Archives 1—10,000—6-10-76.

(1) Number of pages 28.

(2) Date of repair 9.7.86.

(3) Initials of the Referencer

# TAMIL NADU ARCHIVES

## GOVERNMENT OF TAMIL NADU

Revenue. DEPARTMENT

G.O. No. 967 Press.
B.R. No. Mis.

Dated 12-3-1879 197

***Not to be folded or roughly handled***

# INDEX TO NOTES OF INSPECTION.

*Godavari—December* 1877, *January and February* 1878.


| | Paras |
|---|---|
| Quarries and Quarry Railway | 2 |
| Workshops | 2-A |
| General Plan of Head Works | 3 |
| Wharf at Creek | 4 |
| Burnt Clay (Surki) Factory | 5 |
| Concrete Blocks | 6 |
| Morgan's Cement | 7 |
| Boat Repairs | 8 |
| Ferry Boats | 9 |
| River above Anicut | 10 |
| Shoals above Vijeshwaram Anicut. | |
| Bobberlunka Head. | |
| Anicut | 11 |
| Dowlaishvaram Branch. | |
| Do. Under-sluices. | |
| Do. do. Apron. | |
| Pitchikilunka Head. | |
| Ralli Branch. | |
| Bobberlunka Under-sluices. | |
| Muddur do. | |
| Vijeshwaram Branch. | |
| Eastern Delta—Main Canal | 12 |
| Do. —Samulcotta Canal | 13 |
| Do. —Cocanada do. | 14 |
| Do. —Notice and Distance Boards at Locks | 15 |
| Do. —Coringa Canal | 16 |
| Do. —Bank do. | 17 |
| Do. — Do. do. Irrigation | 18 |
| Do. —Takee Drain | 19 |
| Floating Plant | 20 |
| Lock, Lock Weir, and Sluice Gear | 21 |
| Central Delta—Main Canal | 22 |
| Do. —Ramachendrapur Set | 23 |
| Do. —Gopalpuram Drainage Sluice, River Bank | 24 |
| Do. —Gunnaram Canal | 25 |
| Do. —Gorinkala Drain | 26 |
| Do. —Reason of Termination of Tour | 27 |
| Do. —Executive Sub-Divisions | 28 |
| Western Delta—Main Canal | 29 |
| Do. —Kakarapurru Canal | 30 |
| Do. —Bank Canal | 31 |
| Do. —Kaza Drain | 32 |
| Do. —Bhoopiah Channel | 33 |
| Do. —Nursapur Canal | 34 |
| Do. —Gostanaddi and Velpur Canal | 35 |
| Do. —Attili Canal | 36 |
| Do. —Undi do. | 37 |
| Do. —Junction Canal | 38 |
| Do. —Venkiah and Weyeru Canal | 39 |
| Do. —Ellore Canal | 40 |
| Do. —Chettipett Station (Headquarters) | 41 |
| Do. —Cattle Pounds | 42 |

| | Paras |
|---|---|
| General—Plantations ... ... ... ... ... ... ... ... ... ... | 43 |
| Do. —Trees near Masonry Works ... ... ... ... ... ... ... | 44 |
| Do. —Nanel Plantations ... ... ... ... ... ... ... ... | 45 |
| Do. —Revetments at Bifurcations of Canals ... ... ... ... ... ... | 46 |
| Do. —Drainage of Canal Banks, Berms and Tow-paths ... ... ... ... | 47 |
| Do. —Supersession of Palmyra Sprouts ... ... ... ... ... ... | 48 |
| Do. —Boundaries of Canal Lands ... ... ... ... ... ... | 49 |
| Do. —Ferries ... ... ... ... ... ... ... ... ... | 50 |
| Do. —Conference with Collector ... ... ... ... ... ... | 51 |
| Do. —Upper Godavari ... ... ... ... ... ... ... ... | 52 |
| Do. —Plant at Dumagudiem Workshops ... ... ... ... ... ... | 53 |
| Do. —Anicut and Head Works ... ... ... ... ... ... ... | 54 |
| Do. —Short Canal ... ... ... ... ... ... ... ... | 55 |
| Do. —New Dumagudiem ... ... ... ... ... ... ... ... | 56 |
| Do. —Boat Canal to Bhadrachalam ... ... ... ... ... ... ... | 57 |
| Do. —Irrigation from the Sewry or Sabary ... ... ... ... ... ... | 58 |
| Do. —Irrigation in Bhadrachalam and Rekapalli ... ... ... ... ... | 59 |
| Do. —Five and Ten-ton Cranes ... ... ... ... ... ... ... | 60 |


No. 356 T.

## MEMORANDUM.

THE following notes of inspection of a [tour] in the Godavari Delta made in December 1877 and January and February 187[8] are submitted for the information of Government. The delay in writing out these [notes] has been occasioned by press of work.

2. QUARRIES AND QUARRY RAILWAY.—The [quarries] are being worked in various directions, and there appears to be an abundance [of] good stone. On the stock account there is much small material of which the value [is] doubtful, and it is considered that it will be better to treat such very small stone [for] the future as of no value in determining the cost of quarrying building stone, [be]cause it has unavoidably to be taken out in getting the good stone, and it is useless ex[cept] for certain purposes, such as for concrete and ballasting, while for these descript[ions] of work there is no steady or reliable demand. The proper and full cost of [quarrying] has, it is believed, been under-estimated, because from the receipts the [railway] should be maintained in good order, and this important work has not been suffi[ciently] attended to. Quarry rubbish including concrete stone should then be kept out [of] the stock account, but when sales are effected the receipts should be credited to th[e] quarries, and may eventually allow of an adjustment of the price of building stone. It is of great importance that the quarries should always have money in hand [to] maintain all the special plant in thoroughly efficient condition.

*The Railway* has been much improved, but [is] not yet in as good order as it should be, partly from the laying of the permanent-wa[y] being imperfect, and possibly also from the absence of that constant attention wh[ich] is essential. The sleepers are in places too far apart; the fang nails are probabl[y] too short; there is some very light bridge rail which is injurious to the rolling stock [and] should be removed and replaced by foot rails. Some labor should be constantly employed in keeping the ballast in order and repacking the sleepers. There is r[oom] for improvement in the railway system. There should be a permanent single l[ine] common to all the quarries with branches to all the principal places where stone is quarried. A good survey is essential to enable the several branches to be laid ou[t] in the most convenient and economical manner. Hitherto the system has not been pr[erly] systematized.

*Locomotives.*—There are three locomotives [which] were sent down from the Upper Godavari. One is ready for work, and the oth[er two] have not been set up. It is said that the Wullur Rajah has offered to buy one, a[nd] as there is apparently little chance of work for three engines being found here or elsewhere, it will be advisable to sell one or perhaps two of them.

2-A. The machine shop has proved to b[e a] great convenience, and it enables work to be turned out much more rapidly. A [traveller] to place heavy articles on the machine tools is much required, and it will be [necessary] to raise the walls and roof about six feet to allow of a traveller being employed. It is much to be regretted that this requirement was not foreseen.

Workshops.

*Truck Wheels.*—Some require to be put in the lathe and returned; others should be broken up for castings.

3. GENERAL PLAN OF HEAD WORKS, &c.—A good general plan is much required. There are the charts of the river near the [anicut], and there have been numerous small surveys made from time to time for [special] purposes, but without a general plan good detailed arrangements cannot be [secured]. The Revenue Survey maps on the 16 inches to the mile scale will be useful [and] save out-door work, and probably 8 inches to the mile will be a convenient scale [for] the general plan.

4. WHARF AT CREEK.—The creek behind the pagoda hill has always deep water, and a line of rail from the quarries runs down to its bank. The arrangements for

loading punts here are rude and not co
wall to facilitate the loading of punt
slope the wharf wall from 6 feet to 4
level track of the railway at 9 feet abo
higher than 6 feet above crest level, a
limited.

5. Burnt Clay (Surkhi) Facto
alongside the main canal, Eastern Del
from the bed of the river, is burnt in
driven by a steam engine. The qu
fairly fine, and its cost is 4 Annas the
feet. There is clay in the Delta, e.
Delta, which would probably give bet
be tested. The cost of bringing good

6. Concrete Blocks.—The co
There are a few made in 1873 which
clay will evidently not bear much di
kind of clay better results would be

7. General Morgan's Cement.
sills, setting shutter grooves, and for
course special care should be taken to

8. Boat Repairs.—These are
where space is available and conside
simple slips or slideways which do n
the labor of getting the punts in and
slideways consist of pairs of long pl
on the under-surface and convex on t
on the under and flat on the uppe
lubricator, and the arrangement an
together by iron straps attached to th

9. Ferry Boats.—A great nun
time. Many of them though new
rings or other proper fastenings for ro
The style of construction is not at
will not get much looking after. Th
workshops for the Collector at the ti
maintained out of the canal and ferry
into use without further delay.

10. River above Anicut.—Th
growing for several years past, and b
ram branch of the anicut, have interf
to affect very prejudicially the supp
branch and the head of the Western
The left flank of this part of the anicut
the north end of this island there has
which water has reached by a some
Beyond this channel is the great Vadd
as 12 feet above the anicut crest, whil
steadily towards the west bank of the
direct approach to the anicut. From
Vadapilly a shoal which has always

* Below anicut crest level.

between it and the northern end of th

There has been much considerati
ing the direct approach to the Vijes
desirable to try the effect of creating
freshes by substituting for the pres

nvenient, and it is proposed to construct a quay
s. Probably the best arrangement will be to
feet above anicut crest level, and to place the
e crest. The river is seldom for long together
d when such is the case the traffic is necessarily

RY.—Burnt clay for hydraulic mortar is prepared
ta, near the dry dock. The clay, which is silt
ude kilns, and is then ground in a mortar mill
lity of the clay is doubtful. The powder is
parah of 4,000 cubic inches equal to 2·315 cubic
., about 8 miles from the head of the Central
er results and various descriptions of clay should
clay from a distance would be trifling.

ncrete blocks have not generally proved good.
are good, but the mixture of lime and burnt
ution with sand. Probably with a more suitable
obtained.

