance with the policy above stated, to be met partly from Loan Funds and partly from ordinary revenue. In 1879, however, the expenditure under the latter head was written back to Loan Funds in the accounts, as if constructed from money raised on loan. The reason why this course became necessary in 1879 was owing to the following cause :—

The understanding on which "Extraordinary" Public Works were originally undertaken was that, if money was available from the general revenue of the country, it was to be made use of, and borrowing was only to be resorted to in case of need. But, as it was found impossible to determine exactly the profit derived from expenditure incurred from Loan Funds, the works having been carried out partly from Loan Funds and partly from ordinary revenue, it was ruled in 1879 that the entire cost of the works, from whatever source the expenditure was met, should be brought together in one account, and that no part of the cost of construction or improvements to such works should thereafter be charged to ordinary revenue.

From 1867, therefore, the distinction between the two classes of works (*a*) and (*b*) has been strictly observed, while practically the cost of the first-named works has, since 1854 to the present time, alone been charged as ordinary expenditure against the general yearly revenue of the country, and those in the latter category have virtually been made with borrowed money, as the expenditure incurred on them from ordinary revenue was comparatively small. The expenditure upon the extension of irrigation may, therefore, be said to have passed through three phases :—

First.—From the establishment of British rule to 1854, when the annual disbursements were comparatively small, and were met from yearly revenue.

Second.—From 1854 to 1867, during which time the experiment of private companies was tried in addition.

Third.—From 1867, the date of the "Extraordinary" Public Works policy, under which all irrigation works were undertaken by the State, and a certain sum was devoted annually to their prosecution.

In 1876-77 the term "Extraordinary" was dropped in favour of that of "Productive;" and very strict rules (which have since that date been reiterated with increased emphasis) were laid down, limiting the outlay of borrowed money to works which were likely to be remunerative, by yielding in the shape of annual income within ten years after completion a sum equal to the interest on the money expended on their construction. In point of fact, from the very commencement, in 1867, of the policy embodied in the Productive Public Works scheme, it was assumed that the works comprised in the category of, and sanctioned as, Productive Public Works, would prove remunerative, and orders on the subject were issued, though it was not until 1876-77 that stringent limitations regarding the certainty of their financial success were insisted upon before works could be so classed. How far this assumption has been realised in the case of the Productive Public Works of the Madras Presidency will be seen from the following figures, exhibiting the total gain or loss to the State from outlay on works originally so classed :—

Statement of Financial Results of Irrigation Works classed as "Productive," in the Madras Presidency up to end of 1882-83.

Systems.	Total estimate including indirect charges.	Total outlay to end of 1882-83.	Total revenue due to works to end of 1882-83.	Charges to end of 1882-83.			Surplus revenue after payment of all charges.	Percentage of surplus revenue on capital outlay.
				Working expenses.	Interest.	Total.		
Productive Public Works.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	
1. Godávery Delta system.	1,30,32,653	1,10,20,241	3,21,40,280	83,09,475	81,74,910	1,64,84,385	1,56,55,895	142·06
2. Kistna do. do.	1,49,00,944	63,30,628	1,49,75,292	46,01,857	48,19,225	94,21,082	55,54,210	87·74
3. Penner Anicut do.	18,94,784	16,65,159	13,61,115	1,51,356	10,74,532	12,25,888	1,35,227	8·12
4. Cauvery Delta do.	18,54,847	11,50,238	1,38,42,450	— 1,85,934	11,60,217	9,74,283	1,28,68,167	1118·74
5. Srivaikuntham Anicut system	14,76,806	13,12,135	6,11,579	2,64,497	5,92,518	8,57,015	— 2,45,436	— 18·71
Total ...	3,31,66,034	2,14,78,401	6,29,30,716	1,31,41,251	1,58,21,402	2,89,62,653	3,39,68,063	158·15

The Madras Irrigation and Canal Company's Canal, which was purchased by Government in 1882, and was classed as a Productive Public Work in the same year, was, as has already been explained, constructed by a private company, and has therefore purposely been excluded from the foregoing statement as embodying the result of a different policy. The enormous loss which this work has entailed upon the State is shown by the following figures :—

Statement showing the financial result of the Kurnool Canal from its commencement up to end of 1882-83.

CAPITAL EXPENDITURE.

	Rs.
Amount paid by the Secretary of State to the company for the purchase of the canal ...	1,76,25,050

REVENUE RECEIPTS.

Total irrigation revenue from the commencement of the work to the end of 1882-83	10,73,097
Total navigation and other receipts collected up to 31st March 1883	2,07,764
Total ...	12,80,861

CHARGES.

Total working expenses to end of 1882-83 ...	18,55,385
Total interest charges	135,60,282
Total ...	1,54,15,667
Net loss ...	1,41,34,806

About the year 1881 a new class of works, called Protective Public Works, was instituted, and may be defined as works, which, although not directly remunerative to the extent which would justify their inclusion in the class of Productive Public Works, are calculated to afford a protection against famine, and to guard against a probable future expenditure in relief of the population. A certain proportion of the total sum of $1\frac{1}{2}$ millions sterling annually reserved for "Famine Relief and Insurance" purposes is appropriated for works of this class.

4. *Classification of irrigation of works.*—All works under the charge of the irrigation branch are divided into the three following main heads :—

I. Productive Public Works.
II. Public Works not classed as Productive.
III. Protective Works.

I. *Productive Public Works.*—Productive Public Works are those specially classed under that head, in consideration of their remunerative character. The cost of their construction or material improvement is met from Loan Funds; and their working expenses are met from "Ordinary Revenue," to which head the revenue derived from them is credited. The revenue and expenditure of these works are treated as "Imperial," and are held at the disposal of the Government of India, and applied to the general services of the empire, as distinguished from Provincial Funds, which are held at the disposal of the Local Government, and are appropriated to the exclusive wants of the Presidency. The works in the Madras Presidency classed under this head up to the end of 1883-84 are—

Name of Work.	District.
(1.) Godávery Delta	Godávery.
(2.) Kistna do.	Kistna.
(3.) Kurnool Canal	Kurnool and Cuddapah.
(4.) Penner Anicut	Nellore.
(5.) Sangam Anicut	Nellore.
(6.) Barur Tank	Salem.
(7.) Cauvery Delta	Tanjore.
(8.) Srivaikuntham Anicut	Tinnevelly.

For all these eight works capital and revenue accounts are kept. With the exception of the Sangam Anicut and Barur Tank, which have only recently been commenced, they have all been in operation for some years. The Kurnool Canal was classed under the head of "Productive" in the year 1882, owing to the purchase money paid to the late Madras Irrigation and Canal Company being met from Loan Funds.

II. *Public Works not classed as Productive.*—Public works not classed as Productive are sub-divided into

(*a.*) Irrigation and Navigation Works, for which Capital and Revenue Accounts are kept.
(*b.*) Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.
(*c.*) Agricultural Works.

(*a.*) The following are the works for which capital and revenue accounts are kept, which are again sub-divided into "Imperial" and "Provincial," to which heads the expenditure incurred on them is respectively charged.

Name of Work.	District.	
(1.) Chembrambaukum Tank... ...	Chingleput.	Imperial.
(2.) Palar Anicut	North Arcot.	Imperial.
(3.) Pelandorai Anicut	South Arcot.	Imperial.
(4.) Madras Water-supply and Irrigation Extension Project	Chingleput.	Provincial.
(5.) Buckingham Canal.	Nellore, Chingleput, and South Arcot.	Provincial.

The financial results of all the thirteen works for which capital and revenue accounts are kept are tested as follows :—

(*A.*) By considering the "capital" cost of any work to be simply the sum actually spent on its construction.

(*B.*) By debiting the "revenue" account yearly, with the simple * interest on the capital cost of the works at the commencement of the year and with the working expenses of the year.

(*C.*) By crediting the "revenue" account yearly, with the total receipts, "direct" and "indirect."

The difference between (*B*) and (*C*) for any one year shows the profit or loss for that year, while the difference between (*B*) and (*C*) from the commencement of the works to any date shows the financial position of the works at that date. The rules regarding the debit of the outlay on works, for which capital and revenue accounts are kept, are that all the past outlay on construction and all fresh estimates amounting to more than Rupees 2,500 each for the material improvement of the existing works are charged to "capital"; while all outlay on the maintenance and repairs of the works, together with estimates for their extension and improvement amounting to less than Rupees 2,500 are charged to "revenue."

(*b.*) The expenditure on the irrigation and navigation works for which neither capital nor revenue accounts are kept is met from Imperial Funds. Many of these works are of very considerable importance individually, and for such, under the orders of the Madras Government, a continuous record of expenditure has been ordered to be maintained in a simple form, which will afford all the information necessary for administrative purposes and for the determination of their financial value. The number of important works for which such accounts are kept up to the end of 1883-84 is 59. A complete list of these works will be found in paragraph 22.

The remaining irrigation works under (*b*) are of small importance individually, though important collectively, and are dealt with in the groups or classes to which they belong, viz. :—

First.—Irrigation works supplied by rivers and streams.
Second.—Groups of rainfed tanks.
Third.—Isolated tanks—rainfed.
Fourth.—Miscellaneous works including spring-channels, ponds, &c.

(*c.*) Agricultural works are those which do not yield revenue, but which are necessary for the safety or prosperity of agriculture. They are divided into the following main heads :—

River conservancy.
River embankments.
Drainages.
Miscellaneous works.

Expenditure on these works is also met from Imperial Funds.

III. *Protective Works.*—Protective works have already been defined in paragraph 2. They are carried out from Famine Relief and Insurance Funds, formed of insurance taxation levied for famine purposes, and treated as imperial. The only work classed under this head up to the end of 1883-84 is the Rushkulya Project in the Ganjam District.

5. *Classification of Revenue of Irrigation Works.*—The revenue derived from the irrigation works of the Presidency is either direct or indirect. The former, properly speaking, represents revenue *separately* assessed for water supplied by the works, and the latter exhibits the increase of land revenue, which would not have been obtained but for the works. In this Presidency, however, where the ryotwari system of tenure prevails, the Government is virtually sole landlord and also proprietor of the water, and its demand for irrigated land is commonly a lump sum, in which no distinction is made between the charge due for the occupancy of the

* Under recent orders from the Government of India, interest on capital is not to be debited to the "revenue" account for works not classed as "Productive."

land and that due for the use of the water. The whole land revenue is therefore assessed and collected in the Revenue department, and is credited to the head "Land Revenue" without any separation between "Land Revenue Ordinary" and "Land Revenue Irrigated." The water-rates or bulk of the irrigation revenue proper are therefore shown under indirect revenue, while the direct revenue comprises only navigation and other miscellaneous receipts collected in the Public Works department. In the single case, however, of the Kurnool Canal, the water rates are credited to direct revenue, as the system in vogue, under the late Madras Irrigation and Canal Company, was continued after the transfer of the canal to Government.

In addition to the anomaly which exists in Madras of showing the great bulk of the irrigation revenue proper as "Indirect Revenue," a further anomaly is caused by the difference between the official year ending 31st March and the agricultural or revenue year ending 30th June. Owing to this difference between the official and revenue years, the "direct" revenue due to irrigation collected in the Public Works department is shown for the official year, while the "indirect" revenue collected in the Civil department is the net ascertained demand for the revenue year. From the irrigation revenue thus ascertained, the portion due in the more ancient irrigation works to the old irrigation which existed prior to the improvements and additions carried out by the British Government, is deducted, and the share of enhanced land revenue, or assessment on waste lands which would not have been brought under cultivation but for the irrigation works executed, is added thereto. It has already been stated that the water-rates on irrigated lands are collected in the Civil department. In order to provide for these collection charges, a fixed percentage is deducted from irrigation. The rate at which this deduction has hitherto been made is 7·2 per cent. on the ascertained demand, but, from the commencement of the official year 1884-85, the rate has been reduced to 5 per cent., which is found to be approximately the actual cost of collection. In the accounts of the Finance department, revenue derived from irrigation and navigation works is shown under the following heads :—

G. Revenue from Productive Public Works—
XXVII—Irrigation and Navigation (Direct Receipts).
XXVIII—Portion of Land Revenue due to Irrigation.

H. Receipts on account of public works not classed as Productive—
XXXI—Irrigation and Navigation.

Irrigation revenue due to works not classed as Productive is not shown separately in these accounts.

6. *Classification of Expenditure on Irrigation Works.*—Expenditure in the irrigation branch is shown under the following heads in the accounts of the Finance department.

N. Productive Public Works (Capital Account).
51. Irrigation and Navigation.
G. Productive Public Works (Revenue Account).
38. Irrigation and Navigation (Working Expenses).
H. Public Works not classed as Productive.
44. Irrigation and Navigation.
F. Famine Relief and Insurance.
34. Protective Works—Irrigation.

In budget estimates and accounts of the Public Works department, the same heads of account are adopted, except that the head of account denoted by H is sub-divided into the following budget heads :—

Imperial.

I. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
II. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.

III. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept.
IV. Agricultural works.

Provincial.

V. Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account.
VI. Irrigatian and Navigation Works for which Capital and Revenue Accounts are kept— Revenue Account.

