185/43

M.R.O. 1—20,002—12-8-65.

(1) Number of Pages 86

(2) Date of repair 27-6-67

(3) Initials of the Referencer 22.1.68

MADRAS RECORD OFFICE

GOVERNMENT OF MADRAS

Revenue DEPARTMENT

G.O. No. 185	Press
B.P. No.	Mis.

Dated 21-7-1874 196 .

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Works Department, 15th July 1874.

Read the following papers :—

No. 295. From the District Engineer, Godavery, dated 19th Dec. 1873, No. 2,851.
No. 296. From do. do. ,, 13th Jan. 1874, No. 3,023.

No. 297. Memorandum from the Chief Engineer for Irrigation, dated Madras, 26th February 187[illegible] No. 184-C.

THE following notes on the Godavery Delta Works, in connection with a tour of inspection made in October and November 1873, are submitted for the information of Government.

Anicut and head works with the river in the immediate vicinity.

2. With a few inches of water going over the weir, the appearance of the [illegible]prons indicated that no disturbance of [illegible]y consequence had occurred during the [illegible]hes of the season, and that none but ordinary repairs and renewals would be required. I have since heard from the District Engineer demi-officially that below the Muddur branch there is a deep hole, the result no doubt of alterations in the sand banks above the anicut. I have not as yet received the particulars, but the remedy will probably be the running out of trailing groynes on either side of the hole from the apron, with perhaps the pitching of the slope of the hole next the apron, in order to prevent it working back, then the hole may be expected to fill up. An examination of the chart may show how the cross currents have originated, and the cause may then perhaps be removed. At places concrete has been used to repair the hollows in the cut-stone apron of the anicut, and, with the greatly superior cement which is now prepared with clay and lime at Dowlaishweram, this material, if carefully applied, will probably be able to stand the wear and tear of the sand laden water much better than the sand-stone. It is intended to do a good deal of work in this way this season.

Head-sluices.—For the improvement of those of the eastern and western delta main canals, items more than sufficient have been provided in the completion estimates, but hitherto the exact nature of the alterations to be made had not been determined ; all that is necessary is to arrange for shutters of sufficient strength to be worked by screw gearing. The present shutters are in bad order, and are both very inefficient and troublesome to work ; they soon get knocked to pieces by the hammering required to get them down, and from the absence of fit between the shutters and the stone grooves in the piers they are more liable, than need be, to be choked with brushwood, which comes down the river in large quantities. After making the requisite calculations, the District Engineer has been requested to estimate for new shutters with screw gearing, the bearing surface in the grooves to be of iron. The improvements are to be carried out as far as possible this season, and the dimensions of the shutters and shutter spears, together with drawings of a suitable description of gear have been furnished to Colonel Fischer. The Central Delta head sluice will be similarly treated in due course.

There is much room for improvement in the regulation of these sluices. The Superintendents who look after them appear to have thought that the required depth in the canal below had alone to be considered, whereas this is only one matter to be attended to, and another and very important one is the passing of this supply through the sluices with as little disturbance as may be, and in such a manner that there may be no silting above or below any portion of the sluice. Instead of open-

ing a few vents widely, the shutters of many vents should be raised to the necessary height, and generally all the opened vents should be lifted to the same extent.

The river above the Dowlaishweram branch of the anicut has deepened considerably within the last three years. It was then considered necessary to keep the deep channel at a greater distance from the anicut, and five groynes for this purpose were to have been constructed, but this work has not been carried out. The latest soundings, those taken in the hot weather of 1873, show as great a depth as 27 feet* 4 inches at 300 feet from the weir, and the bed approximates to 20 feet below the crest at 50 to 100 feet in places. This is certainly far from desirable, and the groynes should be completed within the present season. Another matter requiring the District Engineer's attention is the maintenance of a complete record of all that is done each year; the necessity for this was pointed out in the Proceedings just referred to, and it was observed that the charts themselves were the best place for noting down all such information. Nothing has been done to carry out these instructions, and in one instance a retaining wall has been put down in rear of under-sluices without the levels the foundations being recorded. All this is very irregular, and would be altogether improper even were it not requisite to have information available when transfers of officers in charge take place, while as these are unavoidable the result must be that instead of working on proper data, an officer new to the works must waste money in trying to ascertain how they should be dealt with. It must also be remarked that the work of the department is very heavy, and there certainly is no time to look after those who, having been furnished with instructions, omit to attend to them.

G. O., 3rd February 1871, No. 331.

* The maximum.

At the west end of the Dowlaishweram section of the weir is the *Pitchikalunka* or island of which the east face is in good order, and its outline will do very well. A little nanul planting is wanted just above the dam. Below the weir this face of the island requires a moderate extent of planting to secure a good line for the river bank. The west face of the island above the anicut needs a good deal of planting, and this should be done with the grass on the shoal to the west, all of which grass should be rooted up. This shoal has been rented out this year, but it will be better in future not to rent the land of any lunka which it may be desirable to wash away. It is probable that a better theoretical outline for this head or spit might be laid down, but the outline has been established for many years and most of it is faced with stone, and so I have decided not to make any alteration here, except the rooting up of the nanul grass on the shoal and island west of the head. No grass should be allowed any where outside the proper boundary lines of the heads and islands. Steady attention to this point will probably do more than anything else to establish and maintain free channels leading directly to the several sections of the anicut. The soundings taken annually have not extended west of the Pitchikalunka, but in future they should be taken for 100 yards above each section of the anicut, and at such intervals as may upon investigation prove necessary all over the river bed above the anicut to, or to a little above the line of the heads of the islands, and below to a distance of 100 yards or thereabouts from the lower edge of the aprons.

The next branch or section of the anicut is the *Ralli*. The river below this is in a favourable state. The under sluices at the west end of this branch had

for a time ten vents open this season, but they had to be closed owing to the erosion caused to the river bank below, and to the partial destruction of one of the retaining walls of the apron. The aprons of this and of the Vigeshwaram under sluices are now much too high, owing to the river bed below having in the course of years been lowered several feet. The most effective way of dealing with them will be to drop these aprons by half-yard steps, having retaining walls at their edges, down to summer water level, the cut-stone work may be confined to the first and second aprons, and the others may in succession be composed of smaller and smaller material. As it is they give a great deal of trouble and prevent the sluices being opened when most required, viz., when the river is not in high fresh. Plans and estimates should be submitted by the District Engineer; the work probably can be carried out under "extensions and renewals" from revenue.

The training revetment from the west abutment of the Ralli under sluices needs lengthening, and its present outer end is a few feet too forward. The bank of rough stone at the end of water-wing on east side should be strengthened. The groyne from the east abutment above the sluices requires considerable strengthening. It is, I think, immaterial whether there be a channel or not from the Ralli branch of the river to these sluices. Perhaps, in the interests of the central delta navigation, it will be best to have no such communication; at any rate nothing need be done at present to favour it. The groyne between the under sluice and lock channels may be raised half a yard and somewhat extended; it is at present not as long as was proposed. This and other groynes should not be constructed with nearly vertical sides.

The channel to the Central Delta head sluice and lock runs for a distance of about 1,500 yards through the Bobberlunka, a head which has from time to time undergone great changes. When the arrangements indicated by the stone noses were established, I do not know. A survey of 1848-49 shows an entirely different state of the river hereabouts from any I have seen, for then a large island completely screened the approach to both the Central Delta head sluices and the Muddur branch of the anicut. However, a good many years ago, the head was established with open water to the northward, and was protected by stone work, a good deal of which was visible in November last. The freshes of this year have washed away a good deal of the head and breached it extensively to the south of the stoneworks, when I first saw this alteration it struck me as doubtful whether the omission to maintain the heads as they were left a few years back was not a mistake, and subsequently when going in the *Thistle* to the head of the Central Delta it turned out that with the water at a considerable depth on the anicut this light draught boat could not get down the Bobberlunka channel. What is wanted is that the head should be on the edge of a permanent deep channel; that it should be there effectively maintained; and that the Ralli under sluices should be freely used to create a considerable current down the channel and prevent shoaling; then if the alignments of the two sides be good, the navigation will be efficient. There is certainly a deep channel not far off leading from the neighbourhood of Wadapillylunka, first towards this head, and then across it to the Dowlaishweram weir, and soundings will show exactly the configuration of the bed. At any rate the Bobberlunka heads must not be allowed to disappear, but planting must be vigorously

carried out, and if requisite more stone ould be used to re-establish them on the former alignment, or on that which the ition of a deep channel of, say, 7 or 8 feet below the crest of the anicut may indic to be desirable. Some planting has been done on the west face of the head abo the Muddur anicut, and below the weir on this face a very extensive plantati has been formed, while a great deal yet remains to be done.

The next head is called the Mu rlunka, and is on the west side of the branch of the anicut bearing that nam The east face requires a little planting. The west face is very irregular, and th is a great deal of shoal above the anicut crest level. An effort must be made reduce or destroy the island to the north-east of the Muddurlunka proper; also great island to the north and north-west, which since the surveys of 1873 were le tended considerably to the west-ward, thereby injuriously reducing the ge over the Vizeshwaram branch of the anicut. Nanul must be persistent cooted up where shoals and islands are not wanted, and as persistently planted an naintained where land has to be secured or extended. The head between the W tern Main canal channel and its continu-ation below the anicut wants just a l e protective planting, but nothing more. The channel leading to the Vizeshwara nder sluices is smaller than it should be, and it looks as if it had been but littl sed. It should be remembered for what purpose under sluices are built, and th pon them depends in a great measure the efficiency of the approaches to the hea sluices. led to the disuse of the scouring slui , and the remedy already indicated can without much difficulty or expense be lied.

3. These should always be prot ed where not in advance of their proper alignment by nanul or lunka grass; it is easier to prevent than to repair damage, and so much can be done to preserve river margins by this means at a bare face of earth in such positions should not be seen anywhere. It will ke time to cover scores of miles of river bank with this grass, but year by year much as possible should be accomplished. Some times also nanul revetment will e required, and this when properly con-structed and well rooted is remarkably able.

Faces of river banks should everywhere protected.

3 A. Formerly a subordinate m ber of the permanent executive establish-ment was placed in charge of the anicut and head works and of the river regu-lation in the neighbourhood of the r; but changes in the Department led to the abolition of this special appointm t as an executive charge, and the want of a Superintendent having been much lt, it has recently been recommended to Government that this appointment sh ld be made a part of the Delta conservancy establishment, an arrangement whic will ensure permanency and therefore be suitable to a charge which requires le thened experience of the works and their requirements.

Anicut Superintendent.

4. *Dowlaishweram quarries.*—Mo of the old quarries contain now but little is not procurable at a moderate cost. good stone, and this from the great amount of debris or superincumbent soil r. Martin, the Assistant Engineer in charge,

Quarries.

has recently broken ground at a new spot with good results. Rails are to be laid to this quarry, and some of the old lines may th advantage be taken up.

Quarry plant.—There is much room improvement in the arrangements connected with this plant. Some of the lin of railway are not all efficient; those which are to be maintained should be ver onsiderably improved. The mainte-hance of the gauge, the proper support o he rails, and the correct fitting of the joints are all matters not of choice but of ne sity if the railways are to do the work for which they may be constructed econo ally and satisfactorily. The rolling plant is not what it should be—channelled w heels should on no account be kept in use; the tires should be turned down as s n as they get worn so much as to be unable to traverse on the rails, and when n orn down at length too much to be of use they should be sent to the foundry to re-cast. There is a great deal of old or unserviceable cast-iron work lying about nich should be cleared off the ground and either stored at the workshops for fut re use or re-cast at once. The wood work of the quarry wagons is by no means pt in a proper state of efficiency.

A great deal of plant was received from the Upper Godavery. Some of it, as for instance iron-bodied tip wagons or set of iron work for these, will never be used at Dowlaishweram, and the smaller ir work in boxes is lying exposed near the quarries and will inevitably deteriorat It will be advisable to see whether this cannot be utilized elsewhere, perhaps e tip wagons would be useful on the Carnatic Railway. At any rate a list of t plant not required in the Godavery should be sent to the District Engineer, Pr sidency, so that the General Superin-tendent, Public Works Workshops and St s may know of what it consists and may be able to utilize it.

The quantity of rails is in excess of the requirements of the Northern Deltas.* There are several patterns: bridge rails large and small, the former very excel-lent, the latter fit only for light work and somewhat destructive to wheel tires; foot-rails, the heavier very good, and some so light as to be useless for any ordinary quarry rail work. All of these small foot-rails may be transferred elsewhere; possi-bly they might be used in lieu of timber joists in roof work. The rails of different patterns should be stacked separately; at present they are mixed, and their numbers cannot easily be checked. The gauge of the Upper Godavery pairs of wagon wheels is different to that of the Dowlaishweram quarry plant, and some of the former have been altered, while for a new quarry at Yerrapolliem six or seven miles distant, the Dowlaishweram gauge was about being laid down although Upper Godavery rolling stock was to be used and this appeared to be unadvisable, so it has been arranged that the railway shall be laid to suit the gauge of the stock. This *Yerrapolliem quarry* is at about 2⅓ miles inland from the 7th mile of the Samulcottah canal, and it promises to yield a large quantity of stone of a good quality. It is in some respects inconveniently situated for the works to be supplied, but it is expected that the cost of the stone at, say, the Dowlaishweram head lock will not exceed that of the stone now used, because the bed will be easily worked and there will be little refuse. Instructions were given for a far more careful laying of the railway to this quarry than was apparently intended. It is bad economy to have too few sleepers, and rails of different patterns should not be laid down indiscriminately.

* Godavery and Kistna.

5. Upon a recommendation made in my last memorandum of inspection, a sum of Rupees 5,000 was sanctioned* for experiments to ascertain the best way of manufacturing concrete blocks to be used as a substitute for the sand-stone, of which, even in 1870, there was difficulty in obtaining sufficient quantities. The matter to be determined as of course the best proportions of the ingredients to be used in the cement which with quarry refuse stone and sand would form the ingredients of the concrete, while as the lime-stone available is though excellent but feebly hydraulic, was of much importance to obtain a cement which could be relied on for the foundations of the numerous locks and other masonry works then about to be built all over the delta. This investigation was not taken up with the attention and which its importance demanded, and, up to the end of December last, the total expenditure on the experiments had amounted to Rupees 1,246 only. In the meantime many large masonry works have been constructed which would certainly have been the better for the use of a cement instead of the lime in its ordinary state. The experiments which have been made show very clearly that a cement of very greatly superior strength to the lime by itself can be made by mixing 1½ parts of river mud (principally clay) with one part of burnt lime. Some of the brickets made with this mixture broke with a weight of 375 lbs. on the 2¼ square inches of the standard bricket, the standard for Portland cement brickets being 500 lbs. on the same area. The clay was burnt in small cakes, ground, and then mixed with the lime—two days air drying were needed before the immersion of the brickets in water, but this sufficed to ensure complete setting and prolonged immersion resulted in a considerable increase of tensile strength; consequently this cement will do very well for most hydraulic masonry works, as the water can generally be kept from such for a few days without difficulty. For lock foundations cement which will set under water is often required to save expense in baling, and to ensure the concrete of which the lower foundations are composed retaining the cementing material. It appeared to me that a cement of this kind could be obtained in one or both of the following ways; 1st, by mixing unburnt clay and burnt lime together and burning them in the form of balls or cakes; 2ndly,† by mixing burnt clay and slaked lime and reburning the mixture. The first process, if found to answer, would probably be the cheaper of the two, but not certainly so as a high temperature may be required to enable the lime to attack the clay. Instructions were given to the District Engineer, but as yet no report of results has been received. Hitherto the materials used have been coarse and the mixtures have been far from homogeneous, and there is consequently every reason to suppose that the limes and clays obtainable on the spot will, if judiciously treated, yield cements adapted to every required purpose, and this too at a cost which will be very satisfactory, for clay is cheaper than lime, and the resulting cement is so greatly stronger than the lime itself that it will bear to be diluted or reduced by the admixture of more sand. For lock sills and weirs the cement will be particularly valuable.

Concrete and cement.

* G. O. No. 1,077, dated 18th April 1871

† This process was successfully employed at Nellore.

For concrete blocks the cement of two clay and one lime is very suitable; these can be air-dried for a couple of days and then immersed, and at the end of a month they are quite ready for use and will make excellent masonry. They can be manufactured of any convenient size, and it is hoped that it will not be long before large quantities are prepared at a price which will make their use very economical. The quantities of small stone available for this purpose are very large, and with good arrangements for mixing and moulding, etc., the cost will be small. It has been found requisite to put a thin coating of cement all over the blocks on removing the moulds, but probably either this necessity can be got rid of or, if the practice be retained, the surface should be left as nearly resembling that of the sand-stone as may be, so that the adhesive qualities of the mortar used in building with the blocks may be fully developed. Of course with no young officer available for this special work, less attention could be given to it than would otherwise have been possible; nevertheless the practical importance of the investigations, and the urgent need of a determination of the proportions of a good cement might, in my opinion, have ensured the requisite information being obtained a couple of years ago, had its great value in connection with the delta works been duly appreciated.

The results of the experiments are to be tabulated in a form in which they will be of general use as a guide to the officers of the department generally, and will be printed for circulation in due course. These cements are useful not only for hydraulic works but on all masonry works, and in the form of both mortars and plaster they will render such works stronger and capable of more economical maintenance.

6. These were not in work at the time of my visit. The lime-stone used comes from near Rajahmundry and is of very different descriptions. Some is highly crystalline; some hard, compact, fine grained and of dark colour; other soft and light in colour. All these kinds are mixed indiscriminately in a kiln charge; but this is a mistake, as they must require different degrees of heat and differing lengths of time for burning. It is very easy when breaking up the stone to sort out the various kinds into separate heaps, and all the stone should be broken smaller than has hitherto been customary. Similar remarks apply to the lime-stones used in the Western Delta at the Chettipett kilns, at which the limes used are almost identical with those supplied for the Dowlaishweram kilns.

Lime kilns.

7. This dock is situated on the right bank of the Main canal of the Eastern Delta. It is but seldom used, and the improvements suggested in 1870 have not been carried out. Properly this dock ought to be in constant use for the repair and repainting of the hulls of floating plant, and indeed more than one dock might be constantly so employed. The engine erected some years since for emptying this dock had recently been dismantled, it being supposed to be necessary to send it to the Mogultur lock in the Western Delta just about to be commenced. The necessity for this was not apparent, there being some rotary pumps received from the Upper Godavery at the workshops.

Dry dock.

8. This channel, if it can be kept open at a moderate cost, would be very useful as it would remove the necessity for navigating the somewhat dangerous channel which hugs the anicut near the under sluices. It is only at the junction of this channel with the deep channel along the left bank of the river that there is very

Workshop channel.

shoal water; elsewhere there is a sufficient width having a depth of over 4 feet. In the channel along the left bank there were 21 feet of water, and here the dredged material was being deposited. It is somewhat singular that at the north side of the workshop channel near its head there is deep water, while opposite or on the south side which appears to be exposed to the set of the river there is a sand spit which bars that side though there is deep water immediately below that spit. Dredging was in progress, but the inefficient condition of the dredge* and the want of punts made the progress less satisfactory than was desirable.

* No. 2, vide floating plant.

9. This which was sanctioned in G. O., No. 3037, dated 14th December 1870, as one of the rest-houses of the Eastern Delta has been built on a good and convenient plan, differing materially from that sanctioned originally. There are two principal rooms instead of one; these are well ventilated and have a tiled roof. The verandahs, parts of which are enclosed to form minor rooms and bath-rooms, have Cawnpore roofing. This latter roofing leaks in several places; otherwise the work appeared to be sufficiently good. It was said that this house had been built owing to its proximity to the quarries, &c., for the amount, Rupees 2,900, allowed for the other design, but elsewhere the additional cost is estimated at Rupees 270, and the District Engineer proposes to substitute the improved design wherever the sanctioned houses have not been already built. The question will be disposed of as soon as a detailed estimate shall have been prepared.

Rest-house, Dowlaishweram.

10. I do not think that these workshops are at all equal to the work to be done. All the machinery in the present machine shed, an old and very unsuitable building, is driven by coolies, and a machine shop is urgently required. Its cost may properly be added to the capital of the shops, and I have instructed the District Engineer to prepare a plan and estimate; and, in order that the arrangements may be as good and convenient as possible, he has been requested to consult Mr. Grainger as to the machine tools which should be placed in this shop, and as to the position and space which should be assigned to each; with regard to the dimensions and mode of fixing the shafting, &c., Mr. Grainger's advice will be of service, for a good deal depends upon the efficiency of this, and generally insufficient attention is paid in District Workshops to the strength of the shafting, the firmness of its bearings, and the position of the driving pulleys which should be as near the supports as practicable. At present new work is necessarily long delayed, while the repair of the floating plant and its machinery cannot apparently be carried out with that promptness which is essential to economy and efficiency. The new or constructive work to be done during the next 20 or 25 years at any rate must be very large; for not only are the demands for the delta works great, but Local Funds are providing numerous iron bridges over the canals and channels, drains and streams. The work to be done to the steamers, dredges, iron and wooden boats, &c., of the floating plant and the machinery and plant generally will certainly not decrease, but must be expected to be constantly on the increase, and the means of carrying on all such works are confessedly inadequate now and will year by year become still more so. I hope therefore that the estimate for the machine shop will

Dowlaishweram Workshops.

Proceedings of the Madras Government, Public Works Department,
15th July 1874.

shortly be placed before Government in so complete a shape as to admit of its being constructed and made available for use within a year or eighteen months at most.

11. *Steamers.*—The *Little Nell* has been fitted recently with a new boiler of the same design as the old one. I was much disappointed at her performance. It appears to be almost impossible to maintain steam at the required pressure of 50 lbs, although during two days when inspecting the Ingeram and Coringa canals and the Takee drain, the District Engineer, the Range Officer and myself were on board and paid much attention to the firing. It is to be regretted that when the new boiler was ordered the defects of the old one were not brought prominently to notice, so that such improvements as were necessary might have been made. The steamer was in need of re-painting; this had been postponed until the fine weather after the monsoon. The interior of the steamer is in bad order and should be thoroughly put to rights.

Floating Plant.

Shamrock.—This is one of the smaller steamers received from the Upper Godavery. She has powerful engines which were placed in her when employed under Colonel Haig. At present pending final orders as to her disposal she cannot be considered as belonging to the Delta Flotilla, but she is in the meantime employed in towing material boats for which work she is well adapted.

Fawn.—A small steamer with a vertical tubular boiler and engines of a very good pattern. The latter when I first saw her were in a very bad order, and had not been properly cleaned or cared for. For towing she will never be of much use, but for inspection purposes she would answer very well could steam be maintained in the boiler at a suitable pressure. It appears that when in use at the Upper Godavery it was found that the exhaust steam when passed into the funnel as was arranged by the Engineer who constructed the engines created such a powerful draught that the boiler tubes were rapidly burnt through, and consequently the exhaust pipe was diverted to an opening in the side of the vessel, and, as the natural result, the draught became altogether inefficient. The regulation of the strength of the draught by the blast from the exhaust pipe is, however, by no means an insuperable difficulty; and before deciding as to whether the steamer is to be considered unserviceable or not, the exhaust should be replaced at the lower part of the funnel, and the orifice of the pipe should be somewhat enlarged, it depending upon this what the force of the blast will be, and with a little trouble it is thought that just the desired strength of draught may be secured. Should the result be successful, the boiler may be turned round, stoking in the present position of the furnace door being difficult owing to the space being very confined, while on the other hand were the furnace turned aft, there would be plenty of room both for the stoker and for fuel.

Thistle.—This steamer has been recently fitted with a new boiler and is now very efficient. With four range boats in tow, steam at a pressure of 62½ lbs. was easily maintained, and her speed is very satisfactory. A new spring to the spring gauge on the safety valve was the only thing that I observed to be needed. Spare fittings for the vessels should be kept in stock in order to replace at once those which may become unserviceable.

Godavery.—I made a trip up the river as far as Pursaotputtum in this steamer to see the right bank along which some protective works had been recently carried

out, and so had an opportunity of seeing how this vessel worked. The hull is barge shaped with vertical sides and overhanging ends. It was designed to steam in very shallow water, and it is capable of going over shoals having even less than 18 inches of water upon them. I was led, however, to doubt very much the appropriateness of this form of hull. It was most noticeable that in deep water the speed was as great as is necessary, but directly the water shoaled to 5 or 6 feet, the speed became reduced very materially, and Captain Barber is of opinion that a depth of about 10 feet is necessary to obtain the full effect of the powerful engines of this vessel. The reason of this is obvious enough; the displacement of water is nearly vertical, and if the water cannot get away easily below it is heaped up in front, and when the water shoals suddenly it actually comes over the deck in front. Lateral displacement of the water would seem therefore to be much the better arrangement for river steamers which are to navigate shallow channels. The boiler is very efficient, but the engine requires to be refixed with stronger attachments, and the framing of the hull below is too weak for the great strain brought upon it. The engine itself cannot at present be kept in perfect order. The necessary alterations should be made, or rapid deterioration will follow.

Prince.—This is another of the upper Godavery steamers, but the type is altogether different. It has side paddles instead of the stern paddles of the *Godavery*. I have not had an opportunity of seeing the *Prince* under steam, but the engines were very clean and apparently in excellent order. The wood-work of the deck and deck-houses needs re-painting and sundry repairs, and the hull will probably be the better for a coat of paint.

12. *Charges for Steamers.*—I noticed in my last inspection report that the charges made for steamers when hired by Government Officers or others were inadequate, and it was recommended that these should be raised, but the instructions had not been acted upon. Permission was given for range boats being towed to and from the Central and Western Delta heads free of charge, and the steamers ought not to be used without payment, except for this purpose and for the inspection when necessary by the officers immediately responsible for the state of the anicut of this work and of the river channels and islands, &c., within 5 miles of it. The District Engineer appeared to have a personal objection to raise the charges, but I could obtain no other explanation as to why the instructions given nearly three years ago had not been carried out. In a statement prepared when I was at Dowlaishweram it is shown that the daily cost of the three steamers in general use is as follows :—

G. O., No. 744, dated 13th March 1871. Memorandum paragraph 9.

	Rs.	A.	P.	Rs.	A.	P.
Thistle.						
Crew, oil, fuel, &c.	11	5	4			
Maintenance*	1	4	0			
				12	9	4
Shamrock.						
Crew, oil, fuel, &c.	13	12	8			
Maintenance*	1	4	0			
				15	0	8
Little Nell.						
Crew, oil, fuel, &c.	12	5	4			
Maintenance*	1	4	0			
				13	9	4

* 300 Rupees a year of say 240 working days.