—This cement should be tried for pointing lock
similar work requiring a strong cement, and of
ascertain the best way of treating it.

for the most part executed near the dry dock
able facilities are to be found. There are some
n appear to be used in the manner intended, and
out of the canal is consequently enhanced. The
nks, of which those laid on the ground are flat
he upper, the other plank of the pair is concave
surface. Semi-liquid greasy silt makes a good
swers well. The ground planks are fastened
eir sides and connected by cross bolts.

ber have been lying in the main canal for a long
re far from being serviceable. There are no
es which are consequently tied to the hand rails.
ill suited to boats which ought not to need and
e boats were built either by contract or at the
ne when it was supposed that ferries would be
nds. They should be made efficient and brought

shoals in the river on the west side have been
ve diminished the discharge over the Vijeshwa-
ered with the navigation, and have threatened
ly of the Western Delta. The Vijeshwaram
Delta lie out of the direct course of the river.
abuts on the Muddur lunka (island), and across
been for some time past a deep channel through
what circuitous route the Vijeshwaram anicut.
vani island and shoal parts of which are as much
e the lower and western part has been extending
river, thus blinding or obstructing greatly the
the western bank of the river also opposite
r for many years been in existence has grown
southwards and eastwards until but a very
small and shallow channel* was left
e Vaddivani shoal.

on and discussion as to the best way of restor-
waram branch of the anicut, and it seemed
much stronger draught to this branch in low
ent masonry crest for a considerable length of





perhaps 1,000 feet a set of sluices having shutters capable of being closed or opened as might be necessary. To this end inquiries were made as to the form and details of similar shutters in use at the Orissa and Sone weirs in Bengal, but there being a well-founded reluctance to recommend the introduction of such sluices which would be costly both to construct and maintain, and it being impracticable to carry out the work, if sanctioned during the working season of the early part of 1878, it was resolved to endeavour to bring about the desired results by bunding across the gap between the Muddur and Vaddivani lunkas and by cutting a large channel through the Vadapilly shoal. These latter works were therefore started as soon as the level of the river would permit, and have made good progress. The gap has been closed

15th January.

to 12 feet below water surface, but as the
passed through this channel it could not be
irrigation season now close at hand. The si
is under crop, and the bank will be thrown
embankment on the Vaddivani lunka is well
17 feet above anicut crest level, and its heigl
about 42 feet. The stability of the bank
precaution has been taken to ensure its
Vadapilly shoal the higher parts or to abo
excavation is being done by wuddurs. Four
is enough water to float them, and it is expe
to complete the channel.

pply of the Western Delta has to be
ompleted until after the close of the
for the bund on the Muddur island
s soon as the crop has been cut. The
lvanced. The top of the bank will be
t the deeper part of the gap will be
of very great importance, and every
ding. At the channel through the
1½ feet below anicut crest level the
am dredges are at work, where there
d that it will take nearly five months

In order to increase the discharge ove
desirable to raise the crests of the Muddur
half of the Dowlaishvaram anicut with planks
effect of this will, it is hoped, be to materially increase the current and discharge on the western side of the river and to expedite the desired washing away of the shoals. In high freshes the water level would not be raised more than between 2 and 3 inches.

the Vijeshwaram branch it will be
and Ralli anicuts and of the eastern
to a height of about 9 inches. The

*Dredges.*—The machinery and gear are in much better order than was the case when they were inspected four years ago, and the results in outturn of work appeared to be satisfactory.

*Bobberlunka Head.*—The work done for the establishment of this head, which extends for about ¾ of a mile from the head sluices of the Central Delta Main Canal, and for the alignment of its west face which is the east side of the approach to the Muddur anicut, has been quite successful, and the improvement effected is striking. The approach from the head to the head sluices, &c., is now very good.

There is now a good navigation channel to the north of the shoal opposite the workshops, a much safer and more convenient route than that to the south of this shoal, which was alone available a few years since. The alteration has been the natural result of the action of the freshes.

11. Anicut—*Dowlaishvaram Branch.*—T ere are several places near the east end where the apron at the foot of the masonry slope has been disturbed. In repairing this apron all small stone should be rejected and large stone should be packed with its greatest length vertical, and the next greatest dimension parallel to the anicut; the interstices should be well packed with small stone and grouted.

Under-sluices.—One vent has been fitted with Captain Brockman's shutters and gear. The gear is movable and fits into a socket in a cast-iron beam to which latter the lower shutters when raised is attached by hooks. The two shutters slide in parallel V grooves and the screw engages by a hook to a T head on the lower shutter. On the bottom edge of the lower shutter are two iron projections (fids) which engage with the upper shutter and bring the latter up. For lowering there are hinged dogs attached to the upper edge of the lower shutter, and these are intended to engage the upper shutter and to make it follow the lower shutter. The gear works extremely well for raising the shutters and the upper shutter during the trial followed the lower shutter without hitch, but the action of the dogs is uncertain, and a modification of this part of the arrangement is necessary. Several substitutes

suggested themselves and were discussed with Mr. Walch, and there being no doubt of the suitability of the design generally to under-sluices circumstanced as are these with a roadway submerged during the freshes, an estimate for fitting the rest of the vents with similar shutters will be prepared.

The hook at the lower end of the screw spear is or was an oval with an opening on one side removed to admit the T head. It was found difficult to get hold of the T under water, and so the opening was enlarged considerably, but without maintaining the curvature of the bearing surfaces. This was a mistake, and induced the slipping of the hook more especially when lowering the shutters. The curvature should be restored, and there is fortunately spare metal on the upper side which can be cut away.

Under-sluice Apron.—The apro m the drop at the first retaining wall to the third wall has failed, and has been sc l out to a depth at one point of as much as 12 feet. The apron was of rubble, r small, and not well packed, and it was grouted and covered in with a thi er of concrete for a width of 18 feet. The distance from the drop to the second r aining wall is 45 feet, thence to the third wall 35 feet, and thence to the fourth wall feet. The part between the first and second walls should be restored with 2 feet rubble masonry bedded on concrete, the top surface being finished off with concre

The retaining walls should be re l, and the rest of the apron where damaged repacked with dry stone. The dry st wall on the east side of the apron should be extended to the line of piling in re d from its present terminus it should be splayed outwards (eastwards), and th rried parallel to the axis of the sluices.

Pitchikilunka Head.—This isl on which the right flank of the Dowlaishvaram anicut rests will, when the small channel through its north-western part is closed, which will now probably be soon effected by natal planting, be of nearly the right form. The exact form desired was laid down some years ago on a survey prepared by Captain Brockman.

Ralli Branch.—The rough stone has been but little disturbed. It is rather remarkable that the small stone at the west end should be so stable. At the east end there is rather large stone between the first and second retaining walls at the foot of the slope, and some of these stones have been picked out by the water. The natal plantations on the left bank below this anicut have been much injured by cattle. The only effective remedy is to take up a strip of land, make a fencing parallel to the river, which fencing would be of aloe and permanent, and to make one or two crossings for cattle to reach the river, with to these crossings temporary fencings to be renewed and maintained by the Conservancy Establishment. Then cattle found in the plantation should be sent to the pound. At the Bobberlunka head also there have been many cattle in the plantations, and for this the Lock Superintendent is to blame. It is said that the cattle belong to the Conservancy Establishment, and if so the owners should be punished.

Bobberlunka under-sluices.—It is proposed to fit these sluices with shutters to be worked by Mr. Larminie's hydrau traveller. The platform is at present on an incline, but the wall in rear is horizo and above flood level, so the platform for the traveller can be placed at any desire evel. The aprons have stood fairly, and the lowered apron beyond the cut stone apron has answered so far the intended purpose of reducing the action upon it.

Muddur Branch.—The apron below the curved fall has been disturbed to a slight extent in a few places. The repairs should be carried out as directed in the case of the Dowlaishvaram branch. There is a deep hole in the river bed below this branch, and it was at one time a cause of so e anxiety. For the security of the anicut the apron was extended, the hole was pa tially filled in, and its north face pitched with stone. The work has stood well, and the hole has silted up to a slight extent. The cause of the hole is no doubt the mee ing of cross currents, and it is hoped that the rectification of the alignment of the west face of Bobberlunka may in time effect a permanent improvement. All possible causes of the cross currents should be watched and as far as possible got rid of.

A good deal of natal planting is r quired on the left bank below this anicut. Some has been done this year.



Vijeshwaram Branch.—The repairs will be light. The bed of the river below the anicut is in a satisfactory state.

Under-sluices.—The aprons have not been at all disturbed this year. Some distance down the sluice channel which is separated from the river by an island of considerable width a dry stone dam was put up about seven years ago to check scour and increase the depth of water on the sluice floor. It has had a good effect. This dam is not shown on the chart of 1877, and it should be noted on all the charts from 1871. The vent of the sluice which has been fitted with Mr. Larminie's shutters and traveller was inspected. The gear works well, and is on the whole effective, but there is a great deal to be done in working it. It is applicable only to under-sluices at which the vents are either shut or fully open.