Each budget head is divided into departmental heads as shown below :—

Budget heads.	*Departmental heads.*
1. Productive Public Works—Capital Account. 2. Imperial, Irrigation, and Navigation works for which Capital and Revenue Accounts are kept—Capital Account. 3. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Capital Account. 4. Protective Works.	I. Works. II. Establishment. III. Tools and Plant. IV. Suspense Account. V. Less receipts on Capital Account.
5. Productive Public Works—Revenue Account. 6. Imperial, Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account. 7. Provincial, Irrigation, and Navigation Works for which Capital and Revenue Accounts are kept—Revenue Account.	IA. Extensions and Improvements. IB. Maintenance and Repairs. IC. Compensation. II. Establishment. III. Tools and Plant.
8. Irrigation and Navigation Works for which neither Capital nor Revenue Accounts are kept. 9. Agricultural Works.	Original Works, Repairs, Establishment, Tools and Plant, Profit and Loss, Suspense Account.

Expenditure shown under the above departmental heads is termed "direct" as distinguished from that known as "indirect," which is not shown in the Finance Accounts of the department, but only in the Capital and Revenue Accounts, or the Administrative Accounts as they are otherwise called, in view to the profit or loss on the works being exactly determined. "Indirect charges" are of three kinds—

1. Capitalized abatement of land revenue.
2. Loss by exchange.
3. Leave and pension allowances.

These charges are calculated as shown below :—

Item (1) 25 times the annual assessment of lands occupied by the works.
Item (2) at the current rates of exchange on payments in England, which are shown in the Indian accounts *at par*.
Item (3) at 14 per cent. on establishment charges.

With regard to the old maintenance charges of (1) "Productive Public Works," and (2) "Irrigation and Navigation works for which Capital and Revenue Accounts are kept not classed as Productive," such charges are deducted from the total charges on "Revenue," and are added to the expenditure under the head "Irrigation and Navigation Works, for which neither Capital nor Revenue Accounts are kept."

Description of the Madras Irrigation Works.

7. *Sketch of the Geographical Features and Distribution of Rainfall as affecting Irrigation.*—The two great mountain ranges of the Western and Eastern Ghauts give the key to the configuration of Southern India. The Western Ghauts are generally of considerable elevation. They stretch continuously along the entire line of the West Coast of the Presidency, having but a narrow strip of land between them and the sea, and within the limits of the Madras Presidency not a single river breaks through their barrier and flows towards the Eastern Coast. The Eastern Ghauts are of low elevation, lie entirely within the limits of the Presidency, have for the most part a broad expanse of land between their base and the sea, and run in a south-westerly direction, until they lose themselves in the Neilgherries, and there join the Western Ghauts. Their line is pierced by three great rivers, the Godávery, the Kistna, and the Cauvery, as well as by numerous minor streams, so that they do not perform the part of a watershed. These two mountain ranges, from a physical point of view, divide the Presidency into three portions.

(1) The short and narrow Western Coast.
(2) The long and broad Eastern Coast.
(3) The central tableland lying between the two ranges.

Each of these three divisions has natural features of its own; is under different climatic conditions, which are determined by the monsoons; and practise in the main different methods of irrigation for the cultivation of their wet crops. The principal monsoon, which is known as the south-west monsoon and is general over a large portion of India, breaks with great violence on the western shore of the Presidency, where the high ranges of the Western Ghauts catch almost the entire rainfall, which is accordingly exceedingly heavy along this coast. No irrigation, in the proper sense of the word, is practised in this division, but the abundant rainfall renders every species of wet crop capable of being cultivated. The average annual rainfall in this tract is 127·14 inches.

Along the east coast of the Madras Presidency, the main portion of the annual rainfall is brought by the monsoon known as the north-east monsoon, which is peculiar to the Madras Presidency, and generally brings an abundant supply of rain to all the eastern coast districts from the district of Nellore southwards—the coast districts north of Nellore, and especially those of Ganjam and Vizagapatam, deriving the principal portion of their supply of rain from the south-west monsoon. The eastern coast of the Presidency is also subject to cyclonic rainfall, from the cyclones which take place in the Bay of Bengal, and during the continuance of these cyclonic storms the rainfall is exceptionally heavy. The average annual rainfall in this tract is 34·97 inches. This second division therefore is under different climatic conditions from the rest of the Presidency, and in this tract of country, owing to its physical features, irrigation is more extensively practised and developed than in either of the other two divisions. It possesses the alluvial deltas of the three great rivers already mentioned, which rising in the hilly region under the full influence of the south-west monsoon, drain a very large extent of country and have an almost perennial supply; it has also numerous other rivers, which, though not so constant in their supply, bring down great volumes of water during the time of the periodical rains; and it has a copious, though uncertain, rainfall during the north-east monsoon. As a consequence, this division has (*a*) the important irrigation works of the Godávery, Kistna and Cauvery Deltas, in which from a dam placed across the river, a vast system of canals and distributary channels supply the means of irrigation to a large area of country; (*b*) the smaller, though still very important, systems on the Penner, Palar, Tambrapurni and other rivers, where advantage is taken of the river freshes by means of rapidly discharging channels, to store water in a large chain of tanks or reservoirs; (*c*) the very numerous tanks constructed entirely under the native rulers of Southern India, which, from very ancient times, have stored the heavy local rainfall of the north-east monsoon.

The central plateau derives its rainfall from both monsoons, and may be said to consist of the districts of Kurnool, Cuddapah, Bellary, Anantapur, together with those of Salem and Coimbatore. In this division the country is, generally

speaking, bare; the rainfall light and uncertain, averaging 27·92 inches; the means of irrigation difficult; and the ravages of famine, particularly in the four first-named districts, most frequent. It contains many tracts of fertile country cultivated with dry crops; but, with the exception of the irrigation from the Tungabhadra, an affluent of the Kistna, and from the affluents of the Cauvery in the Coimbatore District, the irrigation in this division is individually unimportant, and consists for the most part of tanks intended to store the local showers which the monsoons bring from either coast.

The rainfall of each district of the Presidency, from 1870 to 1883 inclusive, is shown in the following statement. The general duration of the south-west monsoon, which is commonly called the "six months' monsoon," is from June to September inclusive; while that of the north-east monsoon, which is known as the "three months' monsoon," is from October to December. In the interval between the two monsoons, there is little rain, except such as is occasioned by cyclonic rainfall and local thunder showers.

Statement showing the average Rainfall, in each District of the Madras Presidency, for the Fourteen Years from 1870 to 1883.

Districts.	Dry Season—January to May.	South-west Monsoon—June to September.	North-east Monsoon—October to December.	Total.	Area irrigated.	Gross Revenue—("Land" and "Water").
						Rs.
Ganjam	4·71	26·91	11·59	43·21	194,756	5,17,552
Vizagapatam	5·86	23·43	12·40	40·69	47,674	1,54,412
Godávery	3·04	22·32	10·82	36·18	554,455	23,66,295
Kistna	2·99	18·60	11·90	33·49	312,893	13,92,414
Nellore	3·10	10·77	19·40	34·27	215,041	9,91,126
Bellary and Anantapur	3·31	11·94	6·50	21·75	142,756	6,16,088
Kurnool	3·29	18·52	6·14	27·95	49,233	2,41,124
Cuddapah	4·50	13·49	10·33	28·32	197,286	8,95,088
Coimbatore	6·92	9·59	10·98	26·49	98,081	6,60,584
Salem	7·23	16·28	11·57	35·08	97,172	5,08,077
North Arcot	5·31	17·49	14·43	37·23	283,786	13,49,170
Malabar	11·52	97·67	12·01	121·20	...	...
South Canara	9·62	114·07	9·39	133·08	...	...
Chingleput	4·80	16·64	20·65	42·09	366,306	13,22,393
South Arcot	4·78	16·92	18·42	40·12	358,428	17,65,352
Trichinopoly	5·91	12·35	15·91	34·17	178,807	7,71,711
Tanjore	5·43	13·67	23·61	42·71	914,801	40,97,382
Madura	6·07	6·24	12·89	25·20	157,845	6,04,011
Tinnevelly	7·33	3·58	14·62	25·53	217,796	18,32,430
Total ...	...	...	...	...	4,387,116	2,00,85,208

8. *General Sketch of the Irrigation System of the Presidency.*—The uncertainty and great variation in the amount of the annual rainfall, brought by the monsoons, render cultivation precarious and fruitless without the artificial storage and distribution of water, and to meet this ever-recurring difficulty, irrigation works have, from time immemorial, been an absolute necessity of existence in Southern India. The works themselves vary alike in magnitude, in character, and in origin. There are works that yearly irrigate 1,000 square miles; others that do not irrigate 5 acres. Some derive their water from great perennial rivers; others from streams and local drainages, or from the rainfall of half a square mile ponded up in a valley. Some works date from periods, of which there is no historical record; others are the latest outcome of scientific engineering.

Artificial irrigation may be said to be carried out in three ways—first, by utilising the water of rivers; second, by utilising the rain water draining off the land; third, by utilising the subterranean springs and water. These three general methods are in the Madras Presidency sub-divided into the following classes of irrigation works. (1) *River-fed Canal Systems.*—Works drawing their supply from rivers, of which the discharge is at all times of the year, except perhaps for a short period during the hot weather, sufficient without storage to keep up a constant supply of water in the canals for the purposes of irrigation or navigation. Of this type are the great delta systems of the Godávery, Kistna, and Cauvery rivers; the irrigation channels from the Bavani, Amravati, Upper

Cauvery, and other lesser rivers, irrigating long and narrow riparian tracts. In all works of this class the main channels take off directly from a masonry dam, or "anicut" built across the river; and, in the case of the Godávery and Kistna works, the main lines of canal are adapted for navigation as well as irrigation, and form the principal means of communication in the districts which they traverse. (2) *River-fed Systems of Tanks.*—Works drawing their supply from rivers having an uncertain and very variable discharge, which is stored and rendered constantly available for the purposes of irrigation by means of a chain of tanks or reservoirs. Of this type are the systems known as the Penner, Palar, Pelandorai, and Srivaikuntham anicut systems, together with numerous other works of the same character. In all these works main channels leading from an anicut supply a great series of tanks and channels. (3) *Rain-fed Tanks in Groups.*—A succession of reservoirs connected with each other and formed by impounding the drainage from the catchment basin above them, by means of long embankments thrown across valleys, or by short embankments thrown across gorges. Vast numbers of such works exist, and in many districts form very large groups. (4) *Isolated Tanks.*—Reservoirs obtaining a supply from a small river or stream, or from the drainage of the catchment area above them. These works, though not forming nearly so numerous a class as those of the preceding, are in some cases of considerable importance. (5) *Well Irrigation.*—This system of irrigation, though not coming in any way within the special province of the irrigation branch of the Public Works department, forms an indispensable part of the general system of irrigation of Southern India. In addition to the above five classes of irrigation works, there are in the Madras Presidency two works solely intended for internal navigation. These are the salt-water canals of the Eastern and Western Coasts. The first known as the Buckingham Canal connects the Godávery and Kistna systems of navigation with the district of South Arcot by means of a navigable canal 261 miles in length. The second, which is practically a system of connected backwaters, is under the management of the Native States and Local Fund Boards, through whose districts it passes.

9. *Detailed Description of the more Important Irrigation Works.*—In paragraph 4, giving the classification of irrigation works, all classes of irrigation works were mentioned, while the names of the works for which capital and revenue accounts were detailed. It will now be necessary to return to this classification, in order to describe the irrigation works of the Presidency in order of their importance. The following description of the works will therefore give (I) a detailed account of the works classed as Productive, (II) a briefer account of the works for which capital and revenue accounts are kept, but which are not classed as Productive; and a general description of (III) the works for which a continuous record of expenditure is kept individually; (IV) works for which a continuous record of expenditure is kept collectively; and (V) Public Works classed as "Protective."

10. *The Godávery Delta System.*—This work like those of the Kistna and Cauvery Deltas is one of a type special to the Madras Presidency. In all these delta systems, the river flows along a central ridge formed by the deposit of its own alluvium, while, on each side of this ridge the ground—formed by successive inundations of the river itself—slopes a way from either bank with a gradual fall, and enables an anicut, built at the apex of the natural delta thus formed, to have a working command of water over the whole area comprised within the limits of the delta.