Now, in the first place, the maintenance certainly costs more than the sum here named, for, as is expressed in the statement, keeping "the steamer in thorough good working order through the year round," and it will be quite safe to assume that at least Rupees 600 instead of 300 a year are needed for this purpose; then the interest on the value of the plant at 5 per cent. and the depreciation at say 10 per cent. ought to be taken into account. The value of the *Thistle* may be taken at 20,000 Rupees, of the *Shamrock* 25,000 Rupees, and of the *Little Nell* 17,000 Rupees, and the charges would then become for the—

	Rs.	A.	P.
Thistle, as above	12	9	4
15 per cent. on 20,000, 3,000 yearly and $\frac{3,000}{240}$	12	8	0
Total ...	25	1	4
Shamrock, as above	15	0	8
15 per cent. on 25,000, 3,750 and $\frac{3,750}{240}$ ...	15	10	0
Total ...	30	10	8
Little Nell, as above	13	9	4
15 per cent. on 17,000, 2,550 and $\frac{2550}{240}$ ...	10	10	0
Total ...	24	3	4

The charge to be made should therefore be for the *Thistle* and *Little Nell* each Rupees 25 a day, and for the *Shamrock* Rupees 30 a day of ten hours under steam, while for a less time than half a day 3 Rupees an hour for the two former, and $3\frac{1}{2}$ Rupees for the latter will not be too much. The use of the steamers is optional, the charges named are moderate, and would generally be fully covered in the case of officers of Government by the mileage allowance given for long journeys. No difference should be made in the charge to Government officers and others.

13. *Dredges.*—No. 2 dredge was at work in the workshop channel. It has a bucket ladder on either side, but the boiler is said to be nearly worn out, and the steam pressure was only 20 lbs., whereas 50 or 60 lbs. would be required to work the dredge effectively. The engine is a very excellent one by Forester, single cylinder, the main shaft carries an endless screw which gears into a worm-wheel on the bucket tumbler shaft. One of the bearings of the main shaft was loose, bucket ladder out of repair, some of the bucket rollers worn out, grease not used sufficiently. A new boiler should be ordered for this dredge without delay. There was only one punt available for this dredge. This is No. 12 and is a trap-punt, a very convenient arrangement for disposing of the dredged material where this can be deposited in the water as was the case here and is usual for the clearances of the channels leading to the heads locks, so that a few additional punts of this class might with advantage be constructed, say half a dozen altogether.

No. This was at work in the head lock channel of the Central Delta. It worked smoothly and well, but the upper end of the shoot requires repair.

No. 6.—This dredge had done its season's work on the Ellore canal and was about to be sent to Dowlaishweram to refit. The Range Officer had examined it

carefully to see what was required to be done to it, and the particulars need not be given here.

No. 7.—The engine appears to be in good order, except that the spur-wheel on the fly-wheel shaft is a good deal worn. The ladder and bucket rollers, link-pins, &c., require attention. The wood work requires re-painting.

Dredges when work is stopped should be sent to be refitted.

When a dredge stops work it should go at once to the shops to be refitted and made ready for another turn of work. This has not been the practice, but it is essential to keeping the machinery in proper order, and the over-hauling should be frequent. When dredges are employed in ranges away from head quarters, a fitter should be sent to inspect them once in three months or so, or this may be done by the Boat Superintendent if one be sanctioned.

To be inspected by competent persons from time to time if not sent to workshops.

14. The District Engineer has frequently complained of late of the inadequate number of boats available for the transport of materials and for the dredges. A statement dated 5th November last and appended to this memorandum shows that there are altogether seventy-three punts and boats, of which one is a drop-punt for dredging and discharges through a trap in the bottom, eight belong to Local Funds, sixty-four belong to Imperial Funds. The seventy-two boats can carry materials, some being suited for any work of this kind, while others are adapted only for conveying sand, lime, &c., and not stone, except perhaps small stone for concrete.

Punts and boats.

Colonel Rundall, the Inspector-General of Irrigation Works, in his notes on the Godavery, page 5, states that fifteen new boats of 50 tons each are required for the transport of materials and twenty-eight additional punts for use with the dredges, of which there are six so as to allow ten punts to each dredge.

In order that a more accurate idea might be obtained of the circumstances and requirements, the District Engineer was asked to show what had been accomplished during a year, and he has prepared a statement of the work done from the 1st November 1872 to the end of October 1873. From this omitting the sea dredge punts and a few of the boats which, from various causes, were not regularly worked, it appears that thirty-five of the boats travelled during the year altogether 46,325 miles, but that the distances vary very greatly for different boats, the greatest being that for boat No 23 1,991 miles, the least one* of the Nos. 2, 560 miles, and the average 1,324 miles. Now, if the plant were kept fully at work, I think allowing for repairs, detentions, &c., there should be 240 working days in the year, and it is admitted that ten miles a day on the average can be very well performed. Then the proper yearly distance would be 2,400 miles, or somewhat less than one-fourth in excess of the greatest distance shown. Taking, however, 2,000 miles only as the average, had this been accomplished by all the thirty-five boats referred to, the work done would have been rather more than half as much again as was achieved, and this increase of work would have been equivalent to an addition to the plant of seventeen or eighteen boats. The proper number of

* Iron flat.

days in a month on which a boat should be moving is about twenty, giving ten for loading and unloading, etc., and Sundays, and I have but little doubt that this could be accomplished. A glance at the statement shows very plainly that the detentions for loading and unloading were out of all proportion to the days the boats were in movement. What is clearly wanted is an improved system of management, whereby the days of detention may be reduced to a minimum and those of travel increased to a maximum. It has to be remembered also that considerable numbers of private boats are available for the transport of materials, and that these work at fairly economical rates and probably more cheaply than the Government boats. The rate paid for materials carried by private boats is 5 Pies a cubic yard a mile, and the charge to the works is 6 Pies; the difference covering supervision and sundry expenses attending the use of such boats. It will not do to rely too much on private boats which are liable to be diverted whenever more profitable work may offer, but on the other hand it has to be remembered that the works are not dependent altogether on Government boats for the conveyance of the materials required.

For the transport of stone of large size iron punts are required; for the dredge spoil boats iron punts are also much the most suitable, and it will be well, therefore, somewhat to increase their number. The conversion of the hull of an old steamer and the construction of a new punt of the largest size in use have recently been sanctioned, and I would recommend that, on the submission of estimates, six more iron punts be built. Further additions to the plant should be dependent upon its being shown that all that which is available has been fully utilized. Hitherto, as the Government are aware, the plant has not been maintained in an efficient state, and it would be unwise to add largely to the number until it be demonstrated that existing boats can be properly cared for and fully employed. I do not myself think that ten punts are required for each dredge; I have certainly never seen any dredge working so as to be able to supply ten punts with spoil, and probably five or at most six are as many as would be required, unless the circumstances were exceptional, certainly but few of the dredges in their present condition could find material for even this reduced number. I am myself in favor of using drop or trap punts for dredges employed above the anicut, as for instance in the head lock channels. The mud taken up from these channels is a tenacious clay, and much labour is expended in getting it distributed over the deck of the punt in the first instance and afterwards in clearing it from the deck. Mud so dredged is deposited either just above the under-sluices or in the deep river channels, and this can be done with great facility with punts having moveable bottoms. It will be well, therefore, to build the additional six punts of this description; the details of the only existing punt of this kind appeared to be efficient, and probably but slight, if any, modifications will be needed.

G. O. No. 15, dated 7th January 1874.
„ No. 139B, „ 21st „ „

There are objections to the use of wood as a material for boats of this kind. So long as they are in constant use they can be kept in good order, but they deteriorate so rapidly when out of work that I am not disposed to recommend any considerable additions to this description of plant. Nevertheless, under some circumstances, small boats of Native construction prove to be very useful, and they are sometimes to be purchased at a low price, at indeed a cost not exceeding

one-eighth of that of iron boats of corresponding tonnage. Whenever therefore the want of such boats is experienced and continuous employment for them can be found, it will be advisable to sanction their purchase and afterwards to dispose of them when no longer required. Boats of the kind alluded to may be bought at from 350 to 700 Rupees according to their size, and they are strongly and well built, while the lines of those of recent construction are very good. I shall be quite prepared to recommend sanction being given for an outlay of Rupees 5,000 for the purchase of such boats for use in 1874-75 on an application from the District Engineer supported by such information as may show that they will be usefully and continuously employed. It may be noticed here that it will be well to have all the boats and punts numbered consecutively. In these statements of the floating plant the same numbers recur, and this leads to confusion and to difficulty in recording work done. The numbers should therefore be revised, and there should be a register, showing the old and new numbers of all existing boats. When boats are built the number should be given as soon as they are commenced and when bought at the time of purchase. With regard to the carrying power of the boats, the information is defective, and I have noticed that full loads are by no means the rule. Different classes of boats are supposed to be able to carry certain numbers of cubic yards, and the load has been determined experimentally by placing enough stone on the boats to bring them down to the proper load line. Something more than this, however, is needed, because a comparatively small difference in the quantity of material carried during a number of trips by many boats will make a very considerable difference in the quantity of work done and in the cost of that work. Every boat should have its proper load line marked upon it, and this line should be placed as high as may be practicabe, taking into account the free board required and the limit of draught in connection with the depth of water in the canals. This latter ought on most of the canals to admit of the boats being fully loaded, and generally attention is required whenever boats have to be sent with a light draught owing to shoals or obstructions. For every boat also the following information should be recorded.

(1.) The dimensions over all; and this should be done accurately, and not as in the two statements, dated 5th November and 13th December 1873, respectively, in some cases with variations of importance for the same boat.*

* *e. g.*
No. 11—60 × 11 5/12
61 × 11 1/12
No. 10—43 3/4 × 12 3/4
43 × 12 1/2
No. 22—83 5/12 × 14 1/4
83 1/2 × 14 1/2

(2.) The draught when unloaded.

(3.) The corresponding displacement and weight of boat.

(4.) The load draught and displacement.

(5.) The tonnage or carrying capacity.

(6.) The quantities of materials of the different descriptions usually carried constituting a full load, *i.e.*, placing the boat down to her load draught line. All loading stations should be provided with tables of the loads of all the boats.

15. In order that the management of the floating plant may be systematized, a recommendation* has been made for the appointment of a Boat Superintendent. Wherever, as in this case, there is ample employment of a particular kind for the most active man, it will generally be found financially advantageous to provide special superintendence, and this is particularly needful where there is a large number of men employed who may do much or little, and will certainly do little if not looked after. Forty boats require probably $20 \times 3 + 20 \times 2 = 100$ men, who are paid about 500 Rupees a month; an increase of 30 per cent. of work done by these boats would make 150 Rupees a month available, and it is proposed to spend only half this in additional superintendence. This, too, is only one part of the work which the Boat Superintendent is to perform. The present Range Officer, Captain Brockman, may, I think, be relied on to introduce and maintain good and complete arrangements, if the requisite assistance be given him.

Boat Superintendent.

* No. 872-A, dated 6th December 1873.

16. This canal has since 1870 been in course of improvement on an estimate of Rupees 1,86,800. The work provided for was the reduction of the surface fall and the consequent improvement of the navigation, as well as the securing of greater facilities for irrigation. To obtain these results an additional lock was provided at Thossapudi in the 16th mile, and this line of navigation being particularly important and some of the old locks not efficient, it was determined to substitute new first-class locks for the three formerly existing at the 9½ and 21st miles and at the junction of the canal with tide water. All the new locks have been constructed and have been in use for some time. In several very important respects the outlay has failed to secure as much advantage as might have been obtained had more attention been paid to the circumstances of the traffic and to instructions.

Cocanada canal.

The tail bay bridges are generally too low; circular No. 14, with the approval of Government, prescribed 11 feet as the minimum headway above ordinary high water level for first-class lines of navigation; at Kovur, the tidal lock, the range of the tide appears to have been left out of consideration, and the headway is only 8½ feet; on this canal there was nothing to prevent the minimum being exceeded, while there was much to make it advisable and convenient that ample headway should be allowed. At times it is difficult even for range boats to pass the bridges. The arches of these bridges have been constructed of brick and have been plastered; certainly the faces should have been of large-sized stone; they have been already damaged, and are not creditable. The locks have not been constructed in accordance with the instructions contained in a circular* which was intended to prevent the repetition of mistakes which have now been perpetuated. The maximum time to be allowed for filling or emptying lock chambers was to be three minutes, and this has not been attended to, principally because the shutters and valves have been fitted with screw gear, although in the circular it was specially pointed out that such gearing was unadapted to lock-sluice gates. The locks have

Lock tail bay bridges too low.

Locks not built in accordance with instructions.

* No. 30, dated 12th November 1870.

not been built with side culverts at the lower end as prescribed, but with gate valves. The canal below the *Kovur lock* is much obstructed by the wash down of the lock excavations or spoil, which should be properly sectioned and sloped, the face dressed with soil and the drainage properly disposed of. The mitre posts of this lock require a little adjustment. It was filled in 5 and emptied in 4 minutes 35 seconds.

Levels of the Cocanada canal.

17. It was supposed from the water reports of the canal that a serious error in the levels had occurred, and special inquiries were made as to the way in which the levels of the Thossapudi and Chintapilly lock sills had been fixed, while check levels were taken to ascertain accurately the facts and to enable it to be determined how the results of the error could best be removed. The levels taken showed that the sills had been built at very nearly their proper relative level, and that much of the apparent error was due to the gauge, for the upper sill of Thossapudi lock had been placed at the lower sill, and this gauge having its zero 6 inches from the end, occasioned an error to that extent in the registered depth of water. Longitudinal sections of the canal, as designed and as constructed, have been called for, but it is satisfactory to know that no mistake of moment has occurred.

Lock weirs.

18. These are in some respects not quite as efficient as they might have been, the cushion walls being too near the drop walls, and the space too confined to kill properly the velocity of the water. The revetments in rear should be attended to and made more substantial; probably nanul revetment may be used with advantage, at any rate at a short distance from the wings. At the Madapad lock weir the gauge does not give the reading from the still head; the lock upper sill gauge should be used to determine the depth of water passing over the crest. The roadways of the tail bay bridge of the lock and of the weir bridge are not, though only a few yards apart, on the same level, the latter being the higher. It may sometimes be proper, on the ground of economy, to make weir bridges lower than those at the locks, but the reverse can hardly ever be right. The left bank of the channel below the Thossapudi lock weir has been scarped by the water; nanul revetment would stop the action of the currents. The holding down bolts of the shutter bars of the weir are not vertical as they should have been. The earthworks about the lock and weir want making up.

19. *Earthworks.*—These have for the most part not been executed with sufficient care. Just above the Madapad lock the high bank on the south breached sometime before my visit, and when I was there the north bank was in a dangerous state, the rear slope having slipped considerably. The soil is much of it silt, but it is quite water-tight and, if properly put up, the banks would have stood very well. The fault seems to have been the neglect to carry up the bank to full section from the bottom, ramming each 6 inch layer thoroughly, and the soil lately added had been thrown loosely on the upper part of the far too steep rear slope, and it was consequently on the slide. The Range Officer was furnished with a sketch showing how the bank was to be made good. From Thossapudi to the 12th mile the earthworks are better than in most places, but still not sufficiently neat and regular. The canal clearances should be disposed regularly as required, and should not be thrown on the berms

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without regard to section; they are not only in the way when thus placed, but they cause guttering and some soil gets washed back into the canal. They may often be used to improve the tow-paths, but where no good use can be made of this material on the inside of the banks it should be thrown outside.

Distribution and other minor works.

20. The irrigation sluices on the two sides of the canal above the Thossapudi lock have been built with their rear wings convex instead of concave. Below the lock on the south side an aqueduct over the surplus channel has wings much too short and not properly placed. In several respects the design of this work is unsuited to the site. A high level retaining wall has been placed very improperly at the lower end, and this should be removed or lowered. The Kykavole head sluice just above Chintapilly lock on the left bank will have to be enlarged. With six feet eight inches on the lock upper sill the discharge was found to be about enough for 4,800 acres; the sill is about four feet above the lock sill. Just below the sluice there is an aqueduct over a large surplus channel or drain, and this prevents the sluice sill being lowered.

Surplus weir at head of Tooliabaga.

21. Has three bays of ten feet each; masonry very rough, and the string courses should be dressed to look a little better. The new bund on the right bank is not at all what canal earthworks should be; lower apron very irregular, five to three feet of water on it; drain incomplete and choked with weeds of all sorts. The weir had not been used but subsequently a heavy rain-fall rendered it necessary to discharge water. The screw-gearing should be greased and kept in proper order.

Kykavole drain.

22. This is on the north side of the canal; it has been partly excavated, but instead of cutting the outfall into the Biccavole drain first and then working upwards, the work has been done in such an unconnected way that it has been of little use and the water cannot get away; it was on the same level as that inside the canal, although this level were the drain cut through would be reduced five or six feet. There is a great deal of swamp which will be reclaimed as soon as these drains are finished.

Chintapilly Rest-house.

23. This is nearly finished. It is thatched over the centre room and tiled at the sides. In the hot weather the principal room may be cool, but it struck me as being close in the cool weather. The doors have by mistake been made a good deal narrower than was intended, and they are somewhat inconvenient.

Bifurcation of Samulcotta and Cocanada canals.

24. The nose between the canals should be revetted to one foot above full supply level.

Lower part of Samulcotta or Junction canal.

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enough. The shutter works very easily, much more so than might have been anticipated from the high pitch of the screw. On the channel below there are two rough-stone drops which answer their purpose, but are hardly as substantial as they should be. The earthworks in the neighbourhood of these masonry works require to be put to rights.

26. *Mundapetta Canal.*—This connects the Cocanada and Coringa canals. The nose at the off-take from the former canal should be revetted.

Surplus weir into Tooliabaga drain, one mile above Thapeswaram. The improvements to this weir, which were to consist of a masonry cushion wall and shutters with screw gearing, have not yet been carried out. The platform bridge should be shifted eighteen inches to the northward, and its width reduced so as to enable the shutters to be got at conveniently.

Memorandum, paragraph 22, Proceedings of Madras Government, 18th April 1871, No. 1,077.

Thapeswaram Lock.—A new second-class lock which will be ready for use as soon as the lock gates and valves have been fixed. This is the only new lock in this part of the delta which has been constructed with side culverts at the lower end. The lower sill has been built at 19·50 instead of 19·00 as directed. The upper sill is at 26·00. The face work of the masonry looks well, but there is a great deal of very small stone in the walls. The tail bay bridge arch is of brick, which is unsuitable.

Memorandum, paragraph 22, Proceedings of Madras Government, 18th April 1871, No. 1,077.

Lock weir.—On my last inspection it was stated that the then existing weir was a good work needing only some improvement to render it efficient, and that therefore the new weir included in the estimates would not be required. The new weir has nevertheless been built. Its crest is at 29·16, top of shutter 32·00, floor 19·50, cushion wall 22·00. It would have been better had the floor of the cushion been at 17·50. It would have been easier to build and not more expensive, while the depth of cushion would have been greater. The rear wings are too short. Part of the floor has failed owing to the use of too small stone not fully dressed or properly bedded. The floor has been temporarily protected by raising the cushion wall 3 feet by a bank of rough stone. The cyclopean stone of the floor was only one foot thick instead of the usual allowance of two feet, and the cushion wall was reduced in height one foot. The best plan will be to lower the floor two feet; all the face-work good.

The masonry works (old) of the two irrigation channels taking off from the right bank just above the lock were designed without any reference to local circumstances. The wing walls are not suitable. The aqueducts over the same drainage differ widely in level though there was no necessity for this, and altogether the arrangements are very far from creditable. The lower part of this canal was not inspected.

27. *Coringa Canal, Alamur Lock.*—This is a short distance from the head of the canal which takes off from the Bank canal in the 14th mile. The upper sill is at 22·64, the revised bed-level being 21·75. The actual depth of water on the upper sill was 6·70, or 0·59 too much. Lower sill 3½ feet or two feet less than intended. The lock walls are 2·29 feet above full supply level, which will do very well, as there

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is to be a surplus weir into the Takee just above which will relieve this and also the Bank canal when necessary. The lock lower wings have not yet been buttressed as stated to be necessary three years ago nearly. The lock weir of the sanctioned estimate requires entire revision, as it was designed to discharge the surplus, which will now be separately provided for by the surplus weir. The arrangements have been settled in detail as regards the dimensions of the weirs, and no time should now be lost in preparing the designs, and after their approval in carrying out the works.

Memorandum, paragraph 21, Proceedings of Madras Government, 18th April 1871, No. 1,077.

Nullur drain aqueduct.—The water was very high, and it does not get away freely on the lower side. The aqueduct has been repaired and the tow-path widened; revetments required on the canal in continuation of the up and down stream wings. This drain is an affluent of the Takee.

Kartair aqueduct.—Water was high and had been one foot higher, but it has a fair outfall. Gauges should be placed on upper and lower wings or elsewhere as may be convenient to enable the discharge to be calculated.

The *Ootramilly irrigation sluice* opposite the twenty-third mile-stone should have its wings lengthened and its shutters made efficient.

Bridge at Undur road.—The headway was twelve feet above the water in the canal and eleven feet above full supply level as intended.

Vellah Lock.—Five feet four inches of water on the upper sill. The improvements required to prevent leakage through the side walls have not been carried out.

Memorandum, paragraph 21, Proceedings of Madras Government, 18th April 1871, No. 1,077.

Vellah north side channel and Yennamdula channel dividing dam.—This is a rather large work of two spans of sixteen feet each with cast-iron posts for regulation. It has a broad roadway over it. It is a very ugly work, very unnecessarily high viewed as a bridge, and with nothing to recommend it as a regulator. It was built on Colonel Fischer's sanction, when Superintending Engineer, and though a single work, in order to bring it within the limits of local sanction, it was considered as two works. The construction of a bridge having really nothing to do with the regulator would not in any case have been proper, though it is right to accommodate the public when this can be done without materially adding to the cost of an irrigation work; just above there is an aqueduct (old) with a very heavy fall over it. A regulating weir below this would have been a suitable addition, and had proper wings been added to the aqueduct it would have been well, for like most such works the wings are about one-third of the proper length. The two sluices supplying these channels will need re-construction. A considerable drainage passes under the Mundapett canal just above its junction with the Coringa canal and then runs along behind the left bank of the latter until, passing under the aqueduct above noticed, it enters just below the Vellah lock.

Most of the irrigation in the reach above this lock is supplied through temporary palmyra sluices, a very dangerous arrangement and one which must be superseded by permanent works without further delay, especially as a breach in the canal bank with the deep drainage channel alongside would be a serious matter.

Irrigation sluices required.

Lock Weir.—Revetments are required to the lower wings. Shutters with screw gearing should be provided as soon as possible for the regulation of the weir.

Munjair Lock.—The repairs and improvements pointed out as required at this lock have not been carried out. The tail bay bridge is low, and we were detained for some hours until the water on the lower sill had fallen to eight and a half feet. Similarly the improvements (clearing of bushes and formation of tow-paths) to facilitate navigation in the tidal creek below the lock have still to be executed, but some dredging has been done.

Memorandum as above, paragraph 21.

Irrigation sluice above lock, left bank; the rear wings are good quadrants of three and a half feet. Similar wings in front where they should have been convex. Shutter inefficient.

28. This is a branch of the Coringa canal. A good deal of work ought to have been done to this canal in the last two and a half years, especially as regards earthworks and providing proper distribution arrangements. The banks are in many places barely above full supply There are a great many irrigation off-takes without sluices and, as usual, they are much more numerous than is at all necessary; they cause waste of water and are dangerous also. This canal intercepts the natural line of drainage in several places, and the arrangements necessary to remedy this evil and to provide readily for the escape of all rainfall and other drainage water should receive early attention. In the twenty-eighth mile for instance there is some swamp on the left bank which can be easily, and should be, drained. The cattle crossings all need attention.

Injeram canal.

New Ventur escape weir.—An efficient work of one bay of ten feet; two and one-third feet going over, and the off-flow quite quiet. The front wings should have been sloped to one foot above full supply level.

Bridge over canal at twenty-seven miles. This has no tow-path, a convenience which should be added.

Yerrapotharam lock.—The revetments of the chamber will soon need repair, six feet of water on the upper and three and a half feet nearly on the lower sill. It will be a convenience if room for turning a steamer or one of the larger material boats be allowed above this lock. At present there is no turning place on this canal.

29. Completion estimates for these have recently* been submitted to Government. The canal is generally in the same state as on my last inspection, and no remarks here are necessary.

Bank canal.

*No. 83-A, dated 27th January 1874.

30. I have considered it necessary to instruct the District Engineer to discontinue the renting of the canal berms and banks for grazing purposes. The cattle, especially in wet weather, do a great deal of injury to the earthworks, and they must be excluded entirely from the canal banks, except first at regular crossings and secondly where the banks are used also as district roads, and then there will be a maintenance allowance for keeping the bank in proper order. The right to cut grass may with advantage be rented out. At first at any rate this will probably cause a diminution of the grass receipts, but this is of minor importance

Cattle grazing on the canals.

ultimately; the grass cutting will, I think, produce as much if not more than the grazing rents.