12. Eastern Delta Main Canal—*Head Sluice.*—The gear for working the shutters is of two kinds, both designed by Captain Brockman. In that which is on the whole the best and fully efficient the shutters are in three parts sliding in parallel V grooves and are worked by three independent screws. In the other the shutter is in two parts, and as at the under-sluices worked by one screw. There is nothing in the design to prevent this arrangement working with certainty, but the execution of the design is, as regards the gear for lowering the upper shutter, faulty; one of the dogs was found to be immovable. The journals of the dogs should work very easily; the length of the counterpoise lever should be increased, and care must be taken that the inclined rebates at the lower part of the upper shutter are sufficiently wide. The clearance between the two shutters is hardly sufficient.

13. Samulcotta Canal—*Surplus Weir at head of Biccavole Drain.*—The three bays of the bridge have been converted into six openings by means of cast-iron H posts, and the shutters are now worked by screw gear of Captain Brockman's design. The arrangement allows of the screw being lifted within the pipe, and as the screw has to rise somewhat above the parapet of the bridge and considerably above the girders which carry the gear there is a collar piece (double) on the pipe at girder level and an iron stay from the parapet to the pipe: this stay might with advantage be stronger. The top of the pipe has a collar and the usual square head for the spanner. The gear works well and is well adapted to the special circumstances.

Head Sluice of No. 4 Distributary.—The design is appropriate, but the masonry is not as good as it should be, and is decidedly inferior to recent work elsewhere. The copings are not at all well set, and nearly all the joints are open and must be pointed if the stones be not taken up and reset. The filling in of the earthwork has not been properly tamped. There is much weeping through the masonry—an indication of indifferent work or the need of puddle behind the walls. The gear is carried by a cast-iron bar, and this material is less suitable than wood at detached works. Several similar bars have been broken apparently dropping stones upon them. The screw is pivoted on the sill and the shutter r upon it; this is an arrangement which should not be adopted in future unless f circumstances specially suggest it.

Samulcotta Double Lock.—The side c rt gear at the mid sill should be replaced by some much faster arrangemen Double purchase rack and pinion gear or spears with rollers and lever bars res g on good fulcrums will be much better. The loss of time at present is a great nuisance. The upper culvert shutter is worked by a lever and is fairly efficient. The lower valves are in the gates: two in each gate. The lock establishments should be provided with the means of clearing silt from the gate recesses and should be required to open the gates fully every time the lock is used. It was only with great difficulty that the "Little Nell" was got through the lower gates of the *Cocanada Lock* owing to the gates not being capable of being sent home into the recesses.

The enamelled iron gauge has been fastened to the metre post of the right lower gate, and some of the enamel has been knocked off by boats. It should be placed where it will be out of reach of passing boats. These gauges are not affected by salt water and are most serviceable.

New cut below Cocanada Lock.—The lock channel has hitherto tailed into the Yelleru, and as this river brings down a great deal of silt the navigation is subjected to frequent delays. A short cut to carry the navigation into the main creek was in

progress and was well advanced. The curves are rather sharp, and an improved alignment could have been secured by making the junction with the creek a little lower down.

14. Cocanada Canal—*Medapad Lock.*—The screws of the lower gate valves are not easy to work, and the gates get much shaken. Each screw takes two men, and with rack and pinion gear the valves might be opened in half the time and with half the number of men. The screws of this and other similar locks should all be transferred to regulating works and rack and pinion gear substituted.

The cast-iron frames carrying the rack and pinion gear of the upper side culvert gates are of good design. Care should be taken that the gear is sufficiently powerful, and the levers of adequate length; then the arrangement will be both economical and effective. At the—

*Thossipudi Lock* it took 40 seconds to open the right upper culvert gate, and 95 seconds to raise the left culvert gate.

*Chintapilly Lock.*—Some of the stone has weathered a good deal. The masonry needs pointing. The bridge over the drainage which enters the canal just below this lock is the best masonry work on the canal, and with plain copings to the wings it would be all that is desirable as regards style and finish.

*Covur Lock.*—The filling of the lock takes much more than the three minutes prescribed as the maximum, and here as elsewhere the culverts are too small owing to their having been contracted in the lower part.

The masonry of the locks on this canal is decidedly inferior, and in constructing them several specific instructions were disregarded with loss of convenience and efficiency.

*Distribution Sluices.*—Many of the sluices on this canal are not at all satisfactory works, and some such are now sluices.

There are now excellent examples in the delta of almost all descriptions of masonry works, and none that are unsuitable or badly built will in future be allowed to remain.

15. Names and Distance Boards at Locks.—These have been ordered, but none were to be seen. They should be put up without delay, the notice boards at the locks and the distance boards at the points between which and the locks boats are not allowed to be moved.

16. Cocanada Canal.—This canal was not inspected on this occasion below the Head Lock (Alumur)

*Tatipaka Weir.*—This weir is for the discharge of surplus from the Bank and Coringa Canals and is a creditable work. The gear is not of the most convenient pattern. The flow of water below is quiet.

*Alumur Head Sluices.*—Good with the exception of the gear and the absence of a coping.

*Lock Weir.*—A fine work and well built with the exception of the cushion floor which is not so good as it should be and the heavy fall has picked out some of the stones. The floor is laid on a S curve and the stones were bedded on rubble instead of concrete. The width also is too confined, and the fall strikes on the sloping part of the apron. It was decided to fill in the lower part of the cushion with 15 inches of concrete.

17. Bank Canal.—The new head has been well laid out, but the spoil has not been arranged as it should have been to form regular tow-paths behind which clearances could have been placed. This should be attended to and the waste ground utilized for fuel plantations.

A short distance below the head a stone dam has been placed to diminish the discharge; there having it is said been a mistake of some inches in the levels of the first reach and the great capacity of the old weir channel course in the 2nd and 3rd tallies, into which the canal was turned when it was remodelled to place it at a greater distance from the river, has practically added materially to the fall in the upper tallies. It is not quite certain that any beyond trifling alteration of the works will be necessary to secure the required water surface level, and instructions were given to ascertain what level must be maintained at the first lock to keep normal water level at 1 mile below the head.



The canal in the first reach is in very fair order.

The cattle crossings have been carefully made and are in good order, the gravel laid down having stood well, but the post and rail fences are useless as the rails are single and so high that small cattle can pass under them. The cattle have damaged the banks for a considerable distance on either side.

*Chopella Lock.*—A well built and altogether very creditable work. Should it be necessary to raise the lock walls, the coping will be removed and replaced. The gear of the culvert gates is carried by frames of the same pattern as those in use at the locks on the Cocanada canal, but there is only one pinion, and the general impression is that it is better to have the double purchase. The levers of the lower culvert gates require lengthening about 9 inches for both convenience and power. These lower valves were opened in 15 seconds. The bridge over the tail bay has iron girders and an iron railing which is some inches too high for the parapets at the ends. There is considerable leakage at the upper gates which is probably due to the gates requiring slight shortening. There are no wooden sill bars, and their omission after the instructions which have been given is blameworthy.

*Lock Weir.*—A very good work, and the water flows from it very quietly. The gear is not good, the cast-iron beams being inferior to wood in all respects, and the fixed screws being difficult to work and objectionable.

The bridge is neat and light. The height of this work is certainly sufficient, and if the sill be too low the shutter can be made somewhat higher, or a bar can be fixed on the sill. The flow of water from the cushion below the weir is remarkably quiet, and the arrangements are decidedly good

The only work which should be done at once is to run a bank 3 feet higher than the top of the lock chamber walls and parallel thereto from where the left bank of the canal terminates to the bridge approach. There will then be no risk from a high water level.

Kowlaishvaram Lock, 16th Mile.—There is a great deal of leakage at the lower gates. The gear of the culvert gates is all single rack and pinion and the levers are too short. The upper culverts were opened in 37 seconds and the lock filled in 1 minute 55 seconds. The lower culverts took 40 seconds to open and the lock emptied in 100 seconds. The water stood at 6·17 on upper and at 4·92 on lower sill.

Lock Weir.—Two bays of 10 feet each with the shutter gear under the roadway. In order to get at the gear for cleaning and oiling one or two of the roadway planks should be made movable and should be secured by Ts. The rough edges of the planking are a disfigurement to an otherwise carefully built work, and they should be cut to an even edge and finished off with a longitudinal string or ribbon piece. The arrangement of the water cushion which has a S curve is good, the water flowing away quietly with a moderate current.

Kula Lock, 21 Miles.—The single purchase gear of the lower culvert gates is too weak, one set has been damaged and the other broken. The water gauges should not project beyond the face of the walls. The gates need caulking. The left bank a little above and at head of weir channel should be levelled and brought to section.

Lock Weir.—This has two bays and a water cushion with a S curve to the floor. The banks below show that there has been but little waste and that the arrangements are in this respect good.

Kotapilli Road Bridge, 26th Mile.—This has a single span and is without tow-paths which are however to be added. The masonry of the abutments is very unsightly. The side girders are deeper in the middle than at the ends, and there is a light central T iron which is supported by struts resting on the lower flanges of the side girders with ties between the flanges. The arrangement is good. The side rail on the lower side has been much damaged and clearly wilfully. The top rail was too slight.

Earthworks from Kotapilli Bridge to 29½ Miles.—There has been some waste of earthwork here, first in order to bring the canal to section and to confine the water to its proper area a right bank inside the old bank has been formed, and this where the river bank is near should have been only 8 inches above F.S.L., whereas it has been made as high as the left bank; second the margin of the left bank above F.S.L. is greater than was necessary; 2½ feet would have been proper.

Judging from the uneven levels of the top of the bank it would seem that the new earthwork was not tamped.

There should have been special sections for the varying circumstances of this part of the canal.