I. Productive Public Works.

The river Godávery, the largest and most important of the rivers traversing the Madras Presidency, rises in the Western Ghauts, and, at the site of the Godávery Anicut, is 898 miles in length; has a drainage basin of 115,570 square miles; and a maximum flood discharge of 1·21 millions cubic feet per second. The anicut was commenced in 1844-45, and commands an alluvial tract of country of 2,020 square miles in area. It is a massive work of masonry, and is built across the sandy bed of the river at a spot 33 miles from the coast, where the river is nearly 4 miles broad, and is divided by three islands into four channels. Of these, the two eastern channels re-unite just below the anicut, and similarly the two western channels. The land included between these two principal branches forms what is known as the central delta, while that on the eastern branch is called the eastern

delta, and that on the western branch the western delta. The irrigation in each of these three natural divisions is distinct, and is supplied by a head sluice and main canal from the anicut. This great work consists of a masonry dam built in separate portions between the islands, the total length of the masonry work being 3,982 yards. The general section of the dam consists of, first, a front curtain wall running along the whole length, resting on wells; second, a horizontal flooring or waste-board 19 feet in breadth; third, a masonry counter-arched fall 28 feet in breadth; fourth, a rough-stone apron in rear formed of massive stones, and extending about 184 feet down stream, so as to protect the rear foundations against the erosive action of the water passing over the dam. The crest of the anicut is 38 feet above mean sea level; 13 feet above level of top of foundations; and the greatest depth of water which has passed over it is 15·25 feet. The delta is fully supplied when 3 feet of water is passing over the anicut crest. On both flanks of the dam, and at the head of the central delta, is a lock for the passage of craft; an under sluice for purposes of scour and clearance; and a head sluice from which takes off the main canal of each delta, and supplies a network of branch and distributary channels, of which the principal ones are adapted for navigation as well as irrigation. The dimensions of the head sluices are as follows:—

Eastern, 13 vents 6′ × 8′
Central, 15 vents 6′ × 8½′
Western, 15 vents 7½′ and varying in width from 5½′ to 6′.

the sills of each sluice being 6 feet below the level of the anicut crest. The capacity of the three main canals is—

	Discharge in cubic feet per second.
Eastern	2,826
Central	1,745
Western	3,945
	8,516

The system is not yet finished, but is expected to be completed by the year 1889—1890, and the completion estimates, amounting to a total of Rupees 1,30,32,653 for direct and indirect charges, have been sanctioned by the Secretary of State as follows:—Direct charges, Rupees 1,10,88,695, indirect charges, Rupees 19,43,958. The length of navigable canals is 458 miles, which will be increased to 502½ miles on completion of the works. The extent of irrigation in 1882-83 was 528,129 acres, which will be extended to 612,000 acres on completion of the works. The net annual income of the system for the year 1882-83 was Rupees 12,11,028, and the surplus revenue, after payment of interest charges, was Rupees 8,45,830. A reference to the statement of paragraph 3, exhibiting the financial result of Productive Public Works up to the end of 1882-83, will show that the works have paid 142·06 per cent. on the total capital outlay, i.e., the system has paid in surplus revenue nearly one-and-a-half times the money expended upon it. On completion of the works in 1889-90, it is estimated that the system will yield a net annual return of 12·7 per cent. on the total capital outlay of Rupees 1,30,32,653. These highly satisfactory financial results do not represent by any means the total profits which have accrued to the State from this most successful work. Directly traceable to the work are the enormous increase in the import and export trade, the rise in land revenue, in population, and in the general prosperity of the district; while as an insurance against famine, the work is invaluable. One instance of this last fact may be cited. During the famine of 1876-77, when every unirrigated district was importing enormous quantities of grain to feed its population, the quantity of grain exported from the Godávery District was valued at £1,740,000.

11. *Kistna Delta System.*—The river Kistna, the second in point of size of the rivers of the Presidency, rises in the Western Ghauts, close to the source of the Godávery. The anicut is built at the natural head of the delta, where the river flows between rocky hills, and is only 1,300 yards wide, or much narrower than its normal width. At the head of the delta, the river is 800 miles long; has a drainage area of 97,050 square miles; and a maximum flood discharge of 736,000 cubic feet per second. The anicut which was commenced in the year 1852 is situated 45 miles from the sea in a direct line, 60 miles by river, and commands a

delta, which is separated into two natural divisions, respectively called the eastern and western divisions, by the river itself, of 2,110 square miles in area. Like the Godávery dam the Kistna Anicut is constructed on a sandy river bed. It consists mainly of a body wall of stone in mortar founded upon a double row of wells. The body wall is 1,238 yards in width from wing to wing; 6 feet wide at top; and has its crest or sill-board 20 feet above the deep bed of the stream, and 15½ feet above the summer level of the river; and is backed on the down stream side by a massive rough stone apron, containing about 400,000 cubic yards of stone, and sloping away down stream for a distance of 257 feet. In this apron, at a distance of 100 feet from the body wall, is a retaining wall having its crest 6 feet lower than that of the body wall. The crest of the anicut is 43 feet above mean sea level; the greatest flood which has passed over it is 20·65 feet; and the depth of water upon it which is considered to furnish a full supply to the delta is 2½ feet. In order therefore to keep the water level considerably above the anicut, towards the end of the cultivating season when the river is low, a rough dry stone wall about 4 feet high is erected on the anicut crest in October or November of each year, and as the river falls in the dry season this stone is utilised in the annual repairs required by the apron of the Anicut, so that the crest is left clear again before the floods of the south-west monsoon in June. On each flank of the anicut are under-sluices, consisting of 15 vents of 6 feet span, with their floor 8½ feet below the crest of the anicut; while, above the anicut, on either bank, are the locks for the passage of craft and the head sluices of the deltaic channels. The eastern head sluice has 15 vents of 6′ × 9′ span, with its floor 5½ feet below the anicut crest; and the western head sluice 15 vents of 6′ × 8′ span, with its floor 6 feet below the crest of the anicut. Both of the head locks are 16 feet wide, and 160 feet long from gate to gate. The system is not expected to be completed till the end of the year 1901-02. The total estimate for direct charges, amounting to Rupees 1,38,99,784, has been sanctioned by the Secretary of State. The estimate for indirect charges, amounting to Rupees 10,01,160, is now awaiting sanction. The navigable canals of the system are connected on the one side with those of the Godávery delta, and on the other side with the Buckingham Canal. In 1882-83 their total length was 278 miles, which will be ultimately increased to 349 miles. The total area effectually irrigated, and net revenue derived, in the year 1882-83, was 261,158 acres and Rupees 5,85,262 respectively as against 287,027 acres and Rupees 7,13,129 in the year preceding, the decrease being due to the very heavy floods of 1882, which caused much damage and entailed large remissions in the delta. On completion of the works the area of irrigation will be increased to 475,000 acres. The surplus revenue of the year, after paying all charges including interest, was Rupees 3,51,945, or 5·57 per cent. on the total capital outlay of Rupees 63,30,628. A large portion of the further expenditure to be incurred on the system consists of works, such as drainage, &c., for the purpose of securing existing irrigation from risk. Expenditure of this description, while adding largely to the capital outlay brings no proportionate increase in revenue, and it is accordingly estimated that the net returns of the system, which have during 1882-83 been 9·92 per cent. will, on completion of the works in 1901-02 be reduced to 8·38 per cent. on the total capital outlay of Rupees 1,49,00,944. As in the case of the Godávery system, this work, while paying a large direct profit to the State, is a safe insurance against famine, and has immensely increased the general prosperity of the district, which is now one of the richest and most thriving in the Presidency, but previous to the construction of the Kistna anicut was one of the poorest, and suffered most severely in the famine of 1833-34.

12. *The Kurnool Canal.*—This work takes off from an anicut, 17 miles above the town of Kurnool, on the river Tungabhadra, which, rising in the hilly country of West Mysore, skirts the dry district of Bellary, and joins the Kistna river in that of Kurnool. In describing (paragraph 3) the financial policy of Government in respect to large works of irrigation, allusion was made to this canal, which was purchased by Government in 1882 from the Madras Irrigation and Canal Company, and from that date has been designated the "Kurnool Canal." The work owes its inception to the policy of introducing into India British capital and enterprise in the construction of irrigation works. So much was anticipated from this policy that, when in

1858 overtures were made to Government to carry out a project, initiated by Sir Arthur Cotton, and then known as the "Tungabhadra Project," by the agency of a private company, the proposal was readily met by Government. The company, known as the Madras Irrigation and Canal Company, was therefore incorporated in 1858, and in 1863 the regular contract deed between the Secretary of State and the company was drawn up, by which a Government guarantee of 5 per cent. was given on a capital of one million sterling for the execution of the work proposed. In 1866 the company was already in financial difficulties, and had spent £937,242 out of a capital raised of £964,521, while the works were still in a very unfinished stage. A second indenture was therefore signed in that year, modifying the original contract in so far as to allow of the company obtaining from Government a sum of £600,000 by means of debentures. By 1872 the original capital of one million sterling, together with the Secretary of State's loan of £600,000, had been wholly exhausted, while the canal still remained unfinished. Mortgage debentures were then issued, but the credit of the company was not sufficiently good to make funds readily forthcoming; and, as the improvement of the financial state of the work was impossible as long as it remained under the company, Government decided to forestall the date of the termination of the contract, and to take the work under their direct control. Terms were accordingly offered to the stock and mortgage debenture holders, which were at once accepted by the former but not by the latter. The matter was therefore referred to the Court of Chancery, and finally in 1882 the Court gave a judgment, authorizing the transfer of the canal to the Secretary of State. The works of the company were accordingly purchased, and were officially transferred in July of that year; and the canal was formed into an ordinary public works division; was placed under an Executive Engineer; and was called the "Kurnool Canal Division."

The anicut supplying the canal is built across the river Tungabhadra at Sunkasala. It is 1,500 yards in length; is founded on rock; has a clear overfall; and is furnished with a set of under-sluices. The highest flood that has yet passed over it is 6·80 feet. The water passes through a head sluice into the canal, which, in the upper portion of its course, has a general cross section of 90′ bottom width, side slopes 2 to 1, depth 8 feet, and capacity of 3,000 cubic feet per second. At the 75th mile the canal passes through the watershed between the Tungabhadra and Penner rivers, crosses the Penner at the 182nd mile, and terminates at the town of Cuddapah (on the Madras Railway) 190 miles from Sunkasala. An anicut at the crossing of the Penner affords the supply necessary for the continuation of the canal to Cuddapah. This anicut is 2,333 feet in length, of which 509 feet are founded on rock, and 1,724 feet on wells sunk in the sand. In addition to this work there are on the canal two other anicuts, two important aqueducts; surplus and cross drainage works; 48 over-bridges; and 42 locks, of which 7 are double and 35 single. The canal was completed in 1871, but navigation was not started until 1880, owing to the embarrassed state of the company's affairs. A telegraph line runs along the canal, and at the end of 1883-84 was in progress of reconstruction by the Telegraph department. When completed, the line will be inspected and maintained by the Telegraph department; and will be worked by the Public Works staff of the canal as a licensed system, so that it will be available for carrying messages for the general public, in addition to those on the service of the canal.

. The works have suffered from numerous accidents, the latest serious ones being the breaching of the Sunkasala Anicut in the year 1882, a few days after the transfer of the canal to Government; and the damages done to the canal by the breaching of a tank in the following year. The extension of irrigation under the canal has been of the most disappointing nature. For the five years, from 1871 to 1876, the irrigated area and revenue averaged 14,700 acres and Rupees 50,650, the charges against revenue being Rs. 1,80,000. The impetus given to irrigation in the years 1876-77 and 1877-78 by the failure of the monsoon rains raised the area shown as irrigated materially, as the following figures will show:—

	ACRES.	RS.
1876-77	90,285	2,47,351
1877-78	50,918	1,49,130

This increase was due to watering dry crops, and soon declined, as the average for the years 1878-79 to 1881-82 was only 20,018 acres and Rupees 73,363. In 1882-83 the area irrigated was 14,903 acres, the revenue from irrigation Rupees 59,255, and the traffic receipts from navigation, Rupees 10,683. The decrease in the irrigated area during 1882-83 was owing to the breach in the anicut, which occurred in July 1882. The financial result for the year was a loss of Rupees 63,708, in addition to the charge for interest on capital. It is as yet early to predict what the future of the work may be now that it has been taken under the management of Government, but the enormous capital outlay sunk upon it, in proportion to the capacity of the canal, absolutely precludes it from ever being a paying concern. It is proposed to complete the distributaries required for the extension of irrigation by the end of 1885-86, and it is anticipated that, at the end of 1886-87, the revenue will be sufficient to meet the cost of maintenance.

. The causes of the financial failure of the work are numerous, and prominent among them are—

First.—Excessive cost of works and faulty execution and design.
Second.—Nature of soil commanded, and circumstances of people.
Third.—Faulty administration on part of the company; unsatisfactory relations between company and the revenue officers; and antagonism between company and the ryots.
Fourth.—Delay in starting navigation.

. The first and second causes of failure are permanent; the third and fourth no longer exist. The enormous cost of the works in relation to the capacity of the canal has already been noticed, and both the anicut and the canal have suffered repeated accidents. The canal flows through a country where irrigation is but little practised, and the people are unused to it; where also the food grains grow perfectly well in ordinary years without being irrigated. The only chance of success for the work was therefore to offer water on the most tempting terms, and to furnish by means of navigation cheap means of transport and access to a profitable mart. Neither condition was complied with. The system of applications for water introduced was absolutely of a nature to deter the ryot from making any application at all, while navigation was delayed for nine years.