31. The necessity for providing a sufficient number of these and of making them efficient by giving suitable ramps properly paved or metalled was noticed at the time of my last inspection at the end of 1870, but the subject has not yet received the attention it deserves, and but very little has been done during the three years that have since elapsed. It is a matter of very considerable importance and, as the District Engineer's attention has now again been specially called thereto, no further delay must be allowed to occur. In all directions the berms are cut away and the canals injured by the cattle crossing in numerous places, and in the Central Delta on the Gunnaram canal not only have the berms disappeared but the banks themselves have been scarped to an extent which will render a considerable delay for their restoration necessary. The first thing of course is to provide a sufficient number of suitable crossings, and then the villagers must be required to keep their cattle to these. It will take some little time and patience to put a stop to the improper practices which have been allowed to go on for years, but the disgraceful state of the canals at present should not be allowed to continue a day longer than is necessary.

Cattle crossings.

Memorandum, paragraph 16.
G. O. No. 1077, dated 18th April 1871.

32. This has its head in the right bank of the Samulcotta canal near Biccavole, but it is really a continuation of a considerable upland drainage on the left bank. This drainage might without much difficulty have been taken under the canal, as the fall of the country is very great. The escape, by which water finding its way into the canal is discharged, has three bays of 13½ feet span each with cast-iron posts and planks; these, as pointed out in the report on my last tour, need to be superseded by better arrangements for regulating the discharge, and these can easily be introduced; the piers should be lengthened to form a shutter platform; each bay should be divided into two or perhaps three as the depth of water is considerable, by cast iron standards, and shutters with screw gearing should be given. The fall from the escape into the drain is very rapid: the soil is very tenacious, and if the escape lascars attend to the repacking of the rough-stone apron after each discharge of flood water, probably no further work will be needed for many years. Ultimately it may be necessary to drop the water several feet on to lower masonry aprons.

Biccavole drain.

Estimate Rupees 65,000.
Expenditure to 31st December Rupees 31,484.

The fall in the upper part of the drain is very great, generally the soil stands well, but there are many erosions; there are two masonry falls within the upper 1¼ miles. At the first the wings are seven feet one inch instead of seven feet eight inches as provided in the design above the body wall, but they are probably high enough. The earthworks behind the wings are much below the tops of these walls; Executive Officers should be specially careful to see that such work is properly and completely carried out, accidents from this cause are numerous, and the responsibility for these should certainly rest with the officer in charge; revetments are required at the upper wings, especially on the right bank. There were the remains of a temporary

dam on the drop and this is altogether improper; it was placed there for the better supply of the Oolapilly channel, the sill of the head sluice of which is three feet below the crest of the drop wall. This head sluice is a common looking work by no means a credit to the range, and it is doubtful whether the vent is large enough. The earthwork filling in to the wings has been very badly done without tamping. Front wings are at right angles to the axis of the channel, which is not a good arrangement; the sluice is without any proper means of regulation; return currents are developed below and above this work with their resulting erosions. At the sharp bend between first and second drops a little revetment is required, and here also a paved ramp on either side of the drain is needed for a cattle crossing. The wings of the second drop are certainly too low, and they should be raised two feet; the water passing down in October rose to within two feet of the top of the coping, and there was but a small rainfall to what will occur in some years. Attention should, as early as convenient, be paid to the inlets for branch drains. These must be treated according to circumstances, and the experience of a season or two was needed to determine the best arrangements. Pending the construction of masonry works, these inlet openings should be spanned by palmyra, or other temporary, bridges. The highest flood-marks of each year at moderate intervals of distance should be recorded on the longitudinal sections, the dimensions of the drain being also placed on record. The measures carried out are tentative only, and it will depend upon observations of discharge compared with rainfall how far the drain should be widened to be fully effective. As yet also the feeders of the drain have not been opened up and made efficient, and it is probable therefore that considerable additions to its capacity will be found necessary. This Biccavole drain is to relieve the greater part of the country between the Samulcotta and the Cocanada canals, and also to carry off a great deal of the cross drainage of the former.

33. This is the next main drain to the southwards. The old Tooliabaga was partly occupied by the Cocanada canal which also crossed the former several times leaving loops, the outfall of which was consequently obstructed. The improvements consist in re-establishing a continuous line of drainage to the southward of the Cocanada canal and in greatly enlarging the capacity of the drain. Here also the maintenance of records of flood levels is very requisite in order to fix the ultimate dimensions of the drain, and care must be taken that every part of the country between the Cocanada, Mundapett and Coringa canals is connected by suitable branch drains with the Tooliabaga or with some other convenient outfall.

Tooliabaga drain, estimate Rupees 1,38,100

Expenditure to 31st December. Rs. 74,176.

34. This is the third great drain of the Eastern Delta. Its head is at the Alamur lock on the Coringa canal, and it will relieve the country between the Coringa and Bank canals, as also a considerable area to the west of the Mundapett canal. No work had been done to this drain up to the time of my visit, and the delay is very far from satisfactory, as sanction for the work had been given two and a half years before. It is intended to take up the work vigorously this year, and it may be expected that a very great improvement

Takee drain, estimate Rupees 2,66,300.

Expenditure to 31st December Rs. 5,307.

in the state of the country will be the immediate result. The estimate provides for enlargement and embankment down to the lower end of the Injeram canal, which abuts on, but is not as yet connected with, the Takee. The levels of the flood waters of the north-east monsoon of 1873 show that the circumstances of this drain are not what were supposed when the estimate was prepared. It appears to be certain that the water at such times will rise much higher than was expected, and that this is perhaps hardly avoidable. The drain is a very small affair at present, but then large tracts of country are liable to submergence for many days, and the drain proper is but a very small part of the means of discharge. The District Engineer was requested to have the flood levels transferred to the longitudinal section; they were noted at the end of the Injeram canal and at the bridge on the road to Kotapilly, and no doubt they have been since ascertained at other points; it will then be seen what modifications of the arrangements sanctioned will be necessary. Probably the chief alteration will be found to be a considerable raising of the embankments, and generally this may be effected at little or no expense, because the spoil from the cuttings will be greatly in excess of the requirements of these embankments. The Nullur and Kartair branch drains and probably many others will need much improvement, and the arrangements for receiving minor drainages and preventing back water will require careful attention. Every endeavour should be made to push forward this drain; the country is greatly in need of relief, and the work is, therefore, a very important one. At the time of my visit four feet of water were found over a considerable area entirely outside the proper channel of the drain, and there the steamer in which we had suspended the Takee was turned round.

Below the Injeram canal no improvements have been provided for; but in the first couple of miles or so a good deal of embanking will have to be done, and at least one straight cut will be required. Lower down the river is of ample dimensions, and a little embanking here and there will be all that will be necessary.

The flood which I saw at the end of October was the result of only a moderate rainfall, and far more water will occasionally have to be discharged. At the Kotapilly road bridge which has a span of sixty feet, the mean width of the drain, as designed, will be 147½ feet. The water was over nine feet deep at the bridge, and it was at one foot two inches below the under side of the girder. The surface velocity was estimated, for it could not be measured, at six feet a second; and if the mean velocity be supposed to be five feet and the depth nine feet, the discharge would be 2,700 cubic feet a second; the area draining into the Takee above the bridge is eighty-seven square miles, and the discharge 31·05 cubic feet per square mile per second, or a little under one and one-sixth inches in the twenty-four hours. From this it may be gathered that the sanctioned dimensions of the drain will probably not be found too great, as not only must a larger rainfall be provided for, but, for the convenience and well-being of the neighbouring country, the flood must be passed off at a lower level if possible.

35. It has been proposed to place a tidal lock at the tail of the Injeram canal and to make this line the outlet for the Bank canal navigation. With embankments arranged to serve also as tow-paths, the navigation will certainly be very much improved, but I doubt it ever being made comparable for convenience with

Navigation of the Takee.

a regular canal, owing to the numerous bends which occasion shoals and the transference of the deep channel from side to side. At present the navigation is so difficult that it is but little used, though there is for most of the way up to the Injeram canal a wide deep channel and above that a deep channel for some miles, wide enough for boats of considerable tonnage. The mangrove growing on the banks, and in the upper part trees overhanging the channel render tracking impracticable. When these easily removable difficulties are done away it will be seen whether the traffic will increase. The drain ought, then, to be at least a useful subsidiary line of navigation. There is evidently a strong desire to extend cultivation along its banks, and when the drainage is more efficient it may be expected that the waste lands will be rapidly taken up. Some private and as is generally the case irregular embanking has recently been carried out, and it will be better to arrange as speedily as may be for superseding these and the necessity for all other detached bunds by continuous embanking wherever the level of the lands is below maximum flood level. The mouths of all the subsidiary drains should first temporarily, and afterwards permanently, be bridged to facilitate flowing and communication generally.

36. Branch drains should at their junction with main drains when the flood water in the latter is liable to rise above ground level, should either be provided with self-acting sluices, or they should be embanked on both sides for such distance as may be necessary to prevent back water spreading over the country. It may be noticed that self-acting sluices would diminish the quantity of silt deposited by excluding all foreign water; and, as the mouths of branch drains usually need to be bridged, it will generally be economical to make these bridges self-acting sluices.

Inlets for branch drains.

37. At the end of October about twenty-six miles of the right bank of the river were inspected to see its condition and the defensive work which had been recently carried out under the District Engineer's orders. Altogether thirteen groynes were, Lieutenant-Colonel Fisher states, constructed before the river rose; but according to my view of the subject, and according to the orders issued in the analogous case of the two branches of the Godavery below Dowlaishweram, the proper course would have been to prepare a survey first, ascertain what changes had occurred, and, as far as possible, why they had taken place, and then determine what should be done or attempted.

River above anicut.

A chart of the river is essential to its proper treatment. It is impossible to tell what is the proper alignment for any particular part of the river bank, improvement, or plantation, without a chart. It is also very difficult to fix the sites of groynes without levels and soundings. Permanent bench marks at quarter of a mile intervals should be fixed on or near the line of the new embankment,* and cross sections from these, with intermediate soundings where necessary, should be taken yearly. The principal sets are at or near the villages of Covoor, Komaradave and Thalapudi; and the atlas sheet shows that erosions at these places are of long standing, though how far they have extended during the last fifty or sixty years and during also the last ten or twelve

*Forming also road from Vigeishweram to Polaram.

No. 94.

years can be determined only by comparing the atlas sheet, and the comparatively recent revenue surveys, with a survey of the bank as it now exists. Some considerable slips occurred at the close of the freshes this year, and after some progress with this season's nanul planting had been made. All these sets must be dealt with by working down from above and planting out so as to recover lost ground gradually up to the proper alignment; groynes may be required in some places to establish the plantations; but their localities, length, direction, &c., need to be determined on much better data than were available last October; and the causes of the deflection of the currents against the bank must be ascertained, and, if possible, removed. There are some very large islands and sand-banks in the river above Rajahmundry, and the shape and position of these are intimately connected with the direction and strength of the currents. Some time may be requisite for obtaining the information on which radical improvements can be planned, and in the meantime operations should for the most part be confined to the protection of the face of the bank by nanul, and to planting from the upper ends of the bays downwards, within the line joining the head-lands, to such extent as may be practicable with due regard to the maintenance of the outer-margin of all such stations on such a line as will serve gently to divert the currents by taking them at a very small angle. Two or three miles above Polaram there is a temple on a rock in the middle of the river, and below this rock a sand-spit has formed on which some private planting has been done. This should not be permitted, as the available width of the river here is below rather than greater than that which is needed, and land gained from the bed would certainly be lost by erosion of the banks, much mischief might result from diversion of the currents.

38. The systematic treatment of the

Rivers below anicut.
Gowtami-Godavery.
Vasista- do.

and some surveys were made; but, as has already been reported,* the District Engineer did not appreciate the importance of the charts, omitted to push forward the sections were completed, and the surveys of both banks of each river as fast as the successive

*Pro. of M. G., No. 2411, dated 14th Oct. 1872.
Do. No. 1862, „ 22nd July 1873.
Do. No. 2502, „ 13th Oct. 1873.

G. O., No. 1862, dated 22nd July 1873.

time before they can be completed. The Central Delta having been destroyed have afforded valuable information regarding, the result is that the charts are to twelve years ago have hitherto been ignored, yet ready, and it will be some little with the one inch to the mile maps, as well as revenue surveys moreover which would taining the river margins in connection with a state of the banks and islands ten trary to instructions, defensive works have each Range Officer should be supplied sanctioned locally. In some cases, as on with the large scale village maps con- for some distance below the anicut, the de- the subject. On the other hand, continued to be carried out on estimates ful, but even here it may be noticed that ins left bank of the Gowtami-Godavery

s ordered in G. O., No. 377, dated ebruary 1871, and charts connected the Revenue surveys were to be ared as an essential preliminary. ey establishments were sanctioned y been reported,* the District Engi- did not appreciate the importance charts, omitted to push forward the ys, and to connect those of the two s of each river as fast as the successive Central Delta having been destroyed re, the result is that the charts are yet ready, and it will be some little nue surveys moreover which would e state of the banks and islands ten ach Range Officer should be supplied ith the large scale village maps con- e subject. On the other hand, con- inued to be carried out on estimates left bank of the Gowtami-Godavery e work done has been fairly success- of systematic treatment, the urgent

wants of the moment have been met by the multiplication of groynes, and this is not an economical arrangement. There is no record also of the state of the river before and after the construction of the several groynes.

On the left bank of the Gov[illegible]ni-Godavery, a little below the head of the Coringa canal, there is an old groyne pointing somewhat up instead of down the river. It should be turned to form an angle of about 38° with the proper line of the bank. The whole of the face of the river bank and a small width at its base want planting up with lunka grass. The line of the bank here is apparently very nearly correct and it can easily be preserved.

The old Koola groynes and pitching have stood well and prevented any further injury of importance, but they have done nothing towards the rectification of the river margin. A sand bank runs parallel to the river bank at a distance of about 100 yards, and the channel between is deep with a rapid current. On the other side of the sand bank there is a wide but shallow channel which tails into the deep channel by one principal and several minor openings. The entrance to the deep channel is just below a rather projecting point, and the current here sets at right angles to the bank or somewhat in a reverse or upstream direction owing to the upper end of the sand bank being a long shallow spit. This entrance might be closed by raising the bed all across from the groyne to the spit by means of durbah or grass rollers, bags, or stone work[illegible] from the bed upwards and not from the sides outward; were this done, however, I doubt whether the results would, on the whole, be beneficial; for though the whole of the deep channel and the greater part of the sand bank are within the proper line of the river bank, the closing of the upper end of this channel would lead to the deepening of the shallow channels lower down. Here, as elsewhere, the want of a complete survey was felt; that of the margin only was of so little use that some of the groynes could not be identified. A great deal of nanul has been planted and much of this is thriving well; a great deal more remains to be done.

A little way above this three low groynes were constructed last season to stop another set, which result was to a considerable extent secured, but here again the work done is of no general benefit. The direction of the groynes here is oblique, and in that respect much better than the old ones; they have too great a surface slope, especially near the foot, and their length is insufficient. They suffered some damage from the recent freshes. The next considerable set down the river on the left bank is that near Maskapilly, and an extensive series of groynes was here constructed many years ago. On the completion of the surveys some permanent improvements may be effected here by working down from the upper end of the set and dealing also with the origin of the latter. As no immediate danger need be apprehended, and as the groynes have stood for many years, nothing beyond repairs and slight alteration should be undertaken at present. Groyne No. 28 will probably be a good one to turn in a more oblique direction and lengthen, but this can be postponed. No. 32 has been breached; it should be turned towards the head of the island just below, and should be at least three times as long as before to be of value in diverting the current.

No. 3 groyne is now above the commencement of this set, which as is usually the case has gradually worked down stream.

Nanul planting was going on along the face of the bank; there is but little foreshore, the groynes not having diverted the stream. Nanul must not be allowed to grow on the sand banks. Opposite the [illegible]th mile there is an extensive sand bank occupying part of what should be the deep bed of the river, and there is some nanul upon it which will soon and rapidly increase if not attended to.

The Pillunka set a few miles lower down is comparatively a recent one. It is the result of the opening or deepening of the channels at the head of and through Govalunka, communicating with a narrow deep channel to the north of that island. One groyne for this set has been sanctioned and a second a little lower down will probably be required; but the proper way of dealing with this part of the river cannot be determined until the charts are completed; very considerable changes have occurred here since the atlas sheet surveys were made, and even since the time of the Revenue survey the alterations which have taken place are very apparent. The right bank of this branch of the Godavery I did not see, but the origin of sets on the left bank will be traceable in many cases to the configuration on the other side and to the position and direction of shoals.

G. O., No. 176, dated 26th January 1874.

In the upper part of the *Vasista-Godavery* on the right bank is the Kakarapurru set on which a considerable expenditure has been incurred without, in my opinion, any beneficial results, while in some places the groynes have aggravated the erosive effect of the current and I have been obliged to direct their removal. This set must be traced back to Vusvuntwada on the left bank, and a remedy must be sought in an improved alignment from the anicut downwards. This set has shifted a long way down the river since its commencement some years ago when a part of the original line of the Coringa canal was carried away. At that point the bed has silted up for a width of several hundred yards. As far as I was able to judge without the aid of charts the set has nearly reached its limits, but at one place the margin between the Bank canal and the river bank is so very small that some protection is emergently necessary and it appeared to be best to afford this by a massive stone pitching or revetment from the toe of the bank to about a yard above low water level, and above this by grass or nanul revetment; the bank above and below is to be reduced from its present irregular form to a regular curve, and probably then the current will glide along its course without obstruction and without, as a consequence, further erosion. Planting at the upper end of the set in continuation of the shoal, which has formed above can be gone on with in anticipation of the settlement of a permanent alignment which will be fixed as soon as the charts are ready.

About ten miles below anicut.

The re-action of this set on the left bank some three or four miles lower down is known as the *Ramachendrapuram set.* As the Kakarapurru set has progressed, the lower set on the opposite bank has retrogressed; this is due very clearly to the aberration of the current more and more from the axis of the river. Of the defensive works here;

Groyne No. 1 has been cut through by the river at the root; it should be repaired by an earthen bank covered to a thickness of a yard with stone; the top of the groyne should slope up to the lip of the bank; the up-stream slope to be half

to one and the down-stream one to one. A good deal of silting has taken place above this groyne and it should be kept well planted up. Soundings should be taken at furlong intervals across the deep channel of the river and in the neighbourhood of the groynes at much shorter intervals for the distance affected. Connecting banks across the berms or lunkas should for the future be formed on the shortest lines available, and not necessarily on a prolongation of the groynes; they should be well above flood level.

A subsidiary groyne in a much more oblique direction was thrown out from the same starting point as No. 1 groyne to stop the action of the backwater from the latter.

No. 2 Groyne.—Only a small bit of this, at a distance of forty or forty-five yards from the bank, remains, and there were twenty-seven feet of water between this and the bank, and twenty feet outside the nose.

No. 3 Groyne has been swept away, and just below the site of this a small groyne on a low level has been run out.

No. 4 Groyne.—A little stone remains on the river bank, but the work has been swept away elsewhere.

No. 5 Groyne.—About fifty feet of this have held together, but they stand on a spit of clay scarped on both sides. A considerable erosion has taken place of the bank below this groyne, caused by its action. It should be removed and the spit of clay on which it stands should be cut down to as low a level as can be reached.

There can be no doubt that the treatment of this set has not been successful. The condition of the river here is worse than it was three years ago, because the direction of the principal channel and of the axis of the stream is much further from the correct line. A return to the circumstances of 1870 will be necessary as an intermediate stage before a satisfactory arrangement will be secured. It must not be supposed that the groynes have caused this wider departure from the normal direction of the axis of the main stream; that, as before-mentioned, is the result of the progression of the Kakarapurru set. On the right bank of the river, again lower down, the current deflected from Ramachendrapuram strikes at the *Khandavelly set*; nothing can be done here towards permanent improvement until the cause of the mischief is removed, but further erosion may be stopped by planting supported in some cases by groynes.

Nanul or grass-roller groynes.—These have been introduced with considerable success by the Executive Engineer Mr. Walch. They consist of large rollers of grass and soil disposed in the form of a groyne, covered sometimes with a little stone, but elsewhere without any stone. Their use in lieu of stone groynes will save a great deal of money.

Siddhantum set.—This is on the right bank about three miles below that last mentioned; it is not severe, nor would it be serious, but for the narrow margin between the river bank and the embankment, behind which latter is the Bank canal. An existing groyne should be extended in the manner marked out on the ground. The alignment of a nanul plantation was also marked, which is intended to secure a good line for this right bank in readiness for the return of the deep channel to this side, an event which is not improbable and which will follow the reprogression of the Ramachendrapuram set. Were this return to take place

immediately, there might be an inconveniently deep channel close to the narrow berm of the river embankment. These notes refer only to the sets which I have seen, but there are others which I was unable to see, and which equally need to be dealt with in a reasonable and intelligent manner with reference to their causes, and the first thing necessary is a good chart, then a comparison of the present circumstances with those of a former period, then a settlement of the improvements which should be attempted, and, lastly, the employment of suitable means to that end. There is no need for wasting money if the right course be followed, or at any rate waste will be reduced to a minimum, but nothing is easier than to spend large sums unproductively on such work; everything that may be done and its results should be fully recorded.

39. Uniformity in the scales is essential where numerous surveys and sections have to be put or used together. In the

Scales of river charts.

Eastern Delta a scale of $\frac{1}{6000}$ which will do for general purposes and a much larger scale which I did not see have been adopted, while in the Central Delta $\frac{1}{24000}$ which is useful only for an index map has been alone used.

The larger scale should be a multiple of the smaller, and seeing that the Revenue survey maps as also the atlas sheets are on the mile and inch scales, these charts may conveniently be scaled on the same principle, and I think the larger detail surveys should be plotted on a scale of the village maps, sixteen* to the mile, the index maps on the taluq map scale of one inch to the mile, while an intermediate scale of eight† inches to the mile will probably be required for exhibiting general arrangements.

* Five Gunter chains to the inch.

† Ten do. do.

40. *Ramachendrapur lock weir.*—The boat wall and piers have sunk, and the new weir which has been designed in connection with the completion estimates for this section of the delta must be built as soon as possible; the central of the three bays is that most injured. It was built in 1861, and had no masonry apron.

Central Delta, Naggaram canal.

The remains of the right abutment of an old bridge a few yards below the trussed bridge in the 18th mile should be removed; nanul grass must not be allowed to grow inside the canal banks. These banks are much injured by cattle which cross at twenty to thirty places in a mile. Sufficient attention has not been paid to the requirements of the canals as regards crossings, and no time should be lost in making them and in adopting measures for confining cattle to them. Delta Superintendents should understand that, after crossings have been provided and cattle grazing abolished, they will be held responsible for the good order of the canals in their ranges, and that neglect will certainly be followed by reduction or dismissal. In the 19th mile a heavy slip of the right bank has occurred.

Naggaram Aqueduct.—This work is in fair order; the filling up of the spandrils so far as this has gone has been very beneficial, and this work should be carried on to completion. The aqueduct should be kept in the best possible state of repair at all times; a cement of lime and clay, as prepared at Dowlaishweram, will be

much better than mortar for pointing, plastering, &c.; the branch of the river which is spanned by the aqueduct has been improved by nanul planting.

41. The present head of the Bank canal is altogether unsuitable, and the question to be decided was whether the new head should be taken off immediately below the bridge over the Mukkamala channel on the Nursapore road close to the head of the Nursapore canal, or whether it would be better to make a new line to the Kakarapurru canal about half a mile above the bridge; this latter would be the best line but for the necessity for another bridge. Mr. Walch was told that he might estimate for both lines when a final decision can easily be arrived at. For the below bridge diversion curves of 660 and 1,500 feet radii would be obtainable. The survey of the locality was not accurate, and it must be corrected before the exact details can be determined.

Western Delta, Bank canal.

The improvement of this canal is to be taken up this season, and it is hoped that two locks and lock weirs will be built; then materials can be carried down for the new masonry works at the lower end; at present the navigation ends at Kodèr. It was intended to retain the Siddhantum lock weir in connection with the new lock to be built there; it cannot, however, be conveniently adapted to carry the road, and it is not in line with the site at which the new lock must be built, and so it has been decided that it will be preferable to construct a new weir instead of altering the old one.

42. *Perivelly Lock.*—This is a low lock; the water on upper sill stood at six and a half feet, and on lower at $5\frac{7}{12}$; lift is four and a half feet; emptied in $3\frac{5}{12}$ minutes, of which two and a half minutes were occupied in raising the valves which are fitted with screw gearing, an inappropriate mechanical power; filled in $3\frac{2}{3}$ minutes; headway under platform bridge twelve feet. There are side culverts at both ends, and those at the lower end discharge through the wing returns, an arrangement which in future will be superseded by openings in the side walls which are decidedly preferable. Similarly the entrance to the upper side culverts will be made in future through the side walls.

Nursapore canal.

Lock weir.—The revetments on the lower side should be four feet higher at the wings and two feet at the outer ends. This weir was built three years ago; its defects are, cushion wall is too near drop wall, and wings would have been better if splayed on a concave curve.

Bhupia head sluice.—When the shutters are regulated by screw gearing, it will be an efficient work. The Executive Engineer has added a lower rough-stone dam which answers well.

The *Rest-house* has been constructed on the sanctioned plan and was ready to receive the roof covering. The godown floors are somewhat too low and they must be well drained or the servants will be liable to fever.

Sluice at lower end of 20th mile, right bank.—The channel needs attention; there is a breach in the right bank.

Itempudi lock.—Water on upper sill $5\frac{1}{12}$ feet, and on lower sill $6\frac{11}{12}$; some of the wood-work of the upper gates is inferior. The balance beams at this lock and

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at Perivelly also were made much too short by mistake. The drop is four and a half feet, and the lock, which is a new one, is similar to that at Perivelly.

Scantling of lock gates.—It is observable that the gates in the Western Delta are very much lighter than those recently constructed in the Eastern Delta, and as the former appear to be sufficiently strong, it will be well for the District Engineer to see that more timber than is needful is not put into the gates of the locks yet to be built; all were made at the Dowlaishweram Workshops.

Martair Lock.—The headway of the bridge below this lock was nine feet eight and a half inches with $6\frac{7}{12}$ feet on the lock lower sill. This bridge is inconveniently low, and, as it can be raised without much difficulty, this should be done as early as may be convenient.