Muskapilli Set.—This is an oil set to stop which stone groynes were put up a good many years ago. The condition of the river bank has not altered much in the last six or seven years, but the canal is now very close to the river, and as the wash of the water was eating away the soil between the groynes, Mr. Walch is putting in a small bank of stone and will make a runel facing above this. These improvements will it is hoped make the canal quite safe.

Muskapilli Lock, 30th Mile.—The concrete foundations were being put in, the soil is good, and extremely little water has been met with. The lock weir has not been commenced.

Pillunka Set.—The river runs here between a large island and the main land, and through this island a channel ran which caused severe action on the river bank. To stop this a groyne was put up several years ago at the suggestion of the undersigned, but it has not done any good, but the closure of the channel through the island promises to accomplish what was desired, viz., the establishment of the current parallel to the axis of the river. The current entering at the head of this island is cutting away the river bank considerably owing to the obliquity of its course to the river axis, and this obliquity is on the increase. Nanel will not grow below H.W.L. (tidal), but it grows very well above that level. There is not as regards the canal any danger at this point.

Extension of the Canal to the Coringa River.—The direct extension would carry the canal through Yanam which is French territory, and the French authorities are ostensibly not anxious that this line should be taken while there are many reasons which make it desirable to keep clear of foreign territory. The information required to allow of a line for the canal being definitely settled was not complete, and to admit of a conclusion being arrived at it is dearly necessary to have a detailed survey of the country from the river to the Takee drain estuary and from the Muskapilli lock to the French boundary, and to show thereon the present drains and distributing channels so as to interfere as little as possible with these. The French boundary has been surveyed. The Revenue Survey maps should be made as much use of as practicable.

There is apparently nothing to prevent a good line being selected which would enter the Coringa river just north of French territory. As early as possible a settlement should be arrived at.

18. Bank Canal Irrigation.—There has been so far no material development of irrigation under this canal, though the area has considerably increased in the Eastern Delta generally. When the estimates were framed in 1870-71 it was the opinion of the late Mr. Sage that much irrigation was not to be expected, but Major Fischer held a different view. It is perhaps early yet to arrive at a conclusion, but so far the demand for water has been small notwithstanding the impetus given by the famine.

19. Takee Drain.—This relieves the country between the Coringa and bank canals. The artificial drain ends at the lower end of the Injeram canal, but will have to be carried a little further. This part of the country was formerly* very badly drained, and after even moderately heavy rainfall the inundations used to be extensive, there being only a small tortuous creek for many miles. The enlarged drain has not been cut to the full dimensions provided for in the estimate, as it is considered desirable to proceed tentatively and ascertain practically what capacity will be sufficient. The sections of the work done show that the bed was not taken out to a completely regular slope, but the inequalities may have been corrected by the action of the water as the flow is regular. At the time of inspection there was no drainage water but only canal surplus flowing down. This sufficed to afford easy down stream navigation. The drain is generally in very good order. In places there are shoals caused by fallen trees and brushwood which should be removed, and all trees likely to fall in should be cut down.

* *Vide* Inspection Notes 1873.



There is a gauge just above the Kotapilli road bridge on which the water level reads 4·17, and the water was 6·33 feet below the underside of the bridge girder. In 1873 when the inundations was extensive the water was 1·17 below the girder. The highest water mark of this season is about two feet above present W.L. and the highest visible on the gauge three feet.

The improvements end at the tail of the Injeram canal and must be carried forward until the stream affords adequate capacity. At the same time the creek should be straightened as much as may be possible. The water gauge at Kurupudi reads 4·66 and that at end of Injeram canal 4·58 feet.

It appearing from a survey of the creek from the junction of the Injeram canal that four or five miles of the creek could be superseded and the drainage much improved by a cut about one mile in length. The ground which the cut would traverse was therefore gone over, and it was found that the survey was radically wrong, and that no idea of the circumstances could be obtained from it. Afterwards the creek was traversed by boat. The survey should be revised and the improvements required laid out and estimated for. Probably the existing sanction though ending at the Injeram canal will more than suffice for all that is needed.

Injeram Canal—*Surplus Weir.*—The excavations were partly done but the design needs revision. The bed of the channel below the weir and consequently the top of the rear retaining wall should not be higher than the normal bed level of the Takee drain, and foundations five or six feet below this level will probably suffice. It is not quite clear that the site of the weir has been fixed after due consideration of the ultimate alignment of the left bank of the Takee, and this point should be attended to and was mentioned to Mr. Walch.

Some mile coolies should be employed on the drain to keep it clear of obstructions by removing brushwood, weeds, bulrushes, &c., and to look after the Tooma trees which grow freely, and will with proper management more than pay for the maintenance of the drain.

20. Floating Plant—*Trap Punt No.* 12.—This which was in use at the river work was found when empty to draw one foot of water and when loaded with sand flush with the deck to have only 11½ inches of free board which is too little for river work, the draught being there. The skin plates are too thick, and the slopes at ends of well too flat. This class of punt is very useful especially when loamy clay is being dredged, and it will be desirable to have several more punts, but they must be altogether lighter and more capacious. This punt needed caulking so prevent water washing into the interior.

21. Lock, Lock Weir, and Sluice Gear.—The design and arrangements of much of the gear introduced since the delta was last visited are not altogether good and convenient or are susceptible of improvement. For lock culvert gates the gear should be of ample power and capable of lifting the gates rapidly. The Cuttack pattern of double purchase rack and pinion gear is excellent and should be used for the gates of lower culverts when the difference of water level is considerable. It is however somewhat expensive, and Captain Brockman's cast-iron gear frame with double purchase, well proportioned toothed wheels and sufficiently long levers is considerably cheaper, and will answer very well for moderate lifts.

For weirs and sluices fixed screws pivoted on the sills are objectionable as they catch straw, brushwood, and other floating materials, and it is difficult to keep the screws clean. When for special reasons such screws are used the pipe fixed to the shutter is the best way of arranging the female screw.

All gear should be so placed as to be readily accessible for cleaning; consequently the plan of placing the gear under the roadway of bridges should not be repeated, but

the line of the shutters should be outside the roadway, and there should be a proper platform for the lascars to stand on.

All gear found in any way defective should be modified without delay as may be necessary. Often alterations very easily effected, as when levers are too short, are all that will be requisite.

The levers for working screws, pinions, &c., should be of a form which will reduce cross strain as much as possible. Generally the levers should have four arms and the ends of the arms should be turned up at right angles; they can then be conveniently worked, and the power is applied with full leverage.

22. Central Delta Main Canal—*Head Lock.*—The chamber walls are low, but the roadway of the bridge is much higher, and if this is or be made sufficiently above F.L. there will be no risk. The lower gates are to be replaced, but the present balance beams are very good and should be retained.

*Head Sluice.*—With the new gates, for which gear has been prepared, the regulation will be made all that is required. The left wing revetments should be carried to the nose between the canal and the lock channel.

The depth of water was 4·50 feet at the head and somewhat greater than the full supply depth at the lower end, the water being held up at the lock weirs.

*Rolli Lock.*—Gunnaram canal.

*Lolla Lock.*—Bank canal.

The gates are worn out and rotten, and they will with difficulty be kept going until the new locks are built.

*Rolli Lock Weir.*—A very good work of 6 bays of about 18 feet each, and the floor is said to be very good and in good order. The weir can easily be modified to suit the new arrangements; it may also be made to look very well. The great length of crest will admit of the required discharge of 1,307 cubic feet a second with 2½ feet of water going over, so the crest may be 2½ feet below normal water level.

*Lolla Lock Weir.*—A substantial work, but it has no masonry floor, and the sills are at bed level. It will probably be found not worth preserving, but this can be determined when the positions of the new locks have been fixed.

Mr. Ellis was furnished with a sketch showing the relative positions of all these head works so far as they could be laid down on a not very accurate survey.

23. Ramachendrapuram River Set.—Not much change has taken place since 1873. The destruction of the groyne noticed in inspection notes, paragraph 38, Proceedings, Madras Government, 15th July 1874, was beneficial. The spit of clay on which part of No. 5 groyne was constructed should be still further cut away as it continues to cause some erosion below, and when the bank is wet next season some of the projection behind may be thrown down with advantage. Much of the general sweep of curve of the bank is good, and it is considered that there is no necessity for further expenditure except on hand planting, which should be attended to yearly as the river falls, and the higher parts of the planting should be done about the end of July or immediately after the high fresh of the season. All the stone which can be recovered from the old groynes should be taken to the Gunnaram canal for use on the canal works. The site of the lock is at a distance of several hundred feet from the river, and should it at any future time be threatened the best plan will be to stop further erosion of the river bank by putting in a toe of rubble all along the bank to prevent undermining and to face the bank above this with mats. The current will then glide along without doing mischief.

24. Breach or Sluice in River Embankment, Gopalpuram.—This village was in a great mess, and the sluice in the flood bank built four years ago has done much good. The sluice is of fair brickwork and a swing shutter. The floor in rear of sluice is much above bed of outfall channel, and an amply sufficient rough stone apron should be added.

The embankment here is in very bad order; it should be repaired and fenced, and ramps for the traffic should be provided.



25. Gunnaram Canal—*Ramachendrapur Lock and Weir.*—The gates of the former are said to be very bad, but it is hoped they will hold out until the new lock is allowed to be built. The weir, the piers of which canted over very soon after it was built in 1863, continues to stand well and is in no immediate danger. The lower sill of the new lock will need probably to be lowered 1 foot or more and the water surface in the reach below to the same extent to reduce the surface fall and velocity in the reach above the aqueduct.

*A surplus weir* to discharge into the Gorincala drain should be provided above the lock.