13. *The Penner Anicut.*—The river Penner rises in Mysore, has a drainage area of 20,000 square miles, and a total length of 330 miles. Its principal supply is derived from the north-east monsoon, during which it is subject to very heavy floods of short duration, but the upper portion of its basin obtains a fair, though uncertain, supply from the south-west monsoon. The bed of the river has a considerable fall, which in the lower portions of its course is as much as 3 feet per mile. Owing to the character of the river, advantage has been taken from very ancient times, by means of flood cuts, to utilise the supply brought down by freshes, in filling a very large series of tanks on the southern bank of the river in the neighbourhood of the town of Nellore, and thus the irrigation of this area is carried over the periods when the river itself is dry. The water-supply, however, obtained by this means was very variable, and, in order to improve it and render the irrigation certain, the anicut was commenced in 1853, at a site close to the town of Nellore, and 19 miles from the sea. This work was completed in 1855, but during the extraordinary heavy floods of 1874 was turned at its northern or left flank. The anicut was thereupon repaired and was extended from its original length of 1,581 feet, which is about one-third of the normal width of the river, to a length of 2,039 feet. As existing, the anicut consists of a body wall of this length, founded on a double row of wells; and is backed by a series of rough stone aprons, divided by retaining walls, and having a total fall of 9 feet and total width of 178 feet. The crest of the anicut is 9 feet above the river bed, and 37·47 feet above mean sea-level, while the highest flood which has passed over it is 19·30 feet. It has two sets of under-sluices, and a head sluice and auxiliary head sluice at its southern flank—there being no irrigation under the anicut on the northern bank of the river. The head sluice has 9 vents of 6 feet span and the auxiliary head sluice 6 vents of 10′ × 3½′, while the level of the sills of both head sluices are 8 feet below the anicut crest. From the main canal leading from the

head sluices, two old native channels, which have been extended and improved since the construction of the anicut, convey the river-supply to a great series of tanks, and form the main feeders of the system. From one of these channels, a third principal channel, running midway between the other two, branches off, and is the only entirely new channel of any considerable size constructed by the British Government. The channels of the system generally flow along the watershed, and there is consequently but little cross drainage. The irrigation on the southern bank of the river extends over an area of 150 square miles. The irrigation of the northern bank will be effected by the Sangam anicut, which at the end of 1883-84 was being built across the river, 20 miles above the Penner anicut. In 1882-83 the area irrigated under the Penner anicut was 63,653 acres, and the irrigation revenue derived therefrom Rupees 2,34,957, but of this sum the portion due to the old irrigation, which existed prior to the construction of the anicut, was Rupees 1,20,350. The net revenue due to the work was Rupees 79,989 or 4·8 per cent. on the total capital outlay of Rupees 16,65,159. The complete estimate for this system has not yet been sanctioned. It has however been prepared, is computed to amount to Rupees 18,94,784, including all direct and indirect charges, and will shortly be forwarded to the Government of India.

14. *The Cauvery Delta.*—The river Cauvery rises in the province of Coorg, flows through the Mysore plateau, and through the Madras districts of Coimbatore, Salem, and Trichinopoly, where, together with its tributaries, it feeds a whole succession of irrigating channels, and bifurcates at the head of its delta, 9 miles west of the town of Trichinopoly, the southern branch retaining the name of the parent stream, while the northern branch is known as the Coleroon. About 17 miles below the point of their bifurcation, the two branches very nearly re-unite, forming between them the island of Srirangam. Below this point the Coleroon takes a north-easterly course, skirts the district of Tanjore on its northern border, and reaches the sea with its volume comparatively little diminished. Though there is considerable irrigation from this branch, it has nothing to do with the irrigation of what is classed as the Cauvery Delta proper, to which (as will afterwards be noticed) it affords a great natural drainage channel for the escape of surplus water. The Cauvery branch, on the other hand, runs through the delta, splits up into numerous branches, and covers the delta with a vast net-work of channels, which have from very ancient times been utilized for the purposes of irrigation. Of the numerous offshoots some are lost in the wide expanse of rice-fields, others find their way to the sea, while the branch which retains the name of Cauvery throughout diminishes to an insignificant stream before entering the sea. The Cauvery river, together with its tributaries, is fed by the rains of both monsoons, and has an abundant and constant flow for nine months in the year. At the head of the delta it is 4,400 feet wide, has a drainage area of 27,705 square miles, and a maximum flood discharge of 284,000 cubic feet per second. The total average annual discharge is about 490,000 millions of cubic feet, equivalent to 17·68 inches of discharge from the whole drainage basin. The irrigation of the Tanjore Delta dates to a very remote period, and in order clearly to understand the system as it now exists, and the requirements which have still to be attended to, it will be necessary to show briefly the development of the system up to the present time. Under the old native régime, channels, sometimes supplied by head sluices, were first cut from the main river, and, by means of an infinite number of smaller channels of distribution, afforded a supply of water for the purposes of irrigation. Not only was the main river thus utilized, but the numerous deltaic branches from it (in all of which the water surface was, in the normal state of the river, generally higher than the level of the surrounding country) were also similarly laid under contribution, and, hand in hand, with this process of utilising the waters in moderate floods, necessarily grew up a vast system of embankments, whereby the waters during extreme floods were prevented from spreading over the country and damaging the crops. Thus in progress of time, there grew up over the whole area of the delta an extremely artificial condition of things, the cardinal points of which were (1) the supply of abundance of water, by means of taking up the natural drainage lines for irrigation; and (2) the protection, by means of a system of embankments, of the irrigated area thus formed from the effects of floods. The principal masonry

work undertaken during the native period is that known as the Grand Anicut, built in the eleventh century, and situated just below the island of Srirangam, where (as has already been mentioned) the Cauvery and Coleroon come into close contact with each other. At this point the bed of the Coleroon is nine or ten feet lower than that of the Cauvery, and the Grand Anicut was therefore built across a natural outlet of the Cauvery to prevent its water being wholly drained off into the Coleroon. About the year 1800 the Tanjore District was ceded to the British, and in 1804 it was found that the Coleroon branch, from its more rapid fall and more direct course to the sea, was draining off, at its head, the main portion of the water-supply of the river above the point of its bifurcation; while the Cauvery branch was silting up at its head. It thus became very evident that, if effective measures were not taken to rectify, by artificial means, the natural differences between the two branches, the inevitable issue must be the annihilation of the Cauvery branch as an irrigating stream, and, as a consequence, the total collapse of the delta irrigation. From 1804—1829 an incessant struggle was maintained against the increasing tendency of the Cauvery branch to silt up at its head, and efforts were made to force a larger supply of water into the branch. These efforts were ineffectual. The bed of the Cauvery branch continued to rise, the supply to diminish, and the area under cultivation to fall off. In 1830, under-sluices were built in the Grand Anicut, together with other similar works and waste weirs at eligible sites in the left bank of the Cauvery, in order to endeavour to clear from its bed the accumulations of sand. These works were beneficial, but did not check in any way the evil resulting from the unequal distribution of the volume between the two main streams. In 1836, under the advice of Sir Arthur Cotton, the Upper Coleroon Anicut was built across the head of the Coleroon branch, and was completely successful in its object of throwing into the Cauvery branch a fair distribution of the water-supply, by the simple expedient of placing the crest of the anicut at such a height as to ensure, in the average state of the river, a proper distribution of the entire volume of the main stream between the two branches during the irrigating season. Simultaneously with the Upper Coleroon Anicut, and supplementary to it, was constructed the Lower Coleroon Anicut, 70 miles lower down the river, in order to provide for the irrigation of the irrigated lands of the South Arcot District, and for those of the north-east portion of the Tanjore District, whose supply would of course be much reduced by the construction of the Upper Anicut. As the irrigation under the Lower Coleroon Anicut, and the expenditure incurred thereon, are not included in that of the Cauvery Delta system, and the work is separately classed as one for which a continuous record of expenditure is kept (*vide* paragraph 22), no further mention will here be made to it. The next important work undertaken was in 1845, when a regulating dam was built across the head of the Cauvery branch to counteract the effects of the Upper Coleroon Anicut, which, it was found, was throwing into the Cauvery branch a body of water far larger than was safe or was required. Finally, in 1848, the construction of a regulating dam to the first principal offshoot from the Cauvery branch was begun; and subsequently regulating dams were provided for the other principal branches, thus completing the general system of regulation and control of the water required for the delta irrigation.

The development of the delta system having thus been traced, it only remains to describe briefly the principal works. The total area of the delta is 1,402,880 acres (2,192 square miles), of which 900,000 acres are irrigated. The irrigation in the delta is fully supplied when the river stands 5·7 feet on the Cauvery regulating dam, which represents a discharge of 12,330 cubic feet per second. The Upper Coleroon Anicut is built across the head of the Coleroon, the body wall is 2,789 feet in length, and is founded on a double row of wells. The anicut is provided with under-sluices, and a bridge, six feet between parapet walls, is built across it. The Cauvery regulating dam is practically a continuation of the anicut, is built across the Cauvery branch at its head, and is 1950 feet in length from wing to wing. The highest flood ever known in the river rose to 13·20 above the floor of this dam. Below these works, lower down the delta, are numerous surplus works and the regulating works of the principal branch channels from the Cauvery. The sketch already given of the development of the delta irrigation will have made it plain that a peculiarity of the system is that the natural drainage channels

have been taken up for the purpose of irrigation, and that the numerous deltaic channels of the Cauvery take the place of the artificial canals in the Godávari and Kistna Deltas, and merely require sluices built across their heads to be made available as irrigating channels. The total length of the Cauvery branch from the head of the delta to the sea is 95 miles. At its head, the branch is 2,000 feet wide, and continues that width for 14½ miles, where the Vennar river, its first principal branch, takes off. The Vennar has a regulating dam at its head, and is itself divided into five main branches. Returning to the main river, 2¾ miles below the Vennar, is the Grand Anicut. This very ancient work is 1,080 feet long, and consists of rough blocks of granite built in a serpentine form, having over it a bridge of 32 arches of 32 feet span following the wavy line of the anicut. The crest of the work is 7 feet above the bed of the Cauvery branch. The Grand Anicut is provided with 10 sluices, 3 feet broad, with their sills 10 feet below the crest of the work, which pass the surplus water of the Cauvery into the Coleroon. Besides the Grand Anicut, there are other surplus works passing into the Coleroon branch all the water which cannot be disposed of by the Cauvery branch and its irrigating channels. Further down the Cauvery branch, 9½ miles below the Grand Anicut and 26¾ miles from the head of the delta, the Kodamurti river—the second principal branch of the Cauvery—takes off; while 20 miles lower down is the Arasillar, or third principal branch; and 14 miles lower down, the Verasholen, or last principal branch. All these three main branches have also regulating dams at their head, and supply a vast number of branch and distributary channels. This concludes the description of the delta irrigation under the Cauvery branch. As before stated, there is no irrigation from the Coleroon within the delta proper, but that branch plays a most important part in the delta system, by providing a great natural drainage channel for the surplus waters of the Cauvery branch. Before quitting the subject of the delta irrigation, it will be necessary to notice two important requirements which yet remain to be attended to. First among these is the complete system of head works necessary in order to have the supply of the Vennar, and other branches from the Cauvery, under complete control, and thus to prevent the repeated damages which, for many years, the delta has been liable to during heavy floods in the river. The floods generally occur in the north-east monsoon, and, together with the very heavy local rainfall which often occurs at that time of the year in the Tanjore District, fills the Cauvery branch and its offshoots to overflowing, and consequently bursts the delta embankments. The subject is now being systematically taken up. The construction of head sluices to the Cauvery and Vennar rivers, at a site immediately below the Grand Anicut, is now in progress; and various other works—including alterations to the Grand Anicut, which will enable that work to discharge 85,000 cubic feet of water per second—will shortly be undertaken. The second requirement is a complete survey of the delta. No proper survey of the delta has yet been made, and comparatively little is therefore known of the vast system of minor channels within its limits. Regulators are required at the heads of many of the smaller irrigation channels, but the construction of these works is necessarily delayed until the completion of the survey, which will show accurately how the irrigation is distributed over the several channels. The survey is now in progress.

The total amount of the estimates sanctioned for this system, up to the end of 1883-84, is Rupees 18,54,847.

The area effectually irrigated, and the revenue derived therefrom, for 1882-83 was—

	ACRES.	RS.
First crop	895,719	26,55,600
Second crop	1,08,298	2,53,780
		29,09,380

Of the gross irrigation revenue of Rupees 29,09,380, the portion due to the old irrigation, which existed prior to the improvements and additions made by the British Government, was Rupees 23,43,214. The surplus revenue due to the new works after meeting all charges was, in 1882-83, Rupees 5,80,975, or 50·51 per cent. on the total capital outlay of Rupees 11,50,238; while, as will be seen from the statement in paragraph 3, the total surplus revenue, up to end of 1882-83, was Rupees 1,28,68,167, being 1118·8 per cent. on the capital outlay, or more

than eleven times the total outlay on capital account. It will thus be abundantly clear that the work as a financial investment has been extraordinarily successful.