Kavitum lock, twenty-ninth mile.—The masonry is very good and carefully and neatly built. It is finished, with the exception of the bridge parapets, the valves and their gear. The entrance to and exit from the side culverts is through the side walls. It will, I think, be better in future to make the exit openings rather larger, so as to diminish velocity and disturbance in the tail bay. There is reason for keeping the valve openings somewhat small so as to make the gates easy to work, but nothing is gained by reducing the passages into the lock bay. The mortar used in this lock had set fairly well and hard, but it would have been the better had the lime been mixed with burnt clay.

Lock weir.—This is an old work which is to be fitted with new shutters and screw gearing. If the sub-structure be found to be substantial, it will do very well.

Palkole Lock and Weir.—These are to be superseded by new works, and their location will require careful consideration. The canal approaches the present lock by a great bend, and the new lock must be built to the westward of the old one, while the road bridge below would, if retained, make the canal here extremely crooked. I think the approach to the new lock should be by a new cut behind the Pagoda which stands on a narrow spit of land, and that probably it will be advisable to carry the road over a tail bay bridge, and to remove the present bridge which is below the junction of the weir channel. A large scale plan of the site will be required to lay out the works in the most satisfactory manner which may be practicable.

Irrigation sluice.—A small irrigation sluice in the left bank just above the old lock was about to be replaced by a larger sluice which should have its sill flush with the new lock upper sill.

Mogultur tidal lock.—This was just about to be commenced. It is at the lower end of the extension of the Nursapore canal, and will open communication with the sea by the Oputeru and with the various lines of navigation already in connection with the latter. From tidal observations extending from July 1873 it has been ascertained that if the lower sill be placed at—7·75 instead of at—9·00, it will fulfil the conditions laid down for tidal locks, and this alteration, which will reduce cost and facilitate construction, has accordingly been approved. The lock channel has been somewhat diverted to suit the direction the traffic must take. Soundings taken at the time of my visit showed that at half tide there is a channel with a depth of not less than six feet. It is not very wide, but apparently sufficient; a chart of the soundings to the junction of the creek with the main channel should be prepared,

and to facilitate navigation the deep channel should be indicated by a few stakes just before the lock is opened for traffic.

Lock or surplus weir.—It was proposed to build this close to the tidal lock into the Vasista-Godavery above Nursapore instead of near the Mogultur lock, but on the whole there did not appear to me to be sufficient reason for the alteration, which would entail considerable additional expense for a road bridge; while on the other hand, as the extension canal shows an inclination to choke with weeds, it will be advisable to have the means of maintaining a current through it. The weir will consequently be built at the lower end as originally intended.

Gostanuda.

43. The site for the new head lock had been marked out prior to commencing work, and the face of the upper wing returns was to have been at thirty-five feet from the centre line of the embankment of the Kakarapurru canal, but as a boat, coming up to the lock would thus have had one end at the gates and the other in the current of the canal, it has been deemed advisable to add fifty feet to the approach channel so as to obviate this difficulty.

Lock weir.—The new weir is to be built in the Kakarapurru canal bank below the lock, the old weir channel not being convenient. A guard rail will be required in front to prevent boats being drawn against the weir.

Gostanuddi and Velpur canals.—Mr. Walch showed me carefully prepared surveys of these on which were noted various straight cuts and improvements considered desirable. The former canal or stream is a tortuous navigation throughout, and while it will be well to cut out really bad bends, anything further is hardly necessary. The Velpur canal has to be greatly enlarged, and so improvements to it can, for the most part, be carried out without additional expense.

Kakarapurru canal.

44. In carrying out the improvements to this canal it will be well to see if the reverse bend at Chettipett cannot be eliminated.

Chettipett weir.

45. This surplus weir of 100 feet clear water-way on which so much of the safety and proper regulation of the canals depend was in good working order. The supply of the Venkiah and Weyairu, and through them of the Undi Canal, is passed over this weir, and it would be well to record the discharges. For this purpose it will be convenient to obtain the required discharge by opening all the shutters to an equal extent. A table for the weir will enable quantities to be taken out on inspection. A knowledge of the facts is certainly required by the Range Officers, and these must be brought before him in a convenient shape so that he may be able to issue his orders without having to devote much time to each of the many matters which have to be disposed of daily. According to notes of the positions of the shutters taken at the time, I make the discharge over this weir on the 13th November to have been 1,382 cubic feet a second, and this would have sufficed for 92,136 acres at two cubic yards per acre per hour, while as far I can gather from the statements reviewed in G. O., No. 1,592, of the 18th June 1873, the area of irrigation in 1871-72 was 68,319 acres, and allowing for subsequent extensions it would seem that the supply afforded was much more than that usually considered sufficient, while

if it be remembered that in the Delta project the allowance for this part of the irrigation was taken to be only 1·6 cubic yards per acre per hour, the disproportion becomes still greater. The Range Officer should as early as possible arrange for records of supply at all the principal regulating works coming under his notice at short intervals, and ultimately he should be able to refer whenever necessary to the discharge at any given time at every regulator.

Proceedings of Madras Government, 14th March 1871, No. 768, note, paragraph 5.

Range Offices site for at Chettipett.

46. In paragraph 7 of the memorandum of inspection, recorded in Proceedings of the Madras Government, No. 1,077, of the 18th April 1871, it was recommended that the range head quarters should be removed as early as might be convenient to a suitable site a little way above Chettipett. The Executive Engineer showed me the site selected, which is a few yards above the regulating weir on the right bank of the main canal, and is in all respects a very good situation. Mr. Walch also informed me that a plan and estimate of the buildings required had been submitted to the Inspecting Engineer for Civil and Military Buildings, and I hope therefore that sanction will soon be given for the erection of the offices for the Executive and Assistant Engineers in order that these officers may be located where alone the most can be made of their time, and the range be most efficiently managed.

Chettipett lime kilns.

47. Here, as at the Dowlaishweram kilns, the descriptions of lime-stone vary greatly, and they should be burnt separately in such manner as may be best adapted to develope their valuable properties.

Chettipett Rest-house.

48. A rest-house on the sanctioned plan has been built a short distance below the weir on the right bank.

Nundamur surplus and regulating weir.

49. This weir, which is to supplement the Chettipett weir and which will discharge irrigation or surplus water into the Weyairu below the Nundamur aqueduct, had been built up to nearly the level of the springing of the arches. The crest wall is seventeen feet above the rear floor, and the cushion wall is five feet high. The masonry is good and carefully built; the cut waters are of a pattern difficult to execute, and they have been successfully carried out. The channel leading to the weir must be considerably enlarged, as the weir has been built below the site of the abandoned lock.

Attili canal.

50. From the head to the Godicherla lock the canal is of good width for navigation. At some little distance below there are two sharp bends, one just below the outfall of the Weir channel, and the other a mile lower down which the Executive Engineer proposes to supersede by new alignments. As the banks are much scarped at these bends, and as it would be a pity to enlarge the canal retaining the faulty alignment, I have approved of these alterations, subject to a report being made should the cost on the improved line be estimated to be materially greater. The radius of the improved curve will be 740 feet, which is none too flat

for a navigable canal. Below the Tatili bridge in the same reach there is another sharp bend which may be found capable of improvement.

Godicherla lock.—The masonry is good and the work generally very satisfactory. The side walls have been built with a batter up to the lower gates, thereby leaving the mitre posts unprotected when the gates are open, and this is not a good arrangement. The side culvert valves are worked by double power rack and pinion gear of the Cuttack pattern which is very effective and suitable, but I think the single rack and pinion would do for the upper valves of most locks; the axles should not be made of cast iron, and those so made should be replaced by others of wrought iron. The time of filling and emptying the lock was $2\frac{3}{4}$ minutes for each operation. The yellow sand-stone used for part of the copings is inferior to the other stone. Water, on upper sill six feet, on lower 4·10 or two inches less than full supply level. The roadway of the tail bay bridge is $11\frac{1}{2}$ feet between parapets, while that of the lock weir close by is but seven feet. They should have been of equal width.

Lock weir, three bays of ten feet. The screws of the shutter gear have a high pitch and are apt to run down of themselves; this should be remedied by counterpoise weights attached to the shutters. The revetments in continuation of the rear wings require to be substantially rebuilt with a proper backing. The water below the fall is fairly quiet, but the cushion wall crest being two feet above bed level, the water is higher in rear of the centre of the weir than at the sides or behind the wing splays, and consequently there is a fall outwards and a transverse set against the revetment.

Building for lock establishments.—This was under construction on local sanction upon an estimate of Rupees 750. This proceeding is irregular; in the first place because no general approval has been given (or applied for) to the provision of permanent buildings for lock establishments, and secondly the District Engineer has no power to sanction new residential buildings. The structure contains five rooms, one for the Superintendent, a store-room, and three lascars' rooms. Surplus materials from the lock and broken bricks, &c., were made use of, and of course reduced the amount of the estimate. The building is suitable for the intended purpose.

Tatili Bridge.—Span $39\frac{1}{2}$ feet with one tow-path very badly arranged, the wall terminating at the ends of the abutment; probably a second tow-path could be added.

Site for Gummumpad lock and lock weir.—This is at $13\frac{1}{2}$ miles; a block plan of the ground and a working plan of the lock have been prepared, and as to the latter an alteration of the direction of the lower wings and a reduction of the versed sine of the tail bay bridge arch from one-third to one-fifth of the span are the only changes desirable. The design of the lock weir should be altered so as to place the cushion wall flush with the bed of the canal; the cushion floor may be conveniently placed 1·75 feet below that level. These new works were to be commenced immediately.

Ralinghy branch.—This is to irrigate a large extent of land now supplied from the Gostanuddi, but for the necessary improvements no provision has been made in the completion estimates except for a head sluice. The Range Officer was informed that he must ascertain the cheapest and best way of carrying the water required,

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and then report what increased sanction, if any, will be required for completing this section of the project.

Junction canal.

51. This canal which superseded the communication with the Weyairu by the Nundamur lock, after that had been closed by the lock becoming unsafe, has been opened for traffic for some time. From it the mid and low level channels forming the principal distributaries of the Ellore canal take off. Their head sluices are well built and effective works.

Mudapuram double lock.—A fine and very carefully built work which does credit to the range. Unfortunately here as elsewhere in so many instances screw gearing has been fitted to the valves, and these make the passage of the lock unnecessarily tedious. The time occupied by a stone barge was $24\frac{1}{2}$ minutes, and twenty minutes may be taken as the time for a light boat such as those used by departmental officers. The lifting of the valves occupies about two and a half minutes. The Superintendent required a little instruction in the management of this lock, and this was given by the Range Officer, it having been noticed that water flowed over the side walls of the lower chamber from the omission to empty this chamber fully before opening the mid culvert valves. A little coping remains to be executed. The tail bay bridge is a sightly structure, the stone in the face-work having been carefully selected. The building of a double lock here was a mistake, and I think the District Engineer is now of this opinion; after some discussion a design for a double chamber was passed, but there can be no doubt but that a single drop might have been built with perfect safety, with more probability of soundwork, and at a considerable saving of expense. The side walls of upper chamber are at 9′ 3″ above sill, a rather wider margin than is usual which has been allowed owing to there being no lock weir, and it is necessary therefore to have a margin above the highest water level in the Ellore canal from which the Junction canal takes off. The lock gates are at rather a flat angle, and it will be well in future to make lock gates a little less obtuse.

Undi canal.

52. A difficulty has been experienced here owing to the water levels in the upper miles not agreeing with those designed, and the difference is of moment, because there are high level lands which cannot be irrigated unless the water level be maintained. The cause of the difference appears to be two-fold, 1st, the actual cross section of the canal is larger than that on which the calculations were based; and, 2ndly, a masonry drop weir in the 16th or 17th mile which is not shown on the longitudinal section but which is entered in the statement of works has yet to be constructed. It was ascertained that with less than the proper depth of water the velocity was greater than that intended, and this indicated a greater surface fall. Mr. Walch is to construct in the first instance a rough-stone dam at or near the site for the permanent work and then to fix its crest experimentally so as with the full discharge to raise the water surface at the head to the level intended and required, viz., 14·66.

Head-lock.—This canal has not hitherto been connected with the Weyairu. The lock lower sill was designed to be at 9·50, and in reviewing the estimates it was suggested that it should be lowered to 9·00, but looking to the fact that the water surface is variable, this sill had better be placed at 8·16 or 6·50 below full supply

level and 4·84 below the highest level the water has as yet attained. A sketch survey was made for the purpose of fixing the site of the lock so as to obtain a fair entrance from the Weyairu. The tail bay bridge roadway is to be seven feet wide only, it being required only for a bridle-path.

The surplus weir at 11½ *miles* which will be in connection with the lock into the Yennamaduru should be built as soon as materials can be sent down, because when there are heavy freshes in the Weyairu it is intended that a full supply shall be passed down the Undi canal even when no water is required for irrigation, and it is of importance therefore that the designed means of passing such water to surplus should be got ready. The other surplus weirs at 7½ and 15⅝ miles should likewise be constructed as early as may be conveniently practicable.

Weyairu or Venkiah.

53. From the lower end of the Junction canal to the Undi canal is about 6½ miles, and just below this an iron girder bridge of 55 feet span is about to be constructed from Local Funds. The Executive Engineer is desirous of constructing tow-paths on either side, and it was doubtful whether the waterway would admit of this being done. The irrigation water to be passed is only 322·5 cubic feet a second, but during floods the surplus sluces between the Undi canal head and the Perimella lock are to discharge as much as 1,650 cubic feet. Mr. Walch was informed, after considering the matter, that tow-paths occupying on either side four feet of the waterway with the path above corbelled out to five feet would be unobjectionable, as the depth of water may without risk increase from eight to nine feet, and with the latter the waterway will be 423 square feet and the velocity under four feet a second. The headway of bridge, according to the plan, is 11½ feet. If six inches more can be given it will be an improvement.

Perimella lock.—The upper wings have been raised and this lock is now much more secure. It has been provided also with new gates. There are two chambers, and the leakage at both the mid and upper sills is far too great, and it must be remedied if possible by wooden sil bars, and if this be insufficient by building new masonry sills. The water levels usually admit of this lock being worked as a single drop; so used the time of filling was five minutes, and this notwithstanding much difficulty in working the side culvert shutters. A good lever and fixed fulcrum will when properly tried be found a very convenient appliance for lock culvert gates; hitherto a reasonably handy lever and even a moderately good fulcrum have not been provided anywhere. This form of power is economical, and it can be so applied as to save a good deal of money, while making it fully efficient, by giving rollers to the gate spears and a counterpoise to prevent the gate falling by its own weight, though a simple catch could easily be placed to obviate this. The foot bridge over the upper end of the lower chamber of this lock is only about seven feet above water level; it should be raised.

Ellore canal.

54. Proper cattle crossings are required in many places, and these works which are essential to the good order of the canal should be constructed at the same time that the improvements just about to be commenced are carried out. In

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Paragraph 9 of memorandum, Procs., Madras Govt., 18th April 1871, No. 1,077.

1870 the efficiency of this canal was much impaired by bullrushes and lunka grass, which not only blocked up much of the waterway but rendered towing difficult. It was very satisfactory to find that the bullrushes had almost entirely disappeared and that the grass had been kept within bounds so as no longer to be a nuisance. For some years attention will be required to prevent the bullrushes reappearing, as unavoidably some roots must have been left in the ground. Mr. Walch deserves much credit for the effective manner in which this nuisance has been dealt with, and the example should be followed on other canals. A commencement has been made with the formation of tow-paths close to the water's edge on the berms, and the enlargement and thorough clearing of the canal will enable this improvement to be extended everywhere that it is necessary. The canal banks were by no means in good order or of a uniform level above the water. Circumstances have prevented the carrying out of the completion estimates until the season which was at the time of my visit about to commence, and as these will readily admit of all that is needful being done, this canal will, it is hoped, in this respect be placed in excellent order at an early date and will have a good bridle-path throughout.

The *Tadapillygudiem bridge* has been completed this year with the exception of the coping. It is a lattice girder of fifty-five feet span in the clear, and has one tow-path under it, the arrangement of which is not quite what is required, it being desirable that the tow line should be kept clear of the abutment, and that consequently the track of the tow line should not run within the line of the face of the abutment prolonged until the boat is close to the bridge. The head-way is only eleven feet, which is a pity; this height is the minimum allowed, but it should not be made so little unless there are strong reasons against raising the roadway.

A rest-house is under construction a few yards below this bridge on the right bank, and the wood-work of the roof was being put on. The walls are of brick masonry.

Levels of the canal.—It has been ascertained by carefully checked levels taken in connection with the improvements about to be carried out that the level of the lower sill of the Ellore lock is really 1·28 feet higher than had been supposed, and this has necessitated a revision of the arrange-

Procs. Madras Govt., 14th March 1871, No. 768.

ments mentioned in paragraph 20 of the note on the completion estimates. The water surface at the 8th mile of the canal is to be at 33·13, and the lock sill being 22·19 and the required depth six feet, the water level there must be 28·19, and the average surface fall would consequently be 0·13 feet a mile; but it is calculated that the surface fall in the 9th and 10th miles, owing to the draught of the Junction canal, will amount to 0·60, and that at the 10th mile the surface will be 32·53. Then from the 10th to the 46th mile the surface fall available will be 32·53—28·19 = 4·34 feet, or an average of 0·12 a mile. Practically, however, there will be still water at the lower end of the canal, and so for purposes of discharge a fall of 0·15 a mile will be allowed from the 10th mile until it runs out at the 39th mile, and the surface below that will be assumed to be horizontal. From the 18th mile downwards the depth of water will be six feet, and the bed from the 10th to the 18th mile will be joined by a straight line, while below

the latter point the bed and water surface will be parallel. The revision of the levels will, it is expected, reduce the quantity of earthwork to be executed in enlarging the canal, but until the sections are worked out the difference will not be accurately known.

Bhimadole under-tunnel.—The channels leading to it are in a mess, and a good deal of land has been destroyed by the cutting down of the soil into gullies. The simplest plan will be to construct a curved drop wall, connecting the under tunnel upper wings, the crest of this wall being placed at nearly ground level; all these gullies will then silt up and the land may be again cultivated.

The canal supply was just spilling over the under-tunnel side walls.

The outfall channel needs to be cleared of bullrushes.

Under-tunnel in 38th mile.—Inlet and outlet channels both full of bullrushes, which must be eradicated.

New escape weir in the 42nd mile.—This is one of the works constructed to provide additional means of escape for the upland drainage which crosses the canal. It consists of a bodywall, the crest of which is nearly flush with the ground, the ends being raised in steps to form wings; a little dry stone has been placed on either side of the wall. It will probably answer its purpose very well. The crest is at 28·71, and full supply level will be 2819, so that a reduction of six inches will be advisable.

Under-tunnel, 43rd mile.—The water in the floods of 1872 breached round the upper right wing and carried away twelve feet of the masonry, which has not been rebuilt. This work should be made perfectly safe, the wings must be raised so that water passing over the side walls may not turn the lower water wings; the leakage through the upper water wing, left bank, should be stopped by clearing out the earth and filling in with puddle. The outfall requires to be cleared.

The canal banks hereabouts are very irregular in height, and as a good deal of land drainage is received, a margin of four and a half feet above F. S. L. will be none too much.

In the lower part of the 43rd mile there is a breach of 168 feet in length in the left bank, and an escape weir 150 feet in length should be built here. There is an opening in the right bank opposite to this point.

G. O. No. 616, dated 16th March 1874.

The numerous irrigation cuts in the banks should be closed. Sluices may be built in any or all of the escapes for a few rupees.

Under-tunnel, 44th mile.—The flood-waters breached round the wings, which are very ill adapted to the situation and circumstances. The side walls should be splayed at both ends on both sides of the canal for a length of twelve to fifteen feet, and these new ends should be raised to the height of the banks.

New escape in the 45th mile.—The length of the crest, which is at 28·67 or 0·48 above intended F. S. L., is 200 feet, the design is similar to that in the 42nd mile. It is an efficient work.

Ponungy escape.—This is situated a little below the preceding work. Its crest is 150 in length, and is somewhat too high and should be lowered. It was originally fitted with Ryves' self-acting shutters, which not acting a masonry crest

was substituted. Height of wings above crest two feet nine inches, which will suffice when the crest is lowered.

Ponungy lower escape.—It has two bays of twenty feet each with iron posts and shutters. The crest is about eighteen inches below intended F. S. L., and this being the escape nearest to the Tummelair, the spill from which has much to do with the inundations to which this part of the canal has been subject, there is advantage in being able to discharge at a comparatively low level, and to this end it will be advisable to convert this escape into sluices having their sills about four and a half feet below revised F. S. L., which will increase the discharging power by 1,020 cubic feet a second. A large opening exists in the right bank opposite to this work.

The subject of the disposal of the cross drainage of this canal was, with reference to G. O. No. 3005, dated 18th December 1872, especially inquired into. Much information of value is contained in the Proceedings of Government as per margin and was duly considered.

No. 3,366, 18th November 1863.
„ 484, 18th February 1865.
„ 2,529, 30th August „

From the Nundamoor aqueduct to Bathampudi, twenty-one miles, the drainage works have proved sufficient, except that No. 1 under-tunnel in the 20th mile does not relieve the lands above the canal fast enough. This was referred to in paragraph 9 of the memorandum of inspection in 1870-71, and the estimate for another under-tunnel therein called for should be submitted at an early date.

G. O., 18th April 1871, No. 1,077.

The rest of this section of the drainage down to the 25th mile at Chebrole is sufficiently provided for by the works sanctioned in 1865, which have answered their purpose. The area of the section is sixty square miles. The next section has an area of seventy-five square miles and extends from Chebrole to Poonla at the 31st mile. There is some drainage in the 31st mile to the west of the two under-tunnels, Nos. 4 and 5, which is connected with the latter by a small drain, and either this drain must be enlarged or an inlet to the canal will be required with a corresponding outlet on the other side. In 1872 the right bank was breached and a lot of silt was washed in; this was the most eastern of the breaches of that year. The right bank at the breach should be lowered to a few inches above F. S. L. and paved. It will then be seen whether the drain to the under-tunnels will suffice, and if not a masonry escape in the left bank should be given. No other works will be required here.

The 3rd section extends to Bhimadole, and drains seventy-five square miles. No breach occurred and no complaints were received of villages being swamped, but a large extent of land was for a time submerged. The waterway allowed is only seven-elevenths of that in the preceding section of equal area, and I think it will be well to increase the capacity of discharge by constructing an inlet in the 32nd or 33rd mile of waterway equal to that of No. 3 escape which is thirty-nine feet long with four sluices.

The 4th section extends very nearly to the Ellore lock. There are many large openings in the right bank, and the damage sustained was from the water admitted at these having insufficient outlet. Two escapes, one of 100 feet in the 42nd mile and one of 200 feet in the 45th mile, have since been constructed, and a third of 150

feet in length is about to be built in the 43rd mile. These escapes will discharge about 1,725 cubic feet a second, and will add one-fourth to the discharging capacity of the drainage works of this section. Judging from the effect of the unregulated floods which were unusually severe, it seems probable that this part of the canal will be secured from future injury. The escapes are inexpensive works, and there will be no hesitation in adding to their number hereafter if necessary.

The short distance below the 4th section down to the Ellore lock is sufficiently provided for as regards its own safety, but in order to aid the Kistna division of the canal and render unnecessary there the provision of works for taking off the whole of the Tummelair water, it has been recommended that the Ponungy lower escape should be altered so as materially to increase its discharging power.

Ellore Lock.—The water on the lower sill was at 5·5½ inches or 6½ inches below the intended level when all the improvements have been carried out. The drop of the lock is eight feet and the upper sill referred to the Godavery datum is 30·19. The Kistna value of the upper sill is 31·95, but there is no connection between the datum levels used in the two districts. It is hoped that ere long all the levels of both districts will be referred to mean sea level as a common datum.

Mid level channel.

55. The two principal distributaries of the Ellore canal are the mid and low level channels. They were to have had a special head in the Ellore canal, and they may still be considered to be so supplied though the canal from which they take off is now called the Junction canal. I inspected the mid level channel down to the 12th mile. Much remains still to be done as regards the construction of irrigation sluices; at present a large proportion of the irrigation is carried on under unregulated temporary openings which cause much waste of water and are attended with considerable risk. The number of off-takes should be limited to that really necessary, and masonry sluices should be built as early as practicable.

Just below the Duvah and Prettipad road there is a well-built distribution sluice. The road and accommodation bridges of which there are several are suitable works, and some are creditable in appearance, others are somewhat spoilt by having plastered brick parapets and no string courses.

Village cattle instead of using the Rachur bridge in the sixth mile have been in the habit of crossing the channel, and a breach in the left bank has resulted. A notice should be put up prohibiting this wanton proceeding, and thereafter cattle so crossing should be sent to the pound.

Under-tunnel and bridle-path bridge in the seventh mile. A carefully designed work but rather expensive. It was built before the remarks on the completion estimates were received. A little coping remains to be done, and this should be completed.

The water passing under this tunnel should be gauged occasionally in order to check waste, and when the supply is short this will be especially necessary.

Information is needed with regard both to the supply afforded to a known area of irrigation and to the surplus discharged from it in order to ascertain the quantity of water required for rice cultivation. The measurement of the supply can be taken without difficulty when proper sluices have been built, but the surplus is often difficult of ascertainment, so whenever facilities exist for gauging the latter, the opportunity should not be lost. At the lower side of the small tank of Devasiparu

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through which the channel passes is a small drop and an irrigation sluice in the left bank of good design, but the baulk shutters have no proper support and should be superseded by a gate shutter with or without screw gearing. At 9½ miles there is a fall, and just below *an escape in the left bank* and a bridge over the channel. A lot of drainage here falls into the channel. The escape was designed with falling shutters; that built on a plan dated November 1871 is a sluice of three bays of ten feet each, the shutters being fitted with screw gearing the design of which is a modification of that commonly in use and is good. An irrigation channel is carried from above the fall across the escape by an aqueduct supported on extensions of the escape piers. The surplus channel is used also as an irrigation channel and supplies a large extent of land.