*Surplus weir, lower end of 26th mile.*—This is an old work with two bays of 10 feet with cast-iron posts, one of which was recently carried away by a boat. The sill is on a very low level, about 4½ or 5 feet below F.S.L., and the work is hardly worth adapting to the revised arrangements, so the pier can be removed and the substructure will serve to add to the security of a new weir which should be built on the line of the canal bank. A weir of ample capacity here is essential to the security of the great aqueduct a short distance further down and it should be capable with its crest at 3 feet below F.S.L. of discharging two-thirds of the water carried by the canal in this reach. It should have two low level sluice vents 4 by 3 feet or thereabouts for excavating the canal. Piles well strutted will be required along the line of the canal margin to keep boats from being drawn against the weir.

*Sluice of Vainateyam Left Bank Channel.*—The channel supplies 1,500 acres. The sluice is invisible and incapable of proper regulation. Now that the revised bed and water surface levels of the canal have been settled a suitable sluice should be constructed from Revenue, Extensions and Improvements.

*Timber Truss Bridge.*—This is a few yards above the upper end of the aqueduct. It is not a convenient bridge for the navigation, and it is away from the road which strikes the canal bank about 200 yards higher up.

*Gunnaram Aqueduct.*—The run of the water has been very much improved by the filling in of the spandrils, but those of many of the arches at the upper end are still 9 inches below the crown of the arches, and the effect of this is clearly seen in the depression of the water surface at each spandrel.

The rough stone aprons are throughout in good order, but there are some loose stones lying upon them which would be the better for being packed away.

There is leakage on the lower face of the first arch, the water passing apparently between the aqueduct side wall and the arch or through that and then down the face of the wall; the leakage comes through also at the springing of the two-path arch, there having been a slight settlement away from the wing face or prolongation of abutment behind half cut water.

The brickwork should be rebuilt lower on the canal face for about 1½ feet with hydraulic mortar, and the junction of the side wall with the wing should be examined and any indifferent masonry made good.

The spandrils of the aqueduct should be completely filled in and a smooth floor formed. The side walls should be smoothly covered with a thin coat of plaster so that there may be no lodgment for seeds, &c.

Similarly the exterior of the work should be cleaned and pointed.

The railings are weak. The posts are spaced at about twice the proper distance, and the flat bar iron posts on the right side are much too flexible. Intermediate posts and on the right side of T iron or other stiff material should be provided.

Mr. Sub-Engineer Ellis asks for a lascar for this aqueduct and for the surplus weir in the 26th mile with the intermediate short length of canal. This request is quite reasonable and such assistance quite necessary, and it should have been given long since. Until the next revision of the Conservancy Establishment of this section of the delta a man should be employed and paid out of the maintenance estimate of the canal.

Mundapalunka Lock, 28¾ miles.—The canal from the aqueduct to this point is in fair order with numerous good trees, cocoanut, sissoo, and tamarind on its banks. It appears that pits dug in the berms for the repair of the banks silt up again in about

two years, and this silt does not come from the Godavari but from the erosion of the canal above the aqueduct. The canal from Ramachendrapur to the aqueduct has been much scoured out owing to excessive fall, and this will be remedied when the completion estimates are carried out. The rock is to be replaced by another at 28 miles and on a higher level. The present lock walls have a margin of only some 8 inches above F.S.L.

The lock weir has one bay, and the walls are far too low for safety.

*Rubbish.*—A bye-law is much required to prevent rubbish of all kinds being thrown into the canal. An old bamboo mat about 10 by 12 feet was one of the things thrown in, and plantain leaves and other rubbish was constantly floating down. These things get into sluice vents, lock culverts, &c., and are a great nuisance.

26. GORINKALA DRAIN.—This drain crosses the Amlapur road about 2 miles or rather less to the east of the Gunnaram canal. It appears to be efficient though it is only a deep, unimproved water-course. The road is about 15 feet above bed and is carried across by a timber girder bridge of 23 feet span. The proper span would be about 40 feet. Great scour both lateral and vertical has been caused by the contracted waterway between the abutments. The bridge timbers will not last much longer, and when they are no longer serviceable it will be well to reconstruct the bridge. The arrangements which are considered suitable are a masonry bridge of 42 feet span at the springing. The floor at the abutments to be 2 feet lower than at present, and to be an invert with 2 feet versed sine; abutments 6·25 feet high; rise of arch 7·50; arch at centre 2·25 feet thick. The level of the roadway will then be unaltered.

27. REASON FOR NOT EXTENDING INSPECTION TOUR.—A telegraphic summons to Madras prevented the inspection of any other part of this delta, and this was regretted as it was desired to give instructions on the spot regarding the revision of some of the details of the completion estimates.

28. EXECUTIVE SUB-DIVISIONS.—When the Central Delta is joined with the Eastern Delta to form an Executive Division, it may continue until the completion estimates come to be carried out a single sub-division, but thereafter two sub-divisions will be required, and the best boundary line will be the Gorinkala, Sakurru, Lower Kowsika, and Allaram drains. The headquarters of both sub-divisions should be at the lower end of the main canal, and it is intended to put the buildings on the islands between the Bank and Gunnaran canals, and it will be desirable to use all silt clearances to raise and level the sites which will be occupied as the canal station.

29. WESTERN DELTA MAIN CANAL—*Head Sluice.*—The vents have been fitted with screw gear which works well and is very suitable. This pipe gear of Captain Brockman's is the best that has yet been devised for sluices at which the shutter platform is sufficiently high above the sill. The rear apron is in good order, but there is some loose stone above the proper level, and the revetment beyond the left wing and elsewhere wants putting to rights. There is a great bay on the right side below the head sluice which should be planted up with nanal to make the bay silt up; when this has been partially achieved, a revetment should be carried from the right rear wing return and should be built up to the level of the deposit; then as the silting goes on the revetment should be raised and ultimately excavated silt can be used to raise the ground to a couple of feet above F.S.L.

The excavation remaining to be done to bring the canal to its full dimensions is mostly below F.S.L., and this work will be carried out as soon as the canals have been closed. Some of the bends are very considerable and special arrangements will be required to prevent erosion. Either nanal or stone revetment would do, and, if the former be used, care must be taken that the grass is not allowed to flower. The Conservancy Establishment at the head works could be required to look after this.

The noses between the head sluice and lock channels and at the heads of the several islands should be maintained by protecting them with stone revetments.

All the canal banks both here and elsewhere should be drained away from the canal, otherwise the rain will cut away the interior slopes both of the banks and the canal.



The berms should be levelled to form convenient tow-paths.

30. KAKARAPURRU CANAL.—The work provided for in the completion estimate has been completed from near the Gostanaddi head downwards, but the upper part has been left untouched because it is proposed to cut a new head. The cost of the alteration of this upper part would be... ... ... ... ... Rs. 7,640
Allowed in estimate ... ... ... ... ... ... „ 2,433

Difference ... „ 5,207

There has been a considerable saving elsewhere, principally on earthworks, and there would be a net saving even with the new head were it not that the estimate provided nothing for the relief of lands the drainage of which is intercepted by the canal. One under-tunnel has been already built in connection with the Gostanaddi head lock weir, and one or possibly two more will be required. Altogether the revised estimate is likely to exceed the original by Rupees 10,000, and this estimate should be prepared and submitted for sanction at once, so that the cross drainage works may be carried out early in 1879. The earthworks may be proceeded with to the extent of the present sanction as soon as the land compensation has been ascertained from the Revenue Department to be not likely to exceed the amount entered in the Executive Engineer's estimate.

The reasons for cutting a new head are—

(1) The bad alignment of the present head.

(2) Position of head opposite Chettipett weir which has led to accidents.

(3) Village is right up to canal on both sides. The earthworks of the lower miles are in good order and it is a very fine canal.

31. BANK CANAL.—A new head to this canal has been opened and is a great improvement.

The cattle crossings have not been successful. Gravel appears to be of little use unless the soil is such as to make the addition of any material hardly necessary. Sand in considerable quantities might do when the soil is clay, but this is doubtful. What is wanted and essential is a perfectly firm track for a few feet above and below F.S.L., and in most cases pavements laid on gravel and sometimes on concrete will be found requisite together with revetments at the sides of the ramps.

*Surplus Weir, 12th Mile,* into Nukkala.—An effective work of two bays, with a water cushion of which the retaining wall rises abruptly and consequently there is considerable throe.

*Kakarapurru Set.*—The alignment of the river bank above is much improved, and on the whole the bank at the part which was in most danger four years ago is in a much better state and most of it is well protected by nanel. The set has moved somewhat lower down. The deep channel is now very narrow and there is some probability of a channel forming through the great shoal. Further up where the force of the set was felt seven or eight years ago, *i.e.*, above the groyne B, there is now a sand bank and a wide belt of nanel.

It will be desirable as suggested by Lieutenant Dorward to remove the remains of the groynes which are now no longer required.

The channel near the toe of the bank should be barred at intervals by grass-rollers, and the planting up of all blank spaces should be systematically carried out here and elsewhere yearly as the river falls and while the soil is wet.

The canal banks for some distance above Siddhantam lock are lower than is safe and they should be made up to $2\frac{1}{2}$ feet above F.S.L.

*Siddhantam Side Channel, Head Sluice.*—Is a few yards above the lock and, as it has some special features, it has been lithographed as a type design.

*Siddhantam Lock.*—Very well built and finished and looks very well. The rear wings are concave and could have been better with 10 feet less splay on each side. Curved batters very carefully executed.

*Lock Weir.*—The design is good and this work may be adopted for a type design. The splay of the rear wings is just right; the cushion wall has a flat slope and delivers the water with a moderate velocity.