15. *The Srivaikuntham Anicut.*—The Srivaikuntham Anicut is the last of eight anicuts on the river Tambrapurni, in the Tinnevelly District, and is situated 16 miles from the sea. The river rises in the Western Ghauts, and, though comparatively a small stream, derives its importance from the fact that it receives a supply from both monsoons. At the site of the Srivaikuntham Anicut the drainage are of the river is 1,739 square miles, and the maximum flood discharge 118,673 cubic feet per second. The average annual discharge of the river is 60,304 millions cubic feet, equivalent to 14·9 inches of discharge from the whole catchment basin but in the year 1877, when the freshes of the north-east monsoon were extraordinarily heavy, the total annual discharge of the river reached the high figure of 121,295 millions cubic feet, equivalent to 30 inches from the whole catchment basin. The seven anicuts in the Tambrapurni above the Srivaikuntham Anicut are of old native construction, and it was principally owing to the great success of these works that the Srivaikuntham Anicut was projected. This work was begun in 1867. The system is of a simple character, and may be briefly described. From either flank of the anicut, which is 1,380 feet in length between the wings, two main channels, 21 miles in length and supplied with head sluices, are taken off, and supply a large series of tanks which existed before the Srivaikuntham Anicut was built, and before its construction were very inadequately supplied. Besides filling these tanks, the main channels irrigate directly a considerable area of land. The height of the anicut crest above mean sea level is 37·40 feet, while the sills of the head sluices of the main channels are 6 feet below the crest of the anicut. The highest flood which has yet passed over the anicut rose to 11¾ feet over its crest. The works from their very commencement have had numerous accidents, and to this cause must mainly be attributable the slow extension of irrigation under them, and their want of financial success up to the present date. The damages to the works have been due to the breaching of the river embankments, during the very sudden and heavy floods to which the Tambrapurni is liable; and to the breaching of tanks, caused by heavy upland floods. They have now been provided against by completing the river embankments, throwing back the north flood-bank of the river below the anicut, and by affording adequate means of surplus for the cross drainage from the tanks lying above those of the Srivaikuntham Anicut system. The system will not be finally completed till the year 1885-86. The completion estimates amounting to Rupees 14,76,806, of which Rupees 13,61,520 represents the direct and Rupees 1,15,286 the indirect charges, have been sanctioned by the Secretary of State. During the year 1882-83 the area effectively irrigated and the revenue derived therefrom was—

	ACRES.	RS.
First crop	19,546	4,13,450
Second crop	17,647	58,291
		1,71,741

while the ultimate area of irrigation—which it is estimated will be reached in 1886-87, the year after the completion of the works—is acres 25,000, all of which will be double cropped. The net revenue from the system in 1882-83 was Rupees 73,018, while the actual return from the work, after paying all charges including interest charges, was Rupees 23,768, or 1·81 per cent. on the total capital outlay of Rupees 13,12,135. After completion of the works in the year 1886-87, it is anticipated that the net yearly revenue will be increased to Rupees 1,10,902, or 7½ per cent. on the total capital outlay of Rupees 14,76,806.

16. *The Works in progress at the Sangam Anicut and Barur Tank.*—As has already been stated (paragraph 13), the Sangam Anicut will extend irrigation to the northern bank of the Pennér. From the anicut, a main channel, leading from a head sluice on the north bank of the river, will supply two large existing reservoirs, known as the Kanigiri and Duvur Tanks, from the former of which the irrigation channels will be taken off, and thus advantage will be taken of the intermittent character of the river supply. The area to be commanded by the anicut will be 220 square miles. This tract of country already contains many tanks, and is

partially irrigated by cuts from the river. The construction of the anicut will render certain the existing irrigation, and will largely increase it as follows:—

	ACRES.
Present irrigation	44,053
Estimated increase	49,947
Total ...	94,000

The site of the anicut is about 38 miles from the sea, and 20 miles above the Pennér Anicut at Nellore. When finished, it will be 4,290 feet in length, or nearly three times the length of the Pennér Anicut; and will have its crest 7 feet above the deep bed of the river, or 105 feet above mean sea level. The head sluice (which is now finished) has 21 vents of 6 feet span, and is designed to carry 4,800 cubic feet of water per second (when the water in the river is flush with the anicut crest), which will be distributed in the following proportions to the reservoirs which it supplies:—

	Cubic feet per second.
Kanigiri Tank	4,576·5
Duvur Tank	223·5

The present capacity of the Kanigiri Tank is to be greatly enlarged, and the total capacity of the two reservoirs will ultimately be—

	Millions cubic feet.
Kanigiri Tank	6,419
Duvur Tank	1,043
Total ...	7,462

When finished, the Kanigiri Tank will be the largest reservoir in the Presidency. It is estimated that the works will be completed about the year 1889-90. At the end of 1883-84 very considerable progress had been made in their construction, as the whole of the wells required for the anicut had been sunk, the south wing of the anicut and the head sluice had been finished, and a large amount of work on the anicut and other works had reached an advanced stage of progress. The estimate for the work amounts to Rupees 35,69,049, of which Rupees 28,96,437 is for Direct charges and Rupees 6,72,612 for Indirect charges, and was sanctioned by the Secretary of State in February 1881. At the end of 1883-84 the total outlay against Direct charges was Rupees 13,48,624. It is anticipated that on completion of the works, about 1889-90, the annual revenue will amount to Rupees 2,38,000. The estimate of annual working expenses is Rupees 50,255, and the net revenue will therefore be Rupees 1,87,745 or 5·26 per cent. on the total Capital outlay of Rupees 35,69,049.

. *Barur Tank.*—This work is situated in the Salem District, and was commenced as a Famine Relief-work in August 1877, at a time when the district was suffering severely from the effects of famine. The normal value of the work then done was estimated at Rupees 67,185, in addition to which a sum of Rupees 13,172 was paid for land compensation, making a total expenditure of Rupees 80,357 on the work. In 1883 the project was sanctioned as a Productive Public Work by the Secretary of State, and was put in hand towards the close of the year. The scheme is one for the improvement of several existing tanks (of which the Barur Tank is by far the largest) by building an anicut across the Ponnair River. This river rises in the Mysore plateau, and drains an area of 2,082 square miles, in which are situated numerous tanks. The extent of free catchment basin may be put down at 1,080 square miles. The supply afforded by the river is ample, and from the anicut, a supply channel, 7½ miles in length, provided with a head sluice leads to the Barur Tank. The project also provides for the enlargement of this tank, and for two distributary channels from it, which will supply a number of smaller tanks. The work will bring under irrigation an area of 5,430 acres, in addition to 1,457 acres already supplied by the tanks. The total storage capacity of the tanks, when completed, will be 16½ millions cubic yards, of which the Barur Tank will alone store 11½ millions cubic yards. The total estimate for the project is Rupees 3,33,793, of which Rupees 3,20,000 is for Direct charges, and Rupees

13,793 for Indirect charges. In addition to the expenditure of Rupees 80,357 incurred on the work prior to its sanction as a Productive Public Work, a further expenditure of Rupees 7,298 was incurred in the year 1883-84. The work done to the end of 1883-84 consisted mainly of earthwork to the supply channel, construction of waste weir on the Barur Tank, collection of materials, and preparation of foundations for the head works. The project will be finally completed in the year 1886-87, and the net revenue which the work is estimated to yield is Rupees 21,448, or 6·4 per cent. on the total Capital outlay of Rupees 3,33,793.

Works for which Capital and Revenue Accounts are kept, but which are not classed as "Productive."

17. *The Chembrambaukum Tank.*—The Chembrambaukum Tank is a large reservoir about 14 miles from Madras, and is formed by an embankment 7,100 yards in length, connecting high ground on one side with a rocky spur on the other. It is provided with 8 irrigation sluices, and with 3 masonry weirs aggregating 1,192 feet in length, while its capacity is 2,799 millions cubic feet, and the area of its water spread 8·95 square miles. The tank is an old native work, and the improvements undertaken by the British Government consist mainly of the extension of its capacity, and the increase of its water supply. The chief sources of its supply are from anicuts across the Cortelliar and Cooum Rivers. The catchment basin of the tank is about 400 square miles, in which area are 320 tanks, but the supply from this gathering ground is in some years exceedingly scanty. The sanctioned estimate for the work is Rupees 7,36,958, of which Rupees 6,55,310 represent the Direct and Rupees 81,648 the Indirect charges. In 1882-83 the area effectively irrigated and revenue derived was—

	ACRES.	Revenue. RS.	Average Rate per Acre.
First crop	12,763	39,338	3·08
Second crop	3,216	8,294	2·77
Total ...	47,632		

The surplus revenue of the year, after paying all charges including interest was Rupees 8,319, or 1·12 per cent. on the total Capital outlay of Rupees 7,36,589.

18. *The Palar Anicut.*—The Palar Anicut was originally designed to give an improved supply to old native channels feeding a very large series of existing tanks. The work was commenced in 1855 and was finished in 1857. The river, which is very uncertain in its supply, rises in the Mysore plateau, and at the site of the anicut, has a drainage area of 3,974 square miles, and maximum flood discharge of 25,000 cubic feet per second. The anicut is situated in the North Arcot District and commands 201 tanks, of which 127 are on the northern bank of the river and 74 on the southern bank. It was breached in 1874 but was subsequently restored. As existing, the anicut is 2,634 feet in length between the wings, and has under-sluices at either flank. On the north bank of the river three head-sluices supply the principal channels, one of which feeds the Kaveripak Tank, one of the largest reservoirs in the Presidency; and, on the south bank, is one head-sluice supplying numerous channels and tanks. The system is still incomplete, and the work remaining to be done consists principally of improvements to the channels and head-sluices, and the construction of new head-sluices and other masonry works. The area effectively irrigated, and the revenue derived, in the year 1882-83 was—

	ACRES.	RS.	Average Rate per Acre.
First crop	66,571	1,72,074	2·60
Second crop	20,584	45,290	2·20
Total ...	2,17,364		

The surplus revenue of the year, after paying all charges including interest was Rupees 4,581 or 0·27 per cent. on the Capital outlay of Rupees 16,80,965. The completion estimates for the system, amounting to Rupees 19,93,893, of which Rupees 18,94,915 represents the Direct charges, and Rupees 98,978 the Indirect

charges, were submitted to the Government of India in June 1884. They anticipate that, on completion of the works about the year 1886-87, the ultimate area of irrigation will be Acres 68,000 for first crop, and Acres 34,000 for second crop, yielding a net revenue of Rupees 93,720, or 4·7 per cent. on the total Capital outlay, and that the present deficit of Rupees 7,89,416 will not be cleared off until the year 1928.

19. *The Pelandorai Anicut.*—The Pelandorai Anicut is built across the Vellaur River, and affords a river supply to twelve tanks (which existed prior to the construction of the anicut) on the southern bank of the river in the South Arcot District. The anicut was commenced in 1870, but was not completed till 1876. In 1877 it was breached and was accordingly repaired by 1879. In the year 1880 it was again breached, and the head-sluice was carried away by an extraordinary flood which swept two feet over the wings. It was again restored and was in working order by 1882. To these two very serious accidents, occurring within the short period of four years after the construction of the anicut, must be attributed the very slow extension of irrigation, and the very unfavourable financial position of the work. The accidents were due to an under-estimate of the maximum flood discharge of the river, which, as ascertained after the great flood of 1880, reaches the high figure of 85,000 cubic feet per second at the site of the anicut, from a catchment basin of 1,600 square miles. The completion estimates of the system, amounting to Rupees 4,48,246, of which Rupees 4,05,000 is for Direct and Rupees 42,246 for Indirect charges, were sanctioned at the beginning of the official year 1884-85. Against this sanction, the total outlay to the end of 1883-84 was Rupees 3,90,213, and the only works now remaining to be done are the increase to the storage capacity of four tanks from a total capacity of 62·3 millions cubic feet to 174·0 millions cubic feet. The ultimate area of irrigation is 15,728 acres, but in 1882, Acres 3,560 only were irrigated under the system (which is the largest area yet irrigated) and yielded a gross revenue of Rupees 8,596. The net receipts of the year were Rupees 5,270, while the total charges, including interest, debited to the "Revenue" account, were Rupees 56,191 leaving a loss of Rupees 56,191 as the financial result of the year. As irrigation under the works is not at present popular with the ryots, it is anticipated that the full ultimate area of irrigation (Acres 15,728) will not be reached till 1899-1900, when a return of 8·1 per cent. on the total Capital outlay will be received. On this assumption of the growth of cultivation under the work, the interest charges will exceed the net revenue till 1891-92 and the balance of interest charges will not be paid off till 1914-15.

20. *The Madras Water-supply and Irrigation Extension Project.*—This project, which is a combined work affording a water-supply to the city of Madras, and irrigating an area of about 7,500 acres, was virtually completed about the year 1870-71. The work may be briefly described. From an anicut across the river Kortalayur, a stream with a drainage area of 837 square miles, a head sluice, and supply channel eight miles in length, lead the water to a reserve reservoir, known as the Cholaveram Tank. From thence the water is conveyed to the main reservoir, known as the Red Hills Tank, which has four irrigating sluices for the supply of the irrigation under it, and one sluice for the water-supply of the Town of Madras. The two tanks were old native works, but were enlarged from a total capacity of 644 millions cubic feet to a total capacity of 3,523 millions cubic feet, of which the Red Hills Tank alone occupies 2,753 millions cubic feet. The works have suffered some serious accidents since their construction, and have not been a financial success. According to the arrangements concluded with the Municipality of the Town of Madras, that body pay Rupee 1 for every 1,000 cubic yards of water supplied. The average annual consumption of water by the Municipality may be taken as 143 millions cubic feet. A reserve supply is, in bad seasons, maintained in the Red Hills Tank for the water-supply of the Town of Madras, by arranging that, when the water in the tank falls 6 above the bed of the Municipal supply channel, or 38·31 above M.S.L., all irrigation under the tank is stopped. The total

sanctioned estimate for the work is Rupees 18,54,463, of which Rupees 15,62,239 represent the Direct, and Rupees 2,85,224 the Indirect, charges. The total estimated amount of the Capital outlay has recently been divided as follows:—

	RS.
Imperial ordinary	7,78,°74
Provincial	10,75,589

which approximately represents the value of the water used for purposes of irrigation and town supply respectively. In 1882-83 the area of first and second crop effectively irrigated was Acres 10,420, and the revenue derived therefrom Rupees 24,135. The receipts by the sale of water to the Town of Madras were Rupees 32,314, and the total financial result of the year was a loss of Rupees 23,579.