Drop at 9¾ *miles.*—There is a cattle track across the channel here which makes a mess of the banks. It will be well to construct a platform bridge nine feet wide over the drop, which can be cheaply done; and probably where much headway is not required, and where the channels are not very large, it will be more economical to provide bridges rather than ramps.

Drop at 11¼ *miles.*—A neat little work.

Escape and Bridge.—The escape is now hardly wanted, it was to have had falling shutters; in one of the three bays it may now have the crest one foot below, and in the others at F. S. L.; a plank will be required for the bay on the low level. The surplus channel has to be crossed by an iron aqueduct to carry an irrigation channel. The earthworks of many parts of this channel are in bad order; they were badly thrown up in the first instance, and they require now to be thoroughly put to rights.

Drainage of the Western Delta, Nakkala and Kaza drains.

56. The tract of country between the bank and Nursapore canal is drained by the Nakkala and Kaza drains. The former is reported to be efficient. It was considered to be so by Major Ryves, and the present Range Officer confirms this opinion. An estimate of Rupees 13,200 has been sanctioned for a sluice aqueduct which will exclude Godavery floods from the drain.

For the improvement of the Kaza drain, Rupees 5,760 have been provided. The natural out-fall is just to the east of the village of Navarazpuram, and here a self-acting out-fall sluice will be required. At present this drainage is conducted by an inadequate cut, parallel to the river embankment to a sluice not far from the tail channel of the Nursapore lock; this line is circuitous and inefficient; it was recently proved to be so, and an opening through the embankment had to be made to relieve the neighbouring lands. Moreover, a good deal of land west of Nursapore canal will it has been found require to be drained under that canal, and the existing sluice, though perhaps more than large enough for this western drainage, will not suffice for the whole.

The Kaza drain below the village of that name is apparently of ample capacity, and with a good out-fall it will drain all the lands which are capable of being drained, which may be taken to mean all which are above mean sea level. Above Kaza to the Kodair road the drain is much choked with weeds, but there is a deep channel most of the way. It would be navigable thus far were the trees and bushes removed from the edge of the banks, and the weeds from the bed. There was apparently no

current in the drain. The bridge over it on the Kodair road has three bays of 15 feet each; the water stood at 4 feet 8 inches on the floor, and was six feet below the top of the abutment. The highest water mark was three feet above the then level. There is a larger extent of undrained land between the bank and Nursapore canal on the one hand, and between the latter and the Gontair drain to the westward than I had imagined; the want of a complete and connected series of levels is now much felt, and I think the best way will be to prepare a map of all the checked levels which have been taken, and then to supplement these sufficiently to show at a glance what the level of the undrained lands is and what is the proper and natural direction in which to carry off the water.

Drain west of Nursapore.

57. This has been executed on an estimate of Rupees 18,320 to relieve the country between the Nursapore canal and the Gontair, a natural drainage. Its out-fall is into a creek of somewhat less capacity than the drain. The ground is low and the water spreads over it; the water marks of the year (1873) are but little above H. W. L. The earthwork has been very roughly done; the banks have not in any way been levelled or sectioned; and this should now be attended to; a great many openings at every sixty or hundred feet had been left for the drainage to enter from the adjacent lands; about four of these openings to the mile may be left open, and these should have temporary palmyra foot-bridges across them to allow of inspection. The country on either side of this drain in the lower miles should be drained as far as possible independently into the creeks, first by removing obstruction to drainage by cutting through the slight ridges, and secondly by affording such facilities in the way of ditches as each part of the ground may require. Such water as cannot otherwise be conveniently disposed of may be then admitted to the drain west of Nursapore.

Kopuru Malapilly is a village situated at about the limit of high water (tidal.) Above the reach of tide water also a great deal of embanking is needed. In its present state I should say that the drain while it has greatly benefitted the uplands has rather injured than otherwise low-lying lands by conducting foreign water to them; however, Mr. Walch told me that nothing of this kind had come under his notice.

In the salt and brackish water weeds are very troublesome, while above this where the water is fresh there are none.

On the Viraveswaram road this drain is crossed by a bridge of twelve feet span, six and a quarter feet from floor to crown of arch; the water does not appear to have risen to the springing which is three and a quarter feet above the floor. The drain channel immediately below the bridge is capable of improvement.

Buggeswaram drain.

58. This lies between the Jinnur and Rapaka Irrigation channels. It is crossed by a bridge, on the road mentioned above, of three bays of seventeen feet. The highest water mark is just over six and a half feet, and the roadway is nine and a half feet above bed. The parapet is at 11·26 above the H. W. datum of the delta. The work done out of the estimate of Rupees 6,050 for the improvement of this drain has been the clearing of the upper part, and below the road a straight cut through an old tank bund. The drain should be cleared of weeds which occupy a very large proportion of the waterway.

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Gontair.

59. The bridge over this on the Viraveswaram road has three spans of thirty-three feet each. The completion estimates contemplate the use of this drain for the discharge of the principal part of the Gostanuddi drainage. The highest water mark was $2\frac{3}{8}$ feet above the then water level, which was four and a half feet above the off-set on the western side of the east pier near the upper cut water. The top of the pier was four and a half feet above water as far as could be judged without the levels of the bridge; the water surface might be lowered three or four feet, as the bed of the drain at this point is supposed to be at 0·75.

Gostanuddi outfall by the Buswarow Kodu, &c.

60. With regard to the outfall of the Gostanuddi into the lower part of the Gontair with a view of relieving the Yennamaduru drain for which a sum of Rupees 94,000 has been provided in the estimates, besides an item* for an aqueduct or under-tunnel in the Gostanuddi and Velpur Irrigation estimates, some remarks are contained in paragraph 17 of the note on these estimates, and the condition of the country which the arrangement was intended to remedy is described in Mr. Rundall's letter, paragraphs 45 to 49 and 90 to 95, printed in the same proceedings. Mr. Walch, however, informed me that the result of the freshes of 1872 in the Yennamaduru had convinced him that the large outlay proposed for providing a new outfall for the Gostanuddi was unnecessary, and that he believed the former would without difficulty carry off not only its own flood-waters but those of the Gostanuddi as well. The requisite information to enable me to form an opinion on the subject was not available; what is necessary is to show what were the flood levels in the Yennamaduru at and above the village of that name where this line of drainage is embanked; secondly, what were those levels in the lower part of the Gostanuddi, say from Aravilly downwards; thirdly, what were approximately the discharges in each, and what rainfall drainage from the areas relieved by these streams such discharges represented. It will then be possible to estimate roughly what would be the effect of a maximum flood discharge, and it will be seen whether any great improvement of the means of rapidly disposing of floods is requisite or desirable. In the meantime by getting on with the work under the Gostanuddi and Velpur Irrigation estimates as fast as possible, the Gostanuddi below the 14th mile will the sooner be relieved of its irrigating duty, and will be freed from all obstruction to the free flow of drainage water; this, with probably some embanking, may of itself entirely change the conditions of the southern part of the country between the two drains; and of course, if the Yennamaduru can be shown to be capable, at a reasonable level, of discharging all the water coming into it, it will be of much advantage to avoid a large expenditure, which in such case would be unnecessary, in diverting a large body water in a direction in which little or none of it has hitherto flowed.

* Rupees 11,270.

Pundikodu drain, estimate Rupees 59,530.

61. This extends from Bodapad on the right bank of the Weyairu above Perimilla lock to the Colair lake, not far from Pedda Nindrakal. It has already

greatly improved this part of the country, and I noticed a marked change even since 1870, although prior to that much had been effected. At present the lower part of the drain is of only about half the estimated width, and it appears to have acted very well; but although the adjacent lands were in this year certainly relieved without much delay, more definite information as to the level and duration of considerable floods is desirable; for as the drain is in this lower part embanked on one, the left or south, side only, it is not improbable that even ordinary floods may submerge the cultivated lands alongside for longer periods than may be convenient. For this purpose the gauge above the junction of Beckley's drain should be lengthened, it having been twice submerged, and another gauge should be placed near Pedda Nindrakal, and the water levels after heavy rain should be recorded, the maxima of successive years being plotted on the longitudinal section for future reference, and of course the cross section of the drain for the year should be noted, as otherwise very erroneous deductions might be made. The outfall into the Colair is not as efficient as it might be, there being somewhat of a bar across it which should be cleared away. The level of the Colair will be referred to in my notes on the Kistna Delta, and the lands under the Ellore canal will be much benefitted if it be determined to avoid for the future artificially raising that level. The embankments of the Pundikodu are not in as good order as they should be; they have never been sectioned and levelled, and this should be attended to. It will be necessary also to pay attention to clearances which are always specially necessary for a year or two after drains have been newly cut, as their effect must always be to lower the beds of the subsidiary drains, and the soil thus removed is to a large extent deposited in the main drains.

62. The other drains of this delta I had not an opportunity of seeing. All have made some progress, and they should receive steady attention until they have been completed and rendered thoroughly efficient.

Other drains.

63. It has been noticed that the record of flood levels in the Pundikodu is required, and similar remarks apply to all main and considerable drains. Definite information is greatly needed in order that this important subject may be intelligently dealt with. The drains have for the most part been cut to a less width than that provided for in the estimates, and this arrangement was purposely carried out in order that data of which there were none then available might be obtained and unnecessary expenditure avoided, but hitherto no data have been recorded in a shape to be made use of effectually, and, except perhaps to those on the spot, but little more is known than was the case three years ago. In the midst of a press of work matters of this kind are apt to be postponed if not overlooked, but the means of obtaining a record are simple, and gauges should be fixed either on masonry works or elsewhere at convenient intervals in all drains, and arrangements should be made for registering the flood levels so that these may afterwards be shown on the drain sections.

Observations of flood levels in all drains.

64. Having completed the remarks on the Western Delta, I have much pleasure in bringing to the notice of Government the very satisfactory way

Mr. Walch's management favorably noticed.

in which the Range Officer, Mr. Walch, is carrying on the improvements in this section of the delta. With the one exception of the earthworks, to the level and sectioning of which more attention requires to be paid, I was perfectly satisfied with all that I saw of Mr. Walch's work, and with the systematic manner and good order of his arrangements. The new masonry works, including several locks, are highly creditable; the work is superior to any that had before been done in the range, and the cost well within the estimates. Throughout much care and forethought were observable, and I have no hesitation in saying that in Mr. Walch the Government have a very valuable officer of the department. Whenever an opportunity occurs, it will be well to place a few probationary Assistant Engineers under Mr. Walch to learn their work. Nowhere else could they do so as well. I am glad to add that both the District Engineer and Mr. Walch speak highly of the way in which Lieutenant A. R. F. Dorward has worked in the Western Delta, and of the care and interest he has shown in carrying on the duties entrusted to him.

65. This project has been under investigation, and it was taken up for the purpose principally of diminishing floods in the Western Delta by the Yerracalwa, which on entering the delta is called the Weyairu. The site selected for the bund is about 22 miles above the point where the Yerracalwa crosses the Ellore canal by the Nundamur aqueduct. The site is the best available, but it is not a particularly good one. The places available for discharging surplus are three saddles all on the east side of the river of which the two to the eastward are divided by a small hill or hillock, and the eastern is six feet above proposed full tank level, and there is nothing but gravel to be seen in the trial pit, but lower down the hill sand stone crops out; west of the hillock the saddle is four feet above F. T. L., and sand-stone appears at about that level. The third is a much longer saddle nearer to the river, but the soil here is a sandy loam quite unsuitable for the construction of an escape which would be a very expensive work if built here. The bed of the stream or river is sandy; it presents no special difficulties or facilities. On the east bank the hill side is steep. On the west bank there is a nearly level plain for about a mile, on the west side of which the bund would abut on a stony hill. It has been calculated that the tank would hold 160 millions of cubic yards, and that in an average year it would receive and retain 448 millions, or, in other words, that it would store nearly th[illegible] times its capacity. All the plans of the project which has been very carefully pr[illegible] pared by Lieutenant A.R.F. Dorward and does him much credit were looked ov[illegible] The designs of the masonry works are generally too expensive, and the bed slopes of the channels may be modified with advantage. As, however, Lieutenant Dorward has other and more important work to attend to, the estimates will be sent to this office as soon as the revenue information has been received. The land compensation statement had not been completed. The reservoir and its works would occupy 6,440 acres and the channels from it 701 acres, and it has to be shown not only what compensation would have to be paid but what revenue would be relinquished.

Unnamalunka Reservoir project.

66. Several cases have occurred of boats being left in the canals or in the river above the headworks, and sometimes, as for instance when the boats are washed down by the river, their owners

Waifs and Strays.
Abandoned boats.

are undiscoverable. These boats are generally an inconvenience, as they obstruct the traffic and they sometimes become speedily water-logged. It seems to be necessary that the Range Officers should be authorized and required in all cases to remove such boats, the expense of removal and a fine equivalent to a year's license fee being levied from the owners before re-possession is given when the boats are claimed, and when no claim is made within three months after notice has been given in the *District Gazette*, the boats to be sold and the proceeds, after defraying expenses, credited to miscellaneous Canal Revenue, or as will often be the case, when a deficit will have to be made good, this to be charged to the Repair grant as part of the cost of maintaining the canals and navigation; when boats bear a license number, the owners or their representatives ought to be traceable; with waifs and strays the case is different and nothing is gained by delay in removing the boats from the waterway and afterwards disposing of them. Subject to the payment of the fine above referred to, the net amount realized from boats sold might be claimable any time within a year after the sale.

67. Certain instances of unauthorized expenditure having come under notice, the progress reports for the years 1871-72, 1872-73 and the first-half of 1873-74 were gone through, and those entries which appeared to require explanation were noted down in a memorandum on which the District Engineer has entered such explanations as he had to offer. One considerable class of work is that connected with river defences, expenditure on which to a very large amount has taken place on Colonel Fischer's authority, contrary to the orders given in G. O., No. 377, of the 7th February 1871. I did not until recently visit the Godavery after January 1871, and the District Engineer's remark opposite item No. 28 cannot refer to any of these works, moreover, a little further on, opposite item No. 17 and the following, Colonel Fischer has stated that these works were carried out because those which had been ordered by the Chief Engineer had been swept away, and it is supposed therefore that the works referred to in the previous place were temporary works such as those used in the Tanjore rivers. Lastly, it will be seen that the District Engineer has quoted G. O., No. 2,502, of the 13th October 1873, as approving of his proceedings, but how this view has been taken it seems difficult to imagine. Notwithstanding the orders given in 1871 and their confirmation in later orders of the same tenor, Colonel Fischer still says that it was his "duty to see these works properly done as soon as possible." For certain sanctions for additions to the floating plant the District Engineer had no authority. The items as per margin come under this class. In G. O. of the 19th August 1869, the construction of certain punts out of the Agricultural Repair Grant was specially sanctioned, thereby showing that the sanction of Government was required. Moreover the Agricultural Repair Funds are placed at the District Engineer's disposal for the maintenance of existing works, and not for work which ordinarily is debitable to Capital. The District Engineer's explanation is that both he and the Controller considered that he could

Unauthorized expenditure.

Enclosed Appendix.

		Rs.
No. 182, constructing a new pattern wooden boat	... ...	2,330
No. 16, building a boat	... ...	1,557
„ 17, do. do.	... ...	2,117
„ 19, constructing do.	... ...	2,300
„ 44, purchasing 4 do.	... ...	1,400

sanction additions to the floating plant. In what form other than perhaps that no objection was made to the entry in the progress report, the Controller expressed an opinion is not stated, but the District Engineer has not quoted any order giving him the authority, and as the construction of boats has hitherto been sanctioned by Government, it must be assumed that the District Engineer was aware that the outlay was unauthorized. These remarks apply to all the items except No. 16. This latter refers to the construction of a range boat. For an additional boat of this class the District Engineer did endeavour to obtain sanction, which was however, after full consideration, declined, but nothing was said about the boat having been already built without sanction. The boat was built for Colonel Fischer's own use, and the public money spent upon it out of the Agricultural Repair Grant should, I think, be refunded.

G. O. No. 1742, dated 15th July.
„ No. 2268, do. 15th September 1873.

Other irregularities of various kinds have been committed, certain expenditure incurred in dredging in front of Dowlaishweram and Vigeshwaram head sluices in 1872, have been charged to Local Funds, for no other reason than that such funds were available. It is not clear whether the sanction of the Local Fund Board was obtained to this diversion, but the work had nothing to do with those funds.

From the explanation given, item 80, constructing an aqueduct to Karapa Bodi channel, it is probable that this minor new work was not properly sanctioned. However emergent, its commencement in anticipation of regular sanction was alone within the competence of the District Engineer. Item No. 8, steamer *Fred and May*, Rupees 2,780; because no funds were available under Tools and Plant, Agricultural Repair Funds were made use of, although this steamer had nothing to do with the works for which those funds were provided. The expenditure was altogether irregular.

Rupees 980.
„ 750, being the limit for local sanction.

The explanations with regard to items 7, 10, 12, and 13, repairs to punts and to *Pioneer*, one of the river steamers, is not satisfactory; certain regular charges for the river steamers and dredges have been specially provided for by Government under Tools and Plant, and it was understood that the delta works were charged for the work done for them by the floating plant, and that other charges consequently on account of this plant were met from such receipts. Various entries for maintenance charges, however, are to be found under both Tools and Plant and Agricultural Repairs, and the result is that it must be difficult to ascertain first what the up-keep of the plant costs, and, secondly, what the work done by it comes to. It is certain that the transport of materials by private boats is cheaper than by Government boats even were the latter fully employed from years end to years end, for the first charge on account of the latter is 6 Pies per mile, and of the former 5 Pies, and it would now appear that the 6 Pies do not cover repairs, and a considerable addition must be made for idle days.

Item No. 20, constructing new river bank in the limits of Doddaram and Paserlapudi, Rupees 5,200, is another work which, I think, it was not within the District Engineer's competence to sanction. Had it been emergent the course would have been to go on with it and apply for sanction, but it is clear from items 9 and 10, which are connected with the same locality, that the place was endangered in

September 1872, and as the large estimate was not sanctioned until February 1873, there was plenty of time for dealing with it in a regular manner. The surveys on which the sanction was given were asked for, but they have not been sent, nor are they referred to in the District Engineer's reply. Probably none were prepared.

The remarks opposite item No. 57, ballasting in front of the anicut, Rs. 2,510, call for notice. In G. O. of the 3rd February 1871, No. 331, Government approved of the construction of five groynes for the purpose of keeping the deep channel of the river at a proper distance from the Dowlaishweram branch of the anicut. Colonel Fischer prefers other arrangements and sets aside his instructions, without even making any report on the subject. Further, when I was at Dowlaishweram I was told by this officer that he intended to construct these groynes this season, but he now enunciates the opinion, for the first time within my knowledge, that they would be dangerous.

Item No. 11, constructing new embankment and channel near Bramapury, Rupees 3,380. This appears to be a re-alignment of the Bank canal, in consequence of river encroachments. It is represented as being a work of great emergency, but the date of sanction of the estimate negatives this; the freshes occasioning damage being over sometime in November or December, after which until the July following no further damage can occur.

* April 1873.

Item 10, duct to carry water to Singaram fields over drain, Rupees 420. This is a minor new work and its debit to Repairs was irregular.

Item 13, constructing huts for lock lascars, &c. As already noticed in the remarks on the Attili canal, paragraph 50, the erection of this building without sanction was irregular, and this description applies still more strongly to the use of Repair funds for the purpose.

(Signed) J. MULLINS, Lieut.-Colonel, R.E.,
Chief Engineer for Irrigation.

MADRAS,
26th February 1874.

Proceedings of the Madras Government, Public Works Department,
15th *July* 1874.

Statement of Government Boats in use in the Godavery District.

No. of Boat.	Description.	Measurement. Length.	Breadth.	Height.	Iron or Wood.	When Built.	Boat Carries. Cubic yards Rough Stone.	Square feet Cyclopean Stone.	Cubic yards of Kunker.	Garce of Lime.	Average draught of Water.	Remarks.
		Ft. In.	Ft. In.	Ft. In.							Ft. In.	
12	Range Tools and Plant, Ordinary.	61 0	11 5	3 9	Iron.	Prior to 1861.	20	160	...	...	3 0	
2	Flat ...	80 6	19 8	5 0	do.		25	...	...	...	4 0	
8	Deep Boat ...	60 0	12 6	5 0	do.		25	...	...	...	4 0	
13	Do. ...	93 3	9 6	4 0	do.		25	...	...	...	3 0	
II.	Canal Dredge ...	90 0	14 0	3 9	do.		...	...	...	...	...	
III.	Do. ...	50 0	10 0	3 9	do.		...	...	...	...	...	
IV.	Do. ...	90 0	14 0	3 9	do.		...	...	...	...	...	
VI.	Do. ...	90 0	14 0	3 9	do.		...	...	...	...	...	
VII.	Do. ...	90 0	14 0	3 9	do.		...	...	...	...	...	
VIII.	Do. ...	90 0	14 0	3 9	do.		...	...	...	...	...	
6	Canal Punt ...	60 0	10 4	2 9	do.	1859-60.	19	130	...	...	2 0	
3	Do. ...	60 6	10 4	2 9	do.		12	130	...	...	2 0	
5	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
6	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
9	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
14	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
15	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
16	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
17	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
19	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
20	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
23	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
24	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
26	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
32	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
35	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
37	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
38	Do. ...	60 0	10 4	2 9	do.		...	...	130	...	2 0	
12	Drop Punt ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	Only useful for dredging. Cost of conversion into a Drop Punt was Rupees 1,026, paid in 1869-70.
3	Canal Punt ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
4	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
14	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
24	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	
25	Do. ...	60 0	10 4	2 9	do.		12	130	...	...	2 0	

Statement of Government Boats in use in the Godavery District.—(Concluded.)

No. of Boat.	Description.	Measurement. Length.	Breadth.	Height.	Iron or Wood.	When Built.	Cost.	Boat Carries. Cubic yards Rough Stone.	Square feet Cyclopean Stone.	Cubic yards of Kunker.	Garce of Lime.	Average draughts of Water.	Remarks.
	Range Tools and Plant, Ordinary.—(Concld).	Ft. In.	Ft. In.	Ft. In.			Rs.					Ft. In.	
26	Canal Punt	60 0	10 4	2 9	Iron.		2,811	12	130	...	...	2 0	Working in No. 3 Range.
27	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 0	
28	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 0	
29	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 0	
30	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 0	
31	Do.	60 0	10 4	2 9	do.	1859-60.	2,811	12	130	...	...	2 0	
32	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 0	
33	Do.	60 0	10 4	2 9	do.		2,811	12	130	...	...	2 6	
	Steamer Littlenell ...	90 0	9 3	4 3	do.		15,456	...	...	...	...	...	
	Do. Thistle ...	95 0	13 6	4 3	do.		20,014	...	...			...	
	Range Tools and Plant, Extraordinary.												
30	Light Boat	35 0	8 6	3 0	do.	1873-74.	1,433	...	...	...	3	1 9	
31	Do.	35 0	8 6	3 0	do.		1,433	...	...	...	3	1 9	Working in No. 2 Range.
29	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	
33	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	
34	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	Do. ,, 3 do.
35	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	
1	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	
2	Do.	35 0	8 6	3 0	do.		1,000	...	...	...	3	1 9	
3	Do.	35 0	8 6	3 0	do.		1,000	...	...	...			
9													
1	Lighters for conveying lime.	40 0	8 0	3 6	do.		1,000	...	...	...		1 9	Do. do.
2	Do.	40 0	8 0	3 6	do.		1,000	...	...	...		1 9	
2													
	Deep Boat	40 0	9 0	3 0	Wooden.	1873-74.	750	...	...	...	3	1 0	
	Do.	40 0	9 3	3 0	do.		750	...	...	...	3	2 0	Do. ,, 2 do.
	Large Punt	72 0	12 0	3 0	Iron.	1872-73.	6,243	21	...	...	...	2 3	
	Local Funds.												
1	Large Punt	72 0	12 0	3 0	do.	1872-73.	5,817	21	...	...	...	2 3	
2	Do.	72 0	12 0	3 0	do.		5,817	21	...	...	...	2 3	
3	Deep Boat	72 0	12 0	4 6	Wooden.		1,750	25	...	...	...	3 6	
4	Do.	72 0	12 0	4 6	do.		1,750	25	...	...	...	3 6	Working in No. 3 Range, built at Coringa.
5	Do.	72 0	12 0	4 6	do.	1872-73.	1,750	25	...	...	...	3 6	
6	Do.	72 0	12 0	4 6	do.		1,750	25	...	...	...	3 6	
7	Do.	72 0	12 0	4 6	do.		1,750	25	...	...	...	3 6	
8	Do.	72 0	12 0	4 6	do.		1,750	25	...	...	...	3 6	
	Agricultural Repair Allotment.												
1	Deep Boat	72 0	12 0	4 6	do.	1871-72.	2,330	25	...	...	...	3 6	
2	Do.	70 0	10 0	4 6	do.	1872-73.	2,117	25	...	...	...	3 6	
	Dredge Punt	30 0	13 0	2 6	Iron		2,310	...	...	...	...	2 0	
	Do.	30 0	13 0	2 6	do.	1871-72.	2,310	...	...	...	...	2 0	Lock dredge Punts.
	Do.	30 0	13 0	2 6	do.		2,310	...	...	...	...	2 0	Not fit for conveying materials.
	Do.	30 0	13 0	2 6	do.		2,310	...	...	...	...	2 0	
	Do.	45 0	7 6	3 0	do.		500	...	...	...	...	...	Purchased for works in connection with the protection of the river margins in No. 4 Range.
	Open Boat	37 3	7 6	3 0	do.	1872-73	250	...	...	...	...	...	
	Do.	36 7	7 6	2 7	do.		250	...	...	...	...	...	
	Boat Office.												
11	Deep Boat	61 0	11 1	5 0	do.		5,000	25	...	...	...	4 0	
10	Do.	43 0	12 6	5 0	Wooden.	Prior to	1,500	19	...	...	...	4 0	
22	Do.	33 6	14 6	5 0	do.	1862-63.	2,394	36	...	...	...	4 0	Useless.
1	Flat	61 0	11 6	3 9	do.		1,800	20	160	...	...	3 0	
	Range Boats.												
1	Boat, 1st Class ...	44 0	7 0	3 0	do.	1868-69.	1,200	...	...	...	...	...	
2	Do.	44 0	7 0	3 0	do.	1870-71.	1,200	...	...	...	...	...	
3	Do.	44 0	7 0	3 0	do.	1869-70.	1,200	...	...	...	...	...	
10	Do.	44 0	7 0	3 0	do.	1872-73.	1,557	...	...	...	...	...	
5	Do., 2nd Class ...	30 0	6 3	3 0	do.		860	...	...	...	...	...	
6	Do.	30 0	6 3	3 0	do.	1869-70.	860	...	...	...	...	...	
7	Old Range Boat, 2nd Class...	...	...	...	do.	Unknown.	400	...	...	...	...	...	
8	Boat, 3rd Class ...	25 0	6 3	3 0	do.	1868-69.	400	...	...	...	...	...	
9	Do.	25 0	6 3	3 0	do.	1869-70.	400	...	...	...	...	...	
	Upper Godavery Floating Plant.												
	Steamer Shamrock ...	...	...	...	Iron.	...	12,000	...	...	...	...	...	
	Do. Prince ...	...	...	...	do.	...	33,000	...	...	...	...	...	
	Do. Fawn... ...	...	...	...	do.	...	1,800	...	...	...	...	...	
	Paddle Boat... ...	...	...	...	Wooden.	...	483	...	...	...	...	...	
					Cost of conversion into range boat.		300	...	...	...	...	...	Now used as Range Boat No. 11.
	Wooden Flat, 5½ tons ...	...	...	...	Wooden.	...	250	...	...	...	...	...	
	Do., Boat	70 0	10 0	5 0	do.	...	400	...	...	...	...	...	
	Do.	70 0	10 0	5 0	do.	...	400	...	...	...	...	...	