The canal below this lock is narrow.

*Siddhantam Set.*—This set has ceased, and a fine belt of nanel, which has accumulated a good deal of silt, has formed an efficient protection. The plantation should be gone over and all vacant places inside planted up.

*Kodamanchili Head Sluice.*—A good sluice which will be the better when a dam has been put across the channel to irrigate some lands on the right bank not far from the head. At present the fall and dimensions of the channel make the water level near sluice only a few inches above sill.

*Koler Lock*—Built on same plan as that of Siddhantam. There is rather too much leakage at the heel post of left lower gate and at mitre posts. Gates of lower side culverts do not move easily and need adjustment.

*Lock Weir*—Good. The curves of the rear wings very well blended into the vertical facewalls, but a simple rectilinear junction would do very well. One bay to this weir.

*Irrigation Sluice in Right Upper Wing of Weir.*—The vent is said to be too small, and as it cannot be enlarged the channel will be widened to carry the water at a lower level and so increase the head at the sluice.

*Dodipatla Set.*—This set is for a considerable distance very threatening and the scarps are so abrupt that nothing in the way of effective nanel planting is possible. At the upper end however planting is feasible, and if the erosion does not progress very fast during the next three or four years the deep water may be diverted in time. The planting should be very much closer. Wide planting does not check the current sufficiently and is of very little use.

*Lutchmipalem Lock and Weir.*—The excavations for these works are in progress and Mr. Jopp has been detailed to look after them and the baling. It is a pity that a steam engine is not available to work Gwynne's pumps at this work at which the water threatens to be troublesome, but it is said that there is no engine available at Dowlaishvaram which can keep up steam with wood fuel. If there be an engine which would be efficient with coal, it will be better to send it down and get coal for it.

The rear wings of the lock should have a smaller splay; this will look better and will save some money.

The Nakkala below this lock promises to be a fair navigation.

32. Kaza Drain.—*New Outfall Sluice.*—It is intended to begin this about May, but as yet no materials have been collected for it.

33. Bhoopiah Channel.—The head weir needs proper means of regulation.

34. Narsapur Canal.—*Peravelli Rest House.*—This is in very good order with some nice trees about it. The madder is grown here.

*Peravelli Lock and Weir*—in good order.

*Itempudi Lock and Weir*—were not inspected.

*Kavitam Lock.*—Six and a half feet of water on lower sill. The 12 feet headway above F.S.L. is certainly none too much, liable as it is to be reduced as the demand for irrigation water diminishes. A discharge through the culverts should be maintained to diminish silting.

*Lock Weir*—An old work in right bank of canal some little distance above. The weir is to be altered this year and provided with screw gear.

The head of the weir channel is in a mess and should be protected by lunkah grass revetment carried down as low as this grass will grow and below that stone revetment.

*Palkole Lock and Weir*—Complete and very good. The rear wings of lock are at right angles to the axis except the curvature at the ends. With the present height of roadway the arch is too low as there is a loss of a foot. The arch is, however, 12 feet above normal water level.



The weir has two bays. The cushion wall has been omitted, and the rise from the floor to normal bed level has been effected by a slope at the rough stone apron. It should be noted how this plan answers.

The site of the *under-tunnel* for which materials have been partly collected is about one-fourth of a mile above the Narsapur rest-house and tidal lock.

*Mogultur Tidal Lock*—A very satisfactory work. The mixture of lime and burnt clay has not answered well in the pointing of the exposed faces. This is supposed to be due to saline vapour in the air. It indicates that a different clay should be tried. Water should be surplused through the side culverts. The roadway of the bridge is carried on girders.

*Lock Weir.*—This also is a satisfactory work.

35. Gostanaddi and Velpur Canal.—This river for 14½ miles from its head on the Kakarapurru canal carries irrigation water. There a weir has been constructed and below this the river acts only as a drain and the irrigation is served by the Velpur canal.

*Head Lock and Weir*—Built in 1874 and effective. The crest of the weir will have to be lowered to pass sufficient water when the Kakarapurru canal is low.

The Gostanaddi is very tortuous and some of the bends are so abrupt that it is difficult for the larger boats to get round them. The Executive Engineer has estimated for cuts to supersede two of the worst bends at a cost of about Rupees 3,900, and it is proposed to include this work in a revised estimate.

*Gostanaddi Weir*—A creditable work of five bays and apparently efficient in all respects, but so far there has been no heavy rainfall to show to what level the water may rise and to test therefore the assumptions on which the weir was designed. It is not quite clear moreover that the Velpur canal which takes off with an open head will be safe unless its banks be made higher. On the first occasion of a considerable fresh the exact levels of the water throughout should be ascertained.

*Bridge on Marter, Peninnantra Road*—Constructed from Local Funds and is a very suitable work; span 43 feet with iron lattice girders. The revetments in continuation of the bridge tow-path are not quite right. The fall of the canal down to the bridge is 4 inches a mile and below this to the lock 6 inches a mile, which is a pity, for as the canal is in embankment it might have with advantage been made wider at no greater cost, except a trifling addition to the lock.

*Memaduru Lock*, twenty-three and a half miles.—Built in 1876. The splay of the rear wings is just right, and the manner of junction of wings and abutments is very good as it would be difficult for boats to damage the masonary. This lock has a small fall and an addition of 18 inches to the drop would have been easily made.

*Lock Weir.*—This has two bays. The soil below the weir is very sandy and has been eroded by the wash. If the banks be revetted to say 3 feet above bed level a berm given there and then the berm and the slope above planted with nanel, probably the erosion will cease.

It appears that three surplus weirs have been sanctioned for the lower part of this canal and that only one to dispose of surplus irrigation water is required as no drainage comes into this reach. One considerable weir should therefore be built above the Mamaduru lock to get rid of surplus from the Gostanaddi, and the best place for it will be as high up as a suitable site may be obtainable. About five miles of the canal below the lock have been completed; the surplus was discharging into the Gostanaddi.

The way in which this canal should be completed has been left undecided to admit of conclusions being arrived at from experience as to whether there was any necessity as provided for in the completion estimates for relieving the Gostanaddi of part of its drainage by carrying the latter under the Velpur canal into the Buswarow drain and thence into the Gouter drain. It has now been demonstrated that no such arrangement is necessary, and it has been settled therefore that the best arrangement will be—

1*st.*—To carry on the canal as a line of navigation to the Yennamadurru below Bhimavaram and to lock into it at a point where the bed of that river

is at a sufficiently low level to give the requisite minimum of 3 feet of water on the lower sill.

*2nd.*—To bring all the Gostanaddi irrigation under the canal and so to do away with the necessity for bunding the Gostanaddi at its outfall into the Yennamadurru, thus leaving it completely free to act as a drain.

It may be desirable to drain the corner between the Yennamadurru and the Gostanaddi under the latter and under the Velpur canal into the Buswarow drain, but this cannot be decided at present so provision will be made for the under-tunnels, but they will not be built until the effect of the opening of the Gostanaddi mouth permanently has been ascertained.

Distribution sluices should be constructed as soon as the arrangements have been worked out and palmyra spouts should not be allowed to be retained longer than is absolutely necessary.

It was learnt from the Executive Engineer that there is a patch of land near Velpur which has been affected prejudicially by the construction of the weir across the Gostanaddi at 14½ miles. The old line of drainage was north into the Bhoopiah and then into the Gostanaddi; now the best outfall is believed to be into the Gouter drain. The area to be drained is about 1,620 acres and the cost will be about 5,000 Rupees. No time should be lost in determining the details and in obtaining sanction, for it is only right to relieve the owners of the land from the inconvenience occasioned by the improvements of the Gostanaddi and Velpur canal.

36. Attali Canal.—This canal is regularly navigable to the bridge at Attali 16 miles* and below this for some distance, but there only by small boats.

* 23 miles from Vijeshwaram.

*Gummampad Lock*, 13 Miles 52 Chains.—The soil here is very porous and leaks show right through. This should be remedied by bringing puddle or mixing silt with the soil and there is much silt above the lock.

*Lock Weir.*—This has one bay of 9 feet and nanel revetments are needed below it. There are distribution sluices on both banks and below both nanel revetments would be an advantage.

*Mandapaka Surplus Weir*—Built in 1875-76. It has two bays. The outfall channel is in good order.

*Fences*—Are much required from the surplus weir to the upper end of the village. There are two good gravelled crossings for cattle, but the banks are cut up by them in all directions and they are in a mess. There are facilities for fencing from the lower crossing to the weir on both sides. Outside the banks on the boundary of the canal land a V-trench 18 inches deep and 2 feet wide at top will furnish soil for a small bank on which the common aloe can be planted, which will be an excellent fence.

To prevent cattle getting up the interior slopes of canal banks except at the crossings is much more difficult without at the same time interfering with the tow rope. It might perhaps be managed by cutting a berm 1 foot above W.L. and 2½ feet wide and planting aloes upon the berm and this can be tried, but if this should not answer the only way will be probably to put a railing on the slope just above W.L. and inclined towards the water: in addition to a top rail there must be a lower rail if the posts are more than 18 inches above ground. The canal above this point was not inspected.

37. Undi Canal.—*Head Lock.*—This canal was used by boats long before the lock was constructed, the cargo being transhipped at the head. The completion of the lock will be a great convenience to the country through which the canal runs.

The rear wings of the lock are splayed on convex curves and the work looks well, but there is an inconvenient angle at the corner of the abutments. The sill is said to be at 8·00, 8·16 being the level named in 1873, 3·66 feet on lower sill.

*Old Head Sluice.*—This has to be fitted with new shutters and gear.