21. *The Buckingham Canal.*—This is a salt water canal—tidal to a great extent wherever the river bars are open—extending for 261 miles along the east coast of the Presidency, from Pedda Ganjam in the Kistna District to Merkanum in the South Arcot District. At Pedda Ganjam, it communicates with the fresh water, high level, canals of the Kistna Delta system, and thence with the Godávari system, and opens up traffic with the seaport of Cocanada, making a total length of mainline of navigable canal of 462 miles. The canal runs within three miles of the sea-coast throughout its entire length, and in many portions is within half mile of the sea. The excavation of the canal was begun as long ago as 1801, but, previous to the famine of 1876—1878, the expenditure incurred on it was only Rupees 5,49,078. During the famine, an expenditure of Rupees 29,24,924 was incurred on the work, of which Rupees 21,93,584 represented the normal value of work done and was accordingly debited to the Canal, thus bringing up the total expenditure for works up to Rupees 27,42,662. The completion estimates of the system have lately been sanctioned, and amount to Rupees 92,94,954, of which Rupees 86,12,000 represent the Direct charges, and Rupees 6,79,954 the Indirect charges. Against this sanction, the total direct expenditure on Capital account was only Rupees 50,12,722 to the end of 1883-84, so that it will be apparent that much yet remains to be done. With a view to expedite the completion of the canal, grants-in-aid from "Protective" Funds are given by the Government of India. The principal work required to complete the canal is (1) the isolation of the canal into "reaches" between rivers, by means of flood-gates, so as to allow the cross drainage free vent to the sea; (2) the deepening and widening of the canal to its full section of 20 feet bottom width, side slopes 4 to 1, depth 3 feet below level of lowest recorded tide in each "reach"; and (3) provision of locks, bridges, and boat basins, together with an extensive wharf at the city of Madras. The principal commodities carried by the canal are salt, firewood, and food-grains. In paragraph 30 will be found the particulars of traffic for the official year 1882-83, during which year traffic was much impeded from various causes. Until the completion estimates have been more fully worked out, and the canal has been protected from the damages to which it is now liable from river-floods, it cannot be considered a safe line of communication. It is expected that the works will be completed by the year 1893-94. The prospects of the canal are favourable. In times of famine it will be invaluable, enabling the produce of the Godávari and Kistna Deltas to be distributed through the districts of Nellore, Chingleput, and South Arcot. Its value as a cheap means of transport is already recognised, and has attracted much attention from the mercantile community, and should the Singareni Coal fields in Hyderabad be opened up, a short line of railway to the canal will enable cheap coal to be procured in Madras, to compete with the patent fuel and English Coal now consumed by the Railway Companies.

22. III. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT INDIVIDUALLY.—*The works for which individually a continuous record of expenditure is kept.* These works number 59 in all, and are distributed over nine districts. The following list exhibits the names of all the works so classed and the districts in which they are situated, together with the particulars of irrigation for each work or system for the year 1882-83:—

Statement showing the area irrigated and revenue derived from works for which a continuous record of expend ture is maintained individually for 1882-83.

District.	Names of works.	Total area irrigated 1st crop.	Total revenue from irrigation.	District.	Names of works.	Total area irrigated 1st crop.	Total revenue from irrigation.
			RS.				RS.
Vizagapatam.	Six anicuts on the Sarada river...	11,764	27,784	South Arcot (*contd*).	Manimuttanaddy —		
	Four anicuts on the Varaha do. ...	5,533	14,636		Vridachalam anicut	5,074	16,839
	Total ...	17,297	42,420		Mehmatur do.	3,018	11,381
Kurnool ...	Cumbum tank	4,952	39,568		Myorenuddy-Katumyloor anicut.	249	1,080
Chingleput	Kortalayar river—Vallur tank ...	4,856	6,591		Gadilam river—Tiruvadi do....	5,575	22,958
	Madurantakum tank	5,372	14,099		Do. Vanamadavy do....	690	2,729
	Total ...	10,228	20,690		Do. Tiruvandipuram ... anicut.	1,643	8,797
North Arcot.	Cheyar anicut	17,455	62,029		Kullur river—Vikravandy do....	1,244	2,839
	Poiney do.	19,988	66,531		Ponniar—Tirukoilur do....	16,339	53,219
	Total ...	3,71,443	1,28,560		Total ...	141,929	4,31,361
Salem ...	Barur tank (since classed as productive public works) ...	286	1,166	Coimbatore	Bhavani river—		
	Pennugoondapuram tank ...	205	744		Kodnelly { Todpalli channel ... anicut. { Arkankottai do. ...	13,672	97,557
	Total ...	491	1,910			3,945	25,969
Tanjore ...	Lower Coleroon anicut	22,860	66,689		Kalingaroyen anicut	10,912	97,374
South Arcot.	Coleroon Lower anicut—				Amaravati river (twenty-two channels)	25,645	1,39,379
	Rajahavoikal	21,455	64,313	Tinnevelly.	Tambrapurni river—		
	Vadavar	11,462	39,234		Ariyanayakapuram anicut ...	5,124	64,413
	Khansaib canal	11,608	30,680		Bhalavur do. ...	8,405	93,800
	Veeranam tank	38,214	1,09,416		Suttamully do.	6,163	62,194
	Vellar river—Shatatope anicut ...	25,360	67,876		Marudur do. ...	17,100	1,84,041
					Kodamilalaghyan do.	2,855	15,642
					Nathiyuni do. ...	2,486	19,608
					Kamiadiyen do. ...	11,177	1,57,810
					Total ...	53,310	5,97,508
					Grand Total ...	3,42,684	16,88,985

The most important of these works are the Lower Coleroon anicut, the Poiney and Cheyar anicuts, and the irrigation under the Bhavani, Amravati, and Tambrapurni rivers.

The Lower Coleroon Anicut.—The reasons that rendered the construction of this work necessary have already been given in paragraph 14. From the north flank of the anicut two large channels take off for the supply of the irrigation in the South Arcot district. One of these channels feeds the great Veeranam tank—the largest existing reservoir in the Presidency, having an embankment 12 miles in length and a capacity of 5,400 millions of cubic feet. From the south flank of the anicut another large channel feeds a number of branch channels in the Tanjore district.

The Poiney and Cheyar anicuts are built across rivers of that name, and feed a series of tanks. The irrigation under the Bhavani and Amravati rivers (which both rise in a rainy tract of country and have a constant supply of water) is entirely direct. Channels taking off from masonry dams, convey water to the fields, and irrigate long strips of land on either bank of the river, lying in the river valley, and running nearly parallel to the river's course. The irrigation under the Tambrapurni is effected by means of tanks supplied by channels, into which the river water is diverted by seven masonry anicuts of very ancient date. The irrigation under this system is exceedingly valuable and is much sought after.

23. IV. WORKS FOR WHICH A CONTINUOUS RECORD OF EXPENDITURE IS KEPT COLLECTIVELY.—*Works for which no individual record of expenditure is maintained, but which are accounted for collectively.*—Works of this class comprise all works other than those of the first three classes of paragraph 9 (of which detailed mention has already been made in the foregoing paragraphs 10—22 inclusive) and works classed as "Protective." They consist almost entirely of tanks, which are scattered, in great numbers, throughout the districts of the East coast and the central tableland (*vide* paragraph 7). These tanks are formed in numerous ways, according to the nature of the ground they occupy. The majority are constructed by damming up the natural drainage lines flowing through valleys, by means of embankments sufficiently long to close the gorge of the valley. The reservoir thus formed is provided with masonry sluices

for the supply of the irrigation under it, and with masonry surplus weirs, which act as a safety valve to the tank during floods. The old surplus weirs constructed by the natives are generally provided on their crest with a row of masonry pillars, 3 or 4 feet high, placed about 3 feet apart, and are locally termed "calingulas." Towards the close of the rainy season, when the chief floods of the monsoon are over, these "calingulas" are closed by damming up the spaces between the pillars with turf, straw, and earth, so as to enable the tank to retain an extra supply of water in order to carry on irrigation during the dry season. The majority of tanks in the Presidency run in groups, and descending steppes of land are occupied by a succession of reservoirs, the higher feeding the lower from its surplus supply, and the whole group forming one connected scheme of irrigation. According to the latest returns, the total number of Government tanks in the Presidency is 31,648, and it can therefore be readily imagined that the labour involved in keeping up the embankments of these tanks to a proper margin of safety, so as to guard against their breaching during the heavy rains of the monsoons, and the inspection, repair, and restoration of the very numerous masonry works attached to them, are such as to tax very severely the resources of the Irrigation Branch. For administrative purposes (as will hereafter be noticed in paragraph 26) a distinction has recently been made between (1) tanks irrigating an area of 200 acres and upwards, and (2) tanks irrigating an area below 200 acres. The following statement shows the numbers of works of each class, together with their irrigated area and revenue during 1882-83, in each district of the Presidency :—

Districts.	Tanks irrigating above 200 acres.			Tanks irrigating below 200 acres.			Grand Total.		
	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total revenue from irrigation.	Number.	Total area irrigated, 1st crop.	Total irrigation revenue.
			RS.			RS.			RS.
Ganjam	215	82,476	1,30,345	2,654	112,280	1,35,759	2,869	1,95,026	2,66,104
Vizagapatam	24	11,614	21,691	420	18,763	52,526	444	30,377	74,217
Godávari	110	32,326	44,801	1,205	31,146	31,681	1,315	63,472	76,482
Kistna	190	22,274	57,636	248	16,231	44,183	438	38,505	1,01,819
Nellore	209	118,200	4,10,874	563	33,188	1,02,562	772	1,51,388	5,13,436
Cuddapah	156	53,916	2,41,341	2,950	133,893	4,31,761	3,106	1,87,809	6,73,102
Kurnool	46	14,980	57,311	671	23,875	78,832	717	38,855	1,36,143
Bellary	131	28,963	1,60,586	898	24,347	70,225	1,029	53,310	2,30,811
Anantapur	101	39,106	1,39,838	1,495	50,340	1,59,162	1,596	89,446	2,99,000
Chingleput	545	188,433	4,89,298	2,090	126,933	2,75,318	2,635	3,15,366	7,64,616
North Arcot	171	59,034	2,10,814	3,906	141,611	5,01,770	4,077	2,00,645	7,12,584
South Arcot	246	72,068	2,31,325	2,849	141,045	4,22,462	3,095	2,13,113	6,53,787
Salem	78	21,435	1,02,840	3,194	75,246	2,50,833	3,272	96,681	3,53,673
Coimbatore	69	33,097	1,58,568	242	10,810	41,501	311	43,907	2,00,069
Tanjore	52	17,283	32,524	607	28,973	54,033	659	46,256	86,557
Trichinopoly	148	67,572	2,25,720	1,134	64,049	1,68,630	1,282	1,31,621	3,94,350
Madura	207	89,298	2,45,801	1,911	68,547	1,29,415	2,118	1,57,845	3,75,216
Tinnevelly	174	76,059	4,34,471	1,739	68,881	3,70,804	1,913	1,44,940	8,05,275
Total ...	2,872	1,028,134	33,95,784	28,776	1,170,158	33,21,457	31,648	2,198,292	67,17,241

In addition to the works included in this statement, there are large numbers of private tanks and zemindari tanks, with which the Irrigation Branch have no concern.

24. V. PROTECTIVE PUBLIC WORKS—*Protective Public Works.*—The only work yet classed under this head is that known as the Rushkuliya Project. The work was sanctioned by the Secretary of State in 1883, and the preliminary operations for commencing work were undertaken towards the close of the official year 1883-84. The project consists in utilising the waters of the rivers Mahanadi and Rushkuliya, in the Ganjam district, by means of canals to be used both for irrigation and navigation. These rivers unite at the town of Aska, and flow into the sea at Ganjam, and, as they do not rise in the Western Ghauts, are liable to be affected by the failure of the south-west monsoon rains. In order to supplement their supply, two large reservoirs will be formed above them, the reservoir for the Mahanadi having a capacity of 2,457 millions cubic feet, and that for the Rushkuliya 2,160 millions cubic feet. From an anicut on the right bank of the Mahanadi, a channel, 19¾ miles long, and provided with a head sluice, will lead to the

Rushkuliya river. This channel will irrigate 12,000 acres, will be made navigable throughout, and will be provided with a double tail lock. Where it ends in the Rushkuliya river, an anicut will be built, and from the right bank of the Rushkuliya, a second canal, 63¼ miles long, and navigable for the first 44¼ miles of its length, will irrigate a further extent of 108,000 acres. The works will be completed about the year 1894-95, and the full area of 120,000 acres is expected to be cultivated about the year 1897-98. The total sanctioned estimate is Rupees 28,60,239, of which Rupees 26,01,386 are for direct charges and Rupees 2,58,853 for indirect charges, and the net revenue anticipated, on completion of the works, is Rupees 1,44,312, or 5·1 per cent. on the total capital outlay.