Dowlaiswaram,
6th November 1873.

(Signed) R. R. E. BROCKMAN, Captain, R.E.,
Executive Engineer, Godavery District.

GODAVERY DISTRICT.

Memorandum of entries in the Progress Reports of the Delta Ranges for the years 1871-72, 1872-73, *and the first-half of* 1873-74, *which are considered to require explanation.*

Items.	Description.	Amount of Estimate.	Date of Sanction.	Remarks by Chief Engineer for Irrigation.	Explanations of the District Engineer, Godavery.
	EASTERN AND CENTRAL DELTAS PROGRESS REPORT FOR 1872.	RS.			
	Repairs.				
8 & 9	Dredging in front of Dowlaishweram and Vijeshweram head-sluices.	...	.....	Against these there is the remark "transferred to head Local." It is not understood how this could be done.	Sufficient funds having been available under head "Local Repairs, Communications;" funds for these works were provided from that source.
28	Groynes to the Godavery at Ramachendrapur.	11,838	26th Feb. 1871.	Sanctioned locally in contravention of Government Order, 7th February 1871, No. 377.	Sanctioned, as the Chief Engineer had personally given instructions to Range Officers how these works were to be constructed and carried out.
158 234	Repairing Ventur Calingulah.	160	.....	*It appears to require explanation why the requirements of this work were not more accurately ascertained. It appears to have given way soon afterwards.	*Work executed by Major Hasted before he left the district. I had previously after personal examination of the work reported it was not worthwhile retaining it, and this proved to be right after some repairs to it had been attempted. Observes that the second work, No. 234, is "for putting a cross bund in front of the calingulah, and not for the repairs of the calingulah."
182	Constructing a new pattern wooden boat.	2,330	.....	Additions to the floating plant cannot be made except upon Government sanction.	The Controller and I both conider it could.
	WESTERN DELTA.				
17	Groynes at Kakarapurru...	4,340	8th Mar. 1871.	*Vide* remark against item 28 above.	*Vide* explanation as above.
18	Preventing erosion Godavery bank, Mallaiswaram and Siddantum.	2,600	April ,,	Do. do. ...	Do. do.
37	Constructing large stone groyne No. 1 at commencement of set.	2,500	May ,,	Do. do. ... The description is insufficient, as no position is indicated.	Do. do. At Kakarapurru.
70	Do. large stone groyne No. 2 in the limits of Kakarapurru.	4,300	Oct. ,,	*Vide* remark against No. 28 above.	Do.
78	Protecting river bank at Siddantum.	2,000	Feb. ,,	Do. do. ...	Same as against No. 28.
79	Do. at Kakarapurru ...	1,800	,, ,,	Do. do. ...	Do. do.
after 81	Compensation for land for groynes.	191 298	.....	In what shape have those purchases been recorded, are they shown on the plans of the river margins, and what areas are represented by the expenditure?	Compensation paid on surveys submitted to the Collector and approved by him. Payment for both these items were made by the Collector in 1872-73, although advance for the 1st item was made in 1871-72. Land for the 2nd item was taken under the authority given in G. O. No. 855, dated 22nd March 1872, the area of which is acres 1·4, as is observed from the Acting Chief Engineer's letter, No. 199, dated 26th November 1871.
	EASTERN DELTA PROGRESS REPORT FOR MARCH 1873.				
	Repairs.				
B Item 80	Constructing an aqueduct to Kárapabodi channel near 23rd mile, Cocanada canal.	980	.....	Apparently a minor new work, and if so not properly chargeable to repairs, while the amount is in excess of limit of local sanction.	To replace a tunnel old and useless, and sanctioned to improve the drainage of the country emergently required.
	Ordinary works	...	.....	What is the meaning of this sub-head to Repairs, Agricultural?	This is the head for which no Capital or Revenue Account is kept.

These works were put in hand after those ordered by the Chief Engineer in 1870-71 had totally failed and had been swept away by the rain with the loss of a whole season and all the outlay; it was then more than ever necessary to proceed with such works as the experience and knowledge of this river had shown would answer their purpose, and then have been perfectly successful as reported to Government by the Acting Chief Engineer in G. O. of the 26th July 1872, No. 1,786, and further detailed in this office letter printed with G.O. of the 13th October 1873, No. 2,502. As no Surveyors were available, and the work was of the most emergent character from the great neglect of the river and its requirements, and could be easily and effectually done by any one of ordinary experience in the district, I considered it was my duty to see these works properly done as soon as possible, and the Government in G.O. No. 2,502 have approved of this.

Memorandum of entries in the Progress Reports of Delta Ranges for the years 1871-72, 1872-73, *etc.*—(Continued.)

Items.	Description.	Amount of Estimate.	Date of Sanction.	Remarks by Chief Engineer for Irrigation.	Explanation of the District Engineer, Godavery.
8	Steamer *Fred and May*...	RS. 2,780	.....	The time during which this steamer was employed on work connected with the delta, that is the number of days that it was under steam on that service, should be stated. Ordinarily no part of the cost of maintenance of harbour plant is debitable to Agricultural funds.	No funds being available under head "Tools and Plant," these repairs were debited to Agricultural Funds as a temporary measure. This steamer was not employed on work connected with the delta. The number of days she was under steam from 1864 to 1872-73 was 476.
16	Building a boat	1,557	.....	*Vide* remarks against item No. 182 above. The description of boats built should be specified.	*Vide* remark against No. 182. One is a range boat; one to replace a deep boat condemned and sold.
17	Do.	2,117			
Items 7, 10, 13, 12.	Repairs to Punts... ... Do. to *Pioneer* ...	...	.....	It is understood that maintenance charges other than those sanctioned by Government for the steamers and dredges are recoverable by debit to the work on which the floating plant is employed, and it is not understood why these and numerous similar entries under Repairs Agricultural and Tools and Plant come to be sanctioned. The system adopted can be described in a separate communication if necessary.	As no funds were available under head "Tools and Plant," the repairs to punts, etc., were debited to Repairs Agricultural," as this plant is specially employed mostly for the benefit of works connected with the delta.
19	Constructing a boat ...	2,300	.....	This, though cancelled, was a sanction which ought not to have been given.	*Vide* remarks to No. 182, and if cancelled calls for no further remark.
22	Groynes in river bed between 19th and 20th miles.	13,130	April 1872	*Vide* remark against item No. 28 above.	See remarks against item No. 17 of Western Delta; works of this nature must be done on emergency if the river is even to be controlled after so much neglect and loss of time and means.
44	Purchasing four boats for work in connection with river margins.	1,400	Mar. 1873.	Do. do. No. 182 above...	Purchased to assist in the carrying and removal of stones above the groynes in the river so as to utilize the stone as much and as often as possible.
45	Constructing groynes along river bank, Polaram to Tullapudi.	4,630	.....	Do. do. No. 28 above ...	See remarks above; these works were required to save several villages and the whole of the Western Delta—see paragraph 6 of letter printed in G. O. of 13th October 1873, No. 2,502.
	WESTERN DELTA.				
	Minor New Works.				
7	Digging a channel from Vadengypalem.	520	.....	These are virtually one work, and it was not competent to the District Engineer to sanction them.	I do not think so; it is very necessary to afford the means of irrigation as soon as possible to save loss of time and revenue to Government as well as to improve the condition of the ryots
	Head-sluice and duct to ditto.	610			
13	Land compensation, Kakarapurru.	191	.....	The same amount which is here provided under Minor New Works was, in 1871-72, shown as expended from the repair grant.	In 1871-72 funds were given from "Repairs Agricultural," but the advance made to the Collector not having been disbursed in that year, a fresh advance was made in 1872-73, and funds were provided by Government in their Order, No. 829, dated 17th March 1873, from the grant for Minor New Works.
	Repairs.				
34	Compensation for land Siddantum.	298	.....	*Vide* latter part of remark above.	As the grant for Minor New Works cannot be made use of for works in the Eastern and Western Deltas, funds were provided under head "Repairs Agricultural."
51	Compensation for land Mulleswaram.	...	.....	For what purpose? The description is incomplete.	For planting lunka grass.
68	Groyne, limits of Khandavelly.	987	May 1872.	*Vide* remark against item No. 28 above.	In this office letter generally in G. O. of the 13th October 1873, No. 2,502.
80	Protecting bank at Kakarapurru.	450	.....	Do. do. ...	
97	No. 3 stone groyne at do.	460	.....		
98	Protecting bank at do.	360	.....		
119	Protective works at do.	2,320	March 1873.		

Memorandum of entries in the Progress Reports of the Delta Ranges for the years 1871-72, 1872-73, *etc.*—(Concluded.)

Items.	Description.	Amount of Estimate.	Date of Sanction.	Remarks by Chief Engineer for Irrigation.	Explanations of the District Engineer, Godavery.
	CENTRAL DELTA PROGRESS REPORT FOR MARCH 1873.	RS.			
	Original Works.				
2	Surveying salt creek ...	51	April 1872.	Description insufficient. Is this an agricultural work?	Between Goganamutum and Antranady. The survey was made under instructions from the Acting Chief Engineer for Irrigation.
	Repairs.				
3	Planting lunka grass, Vasista—Godavery.	2,056	.....	There should be some specification of locality.	At Ramachendrapur.
5	Constructing groynes, 38 and 39 miles, west bank, Godavery.	1,270	Feb. 1872.	*Vide* remark against item No. 28 above.	See this office letter in G. O. of the 13th October 1873, No. 2,502.
20	Constructing new river bank in the limits of Doddaram and Paserlapudi.	5,200	,, 1873.	It is doubtful whether it was competent to the District Engineer to sanction this work. The surveys on which the sanction was given should be submitted.	Most emergently required to save a large extent of land and cultivation.
*9	Connected with this are emergent* works to the embankments at these villages.	1,220	Sept. 1872.		
10	Prolonging new embankment.	196	,, ,,		
	EASTERN DELTA PROGRESS REPORT FOR SEPT. 1873.				
	Repairs.				
57	Ballasting in front of anicut.	2,510	,, 1873.	It is probable that had the instructions contained in Government Order, No 331, of the 3rd February 1871, been carried out, and the five groynes constructed, this ballasting might not have been required. All that has been done since the 1st January 1871 to the anicut and head-works and in the river bed within the limits of the charts should be clearly recorded on the charts which, with this information, should be sent to this office as soon as possible.	I do not think so; it is impossible to conjecture what the results of the groynes referred to might have been; my own opinion is that the proposed expedient is a most dangerous one, as these groynes are, 1st, to the face of the anicut along which a strong lateral current runs in the freshes and there is a diagonal set of the river towards this branch of the river, the groynes will then very likely create strong eddies between them and scour out the bed to the wells or perhaps below them. The ballasting as done by us is on the contrary immovable, lying in the bed of the river where the current is least and forming a compact covering to preserve the sand all about the wells.
	Ordinary Works.				
11	Constructing new embankment and channel near Bivamapury.	3,380	April 1873.	This appears to be the Bank canal, and if so should have been described as a new alignment of that canal from mile—chain —to mile—chain—. It is doubtful whether the works of this kind can be sanctioned locally.	Executed under great emergency—See this office letter in G. O. of the 13th October 1873, No. 2,502.
12	Making river groynes below Dowlaishweram and Bobberlunka anicut.	4,010	Aug. 1873.	Commenced in April 1873, *vide* remark against item No. 28 above.	See this office lette in G. O. of the 13th Oct. 1873, No. 2,502.
	Tools and Plant.				
5	Charges for shipping three river steamer boilers.	1,000	.....	The charge for one of these belongs to the Kistna Delta, on account of the *Pioneer* transferred to that district; an adjustment should be effected	Adjustments will be made in communication with the District Engineer, Kistna.
	WESTERN DELTA.				
	Repairs.				
10	Duct to carry water to Singaram fields over drain.	420	Mar. 1873.	Is not this a Minor New Work, and if so why was it charged to Repairs?	It is a work executed to save the existing lands from drainage.
	Ordinary.				
13	Constructing huts for Lock Lascars, Lock Superintendent, and Store-room, Gudicherla.	750	June ,,	Certainly not a repair work, and sanction with an allotment of funds should be applied for.	Sanction is requested to transfer it to the head "Minor New Works Ordinary Agricultural," for which no Capital or Revenue Account is kept.

PAULCOLE, *12th November* 1873.

(Signed) JOHN MULLINS, Lieut.-Colonel, R.E., *Chief Engineer for Irrigation.*

(Signed) J. F. FISCHER, Lieut.-Colonel, R.E. *District Engineer, Godavery.*

C

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Wooden deep boats.	FT. IN.	FT. IN.	C. TS.												
10	Wooden deep boats	48 8	12 8	18	November 1872.	...	...	40	...	...	...	...	3	2,800	140	Fourteen days worked; ten days delayed unloading, two days loading, four Sundays.
					December ,,	16	...	36	...	...	...	...	3	1,512	104	Eleven working days; four days delayed unloading, nine days delayed loading, one Sunday, six days worked at Cavetan for conveying stone.
					January 1873.	48	...	40	...	...	...	...	5	[illegible],168	126	
					February ,,	14	...	...	...	...	...	...	1	465	24	Three working days, two days delayed loading and unloading, twenty-one days conveying lime stone from Kantaire to Dowlaishweram.
					March ,,	32	...	...	...	...	...	...	2	83	104	Eleven working days; three days delayed loading and unloading, one and a half Sunday, fifteen and a half days conveying lime stone from Kantaire.
					April ,,	...	130	47	...	...	...	...	11	3,38[illegible]	68	
					May ,,	32	44	128	...	...	...	...	13	6,82[illegible]	80	
					June ,,	48	48	...	...	...	...	...	6	2,36[illegible]	124	Twenty-five days worked, and five days delayed on account of floods.
					July ,,	15	30	...	...	...	...	...	3	2,385	104	Five days worked for conveying fire-wood from wood-yard to lime kiln.
					August ,,	...	15	17	...	...	...	...	3	1,033	128	Twenty-three days worked, and eight days delayed on account of floods.
					September ,,	...	...	15	...	...	...	...	1	570	72	Fifteen and a half days delayed on account of floods.
					October ,,	14¼	...	31½	...	...	...	...	3	1,615	20	
22	Do. do. ...	83 5	14 8	35	November 1872.	26	...	83	...	...	...	...	3	3,317	12	Sixteen and a half days worked; seven and a half days delayed unloading, six days delayed loading.
					December ,,	...	...	54	...	...	...	...	2	3,780	140	Fifteen working days; five days delayed unloading, five and a half days delayed loading, three Sundays.
					January 1873.	60	...	73	...	...	...	...	4	3,356	152	
					February ,,	42	...	...	...	...	...	...	2	964	94	Ten working days; two days delayed loading and unloading, sixteen days conveying lime stone from Kantaire to Dowlaishweram lime kiln.
					March ,,	24	195	...	...	...	...	...	6	3,765	100	
					April ,,	...	243	68	...	...	...	...	9	4,956	60	
					May ,,	...	77	68	...	...	...	...	5	2,055	30	Nine days worked; ten days loading and unloading, and eight days conveying lime stone from Kantaire.
					June ,,	...	...	27	...	...	...	...	1	81	5	Unserviceable.
					July ,, / August ,, / September ,, / October ,,	...	...	...	...	...	...	...	...	...	...	
1	Do. do. ...	73 6	10 0	25	November 1872.	...	...	...	...	...	21	...	3	G. M. 787½	75	Eight working days; seven days delayed loading, and four days unloading.
					December ,,	...	...	77½	...	...	28	...	6	3,587	168	Seventeen working days; six and a half days unloading, seven and a half days delayed loading.
					January 1873.	...	...	30	...	18	...	...	3	1,483	120	
					February ,,	...	...	...	...	32	...	...	4	1,408	176	
					March ,,	...	...	...	...	14	14	...	4	980	140	
					April ,,	...	...	30	...	...	18½	...	3	523	70	
					May ,,	...	...	...	...	...	28½	...	5	1,033	136	
					June ,,	...	...	...	...	...	12	...	4	576	96	Only worked fifteen days; no work for fifteen days by having no indents.
					July ,,	...	...	...	...	...	...	...	...	...	...	No work, by having no indents.
					August ,,	...	...	24	...	13	...	...	3	1,492	190	Twenty working days; six days loading and unloading, two Sundays.
					September ,,	...	...	47	...	...	...	...	2	4,700	200	
7	Do. do. ...	73 0	11 9	35	October ,,	...	...	44	...	...	...	...	3	1,687½	150	Sixteen working days; eight days loading and unloading, seven days delayed on account of floods.
					November ,,	...	...	...	...	...	...	...	...	...	...	
					December ,,	...	...	...	...	...	...	...	...	...	...	
					January 1873.	...	...	...	...	...	...	...	...	...	...	
					February ,,	...	...	...	...	...	...	...	...	...	...	Fourteen days worked for conveying fire-wood from Gootala to Dowlaishweram; she was transferred on 14th February from Upper Godavery to Lower Godavery District.
					March ,,	...	...	...	...	...	...	...	...	...	...	Do. do. for whole month.
					April ,,	...	30	36	...	...	...	...	3	228	38	Eighteen days do. and twelve days worked for conveying stone, etc., to different places.
					May ,,	40	...	164	...	...	...	...	8	2[illegible]	[illegible]4	
					June ,,	22	...	...	...	...	20¼	...	4	[illegible]	78	Only worked thirteen days, and seventeen days no work by having no indents.
					July ,,	25	72	...	...	...	...	...	4	[illegible]	198	
					August ,,	...	...	39	...	...	...	...	2	3,[illegible]00	200	Thirty days worked; thirteen days delayed loading and unloading, eighteen days delayed on account of floods.
					September ,,	...	...	43¼	...	...	...	...	2	4,375	200	
					October ,,	...	...	21	...	...	...	...	1	1,050	100	
8	Do. do. ...	73 6	11 9	35	November 1872.	...	...	...	...	...	...	...	...	...	...	
					December ,,	...	...	...	...	...	...	...	...	...	...	
					January 1873.	...	...	...	...	...	...	...	...	...	...	
					February ,,	...	...	...	...	...	...	...	...	...	...	
					March ,,	51	...	...	...	...	...	...	2	1,224	48	Only worked fourteen days, and seventeen days under repair.
					April ,,	75	54	...	...	...	...	...	5	2,224	100	Eleven working days; sixteen days delayed loading and unloading, three Sundays.
					May ,,	...	...	510	...	...	...	...	8	3,091	86	
					June ,,	20	36	27½	...	...	14	...	5	1,415	120	
					July ,,	25	60	...	...	...	6	...	4	1,468	116	
					August ,,	...	...	48	...	...	...	...	3	2,162	178	
					September ,,	22	...	23	...	...	...	...	2	4,500	200	
					October ,,	23¼	...	25½	...	...	...	...	2	1,800	150	Sixteen working days; eight days delayed loading and unloading, five days delayed on account of floods, two days delayed at Vizasweram lock.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Months.	Tonnage.	Length.	Breadth.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Wooden deep boats.—(Concluded.)			ft. in.	ft. in.	c. ft.										
9	Wooden deep boats	November 1872.	...	73 0	11 9	25	...	...	...	...	...	...	...	...	...	Seven working days, conveying fire-wood from Tooraiyur to Dowlaishwaram, restriction Vide 7th January.
		December "	...	...	...	...	...	...	...	...	...	...	...	...	...	Whole month conveying lime stone from Kuntaire to Dowlaishwaram.
		January 1873.	...	...	...	...	...	...	...	...	...	...	...	...	...	Twenty-two days worked for conveying Groyne stone to anicut.
		February "	...	...	...	...	...	...	...	...	...	...	...	...	...	No work for having no indents.
		March "	...	...	...	...	...	...	...	...	...	...	...	...	...	
		April "	...	...	...	52	...	...	...	...	...	...	...	...	...	
		May "	...	19	23	44½	...	...	...	...	...	...	5	182	14	Twenty-eight working days: thirteen and a half days delayed loading and unloading, fifteen and a half days delayed loading, and one Sunday, twelve days under repairs.
		June "	...	26	...	...	...	...	...	...	...	...	4	1,524	62	
		July "	...	20	28	...	...	...	...	...	...	...	4	2,190	200	
		August "	...	...	...	41	...	...	...	...	...	...	3	4,190	162	
		September "	...	...	...	26½	...	...	...	...	...	...	1	964½	74	
		October "	...	...	...	...	...	...	...	...	...	...	8	1,612½	136	Fourteen working days; nine days delayed loading and unloading, seven days delayed on account of floods.
3	*Iron deep boats.*															
	Iron deep boats ...	80 0	10 6	25	November 1872.	75	...	...	...	...	...	...	3	2,808	75	Eight working days; five and a half days delayed unloading, four and a half days delayed loading, and one Sunday, twelve days under repairs.
		December "	...	...	...	...	...	...	...	...	...	...	1	236	42	Under repairs.
		January 1873.	...	...	...	45	...	...	...	...	...	...	...	...	...	Do.
		February "	...	...	...	...	...	...	...	...	...	...	...	...	...	
		March "	...	87	33	...	...	18	...	...	...	...	6	1,998	178	Only worked seven and a half days, under repairs twenty and a half days.
		April "	...	40	75	25	...	...	...	...	...	...	6	1,736	92	
		May "	...	41	...	184	...	...	...	...	...	...	10	4,342	80	
		June "	...	49	...	...	51	...	...	...	...	...	4	1,352	118	Eleven working days; five days loading and unloading, nine days conveying stone to Dowlaishwaram Anicut from Pichenel Inkah.
		July "	...	24	67	...	...	40½	...	...	...	...	4	3,401	200	
		August "	...	...	...	...	...	...	...	...	...	...	3	4,050	200	Twenty-eight working days; thirteen days loading and unloading, sixteen days delayed on account of floods, four Sundays.
		September "	...	20	...	...	...	...	...	...	...	...	1	720	72	
		October "	...	...	...	...	...	56½	...	...	...	...	3	3,195	220	