*New Head Sluice*—A well-built work which was recently constructed to increase the supply of the canal. The roadway is too low and a good deal of masonry will



have to be removed to alter it without spoiling its appearance. It is to be regretted that the design was faulty in this respect.

*Distribution Sluice*, 2nd Mile.—This has a low level vent in the middle and high level vents on the two sides. The rear wings might with advantage have been a little longer to afford room for the revetments of the side channels. The rear wings of the principal vent are a foot thicker than was necessary.

*Revetments generally.*—There is room for improvement in these, and nanel revetments in continuation of stone should be more generally used.

*Pippara Bridge, 3rd Mile*—A handsome bridge of 55 feet clear span, built from Local Funds. Tow-paths in connection with this and other bridges have not been arranged quite satisfactorily. What is wanted is that the masonry retaining wall should be carried by a somewhat flat S curve to meet the canal tow-path just at that distance at which the tow line will clear the corner of the abutment with a boat at about the middle of the canal, or at any rate that the rope shall only touch and not for a considerable length rub against the abutment. Also that there should be room for the connecting revetments without encroaching on the waterway of the canal. A diagram would in each case enable the arrangements to be easily worked out.

A short distance off another large bridge with three spans of 43 feet and plate girders under construction over the Yennamadurru. The Maistry employed on this is inefficient and careless, the string courses not being true. In the sanctioned project for the Undi canal, a lock was to be built at 11½ miles to connect it with the Yennamadurru river. It appears however that the river is not navigable at this point or indeed anywhere above Bhimavaram except during freshes.

On the other hand the full supply water level at the head of the canal is 2 feet lower than that calculated upon, and this makes the irrigation of some 8,000 acres which are to be supplied a matter of difficulty. The difference in water level is due—

*1st.*—To considerable mistakes in the water levels.

*2nd.*—To much of the canal having had a section greatly larger than the normal section on which the depth was based.

It is proposed therefore to abandon the idea of a lock into the Yennamadurru in the 12th mile and to construct a lock on the canal in or about the 7th mile immediately below the surplus weir which has there to be provided. The exact position will be settled when a site plan has been prepared. It is desirable to build it as near as possible to the village of Yendagandi for which a bridge is much required which would then be obtained at the lock. Though this position is not altogether favorable for the waste weir owing to the left bank of the canal in which the weir is to be placed being on a convex curve for a long distance, the best site may readily be determined when the relative positions of the Yennamadurru, village, canal and village puntas or roads, &c., have been laid down on a site plan.

Instead of a lock weir a sluice is proposed as the crest of a weir would be below F.S.L. in the lower reach. This arrangement, if the design be suitable, will do very well. An extension of this canal to the Akid canal has been supposed probable though it was not provided for in the completion estimate. It has now been suggested by the Executive Engineer that it will be better to carry it to the Yennamadurru below Bhimavaram, the point of entry being opposite to that selected for the Velpur canal. This may be estimated for. The improvement may follow in time if not immediately. In that case there would be four canals in this delta tailing into the Upuleru, the river which takes the surplus from the Colair lake.

It has to be noted in connection with these proposals however that the cost of locking the Velpur and Undi canals into the Yennamadurru above Bhimavaram and of deepening the river down to the point where its bed is at the intended level of the lock, lower sills should also be ascertained. In several respects there would be advantages in effecting the junction above Bhimavaram. There would be fewer bridges, shorter canals, and Bhimavaram is an important town.

38. Junction Canal.—There was a fair depth of water, but the canal silts a good deal owing to there being at present no lock weir which however is to be built, and

the proper site is on the left bank and as close to the lock as it will be safe to make excavations.

*Muddapuram Lock.*—The screws have been taken away from the centre and lower culvert gates, and rack and pinion gear will be fitted this season. The gates are very heavy, but they work easily. There are no wooden sill bars and the sills should be pointed with cement.

39. Venkiah and Weyeru—*Chinnakapuram Head Sluice.*—This if retained will be fitted with screw gear. Even with a powerful lever the shutters are moved with great difficulty and cannot be properly regulated. It appears, however, that the discharge is rather small even for the present acreage which exceeds the area which was expected and that probably 3,000 or 4,000 acres more will be brought under irrigation. It should therefore be considered whether it will be desirable to supersede this sluice or to build only a supplemental sluice for the additional area.

*Periadla Lock.*—The bridge over this has been raised. The lever for working the side culvert shutters is very heavy and unnecessarily clumsy and a good pattern should be prepared.

The navigation of the Weyeru was good, but this is said to be owing to the irrigation being over and water therefore abundant.

*Mid Rest House.*—Stands at a short distance from the left bank of the canal. When the trees which have been planted grow up, it will be a pleasant place.

40. Ellore Canal.—Lieutenant Dorward states that the intended full area under this canal has now been exceeded and that the demand for water is great. It is certain therefore that it will be necessary hereafter to enlarge this canal and the work now being done should be laid out keeping this in mind, and wherever banking is required 8 or 10 feet greater bottom width than was intended can be at once given.

For the present irrigation must be restricted to that intended or to that which it is found can be supplied without reducing the water level at the Ellore lock. The area should be settled and the Collector informed accordingly. The water given off should then be limited to that required for the fixed area under each distributary.

The canal is good except where injured by cattle crossings. Nothing has yet been done on this canal to provide regular crossings or to confine the cattle to selected places. Fencing with a view to the latter object is a crying want on most canals.

*Nandamur Surplus Weir.*—This was built to afford more complete control and to reduce the strain on the Chettipet weir which latter sometimes was overtasked. It has answered very well and has remained in good order though the fall is very heavy. It is said that some floor stones in the corners found by the drop well and the piers were scooped out, but this must have been due to stones left in the cushion basin, and care should be taken that none are so left and that the basin is cleared out periodically.

A bridge is said to be much wanted at Kykaram although there is no made road.

*Kykaram Irrigation Sluice.*—A good design and one generally applicable to distributaries of canals.

*Agadalanka Channel.*—This channel was laid dont with a heavy fall, about 9 feet in the first mile and it is consequently in a mess. The bed at the head may be lowered 2 or 3 feet, an apron and waterwings being added to the head sluice. The rest of the excessive fall must be got rid of by drops. The head sluice was fitted with a pattern of gear which failed and must be modified. The new earthworks in the lower miles want a little more attention to alignment. Elsewhere they are carefully aligned.

There is very little silt in the lower miles and there has been no clearance for a long time.

41. Chettipett Station.—The Office buildings are complete, but owing to the residences for the Executive and Assistant Engineers not having yet been built, the three officers are occupying the rooms which should be their offices. This is not convenient and at any rate one officer should go to the Rest-house which is unoccupied.



*Rest-house.*—The bank on which this is built has slipped considerably and has necessitated the re-building of part of the house. The best thing that can be done is to protect the soil for 12 feet all round the house with gravel so as to prevent the rain getting into it and the slope on the surplus channel side had better be dressed and turfed.

42. Cattle Pounds.—The number of cattle pounds in this part of the delta is so small and the distances to the pounds often so great that cattle-trespass cannot be effectually checked. Pounding cattle is at best however a disagreeable necessity and the remedy against cattle is fencing, first near villages and cattle crossings, afterwards and ultimately generally. The aloe is the best general fence and it is inexpensive. The results are likely to be remunerative: first, damage will be stopped; secondly, the grass rents will greatly increase; while the villagers can graze their cattle upon the canal banks, pay nothing and only run a remote risk of having their cattle pounded, they are not likely to rent the grass crops. It is not unlikely that delta hay will with canal communication all the way be sold in Madras ere long. It would pay to take pressed bales down even 300 to 400 miles, for the carriage would be 10 to 15 Rupees and very large quantities could be sold at Rupees 35 the ton in Madras, there being a ready sale there for hay at even 50 to 55 Rupees a ton.

43. *General Plantations.*—All canal lands on which trees can be conveniently grown should be so utilised. There is much ground so available on the Ellore Canal and in many other places, *e.g.*, head of Bank Canal, Eastern Delta, head of Undi Canal &c. Fuel is wanted now, it will be much more wanted in the future. Some trees may be grown for shade and ornament, but the great bulk of them should be for fuel.

44. Trees near Masonry Works.—There are many instances in which trees have been planted too near to masonry works and not only must the practice be discontinued, but trees so placed must be removed. Banian trees of whatever kind must not be allowed within 100 yards of any masonry work, for not only are their roots most injurious, but their seeds drop into a crevice or ledge on a projection, germinate readily and it is most difficult to destroy the seedlings. No other trees having spreading roots are to be allowed within 50 yards of masonry works, and no trees whatever within 50 feet of any part of any important masonry work, such as locks, lock weirs, surplus weirs, canal aqueducts, &c. All trees within 10 yards of any canal building are also to be removed, and as regards banian trees the 100 yards rule will apply here also.

45. Nanel Plantations.—A great deal of nanel has at various times been planted and a great deal is planted every year, but many plantations are not properly kept up. As regards plantations in the rivers, patches within the boundaries are often from one cause or another destroyed; again the alignments are more or less damaged, or cattle get in and do mischief. Periodical inspection by the Maistries and the repair of all damage should be systematically carried out. Every river plantation has or should have a fixed alignment up to which the nanel has to be maintained and all bare places within the boundaries should be planted up yearly directly the proper time arrives. It is not difficult to provide for such work, for it is easy to see what is wanted and to check the planting work done, so the coolies will need but little supervision. There are numerous places in canals and channels also where there should be some planting done year by year. Nanel planted in canals and channels is not to be allowed to seed, and everywhere some one should be held definitely responsible that not a stalk in flower is to be seen.