25. *Important works projected.*—Many projects of more or less magnitude have been, at various times, proposed and partially investigated. Only one of these schemes will here be mentioned, viz., the Periyar Project, which has been fully worked out, and has been sent to the Government of India for sanction. The Periyar Project is one for the extension of irrigation in the Madura district, which, from its physical configuration, receives a very scanty and uncertain supply of rain from the south-west monsoon, and has but one river of any size running through it. This result is due to the fact that the range of hills on the northern border of the district, separating it from Travancore, rise up very abruptly from the plains of Madura, while on the Travancore side they stretch away towards the sea with a long and gentle fall. The district has, at various periods of its history, suffered severely from scarcity, while from time immemorial, its scanty rainfall has been stored in a multitude of tanks, with which it is literally dotted from end to end. Its one river, the Vaigai (which has a very uncertain flow), supplies a large number of tanks, by which it is drained nearly dry on its progress *eastwards* to the sea. To remedy this state of things, the Periyar Project was planned. The scheme provides for the diversion of the waters of the Periyar—a river rising in Travancore territory, in a region of heavy annual rainfall, and flowing towards the *West* Coast—into the valley of the Vaigai river by (1) a dam closing the valley of the Periyar, and thereby storing 13,300 million cubic feet of water; (2) a tunnel through the water-shed ridge between the two valleys, for the purpose of drawing off the water from the reservoir thus formed; and (3) the necessary regulating works for passing the water thus diverted into the tanks now inadequately supplied by the Vaigai river. The dam (which will be a work of great magnitude) will be 155 feet in height, constructed of concrete throughout. The complete estimate for the work amounts to Rupees 64,41,463. The work is expected to be of the most remunerative character, and has been recommended for sanction as a Productive Public Work. The full ultimate area to be brought under irrigation is estimated at acres 101,000 and the net annual revenue therefrom Rupees 5,74,600, or 8·92 per cent. on the total capital outlay.

ADMINISTRATION OF IRRIGATION AND NAVIGATION WORKS.

26. *Conservancy of Irrigation Works.*—In general, the entire maintenance of the irrigation works for which capital and revenue accounts are kept rests with the Irrigation Branch of the Public Works Department. In the Kaveri Delta, however, which (as has already been noticed) is a very ancient system of irrigation, the Irrigation Branch only deals with the maintenance and repair of all masonry works and embankments, and the annual silt clearances required, on channels that irrigate the lands of two villages or more, the villagers themselves undertaking all the necessary repairs on the smaller channels. On all irrigation works other than those for which capital and revenue accounts are kept, the upkeep of the works also devolves, in most cases, upon the Irrigation Branch; but, in some of the more ancient river channels, the works are maintained entirely by the villagers concerned; and, on other channels, the villagers supply customary labour, or "kudimaramat," by which agency, in former times, the State maintained the great majority of its irrigation works. The old ordinance of "kudimaramat," or unpaid labour of the ryots, has long ago died out on the numerous tanks throughout the Presidency, and is only now in force on channels, where the ryot sees it is entirely to his own interest to execute himself any little repairs that may be necessary,

in the interests of irrigation, from time to time. The reason is not difficult to seek. On channels, clearances of silt are all the repairs that are usually required, and are absolutely necessary, at short intervals, to enable the ryot to get any water at all. Hence he readily contributes his free labour on works of this class. The case of tanks is very different. Their irrigation will go on until the final moment when the tank bursts, and, there being therefore no immediate and pressing need for the ryot to exert himself, the small repairs—which done at the right time would prove of incalculable benefit, and which no one but he is on the spot to do—are, year after year, left undone, until they become so considerable that, the tank either breaches, or, they attract the notice of the Government officers, and are repaired in the usual course by the Irrigation Branch. Owing to the disuse of this custom of "kudimaramat," and to the fact that the vast numbers of the tanks scattered throughout the country absolutely preclude the possibility of their proper upkeep, or even of their inspection, by the officers of the Irrigation Branch, much attention has been lately attracted to the important question of their restoration in the present, and their permanent and efficient upkeep in the future. Before mentioning the arrangements that are at present in force regarding these works, it may be as well to notice, once for all, a common and somewhat widespread misapprehension that exists regarding them. It is *not* the case that the tanks have rapidly deteriorated of late years. The deterioration of the works has been gradual and inevitable, because a tank *must*, from its very nature, gradually silt up and therefore deteriorate as years go by, and the time has now come when a large number of the tanks of this Presidency—works, without exception, of old construction—have reached a stage which renders their deterioration apparent to all observers owing to the great curtailment of their irrigating capacity.

As already stated in paragraph 23, the number of Government tanks in this Presidency is 31,648. These works are scattered over a vast extent of country, and, as experience has demonstrated that it is absolutely impossible for the Irrigation branch to attend properly to the upkeep of so great a number of works, three main principles of concerted action have been decided on, in view to the present upkeep and restoration of the works and their future maintenance:—

First.—A special Public Works Department establishment to be employed in grouping the works, and estimating for their requirements, the actual work required being afterwards done by the ordinary Public Works establishment.

Second.—The Irrigation branch to be relieved of the duty of maintaining all tanks considered not to need any professional supervision. These tanks to be denominated "Minor"—in contradistinction to those retained by the Irrigation branch, and designated as "Imperial,"—and to be maintained by the Revenue Department.

Third.—That, until the result of the investigations of the special establishment are known, it will be impossible to decide definitely what works should be respectively classed as "Imperial" and "Minor:" but that, for the present, all works irrigating 200 acres or upwards to be classed as "Imperial," and works irrigating under 200 acres as "Minor," and this classification into "Imperial" and "Minor" to be finally revised on completion of investigations for each river basin.

This is the state at which matters now stand with regard to the upkeep and restoration of the tanks of the Presidency. For some two years past works classed as "Imperial" have been maintained by the Irrigation branch, works classed as "Minor" by the Revenue Department, while the special establishment is now at work.

27. *Regulation and Distribution of Water on Irrigation Works.*—No uniform system exists for the regulation and distribution of water required for irrigation. In the Godávari and Kistna Deltas the control and distribution of the water from the time it enters the canal to its exit from the village sluice is in the hands of the Public Works Department, who are in possession, from day to day, of information as to the state of the supply at all the principal regulating works. Once discharged

from the village sluice the field distribution rests with the ryots themselves. On the Pénner Anicut system, the regulation of the water-supply among the several channels is in the hands of the Public Works Department, while the distribution from the tanks rests with the ryots. On the Kurnool Canal the regulation and distribution of the water-supply is entirely in the hands of the Public Works Department. In the Kaveri Delta system the sluices built across the heads of the various offtakes from the river are managed by the Public Works Department, while the regulation of the distributary channels rests generally with the peasant proprietors of the soil, locally termed the "Mirassidars." Where the channels irrigate many villages, there is a well recognised custom, defined generally in a written document, settling the days and hours during which each village is to take water, and similar rules lay down each man's turn within the village. An establishment, paid and appointed by the "Mirassidars," manages the distribution of water to the fields. On all the large systems, such as the Palar Anicut, &c., where a series of tanks is fed from an anicut, the regulation of the water at the head works is in the hands of the Public Works Department, while the distribution from the tanks rests entirely with the ryots. On the channel systems of irrigation various rules apply; on some, the regulation of the supply from the river is managed by the Public Works Department, while the distribution of water from the channel itself is controlled by the Revenue Officers; on others, the entire control is in the hands of the ryots, and no Revenue Officer or Public Works Officer interferes with them. On the Tambrapurni Channels above the Srivaikuntham Anicut, the Public Works Department controls the supply entering the upper channels and passing the weirs, but have no authority to check waste of water on the channels, or to see that it is fairly distributed, and each ryot therefore practically takes as much water as he likes. On the Srivaikuntham Anicut system itself, the regulation and distribution is in the hands of the Public Works Department. Finally, to complete this sketch of the regulation and distribution of water throughout the Presidency, it only remains to add that the disposal of water stored in tanks rests entirely with the ryots interested, who regulate the sluices, distribute the supply, and manage for themselves every detail.

28. *Revenue due to Irrigation.*—Reference was made in paragraph 5 to the system which prevails in this Presidency with regard to the assessment of irrigated land. Except in the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment is consolidated, and the shares due respectively to "Land" and "Water" can only be approximately determined. Until 1880 no information existed on this head, but, as it was absolutely required in order to determine the financial position of works of irrigation, an approximation has since been made of the "revenue due to irrigation" as distinguished from the total revenue derived from irrigated land, for (1) all Productive Public Works, and (2) Irrigation and Navigation Works, for which Capital and Revenue accounts are kept, not classed as "Productive" from the commencement of the works up to date; similar information for (3) the works for which individually a continuous record of expenditure is kept is still under preparation. For the year 1882-83 the information for this class of works has already been prepared, as well as for (4) all other Irrigation and Navigation works for which Capital and Revenue accounts are not kept, but it is not considered necessary that the accounts should be prepared for previous years in the case of this last class of works. For the determination of the share due to irrigation resulting from the disintegration of consolidated assessments, elaborate rules have been framed. Briefly in the case of single wet crop the rules are (*a*) where assessments have been revised by the Settlement Department, the consolidated assessments are resolved into Land and Irrigation revenue respectively, by assigning to "Land" the amount proper to dry lands of the same class and sort in each village, and the remainder to "Water;" (*b*) where settlements have not been revised the average dry rate of the village, or where that is not available of the tálooks, or where that cannot be determined of the district, is applied to the total area irrigated. The product is then assigned to "Land" and the remainder to "Water." With regard to double-crop lands, the charge for the two crops is consolidated—the charge for second-crop being essentially in the nature of a water-rate. Everywhere but in Tinnevelly, the normal charge for double-crop land is one and half

times the charge for single-crop land of the same class and sort, and it therefore follows that one-third of the consolidated double-crop assessment represents the normal second-crop charge for the Presidency generally. In Tinnevelly, the normal charge for double-crop land is one and two-thirds that for single-crop, and the normal second-crop charge in Tinnevelly is therefore two-fifths of the consolidated double-crop assessment. The additional charge for second-crop assigned to "Water" is therefore two-fifths of the entire assessment in the Tinnevelly District, and one-third in all other districts, while the remainder is assigned to "Land," in the same manner as for single-crop land.

29. *Water-rates.*—In the Godávari and Kistna Deltas and on the Kurnool Canal, the assessment on irrigated lands are not consolidated, but a separate water-rate is levied on the area irrigated. The following are the water-rates now in force:—

—	Godávari and Kistna Deltas.	Kurnool Canal.
	RS.	RS.
Single wet crop per acre	4	4
Second wet crop per acre	4	3
If compounded for both crops for not less than five years	6½	6
Single dry crop	2	1
Second dry crop on irrigated lands if not compounded	2	1
Garden crop	8	6
Garden crop if compounded for not than less five years	6½	...
Crops requiring frequent floodings	...	3

On the Kurnool Canal, with a view to stimulate the ryots to extend their wet cultivation by converting their lands from dry into wet, certain concessions are allowed on the above rates as follows:—A reduction at 50 per cent. for the first five years, and at 25 per cent. for the second five years, is made, in the case of lands which have not been cultivated within the last ten years. For blocks of 50 acres and upwards of unoccupied lands taken up for irrigated cultivation, water is supplied, without restriction as to crops, free of charge for five years, and at half rates for another five years.

30. *Management of Traffic and Tolls and License Fees on Navigable lands.*—The navigable canals in this Presidency under the charge of the Public Works Department are:—

—	Present Lengths.	Ultimate Lengths.
	MILES.	MILES.
Godávari Canals	458	502½
Kistna Canals	278	349
Buckingham Canal	261	261
Kurnool Canal	190	190
Total	1,187	1,302½

The circumstances of the Godávari and Kistna Canals are most favourable for navigation, as there are few locks, owing to the gently sloping nature of the country permitting the main lines to be carried on without such accessories to navigation. On these canals, as well as on the Buckingham Canal, private boats carry all the traffic. The late Madras Irrigation and Canal Company, when they had charge of the Kurnool Canal, assumed the function of carriers; but, after the transfer of the canal to Government, the boats were let out to private individuals, who now conduct the traffic on the canal, which was also, from July 1883, brought under the same navigation rules as the three other canals. Prior to this date, there were no rules authorized by Government on the Kurnool Canal, the rules for navigation formerly in force under the Company being in vogue.

Boats are licensed to ply on these canals on payment of an annual fee, and those not holding licenses are required to pay tolls for each trip. Prior to July 1883, separate licenses were issued for the Godávari and Kistna Canals, and for each section of the Buckingham Canal, but, with a view to remove obstacles and stimulate traffic, the system of using separate licenses was abolished in 1883, although it

involved a reduction of revenue, and the following rates of license fees and tolls are now in force :—

License Fees.

Cargo boats	Rs.	2½ a ton of 50 cubic feet.
Passenger boats not bound to carry all castes, and charges for freight not limited	,,	5 do.
Passenger boats bound to carry all castes, and to charge for freight not more than 2 pies per mile per passenger in the general cabin, and 3 pies per mile per passenger in the fore or aft cabin, including one cooly load of baggage	,,	3 do.
	,,	5 do.
Steamers	,,	1 per boat.
Pleasure boats		

Tolls.

Cargo or passenger boat	,,	½ per ton of 50 cubic feet.
	,,	1 do.
Steamer	,,	3 per boat.
Pleasure boats	,,	½ per 100 square feet.
Timber raft	,,	¼ do.
Bamboo raft	,,	¼ do.

A license entitles the vessel to use any, or all, the canals without any other payment whatever. A toll once paid clears the vessel over all the canals, and in any direction, for a period of six weeks, and rafts for one month. Each passenger is allowed a space of 7½ square feet. The extreme dimensions of any vessel allowed to navigate the canals are 90 feet in length, 13 feet breadth over all, fixed fittings 6½ feet high over water level, and draught 2 feet. Rafts are not allowed to exceed 90′ × 12′ × 2.