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron deep boats. —(Concluded.)	FT. IN.	FT. IN.	C. TS.												
	Iron deep boat ...	...	...	...	August 1873.	18	20	...	...	...	...	...	2	1,314	134	Fourteen working days; ten days delayed loading and unloading, seven days delayed on account of floods.
					September ,,	...	...	25	...	...	...	...	1	1,250	100	Eleven working days; three days delayed loading and unloading.
					October ,,	19½	...	19½	...	...	...	...	2	1,481	150	Fifteen working days; four days delayed loading and unloading, and twelve days worked at Magultoor for conveying stone.
13	Do. ...	93 3	9 3	25	November 1872.	83	...	...	...	...	...	...	3	1897	131	Thirteen working days, four days delayed unloading, eight days loading, five days worked at Kantaire.
					December ,,	54	...	...	...	...	...	...	3	1,114	72	Eight working days; eight days delayed loading and unloading, fifteen days conveying lime stone from Kantaire to Dowlaishweram.
					January 1873.											
					February ,,	...	...	...	...	...	...	...	...	...	...	Conveying lime stone from do. to do.
					March ,,											
					April ,,	...	47	...	...	...	...	...	2	370	16	Two working days; four and a half days delayed loading and unloading, and twenty-three and a half days worked at Kantaire.
					May ,,	...	...	20	...	..	20	...	6	652	138	Fourteen working days; twelve days delayed loading and unloading, five days worked at Kantaire.
					June ,,	20	45	28	...	...	...	...	4	1,106	87	Nine working days; seven days delayed loading, four days delayed unloading, five days worked at Anicut for conveying sand.
					July ,,	...	50	25	...	...	...	...	3	3,490	148	Fifteen working days; ten days delayed loading and unloading, two Sundays, three days delayed on account of floods.
					August ,,	...	25	44	...	...	...	...	3	1,564	228	Twenty-three working days; eight days delayed loading and unloading.
					September ,,	...	...	21½	...	...	...	...	1	795½	74	Eight working days; eight days delayed loading and unloading, and fourteen days delayed on account of floods.
					October ,,	22½	...	20½	...	...	...	...	2	1,444	136	Fourteen working days; eight days delayed loading and unloading, two Sundays, six and a half days delayed on account of floods.
	Iron flats.															
12	Iron flats ...	61 0	11 5	20	November 1872.	37	...	...	608	...	...	...	4	1,880	167	Seventeen working days; eight and a half days delayed unloading, four and a half days delayed loading.
					December ,,	...	...	...	620	...	...	...	5	1,224	136	Fourteen working days; twelve days delayed loading and unloading, four Sundays and holidays.
					January 1873.	...	...	...	632	...	...	...	4	1,286	165	Seventeen working days; ten days loading and unloading, four Sundays and holidays.
					February ,,	...	16	...	497¼	...	...	...	4	1,504	150	Sixteen working days; nine days delayed loading and unloading, three Sundays and holidays.
					March ,,	...	...	...	166¾	...	...	...	1	135	36	Four working days; three and a half days delayed loading and unloading, twenty three and a half days worked at Poorushotapatam groynes.
					April ,,	...	...	...	...	...	...	...	...	...	...	Whole month worked at do.
					May ,,	...	...	72	250¼	...	...	...	7	1,70	159	Sixteen working days; ten days delayed loading and unloading, five days worked at Kantaire for conveying rough-stone to Chettipett.
					June ,,	...	64	...	522¼	...	...	...	6	3,98	198	Nineteen working days; six days loa ding and unloading.
					July ,,	20	...	...	311	...	...	...	3	340	164	Seventeen working days; twelve days delayed loading and unloading, two Sundays.
					August ,,	16	20	...	192½	...	...	...	3	,744	201	Twenty-one working days; six days delayed loading and unloading, four days delayed on account of floods.
					September ,,	...	...	...	355½	...	...	...	2	1,625	200	Thirty-one working days; thirteen days delayed loading and unloading, and seventeen days delayed on account of floods.
					October ,,	...	...	...	159¼	...	...	...	1	950	100	
1	Do. ...	72 0	12 0	19	November 1872.	68	...	...	...	...	...	...	3	1,340	115	Twelve working days; fourteen and a half days delayed loading and unloading, three and a half Sundays.
					December ,,	62	...	...	...	...	...	...	4	3,348	154	Fifteen working days; four days delayed loading and unloading, twelve days conveying girder bridge to Tadapilligoodem.
					January 1873.	20	...	...	...	...	...	...	2	500	96	Twenty-five working days; ten days delayed loading and unloading, twenty-four days conveying materials of the girder bridge to Tadapilligoodem.
					February ,,	59	...	...	...	...	...	...	3	4,248	144	
					March ,,	51	18	...	...	...	...	...	4	3,825	212	Twenty-two working days; nine days delayed loading and unloading.
					April ,,	51	21	...	...	...	...	...	4	2,460	160	Seventeen working days; ten days delayed loading and unloading, three Sundays and holidays.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of kyroyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Total trips.	Bricks, number.	Sand, garces.	Lime, garces.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron flats—(Contd.)	FT. IN.	FT. IN.	C. Ts.												
	Iron flats ...	...	...	...	May 1873.	70	18	...	...	5	...	...	...	1,356	140	Fifteen working days; thirteen days loading and unloading, three Sundays.
					June ,,	...	...	71	197½	4	...	...	...	1,241	96	Ten working days; six days delayed loading and unloading, nine days worked at Dowlaishweram anicut for conveying sand.
					July ,,	18	36	...	...	3	...	...	...	3,822	194	Twenty working days; six days loading and unloading, four Sundays.
					August ,,	18	...	...	191½	3	...	...	...	101	156	Twenty-four working days; twelve days delayed loading and unloading,
					September ,,	...	...	...	...	1	...	...	...	66	74	twenty-five days delayed on account of floods and rains.
					October ,,	18	...	19½	...	2	...	...	...	1,10	124	Thirteen working days; eight days delayed loading unloading, three Sundays,
	Do.	72 0	12 0	19	April 1873.	16	...	...	...	1	...	...	...	54	63	Only worked six days; she was put up on 28th April 1873.
					May ,,	44	...	110	55½	7	...	...	...	2,938	68	Seven working days; eighteen days delayed loading and unloading, seven days delayed on account of floods.
					June ,,	42	44	...	...	4	...	...	...	1,450	80	Eight working days; eight days delayed loading and unloading, nine days worked at Dowlaishweram anicut for conveying sand.
					July ,,	20	24	...	...	2	...	...	...	1,420	13	Fifteen working days; six days delayed loading and unloading, three Sundays, and rain seven days last month's trip.
					August ,,	55	19	...	...	4	...	...	...	2,937	174	Eighteen working days; eleven days loading and unloading, two Sundays.
					September ,,	19½	...	...	...	1	...	...	...	721	74	Eight working days; three days loading and unloading, one and a half days delayed by the rain, seventeen and a half days stayed on account of floods.
					October ,,	87	...	...	...	2	...	...	...	1,177	124	Thirteen working days; nine days delayed loading and unloading, nine days delayed on account of floods and rain.
2	Do.	72 0	12 0	9	July ,,	18	...	...	...	4	...	...	...	1,062	102	She was put up on 6th July 1873.
					August ,,	88	...	...	...	4	...	...	...	2,116	224	

	Iron Punts.															
8	Iron Punts ...	60 0	10 2	12	September ,,	19	...	...	...	1	760	...	...	...	89	Nine working days; three days delayed loading and unloading, three Sundays, fifteen days delayed by the floods.
					October ,,	54	...	...	...	3	1,388	...	...	...	154	Sixteen working days; twelve days delayed loading and unloading, three days delayed by the floods.
					November 1872.	...	...	...	...	4	1,236	...	...	...	156	Sixteen working days; eleven days delayed loading and unloading, three days of last Month's trip.
					December ,,	12	12	...	...	4	1,176	...	...	...	156	Sixteen working days; ten days loading and unloading, five days worked at Madapad, etc.
					January 1873.	36	...	...	...	4	720	...	...	...	162	Sixteen working days; four days delayed loading and unloading, eight days conveying fire-wood to Narsapur, three Sundays and holidays.
					February ,,	24	...	...	...	7	876	...	...	1,300 and 12 c. yds. of brick jelly.	78	Six working days; ten days delayed loading and unloading, the rest of the days worked at dredge.
					March ,,	12	24	...	...	3	1,908	...	...	...	194	Twenty working days; nine days delayed loading and unloading, two Sundays.
					April ,,	...	12	...	...	5	2,052	...	...	...	202	Twenty working days; ten days louding and unloading.
					May ,,	26	...	...	...	3	390	...	...	...	36	Four working days; seven and a half days delayed loading and unloading, nineteen and a half days worked at anicut for conveying sand.
					June ,,	12	36	...	...	5	1,332	...	...	...	222	Fifteen working days; eleven and a half days delayed loading and unloading, three and a half days delayed by the floods
					July ,,	22	10	...	...	5	1,069	...	...	...	148	
										2	62	...	...	...	62	Only worked sixteen days, and fifteen days at dredge.
										1	44	...	...	...	25	Three working days; two days delayed loading and unloading, sixteen days conveying old rough stone from Papasweram to Cocanada, and nine days worked at dredge.
										3	131	...	...	...	100	Ten working days; four and a half days delayed loading and unloading, five and a half days delayed on account of floods, and eleven days worked at dredge.
										3	636	...	...	...	193	Eleven working days, four and a half days delayed unloading, three and a half days delayed loading, and eleven days worked at dredge.
										5	1,158	...	...	...	163	Seventeen working days; ten days loading and unloading, four Sundays and holidays.
										4	714	...	...	...	143	Fifteen working days; eleven days delayed loading and unloading, five days Sundays and holidays.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Punts.—(Continued.)	Ft. In.	Ft. In.	C. Rs.												
					February 1873.	...	...	...	...	...	...	...	...	...	...	Whole month worked at dredge.
					March ,,	...	...	...	...	...	...	...	...	...	...	Worked at Dowlaishweram and Bobberlanka anicuts.
					April ,,	...	...	...	...	...	...	...	...	...	...	
					May ,,	...	48	...	...	...	...	14,325	7	5½	36	Four working days; sixteen days delayed loading and unloading, the rest worked at anicut for conveying sand.
					June ,,	60	23	15	...	...	...	11 C. yds. brick jelly.	9		122	Twelve working days; thirteen days delayed loading and unloading.
					July ,,	23	12	...	...	...	...	...	3	1,006	170	Eighteen working days; six days delayed loading and unloading, six days delayed by the floods and rain.
					August ,,	...	10	...	...	...	...	...	1	280	56	Only worked thirteen days, and eighteen days at dredge.
					September ,,	...	...	24	...	...	...	...	2	1,152	100	Ten working days; two days delayed loading and unloading, nine days delayed by the floods, and nine days at dredge.
					October ,,	...	...	25¼	...	...	...	...	2	631	100	Ten working days; four days delayed loading and unloading, five and a half days delayed by the floods, the rest at dredge.
6	Iron Punts ...	60 0	10 2	12	November 1872.	60	...	...	...	...	...	...	5	1,525	204	Twenty-one working days; eight days loading and unloading, one Sunday.
					December ,,	24	...	...	...	...	...	...	2	864	72	Only worked fifteen days; under repairs sixteen days.
					January 1873.											
					February ,,											
					March ,,	...	...	...	...	...	...	...	...	...	...	Under repairs.
					April ,,											
					May ,,											
					June ,,	34	...	...	146¼	...	...	...	4	654	90	She was put up on 13th June 1873.
					July ,,	...	20	...	120	...	...	4,400	5	1,300	188	Nineteen working days; eleven days delayed loading and unloading, one Sunday.
					August ,,	10	...	...	116	...	...	...	3	696	128	Thirteen working days; ten days loading and unloading, eight days last month's trip.
					September ,,	10	...	...	108¼	...	...	...	2	682	122	Twenty-one working days; ten days delayed loading and unloading, twenty-eight days delayed by the floods, and two Sundays.
					October ,,	...	...	9½	113¼	...	...	...	2	444	74	
9	Do. ...	60 0	10 2	12	November ,,	23	...	...	...	...	...	...	2	336	61	Six and a half working days; four and a half days delayed loading and unloading, and six days conveying materials from workshop to Chintapilly, etc.
					December ,,	...	...	...	...	...	...	...	...	...	...	Under repairs.
					January 1873.	24	24	...	...	...	...	...	4	1,572	178	Eighteen working days; seven days delayed loading and unloading, three days under repairs.
					February ,,											
					March ,,	...	60	...	...	...	...	...	5	1,200	40	Four working days; eight days loading and unloading, nineteen days worked at Poorushotapatam groynes.
					April ,,	...	...	...	...	...	...	...	...	...	...	Whole month worked at do.
					May ,,	...	11	...	123¾	...	...	...	2	188	72	Three working days; four days loading and unloading, eight days worked at Vizasweram anicut for conveying stone from Vadapilly, and fifteen days do. at Poorushotapatam groynes.
					June ,,	24	...	...	...	...	...	...	2	1,200	100	Ten working days; eight days delayed loading and unloading, one Sunday, and six days conveying materials from workshop to Karapabode channel.
					July ,,	11½	...	15	147½	...	...	...	3	536	90	Ten working days; nine days loading and unloading, eleven days worked at Madapad lock.
					August ,,	...	36	...	159½	...	...	...	4	2,412	150	Sixteen working days; eight days delayed loading, one Sunday, four by the floods.
					September ,,	12	...	...	153	...	...	...	2		85	Nine working days; six days delayed loading and unloading, two Sundays, thirteen days conveying rough stone from Tapaswaram to Cocanada.
					October ,,	...	...	...	338¼	...	...	...	2	960	160	Sixteen working days; eleven days delayed loading and unloading, four days conveying teakwood planks from Rajahmundry to Yerrenepolem.
14	Do. ...	60 0	10 2	14	November 1872.	...	...	...	367½	...	...	16,600	5	711½	119	Twelve working days; twelve days loading and unloading, four days of last month's trip, two days employed on another work.
					December ,,	...	...	...	165¾	...	...	2,000	3	696	116	Twelve working days; seven days delayed loading and unloading, seven days employed on other works, three Sundays.
					January 1873.	44	...	...	261	...	...	...	5	1 150	125	Thirteen working days; eighteen days delayed loading and unloading.
					February ,,	43½	...	...	146¼	...	8	4,200	8	1,666	132	Thirteen and a half working days; twelve and a half days delayed loading and unloading, two Sundays.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Punts.—(Continued.)	FT. IN.	FT. IN.	C. TS.												
					March 1873.	...	12	...	...	...	...	13,800	5	2,192	142	Fifteen working days: thirteen and a half days delayed loading and unloading, two Sundays.
					April ,,	20	24	...	134	...	...	...	5	1,768	188	Nineteen working days; nine days delayed loading and unloading, two days fined.
					May ,,	10	12	...	...	...	...	...	3	[illegible]	108	Twelve working days: twelve days loading and [illegible] one Sunday, and six days worked at anicut for conveying sand.
					June ,,	34	12	...	56½	...	...	...	5	47	40	Five working days; eight days delayed loading and unloading, and seventeen days worked at anicut.
					July ,,	12	46	...	...	...	...	...	5	1,772	186	Eighteen working days; six days delayed loading and unloading, and six days delayed by the floods.
					August ,,	...	60	...	...	...	...	...	6	2,412	178	Eighteen working days; nine days delayed loading and unloading, two Sundays, and two days fined.
					September ,,	...	12	...	202½	...	...	...	2	504	85	Eight working days; eight days delayed loading and unloading, and thirteen days conveying rough stone from Tapaswaram to Cocanada, one day fined.
					October ,,	20	...	...	172½	...	...	...	3	1,090	19	Twenty working days, six days delayed loading and unloading, five days delayed by the floods.
15	Iron Punts ...	60 8	10 2	15	November 1872. December ,, January 1873.	...	...	...	...	...	...	...	...	...	...	Under repairs.
					February ,,	12	...	...	...	...	...	...	1	420	70	Only worked seven days; twenty-one days worked at Cocanada on different works.
					March ,,	12	12	...	205	...	...	...	4	936	128	Thirteen working days; ten days loading and unloading, five days last month's trip.
					April ,,	...	12	...	166½	...	...	...	2	240	40	Only worked ten days; the rest at anicut for conveying sand for cross bund.
					May ,,	12	...	...	197	...	...	...	3	708	118	Twelve working days; eight days delayed loading and unloading, seven and a half days conveying firewood for burning bricks at Hamagery, three and a half days fined.
					June ,,	36	...	...	...	...	...	2,000	4	720	120	Thirteen working days; ten days loading and unloading, two days of last month's trip.
					July ,,	...	10	...	...	...	...	...	1	310	62	Seven working days; three days loading and unloading, one Sunday, six days of last month's trip, thirteen days conveying cut stone from Tapaswaram to Cavetam lock.
					August ,,	8	...	...	138	...	...	...	2	472	102	Ten and a half working days; two days delayed loading and unloading, eighteen and a half days conveying boiler, etc., from Tapaswaram to workshop.
					September ,,	...	...	...	212½	...	...	...	1	144	25	Three working days; one day loading and unloading, sixteen days conveying rough-stone from Tapaswaram to Cocanada, the rest working at dredge.
					October ,,	...	10	...	115½	...	...	...	2	850	150	Sixteen working days; ten days loading and unloading, one Sunday, four days worked at Bobberlunka lock for conveying materials, etc.
16	Do. ...	60 0	10 2	12	November 1872.	48	...	...	...	...	...	...	4	2,230	190	Twenty-one working days; nine days delayed loading and unloading.
					December ,,	12	12	...	...	...	...	...	2	840	142	Fifteen working days; twelve days delayed loading and unloading, two Sundays and two holidays.
					January 1873.	12	22	...	72½	...	...	...	4	[illegible]54	199	Twenty working days; nine days loading and unloading, and two holidays.
					February ,,	12	24	...	...	...	...	...	3	[illegible]	180	Nineteen working days; eight days delayed loading and unloading, one holiday.
					March ,,	16	36	...	...	...	...	...	4	1,[illegible]88	206	Twenty-one working days; ten days delayed loading and unloading.
					April ,,	20	48	...	...	...	...	...	6	2,[illegible]28	168	Seventeen working days; thirteen days loading and unloading.
					May ,,	...	...	10	...	...	...	...	1	[illegible]10	62	Seven working days; five days delayed loading and unloading, [illegible]34 eighteen days conveying stone from Ramachendrapoor, etc., to different works in No. 2 Range.
					June ,,	84	34	...	...	...	...	...	10	2,914	160	Sixteen days worked; nine days delayed loading and unloading.
					July ,,	10	...	10	...	...	...	...	2	450	90	Ten working days; ten days loading and unloading, five days delayed by the floods, three Sundays, and three days fined.
					August ,,	...	60	...	...	...	...	...	5	4,068	174	Eighteen working days; eleven days delayed loading and unloading, two Sundays.

F

Statement showing the work done by Government Boats, from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Punts—(Continued.)	FT. IN.	FT. IN.	C. YS.												
					September 1873.	32	10	...	...	...	...	...	4	1,570	202	Twenty-one working days; nine days delayed loading and unloading.
					October ,,	20	...	...	...	...	...	...	2	1000	100	Eleven working days; eight days loading and unloading, twelve days delayed by the floods and rain.
17	Iron Punts ...	60 0	10 2	12	November 1872.	12	...	12	540½	...	...	...	5	212	130	Thirteen working days; fifteen and a half days delayed loading and unloading, one and a half days fined.
					December ,,	12	...	...	304	...	...	...	4	1,16[illegible]	144	Fifteen working days, twelve days delayed loading and unloading, two days conveying crane from Madapad to Workshop, two Sundays.
					January 1873.	22	...	...	183¼	...	...	...	4	1,076	142	Fifteen days worked; twelve days delayed loading and unloading, three holidays, and one Sunday.
					February ,,	12	...	...	...	...	...	...	1	144	24	Two working days; twenty-six days worked at dredge.
					March ,,	...	...	...	...	...	...	...	...	...	...	Whole month worked at dredge.
					April ,,	12	24	22	...	...	...	...	5	1,992	152	Fifteen working days; six days delayed loading and unloading, nine days worked for conveying sand at Dowlaishweram Anicut.
					May ,,	8	...	...	...	...	...	...	1	272	88	Eight working days; eight days delayed loading and unloading, fifteen days worked in No. 2 Range for conveying rough stone, etc., from Ramachendrapoor to different works.
					June ,,	36	24	...	163½	...	...	...	6	1,380	156	Fifteen working days; ten days loading and unloading.
					July ,,	...	12	...	...	...	...	...	1	480	80	Nine working days; two days delayed loading and unloading, fourteen days worked in Cocanada Canal for conveying mill stones, etc., from Tosepudi to Chintapelli lock and from Pootacondah to Covoor lock, and five days last month's trip.
					August ,,	48	...	...	...	...	...	...	4	1,418	168	Seventeen working days; nine days delayed loading and unloading, one Sunday, and four days fined.

					September ,,	...	...	23½	...	...	...	...	2	1,128	100	Ten working days; two days delayed loading and unloading, nine and a half days delayed on account of floods, the rest worked at dredge.
					October ,,	...	...	12	...	...	...	...	1	228	50	Five working days; three days loading and unloading, nine days delayed on account of floods, one Sunday, the rest worked at dredge.
19	Do. ...	60 0	10 2	12	November 1872.	38	...	...	113¼	...	...	...	4	1,210	140	Fourteen working days; thirteen days loading and unloading, two Sundays, one day fined.
					December ,,	12	12	...	...	...	...	...	2	852	142	Fifteen working days; eleven days delayed loading and unloading, three Sundays, two days last month's trip.
					January 1873.	34	...	...	201¼	...	...	...	5	1,228	216	Thirty-four working days; nineteen days delayed loading and unloading, six Sundays and holidays.
					February ,,	12	12	15	...	...	...	...	3	711	128	
					March ,,	16	36	...	70¼	...	...	...	5	1,036	166	Seventeen working days; thirteen days loading and unloading, one Sunday.
					April ,,	16	12	12	116½	...	...	...	4	624	104	Ten working days; five and a half days delayed loading and unloading, fourteen days worked on Cocanada Canal in different places.
					May ,,	...	...	...	...	...	...	54,000	15	1,368	166	Sixteen days worked; fifteen days delayed loading and unloading.
					June ,,	22	12	12	324½	...	...	...	6	1,239	208	Thirty-four working days; twenty days loading and unloading, four days delayed on account of rain, three Sundays.
					July ,,	...	22	...	...	...	...	...	2	1,364	124	
					August ,,	10	12	...	284¼	...	...	...	4	1[illegible]4	206	Twenty-one working days; ten days delayed loading and unloading.
					September ,,	20	...	...	...	...	...	...	2	[illegible]10	122	Twenty-four working days; ten days delayed loading and unloading, twenty-seven days delayed on account of floods.
					October ,,	...	...	...	318¾	...	...	...	2	684	114	
20	Do. ...	60 0	10 2	12	November 1872.	59	...	...	...	...	...	...	5	1,489	204	Twenty-one working days; eight days delayed loading and unloading, one day fined.
					December ,,	12	12	...	...	...	...	...	2	852	142	Fifteen working days; eleven days delayed loading and unloading, three Sundays and two holidays.
					January 1873.	12	24	...	...	...	...	...	3	1,716	4	Eighteen working days; seven and a half days loading and unloading, two Sundays, three holidays.
					February ,,	12	24	...	...	...	...	...	3	1,824	180	Nineteen working days; eight days delayed loading and unloading, one Sunday.
					March ,,	12	24	...	131	...	...	...	4	1,056	176	Seventeen working days; six days delayed loading and unloading, eight days conveying cut-stones, etc., from Perravely to Cavetum lock.

Statement showing the work done by Government Boats, from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Punts.—(Continued.)	FT. IN.	FT. IN.	C. YS.	April 1873.	...	36	24	307	...	...	...	6	768	76	Eight working days; ten days delayed loading and unloading, twelve days worked at Chintapilly lock on different works.
					May ,,	10	...	...	...	...	...	...	1	48	68	Seven working days; five days delayed loading and unloading, four days delayed working at Chintapilly lock on different works, and fifteen days conveying stone from Ramachendrapoor to different places.
					June ,,	24	34	...	...	...	...	...	5	1,506	118	Twelve working days; eleven days delayed loading and unloading, and one and a half Sunday.
					July ,,	26	23	...	...	...	...	8,000	6	1,268	166	Seventeen working days; twelve days delayed loading and unloading, one day fined.
					August ,,	...	60	...	...	...	...	...	5	4,068	174	Eighteen working days; twelve days delayed loading and unloading, one Sunday.
					September ,,	20	...	...	...	...	...	...	2	610	122	Twelve working days; two and a half days delayed loading and unloading, fifteen and a half days delayed on account of flood.
					October ,,	20	...	...	...	...	...	...	3	500	116	Twelve working days; eight days delayed loading and unloading, four days conveying rails from Dowlaishweram to Yerrampalam quarry, and seven days delayed on account of floods.
23	Iron Punts ...	60 0	10 2	12	November 1872.	53	...	...	129½	...	...	...	5	1,419	164	Seventeen working days; eleven and a half days loading and unloading, one and a half Sunday.
					December ,,	12	12	...	92½	...	...	...	4	846	181	Nineteen working days; eight days loading and unloading, four Sundays, and holidays.
					January ,,	12	24	...	...	...	...	...	3	1,188	198	Twenty working days; eight days delayed loading and unloading, three days leave.
					February ,,	21	12	...	...	...	...	...	3	3,069	186	Eighteen working days; eight days delayed loading and unloading, two Sundays and holidays.
					March ,,	36	24	...	106½	...	...	...	6	1,336	206	Thirty-seven working days; twenty-four days delayed loading and unloading.
					April ,,	21	12	...	278½	...	...	...	4	1,584	162	
					May ,,	8	...	10	...	...	...	...	2	588	130	Fourteen working days; seven days loading and unloading, ten days conveying rough stone from Ramachendrapoor to different places in No. 2 Range.
					June ,,	60	24	...	...	...	...	...	7	904	126	Twelve working days; thirteen days delayed loading and unloading.
					July ,,	...	58	...	...	...	...	...	5	1,772	180	Nineteen working days; ten days delayed loading and unloading, two Sundays.
					August ,,	...	48	...	...	...	...	...	4	2,412	138	Fifteen working days; twelve days delayed loading and unloading, two days delayed on account of rain, one Sunday, and one day fined.
					September ,,	30	...	...	...	...	...	...	3	1,440	170	Eighteen working days; nine days loading and unloading, two Sundays, one day fined.
					October ,,	30	...	...	...	...	...	...	3	2,250	150	Fifteen working days; six days loading and unloading, eleven days delayed on account of floods.
24	Do ...	60 0	10 2	12	November 1872.	59	...	...	...	...	...	...	5	1,441	204	Thirty-five working days; twenty-six days delayed loading and unloading.
					December ,,	12	12	...	...	...	...	...	2	852	142	
					January 1873.	10	24	...	...	...	...	...	3	1,654	174	Eighteen working days; nine days delayed loading and unloading, four Sundays and holidays.
					February ,,	25	12	...	...	...	...	...	3	3,760	192	Twenty working days; eight days delayed loading and unloading.
					March ,,	...	24	...	...	...	...	...	2	396	68	Seven working days; five days delayed loading and unloading, nineteen days worked at Poorushotapatam groynes for conveying stone.
					April ,,	...	...	...	...	...	...	...	...	...	...	Whole month conveying stone to Poorushotapatam groynes.
					May ,,	...	12	12	49	...	...	...	3	348	46	Five working days; ten days delayed loading and unloading, fifteen days conveying stone at Poorushotapatam groynes, and one day fined.
					June ,,	28	24	12	...	...	...	...	5	1,008	156	Fifteen working days; ten days delayed loading and unloading.
					July ,,	21	10	...	...	...	...	...	3	534	104	Eleven working days; twelve and a half days delayed loading and unloading, five days of last month's trip, one and a half days delayed by the rain.
					August ,,	34	48	...	...	...	...	...	7	3,036	242	Thirty-two working days; thirteen and a half days delayed loading and unloading, fifteen and a half days delayed on account of floods.
					September ,,	10	...	...	...	...	...	...	1	379	74	
					October ,,	...	...	...	...	...	...	...	...	...	...	Whole month conveying rails from Dowlaishweram to Yerrampolam for the use of quarry road.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Brick, numbers.	Total trips.	Cubic yards, Miles.	Miles travelled in a Month.	Remarks.
	Iron Punts.—(Continued.)	Ft. In.	Ft. In.	C. Ts.												
27	Iron Punts ...	60 0	10 2	12 0	November 1872.	53	...	...	...	...	...	4,000	5	1,449	169	Seventeen working days; thirteen days delayed loading and unloading.
					December ,,	12	12	...	137½	...	...	...	3	1,002	167	Seventeen working days; ten days delayed loading and unloading, three and a half Sundays and holidays.
					January 1873.	12	...	...	131½	...	...	...	3	672	202	Twenty-one working days; eight days delayed loading and unloading, two holidays.
					February ,,	12	24	...	...	...	...	...	3	1,728	176	Eighteen working days; ten days delayed loading and unloading.
					March ,,	12	...	...	145½	...	...	...	2	636	106	Ten working days; four days delayed loading and unloading, seventeen days conveying sand for cross bund of Dowlaishweram Anicut.
					April ,,	...	...	...	...	...	...	...	...	...	...	Whole month conveying stone from Petchacola lanka to Dowlaishweram anicut apron.
					May ,,	12	24	...	116	...	...	...	4	684	114	Twelve working days; eight days delayed loading and unloading, the rest conveying stone for anicut.
					June ,,	24	24	...	139	...	...	...	5	1,416	168	Sixteen working days; nine days delayed loading and unloading.
					July ,,	12	46	...	...	...	...	...	5	926	158	Fifteen working days; fifteen days loading and unloading.
					August ,,	...	48	...	...	...	...	...	4	1,992	176	Eighteen working days; nine days delayed loading and unloading, four days fined.
					September ,,	14½	...	...	277½	...	...	...	3	726	127	Thirteen working days; nine days delayed loading and unloading, four days conveying rough stone from Tapaswaram to Cocanada, two and a half Sundays, one and a half days fined.
					October ,,	25	...	...	76½	...	...	...	3	1,370	174	Seventeen working days; ten days delayed loading and unloading, four days delayed on account of floods.
28	Do. ...	60 0	10 2	12	November 1872.	...	...	...	...	...	...	...	...	...	...	Under repairs.
					December ,,	...	...	...	187	...	4	...	3	640	70	Sixteen days worked, and fifteen days under repairs.
					January 1873.	...	...	...	234	...	...	...	4	996	166	Seventeen working days; eleven days delayed loading and unloading, three holidays.
					February ,,	36	20	...	...	...	...	...	5	1,220	196	Nineteen working days; nine days delayed loading and unloading.
					March ,,	24	12	...	220	...	...	...	4	1,056	176	Eighteen working days; ten days delayed loading, three Sundays.
					April ,,	...	12	12	437½	...	...	...	5	1,092	182	Eighteen working days, twelve days delayed.
					May ,,	12	...	...	45	...	...	...	2	192	32	Four working days; two days delayed twenty-five days conveying rough-stone from Vadapilli to Vizasweram anicut.
					June ,,	24	12	...	153	...	...	...	4	936	144	Fifteen working days; ten days delayed loading and unloading.
					July ,,	12	12	...	183½	...	...	...	3	732	122	Thirteen working days; twelve days delayed, three Sundays, and two days delayed on account of rain.
					August ,,	20	22	...	...	...	...	...	4	846	168	Seventeen working days; nine days delayed loading and unloading, five days delayed on account of floods.
					September ,,	20	...	...	123½	...	...	...	3	754	146	Fifteen working days; eight days delayed loading and unloading, five days delayed on account of floods, and two Sundays.
					October ,,	...	...	...	291½	...	...	...	2	684	114	Twelve working days; seven days delayed loading and unloading, one holiday, ten days delayed on account of floods.
	Do. ...	60 0	10 2	12	November 1872.	36	...	...	255	...	...	...	5	1,119	135	Fourteen working days; fifteen days loading and unloading, one Sunday.
					December ,,	40	...	...	215½	...	...	...	5	1,190	175	Eighteen working days; eleven days loading and unloading, two Sundays.
					January 1873.	36	...	...	146	...	...	...	4	[illegible]	[illegible]	Sixteen working days; twelve days loading and unloading, three holidays.
32					February ,,	12	24	...	252½	...	...	...	5	2,004	202	Twenty do. eight do. do.
					March ,,	...	12	...	59½	...	...	...	2	324	56	Six do. six do. do. nineteen days conveying stone for Poorushotapatam groynes.
					April ,,	...	...	...	...	...	...	...	...	...	...	Whole month worked at Poorushotapatam groynes.
					May ,,	12	...	...	117½	...	...	...	2	600	100	Ten working days; six days delayed loading and unloading, fourteen days conveying stone for Poorushotapatam groynes, and one day fined.
					June ,,	36	24	...	...	...	...	...	5	1,104	184	Thirty-three working days; sixteen days delayed loading and unloading, five days delayed on account of floods, seven days worked on Cocanada canal for conveying stone, etc., for different works.
					July ,,	10	12	...	...	...	...	...	2	790	142	
					August ,,	...	32	...	135	...	...	...	4	2,136	146	Fifteen working days; ten days delayed loading and unloading, two Sundays, four days fined for delaying work.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length.	Breadth.	Tonnage.	Months	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Punts.—(Concluded.)	FT. IN.	FT. IN.	C. YS.												
					September 1873.	24	312½	...	...	...	...	...	4	1,512	252	
					October ,,	...	...	10½	150½	...	...	...	2	869	150	Forty days worked, fifteen days delayed loading and unloading, five days delayed on account of floods, and one day fined.
35	Iron Punts ...	60 0	10 2	12	November 1872.	12	...	...	158	...	...	...	2	390	65	
					December ,,	...	...	...	331	...	...	...	3	726	121	Seven working days, three days delayed loading and unloading, nineteen days conveying materials for Chintapolle, Madapad, Tosepudi, and Covoor locks, one day fined.
					January 1873.	...	12	...	367	...	...	...	3	840	140	Thirteen working days, twelve days delayed loading and unloading, three Sundays and two holidays, one day fined.
					February ,,	...	12	24	143½	...	...	...	4	1,368	144	Fifteen working days, eleven days loading and unloading, two Sundays and three holidays.
					March ,,	16	12	...	271½	...	...	...	4	2,349	168	Fifteen working days, thirteen days delayed loading and unloading.
					April ,,	16	12	12	...	...	...	...	3	204	34	Seventeen working days, eleven days delayed loading and unloading, three Sundays.
					May ,,	...	...	10	...	...	...	...	1	310	62	Three and a half working days, eight and a half days delayed loading and unloading, eighteen days conveying materials for different locks on Cocanada canal.
					June ,,	35	...	12	148	...	...	...	5	929	150	Seven working days, four days delayed loading and unloading, four days conveying materials for Madapad lock, etc., and sixteen days conveying stone from Ramachendrapur for different works in No. 2 Range.
					July ,,	...	10	...	136½	...	...	...	2	730	132	Fifteen working days, ten days delayed loading and unloading.
					August ,,	...	48	...	...	...	...	...	4	1,992	176	Thirteen working days, four days delayed loading and unloading, thirteen days conveying flooring stone from Kalairi to Cavetum lock.
																Eighteen working days, nine days delayed loading and unloading, four days fined.
					September ,,	33	...	...	140	...	...	...	3	840	145	Fifteen working days, eight days loading and unloading, two Sundays, and four days conveying rough stone from Tapaswaram to Cocanada, one day fined.
					October ,,	10	...	...	112½	...	...	...	2	1,044	180	Eighteen working days, six days delayed loading and unloading, seven days delayed on account of floods.
37	Do. ...	60 0	10 2	12	November 1872.	12	...	...	120	...	...	20,000	7	2,646	209	
					December ,,	...	...	...	318	...	...	4,000	4	1,008	118	Twelve working days, thirteen days loading and unloading, six days of last month's trip.
					January 1873.	40	...	...	53½	...	...	...	4	999	115	Twelve working days, two days delayed loading and unloading, seventeen days conveying stone, etc., in different places of Cocanada canal.
					February ,,	24	24	...	444	...	...	...	5	1,368	180	Eighteen working days, nine days delayed loading and unloading, one Sunday.
					March ,,	36	...	...	112	...	...	7,000	5	3,836	180	Eighteen working days, thirteen days delayed loading and unloading.
					April ,,	22	...	...	260½	...	...	...	4	1,012	180	Eighteen working days, eleven and a half days delayed loading and unloading.
					May ,,	22	...	...	...	...	...	...	2	568	100	Ten working days, six days delayed loading and unloading, sixteen days conveying stone, etc., for different works on Cocanada canal.
					June ,,	12	12	...	132½	...	...	...	3	348	46	Five working days, four days loading and unloading, sixteen days worked for conveying lunkah grass from Bobberlunka to Yanam embankment.
					July ,,	...	...	...	...	...	...	...	...	...	...	Whole month worked for do.
					August ,,	40	...	...	...	...	...	...	4	1,720	200	Twenty working days, eleven days loading and unloading.
					September ,,	...	...	...	183½	...	...	...	1	[illegible]	[illegible]	Twenty-two working days, twelve days delayed loading and unloading, four Sundays, twenty-two days delayed on account of floods and rain.
					October ,,	...	...	...	253	...	...	...	2	[illegible]	[illegible]	Fifteen working days, thirteen days delayed loading and unloading, one Sunday, and one day fined.
38	Do. ...	60 0	10 2	12	November 1872.	52	...	...	...	...	...	...	4	[illegible]	[illegible]	Thirteen working days; fifteen days delayed loading and unloading, three Sundays and holidays.
					December ,,	...	12	...	606¼	...	...	...	3	714	119	Twenty working days, eight days delayed loading and unloading, three holidays.
					January 1873.	12	24	...	...	...	...	...	3	1,188	198	Eighteen working days, ten days loading and unloading.
					February ,,	12	36	...	...	...	...	...	4	1,740	178	Seven do. do. five and a half do. do., eight and a half days conveying sand for Dowlaisweram Anicut.
					March ,,	...	...	...	131¾	...	...	...	1	360	60	Nine working days, five days delayed loading and unloading, and sixteen days conveying sand for Vizaswaram Anicut cross bund.
					April ,,	14¾	...	10	...	...	...	12 Cubic yards brick jelly.	3	505½	90	

H

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Continued.)

Number of Boats.	Description.	Length. Ft. In.	Breadth. Ft. In.	Tonnage. C. ts.	Months.	Quantity of building stone, cubic yards.	Quantity of groyne stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, Barrels.	Sand, Barrels.	Bricks, number.	Total trips.	Cubic Yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Sea Punts.															Under repairs.
40	Iron Sea Punts ...	50 0	13 0	15	From May to Oct.	...	...	...	...	...	...	...	4	1,069	201	Twenty-four working days, thirteen days delayed loading and unloading, two Sundays, from 10th December 1872 up to October employed at Coconada for harbour dredging.
					November 1872.	72							1	283	36	
					December ,,	16										
42	Do. ...	50 0	13 0	15	November ,,		46						2	954	106	Eleven working days, eleven days delayed loading and unloading from 23rd November 1872 up to October 1873, employed for do.
														633	100	
43	Do. ...	50 0	13 0	15	,,		16						2	954	106	Eleven working days, twelve days delayed loading and unloading, one Sunday, for the rest no work on account of having no indents.
44	Do ...	50 0	13 0	15	,,	...	...	...	...	...	...	...	4	633	100	
					December ,,								1	50	25	Five days worked, from 6th December up to October, employed on harbour dredge work.
													4	633	100	
													1	50	25	Same as above past.
													1	150	25	
45	Do. ...	60 0	13 0	15	November ,,	...	...	...	...	...	...	...	2	675	50	Four working days, three days delayed loading and unloading, the rest no work for having no indents.
					December ,,											
																Six working days, eight days delayed loading and unloading, the rest do.
E	Barge Boat ...	...	...	40	January 1873.	...	...	...	...	...	...	...	...	...	...	
																Twenty-one days conveying wagon wheels, etc., from Dowlaiswaram quarry to Bezwara, the rest remaining at Bezwara.
					February ,,	...	...	...	...	...	...	...	...	...	...	Eight days conveying fire-wood from Goolaie to Dowlaiswaram, twenty days remaining at Bezwara for having no work.
					March ,,	...	...	...	...	...	...	...	...	...	...	Whole month conveying fire-wood from Goolaie to Dowlaiswaram.
					April ,,	...	...	...	...	...	...	...	...	...	...	Twelve and a half days do., the rest no work for having no indents.

Proceedings of the Madras Government, Public Works Department,
15th July 1874.

	Iron Sea Punts.															
40	Iron Sea Punts ...	50 0	13 0	15	From May to Oct.	...	...	...	...	...	...	...	4	1,069	201	Fourteen working days, fourteen days delayed loading and unloading, two Sundays.
					November 1872.	72							1	283	36	
					December ,,	16										
42	Do. ...	50 0	13 0	15	November ,,		46						2	954	106	Eleven working days, nine days loading and unloading, the rest no work for having no indents.
														633	100	
43	Do. ...	50 0	13 0	15	,,		16						2	954	106	Fourteen and a half days worked for conveying materials from Dowlaiswaram Workshop to Neelapilly, the rest no work.
44	Do ...	50 0	13 0	15	,,	...	...	...	...	...	...	...	4	633	100	
					December ,,								1	50	25	Sold by auction.
													4	633	100	Whole month worked at Bobbarlanka for planting lanka grass.
													1	150	25	
45	Do. ...	60 0	13 0	15	November ,,	...	...	...	...	...	...	...	2	675	50	No work by having no indents.
					December ,,											Only worked six days, the rest do.
																Transferred to No. 3 Range.
E	Barge Boat ...	...	...	40	January 1873.	...	...	...	...	...	...	...	...	...	...	Sixteen working days, thirteen days delayed loading and unloading, one day fined.
																Seventeen working days, fourteen days delayed loading and unloading.
					February ,,	...	...	...	...	...	...	...	...	...	...	Sixteen do. do. thirteen do. do., two holidays.
																Twelve do. do. fifteen days do. one do.
					March ,,	...	...	...	...	...	...	...	...	...	...	Fifteen do. do. seven and a half days do. do. eight and a half days worked at Tapaswaram on different works.
					April ,,	...	...	...	...	...	...	...	...	...	...	Sixteen working days, fourteen days delayed loading and unloading.
					May ,,	...	...	...	...	...	...	...	...	...	...	Eighteen do. do. thirteen do.
					June ,,	...	...	...	...	...	...	...	...	...	...	Fourteen do. do. eleven do.
					July ,,	...	...	...	...	...	...	...	...	...	...	Only worked thirteen days, for the rest no work having no indents.
					August ,,	...	...	...	...	...	...	...	...	...	...	Fined the whole month on account of the chunam unloaded as a less measure.
					September ,,	...	...	...	...	...	...	...	...	...	...	Only worked twelve days, the rest there was no work by having no indents.
					October ,,	...	...	...	...	...	...	...	...	...	...	Fourteen working days, thirteen days delayed loading and unloadings four days having no work.
31	Do ...	35 3	8 5	10	November 1872.	...	...	...	...	...	...	...	...	...	...	Fourteen working days, sixteen days delayed loading and unloading.
					December ,,	...	...	...	...	...	...	...	...	...	...	Thirteen do. do. seven do. do., the rest having no work.
33	Do. ...	35 3	8 5	10	January 1873.	...	...	...	...	...	...	...	...	...	...	Transferred to No. 2 Range.
					November 1872.	...	...	...	...	...	...	...	...	...	...	Twelve working days, eighteen days loading and unloading.
					December ,,	...	...	...	...	...	...	...	...	...	...	Ten do. do., fourteen do. do., three Sundays, four days fined.
					January 1873.	...	...	...	...	...	...	...	...	...	...	Sixteen do. do., twelve do. do., three holidays.
					February ,,	...	...	...	...	...	...	...	...	...	...	Twenty do. do. eight do.

Statement showing the work done by Government Boats from 1st November 1872 up to end of October 1873.—(Concluded.)

Number of Boats.	Description.	Months.	Tonnage.	Length.	Breadth.	Quantity of building stone, cubic yards.	Quantity of ground stone, cubic yards.	Quantity of concrete, cubic yards.	Quantity of Cyclopean stone, square feet.	Lime, garces.	Sand, garces.	Bricks, number.	Total trips.	Cubic yards, miles.	Miles travelled in a Month.	Remarks.
	Iron Boats.— (Concluded.)		Ts.	Ft.	Ft.	C. Ts.										
		March 1873								7	2			817	172	Eighteen working days, eleven days loading and unloading, two Sundays.
		April ,,								60 45						
		May ,,								12 24						Nineteen do. do., ten do. do., one do.
		June ,,								14			5	9	218	
		July ,,								2	2		4	16	191	Nineteen working days, six days detained loading and unloading.
		August ,,								3						Fifteen do. do., eight days do. do., eight days to work by having no indents.
		September ,,								24			1	99	66	Used the whole month for caulmen unloaded as a loss measure.
		October ,,								3 10			1	71	62	Only worked ten days, the rest no work by having no indents.
24	Iron deep boats ...	November 1872. ,,	25	4	8	5	10						7	6781	129	Transferred to No. 3 Range.
		December ,,								3	10		6	3781	126	Sixteen working days, fifteen days loading and unloading.
		January 1873. ,,								12			4	4571	152	Sixteen do. do., twelve do. do. three holidays.
		February ,,								14	2		6	907	142	Fourteen do. do., thirteen and a half do. do., half day fined.
		March ,,								11	4		4	378	126	Twenty do. do., eleven do. do.
		April ,,								8 20			4	113	82	Eight and a half do. do., fifteen do. do. six and a half days there is no work.
		May ,,								14 45			7	363	264	Seventeen do. do., fourteen do. do.
		June ,,								62	4		5	105	216	Twenty-nine do. do., nine do. do., the rest there is no work by not having indents.
		July ,,								3			1	99	66	
		August ,,								24						
		September ,,											1	77½	62	No work by do. do.
		October ,,								3	6		4	316	152	Only worked eight and a half days, the rest there is no work.
		November 1873. ,,								6	6		5	364	161	Transferred to No. 3 Range.
		December ,,								6			6	556	181	Sixteen working days, thirteen days detained loading and unloading.
		January ,,								18						Seventeen working do., twelve do. do., two Sundays.
																Eighteen do. do., ten do. do., one do.

DOWLAISHWERAM,
13th January 1874.

(Signed) J. F. ESCHER, Lieut.-Colonel, R.E.,
District Engineer, Godavery.

No. 298. ORDER THEREON, 15th July 1874, No. 1,906.

IRRIGATION, No. .

THE Memorandum by the Chief Engineer for Irrigation contains a large amount of information on the Godavery Delta, and his remarks [illegible] receive the early and careful attention of the District Engineer.

2. The Government [illegible] learnt with regret that the instructions given for the systematic record of all [illegible] done in the river near the anicut have not been carried out. Without any [illegible]ctions the necessity for such a record should have been obvious, and the omi[illegible], during the past three years, to note down every operation, having for its ob[illegible]he protection or regulation of the channels of the river, is highly unsatisfacto[illegible]

3. Lists of plant at D[illegible]elavaram or elsewhere which may be in excess of the requirements of the delta, or unsuited to the work to be done there, should be prepared by the District Engineer and transmitted to the Chief Engineer, Public Works Department, who will issue such orders for its disposal as may appear advisable. The remarks of the Chief Engineer for Irrigation on the condition of the quarry and other plat require early attention, and arrangements for keeping the railways and rolling stock in efficient working order should at once be made. As in the case of the floating plant far too little care has hitherto been taken of appliances, much of the value of which is altogether lost from their being allowed to fall out of repair.

4. The importance of the concrete and cement experiments, for which funds were provided so far back as April 1871, has evidently not been recognized. To be of practical use it was requisite that the determination of proper mixtures of cementing material should be arrived at as soon as possible, and thereafter that the manufacture of concrete blocks, and the supply of hydraulic cement for the numerous masonry works to be constructed in the delta, should be undertaken. The Government agree with the Chief Engineer for Irrigation in considering that, even without the services of an officer for this special investigation, much more might have been accomplished than has been done.

5. An estimate for a machine-shop will be awaited, and the Government will be prepared to afford all needful facilities for the performance in a satisfactory manner of the large amount of work to be done in the workshops.

6. The modification of the charges for the hire of the river steamers shown to be necessary three years ago should certainly have been carried out, and the rates suggested in paragraph 12 of Lieutenant-Colonel Mullins' memorandum are approved, and will be at once introduced. Should from any causes these rates be found hereafter to be inadequate, they must be revised, and the charges to be made for other steamers which may at any time be added to the floating plant of the delta will be calculated in the same manner, and will be reported to the Chief Engineer for Irrigation for confirmation.

7. Sanction for six additional dredge-punts will be given as soon as the requisite estimates have been submitted and approved; it is observed that funds under

Extraordinary for plant are provided in the Budget. The purchase of wooden boats for special work will also be sanctioned on the submission of proper information as to the work to be done, etc.

8. The Government notice with grave dissatisfaction the District Engineer's proceedings with regard to the Vellah north side channel and Yennamaduloo channel dividing dam. The evasion of orders h[illegible]iting local sanction was highly reprehensible.

Memorandum, paragraph 27.

9. The instructions of the Chief Engineer for Irrigation prohibiting the renting of canal banks and berms for grazing are approved. It is of the first importance that the [illegible] should be maintained in a state of complete efficiency, and the amount of the receipts of miscellaneous revenue is comparatively unimportant. Probably also after [illegible] time the grass s[illegible] will realize nearly as much as the grazing. The provision of a sufficient n[illegible] cattle crossings is a matter requiring immediate attention in the interests both of the canal and of the villagers, and the District Engineer will see that no unnecessary delay is permitted to occur.

10. The Government consider that the drainage of the delta is of the greatest importance, and they desire the District Engineer's special attention thereto. The instructions given in the Memorandum of the Chief Engineer for Irrigation will enable the ultimate dimensions of the several main drains to be fixed with sufficient accuracy, and all needful enlargements should thereafter be carried out promptly. The secondary drains must also be made to keep pace with the main drains, and year by year what has been accomplished both as regards work and results should be shown in the Administration Report. The delay which has occurred in commencing the Takee, one of the principal drains of the Eastern Delta, is much to be regretted, and this work must now be pushed forward with all possible rapidity, so that the condition of the country, which it is to relieve, may be materially improved at an early date.

11. The remarks contained in paragraph 38 of the Memorandum under notice, regarding the way in which the rivers in the delta should be dealt with, have the full approval of Government. Without in any way drawing conclusions as to details, it is abundantly evident that destructive sets, which are intimately connected and interdependent, cannot properly be dealt with separately, and as if no such relation existed; and that without charts and a very accurate record of work done and of its effects, with a careful study of the changes which have taken place in late years with their probable causes, there can be no certainty of obtaining an adequate return from outlay. Lieutenant-Colonel Fischer's conduct in connection with this subject has already been noticed in the undermentioned orders:—

G. O., No. 11, dated 14th Oct. 1872.
" " 1,862, " 22nd July 1873.
" " 2,502, " 13th Oct. "
" " 1,262, " 11th May 1874.

12. Paragraph 46 of the Memorandum.—Plans and estimates for the erection of offices for the Executive and Assistant Engineers have been approved in separate Proceedings.

13. The Government notice with much pleasure the highly favourable testimony borne by the Chief Engineer for Irrigation to the efficiency of Mr. Walch, the officer in charge of the Western Delta. Lieutenant A. R. F. Dorward's care and attention to his duties are also very satisfactory.

14. The proposals contained in paragraph 66 of the Memorandum, regarding the disposal of abandoned boats or waifs and strays, are approved.

15. In paragraph 67 of his Memorandum, the Chief Engineer for Irrigation reports that having noticed certain instances of unauthorized expenditure, the Progress Reports were examined and numerous cases of outlay without due authority, and of the improper diversion of funds from the purposes for which they were intended were discovered, and he submits a statement of the various items with the grounds of objection, and Lieutenant-Colonel Fischer's replies. From this it appears that irregular action has not been confined to river defences, of which notice has already been taken, to additions to floating plant, the construction of a range boat for personal use, and many works which were altogether beyond the District Engineer's competence to sanction, have not only been undertaken, but have been provided for out of the Agricultural Repair grant, without regard to the purposes for which that grant is made available. District Engineers are responsible officers invested with considerable powers, and the Government must look to them primarily to obey and enforce the rules of the department, to attend to instructions of the Chief Engineers and other superior officers, and to perform their duty in a manner consistent with the known wishes and intentions of Government.

16. His Excellency the Governor in Council observes that it is impossible in an order of Government to notice all the points of executive detail, etc., to which Lieutenant-Colonel Mullins has directed attention in this admirable record of a very thorough and important inspection. The Governor in Council accepts in general his observations and the instructions he has issued, and desires that they receive the attention of the District and Executive Officers.

17. The thanks of Government are due to Lieutenant-Colonel Mullins for his valuable report.

(True Extract.)

E. C. Shunker Colonel, R.E.,
Secretary to overnment.

To the District Engineer, Godavery.
,, Chief Engineer for Irrigation.
,, Revenue Department.
,, Officiating Controller of Public Works Accounts.

Exd. E. C. Shunker.

2 Spare Copies will follow for Mr. [illegible]

No. 2419
Revenue 18th. Dept.

Govt. of {1874} Madras.

PUBLIC WORKS.

To

THE DISTRICT ENGINEER, GODAVERY,

&c., &c., &c.

Dated July 15th.

Recd. " 21st

Encl.

G., O., 15th July 1874, No. 1,906.

JULY

Nos. 295-296

Godavery Delta Works.—Passing orders on Notes by the Chief Engineer for Irrigation on the Godavery Delta Works in connection with a tour of inspection made in October and November 1873.

No. 185 Communicated to the Board of Revenue.

21 July 74.