Toll stations are established at the head locks of each section of the Godávari and Kistna Deltas, at all tidal locks, at the Ellore lock, and at four stations on the Buckingham Canal. A wharfage fee of 1 anna per ton on the registered tonnage on each boat loading or unloading, is charged at the authorized wharfs, but at present the only wharfage station is at Madras.

Executive Engineers, and officers authorized by them, are vested with the power of suspending the license of any vessel for overloading, wrong mooring, not carrying lights, not producing licenses, or for any other infringement of the rules prescribed for navigation as follows :—

15 days for the first offence,
30 days for the second offence
60 days for the third offence

in the same year. For a fourth offence the license may be cancelled. The following statement shows the statistics of traffic for the past two years on the four canals :—

Particulasr.	Godávari.		Kistna.		Buckingham Canal.		Kurnool Canal.	
	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.	1882-83.	1883-84.
Laden boats, number of trips.	19,000	20,520	7,627	7,566	24,982	*17,494	...	...
Empty boats, do. ...	15,025	17,096	4,472	4,220	2,817	7,87,166	...	...
Passenger boats, do ...	21,678	22,448	8,043	9,867	7,970	24,127	...	...
Tonnage	234,564	262,580	110,202	114,710	337,992	17,983	2,773	3,234
Ton-mileage	6,465,893	7,343,834	3,085,411	3,399,929	4,961,087	50,424	...	...
Value of goods, Rs.	1,42,00,998	1,26,17,048	91,04,133	92,03,167	1,00,35,339	98,23,228	3,27,500	7,08,867
Number of passengers ...	422,783	946,813	221,069	451,172	98,802	56,664	...	...
Tolls and License fees † Rs.	57,439	48,472	36,435	22,916	99,758	35,421	10,683	4,592

On the Kurnool Canal the traffic is worked by Government boats let out on hire.

31. STATISTICS. *Financial position of all Irrigation Works for which Capital and Revenue Accounts are kept.*—In paragraph 3, the financial position of each of the Productive Public Works in operation up to the end of 1882-83 was given. The following statement shows the financial position of each of the works for which capital and revenue accounts are kept, but which are no tclassed as Productive up to the end of 1882-83.

* The decrease in traffic on the Buckingham Canal in the year 1883-84 was due to the decrease in the salt traffic.
† The decrease in the receipts from tolls and license fees during the year 1883-84 was due to the reduction in the scale of fees from 1st July 1883.

Statement of Financial Results of Irrigation Works for which Capital and Revenue Accounts are kept, not classed as Productive up to end of 1882-83.

Systems.	Total Estimate including Indirect Charges.	Total Outlay to end of 1882-83.	Total Revenue due to works to end of 1882-83.	Charges to end of 1882-83.			Total Deficit after payment of all Charges.	Percentage of Deficit on Capital Outlay.
				Working Expenses.	Interest.	Total.		
1	2	3	4	5	6	7	8	9
PUBLIC WORKS NOT CLASSED AS PRODUCTIVE.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
Imperial.								
Chembrambakam Tank	7,24,648	7,36,589	2,95,835	30,163	2,86,128	3,16,291	20,456	2·78
Pálár Anicut system	19,93,893	16,80,965	13,23,351	7,41,596	13,71,171	21,12,767	7,89,416	46·96
Pelandorai do.	4,48,246	3,87,028	23,767	2,19,635	99,205	3,18,840	2,95,073	76·24
Total Imperial ...	31,66,787	28,04,582	16,42,953	9,91,394	17,56,504	27,47,898	11,04,945	39·40
Provincial.								
Buckingham Canal	92,91,954	53,74,499	18,42,232	13,13,810	18,90,504	32,04,314	13,62,082	25·34
Madras Water-Supply and Irrigation Extension Project	18,25,615	17,09,997	1,21,628	1,27,480	8,40,719	9,68,199	8,46,571	49·50
Total Provincial ...	1,11,17,569	70,84,496	19,63,860	14,41,290	27,31,223	41,72,513	22,08,653	31·17
Grand Total ...	1,42,84,356	98,89,078	36,06,813	24,32,684	44,87,727	69,20,411	33,13,598	33·50

The following general statement shows the financial position of all imperial works for which capital and revenue accounts are kept, from the years 1879-80 to 1882-83.

—	Capital Expenditure (Direct and Indirect) to end of year.			Revenue (Direct and Indirect.)	Maintenance Charges (Direct and Indirect.)	Net Revenue.	Percentage of Net Revenue or Capital Outlay to end of year.
	Productive Public Works.	Public Works for which Capital and Revenue Accounts are kept.	Total.				
	RS.	RS.	RS.	RS.	RS.	RS.	RS.
1879-80	2,04,42,429	23,73,646	2,28,16,075	38,07,921	11,12,151	26,95,770	11·81
1880-81	2,07,57,153	28,38,935	2,35,96,088	41,05,459	13,99,482	27,05,977	11·47
1881-82	2,09,95,698	29,24,961	2,39,20,659	36,30,105	11,55,884	24,74,211	10·34
1882-83	3,91,03,451	28,04,582	4,19,08,033	35,02,255	9,11,729	25,90,526	6·18

The very large decrease in the percentage of net revenue on capital outlay in 1882-83 was entirely due to the purchase by Government in that year of the Kurnool Canal from the late Madras Irrigation and Canal Company, and to its classification as a Productive Public Work.

32. *Area irrigated and revenue derived from all classes of Irrigation Works during the year* 1882-83.—In paragraph 7, together with the table exhibiting figures of rainfall, were shown by districts the figures of irrigated area and gross revenue ("land" and "water") derived from all classes of irrigation works for the year 1882-83; in paragraphs 10—21 inclusive, were given the figures of irrigated area and irrigation revenue of each of the works for which capital and revenue accounts are kept for 1882-83; in paragraph 23, similar information was given for each of the works for which a continuous record of expenditure is kept individually, while, in paragraph 24, was given a statement by districts showing the irrigated area and irrigation revenue of all the remaining works. The following general statement shows the total irrigated area of first crop and total revenue derived from irrigation, for each class of works, during the year 1882-83, the latest year for which the information is available :—

—	Area.	Revenue.
	ACRES.	RS.
Works for which Capital and Revenue Accounts are kept—		
I. Productive Public Works	1,756,344	57,59,623
II. Works not classed as Productive	89,796	2,95,357
Works for which neither Capital nor Revenue Accounts are kept—		
III. Works for which a continuous record of expenditure is kept individually ...	342,684	16,88,985
Works for which a continuous record of expenditure is kept collectively. IV. "Imperial" Works ...	1,028,134	33,95,784
Works for which a continuous record of expenditure is kept collectively. V. "Minor" Works	1,170,185	33,21,457
Total ...	4,387,116	1,44,61,206

33. *Percentage of Irrigation under works of each class and incidence of revenue per acre irrigated.*—The total area of Acres 4,387,116, as shown in the preceding paragraph, taken up for first crop irrigation during the year 1882-83 was 20·43 per cent. on the total cultivated area of the Presidency. Of the total area of first crop irrigation, Acres 871,533, or nearly 19·87 per cent., were irrigated for a second crop also. The total area occupied for irrigation was divided as follows among the works of the several classes :—

40·03 per cent. under Productive Public Works,
2·04 per cent. under Irrigation and Navigation Works for which capital and revenue accounts are kept, but not classed as Productive,
7·81 under works for which individually a continuous record of expenditure is kept,
23·45 per cent. under the "Imperial" Works retained under the charge of Public Works Department, and
26·67 per cent. under the "Minor" Works under the charge of Collectors.

The incidence of irrigation revenue per acre for each class of works is as follows :—

—	Average Irrigation Revenue per Acre.
Works for which Capital and Revenue Accounts are kept—	
I. Productive Public Works	3·27
II. Public Works not classed as Productive	3·28
Works for which neither Capital nor Revenue Accounts are kept—	
III. Works for which a continuous record of expenditure is maintained individually	4·93
IV. "Imperial" Works	3·30
V. "Minor" Works	2·83

The incidence of irrigation revenue per acre on the works of Classes I and II, and on the more important works of Class III is shown in the following table :—

—	Area irrigated.	Average Irrigation Revenue per Acre.
Productive Public Works—		
Godávari Delta	504,213	3·09
Kistna do.	261,158	3·19
Penner Anicut	63,653	3·69
Kurnool Canal	14,903	3·32
Cauvery Delta	892,871	3·25
Srivaikuntham Anicut	19,546	8·79
Total ...	1,756,344	...
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	12,763	3·78
Palar Anicut	66,212	3·28
Palandorai Anicut	3,386	2·54
Madras Water-Supply and Irrigation Extension Project	7,435	2·84
Works for which individually a continuous record of expenditure is kept—		
Lower Coleroon Anicut	105,599	2·94
Tambrapurni river above Srivaikuntham Anicut	53,310	11·21
Bhavani River	28,529	7·04
Amaravati River	25,645	5·43

From the above it will be noticed that the irrigation under the Tambrapurni river above the Srivaikuntham anicut, under the Srivaikuntham anicut, and on the

Bhavani and Amaravati rivers, is proportionately more valuable than that on the other systems.

33. *Incidence of Expenditure on all works for which Capital and Revenue Accounts are kept.*—The following statement exhibits the capital expenditure per acre irrigated from the commencement of the works up to the end of 1882-83, and the maintenance charges debited to revenue during the year 1882-83, for all works for which capital and revenue accounts are kept :—

Statement showing the Average Cost of construction and maintenance of works for which Capital and Revenue Accounts are kept.

—	Average Expenditure per Acre.	
	Capital Account to end of 1882-83.	Revenue Account during 1882-83.
Productive Public Works—		
Godávari Delta	18·23	0·64
Kistna do.	22·50	1·06
Penner Anicut	22·45	0·72
Kurnool Canal	1189·36	8·95
Cauvery Delta	1·17	0·35
Srivaikuntham Anicut	63·34	1·48
Irrigation and Navigation Works for which Capital and Revenue Accounts are kept—		
Chembrambakam Tank	48·92	0·32
Palar Anicut	24·94	0·63
Pelandorai Anicut	104·41	13·79
Madras Water-Supply and Irrigation Extension Project	198·11	2·20

From this statement it will be seen that the capital cost of the Kurnool Canal, in proportion to its irrigated area, far exceeds that of any other work, while the capital expenditure on the Pelandorai anicut and Madras water-supply works is disproportionately high as compared with the remaining works. With the exception of the expenditure incurred on repairs to the Pelandorai anicut during 1882-83, when the breached portions of the anicut was restored, the year 1882-83 approximately represents the normal cost of working expenses of these systems, and the statement therefore shows that the only work on which the cost of maintenance is abnormally high is the Kurnool Canal. Hitherto, also owing to the serious accidents, the works have received, the maintenance charges of the Pelandorai anicut have been abnormally high, and have averaged Rupees 9·74 per acre from the construction of the works in 1875-76 up to the end of 1882-83. In the year 1899, when the full area of irrigation will be in operation, it is estimated that the maintenance charges of this system will be reduced to about 12 annas per acre.

34. GENERAL. *Legislative enactments affecting the Irrigation Branch.*—At the present time, the Act known as "The River Conservancy Bill" is the only legislative enactment affecting irrigation, which has passed the Madras Legislative Council. As long ago as 1856, a draft enactment was instituted to provide for the safety of life and property, during river-floods, by means of a Bill enabling the officers of Government to attend properly to the conservancy of the great rivers of the Presidency, but it was only in March 1884 that the Bill, after being under consideration for several years, was finally amended and passed by the Madras Legislative Council, and only now awaits the sanction of the Supreme Government to become law. The principal object of the Bill is to give the officers of Government full power to prevent and prohibit the damage, which is at present inflicted on both private and public property, by the unauthorized action of private individuals, in forming and removing constructions within river-beds. Formerly, no officer of Government could in any way check the action of individuals in such matters, without rendering himself liable to a suit for damages, and much public money was accordingly spent on works designed to counteract the evil effect of private or unauthorized interference with the river-beds. The Act provides for the appointment of officers to be styled "Conservators of Rivers," who have power

to prohibit cultivation within river-beds; to direct the removal of all constructions, plantations, &c., which they deem to be an obstruction to the course of the river; and to take any measures which appear to them to be necessary for the safety of life or property, in connection with any river to which the Act has been applied.

35. *Further Legislation proposed.*—An important Bill now under consideration is that known as the "Madras Irrigation Act," which was originally drafted in 1883, was circulated to the Governments of Bengal, Bombay, and the North-West Provinces, for opinion on certain points, and has lately been referred to a Committee. The object of the Bill is to make provision for the construction, maintenance, and regulation of canals, for the supply of water therefrom, and for the levy of rates for the water so supplied. It will empower canal officers to duly inspect and regulate the water-supply; to remove obstructions; to execute repairs where the owner of a "water-course" fails to execute the repairs required of him by the Bill, and to charge the cost of such repairs to the owner; to settle disputes as to rights and liabilities of persons interested in a "water-course;" and to take into custody persons causing wilful damage to canals, or interfering, without proper authority, with the supply or flow of water.

ORDER—dated 26th January 1885, No. 210, Public.

Recorded.

(True Extract.)

R. S. BENSON,
Ag. Under Secy. to Govt.

To the Public Works department, Irrigation branch.

Exd. J. Wright.

No 421 Ir dl 23rd Febry 1885

Recorded

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JANUARY.

Manual of the Administration.

Recording a paper on Irrigation.

Chief Engr for Irrn