46. Revetments at bifurcations of Canals.—The salients at these points need to be maintained at their proper positions and this can but seldom be secured without stone revetments, which should be carefully built with gravel backings. Similarly the upper ends of islands in canals where these occur, as is the case in the Main Canals of the Eastern and Western Deltas; the spurs between lock and head sluice channels; and often the spits between canals and lock tail channels require to be revetted to maintain them in proper order.

47. Drainage of Canal Banks, Berms and Tow-paths.—The tops of canal banks especially where there has been much spoil should always drain to the outside. Berms should slope slightly away from the canal and should be adequately drained either from or into the canals. Tow-paths should be as near the water as possible and F.S.L. are most convenient when they are as little above F.S.L. or M.W.L. in

canals which do not and do receive drainage, respectively, as will suffice to keep them dry. A great deal has been done of late years in these respects and still a good deal remains to be done. These minor matters on which however the good order and usefulness of the canals to a considerable extent depend should be constantly kept in mind especially when clearances are being carried out.

48. Supersession of Palmyra Spouts.—These and other temporary means of dawing off water from canals for irrigation are not being got rid of on some canals as rapidly as is necessary. It is said that there is difficulty in constructing many in one season, but this is not an altogether valid reason for the absence of better progress. Whenever a single sluice is built to supersede several spouts, a connecting parallel channel to supply the several existing channels must be constructed before the spouts are removed. It will sometimes happen that here and there a small extent of land will cease to be irrigable under the permanent distribution arrangements owing to the level of the parallel channel which is suitable to the bulk of the irrigation being too low for one or two fields. In such cases, if such high land cannot by means of a rear cistern to the sluice, or otherwise, be conveniently supplied by flow, and if the extent be too small to warrant the construction of a special sluice, it must be irrigated by lift or thrown out of irrigation.

49. Boundaries of Canal Lands.—The demarcation of these greatly needs attention. In Circular No. 69 (Plantations) it was pointed out how this could readily be done, and the fencing so much required will generally serve also to mark the boundaries. Executive Engineers will be expected to make adequate progress year by year with this work.

50. Ferries.—The means of working the ferry boats across the canals and of securing them when not in use should be attended to. Chains running through snatch blocks and moored at either end will generally be the best means of working the boats to and fro, and the particular arrangements suitable will depend upon the strength of the current. Chains, ring staples, and posts are necessary for securing the boats. Or instead of posts a short chain moored on either bank may be preferable as leaving nothing to interfere with tow-ropes. Boats should not be fastened by ropes attached to the side rails, which are as a consequence often destroyed. Annually at any rate the ferry boats should be repaired and at other times all defects should be made good. These repairs should be an item, generally lump sum, in all canal maintenance estimates.

51. Conference with Collector.—On the 17th January a conference was held with the Collector, Colonel Beatty and Mr. Walch being present, at which the following subjects came under consideration :—

(1) Lands entitled to irrigation free of charge.

(2) Whether any lands are entitled to be so irrigated from the Delta Canals where the sources of irrigation existing before the anicut was built have not been interfered with by the Delta works?

(3) Whether irrigation free of charge in the case of lands under old sources of supply which have been extinguished or absorbed is limited to lands actually irrigated prior to such alteration, and, if not, is there any limitation and what?

(4) The definition of "mamool pullam" and the privileges regarding water-supply attaching to it.

(5) Whether when canal water is supplied to lands formerly or until recently imperfectly irrigated otherwise, any additional rate is levied, and, if so, how the rate is determined?

(6) The terms on which water is supplied to the Nidadavol and Baharzalli Zemindaries.

(7) The measures taken or required before granting permission to irrigate fresh lands, to ascertain whether water will be available. Whether a register is kept of the extent of land under each canal for which water is provided by the completion estimates and of the land for the irrigation of which permission is from time to time given.



(8) The arrangements and check under which remissions of water-rate are granted.

The first four points refer to the large extent of land in the Godavari Delta which does not pay a water-rate, and to some land (2) which is now supplied from the canals though the old sources of irrigation remain. It appears to be very doubtful whether the claims of Government for the water afforded from the canals are at all fully paid, and at any rate no paper in which the circumstances were set forth is available. Probably Mr. Wilson's investigations will show clearly how matters stand and whether any material loss has been sustained.

The fifth point required an examination of the records and the Collector could not at the time therefore say what the facts were. Information may be expected in Mr. Wilson's report.

Mr. Foster furnished papers showing what the existing arrangements with the Nidadavol and Baharzalli Zemindaries are and a special report has been made to Government and orders* thereon passed.

* Procs., Madras Govt., No. 173I, dated 1-3-78.

† *Vide* instructions to Superintending Engineer, printed in Procs., Madras Govt., No. 173I—1-3-78.

...rements† have been made for ensuring ...er-supply being available (7) for ... permission to irrigate which may ...plied for, and these arrangements ... area irrigable by each part of each ... no objection to introduce a rule ...irs before permission to irrigate is ...r is available; and, secondly, that ...plied, *i.e.*, that its level is suitable

will furnish the Collector with information as ... canal. It is understood also that the Collec... requiring the countersignature of the Canal ... registered. This will make it clear, first, that ... the land to be irrigated can be conveniently ... and that the means of supplying it exist.

Rules providing for the opinion of the ... Officers being taken on claims to remission of water-rate were published in the District Gazette of the 30th September 1876, Revenue Circular No. 18. They provide for all that is necessary, but practically the remission statements sent to the Canal Officers are of very little use, because they are received too late to allow of the crops being examined before they are cut and afterwards no opinion of any value can be given. There is a defect, too in that claims are received for extremely small areas. It would seem to be advisable not to entertain such at all, but at any rate it is useless to ask Canal Officers for an opinion about them. These officers are not responsible for the detailed distribution to individual fields. They can show whether a village has been properly supplied or not, but not whether the supply has been properly distributed to the fields.

In Rustambada under the Mogultur part of the Narsapur Canal, for the present season, remission is claimed on 61·17 acres, out of a total of 378·78 acres. There are 27 claims, the highest for 4 acres and the lowest for 0·40 acre, and this latter is a part of 51·10 acres. Here then it would seem that the village was properly supplied and whatever may be said of the larger claims the failure of the irrigation on 40 cents out of 51·10 acres must be due to causes beyond remedy by Canal Officers.

Remissions might, it is thought, be altogether refused on areas under an acre, and on less than 5 per cent. of the individual holding. Such a rule would get rid of a great many petty claims.

52. Upper Godavari.—The state of the river did not admit of the steamer in the latter part of December getting up to Dumagudiem. The lower end of the gorge 46 miles was reached on the 22nd. The gorge, the narrowest part of which is about 200 yards across, was passed on the next day's run, and the steamer anchored at Kottiagudiem, 67 miles from Dowlaishveram. The journey thence to Dumagudiem, 47 miles, was made by land, and by the way which was generally near the river splendid crops of cholum with stretches of jungle intervening were passed through. So far as this part of the country is cultivated, the crops are very fine. On the return journey the short canal down to new Dumagudiem was traversed and thence by the river in a small boat. Parts of this distance of 15 miles are very difficult in ascending and dangerous in descending owing to the numerous rocks, which being at all levels are dangerous at all stages of the river. The rock clearances which were affected some years since reduced the danger in the worst places, and

The Sukalair is said to be never without water. The diagram of the freshes of one year shows frequent freshes of very short duration. Observations of velocities were taken and probably calculations of discharge are on record.

Lists of papers of each proj[illegible] [illegible]uld be prepared and a summary of the information now available with particul[illegible] [illegible] that yet to be obtained should be made out.

59. IRRIGATION IN BHADR[illegible] [illegible]AM AND REKAPALLI.—The Tahsildar says there is practically no irrigation in the[illegible] [illegible]ks. There are no Government tanks apparently except the Gungole, which was [illegible] as a regulating tank above the short canal, and from it a revenue of 170 to 200 [illegible] is obtained, the rate charged being 4 Rupees an acre. The Collector thinks th[illegible] consideration of irrigation projects may be postponed until these taluks are [illegible] [illegible]l.

60. FIVE AND TEN-TON CRANES.—[illegible] here are a good many of these available for transfer elsewhere. They run on [illegible]ils. The iron work is good, but the timber of the trucks needs renewal. The balan[illegible] [illegible] requires careful management and the cranes are bound to upset unless the mo[illegible] [illegible]t of the weight at end of jib and that of the balance box be fairly balanced. [illegible] [illegible]ould be better to mount them on much wider trucks than those sent out with th[illegible]

They could be adopted also to [illegible]ve as wharf cranes.

27th November 1878.

[illegible]gned) JOHN MULLINS, Lt.-Col., R.E.,
Chief Engineer for Irrigation.

Rev. 7153/[illegible]

GOVERNMENT [illegible]ADRAS.

PUBLIC WORKS DE[illegible]ARTMENT.

11th February 1879, N[illegible]o. 93 I.

Irrig[illegible]

Read the following paper:—

No. 40. Memorandum by the Chief E[illegible]er for Irrigation, dated 27th November 1878, [illegible] I.

No. 41. ORDER THEREON, 11th February 1879, No. 93 I.

THE foregoing memorandum by the Chief E[illegible]gineer for Irrigation will be communicated to the Superintending Engineer, First Ci[illegible]cle, for information and guidance.

2. The subjects discussed with the Collecto[illegible]r and referred to in paragraph 51 will receive further consideration when the res[illegible] of Mr. Wilson's investigations are reported.

(True Ex[illegible]t.)

actual

Lt.-Col., R.E.,
Joint Secy. to Govt., P.W.D.,
Irrigation Branch.

No. 967
Communicated to the Revenue Board.
11/3/79

12: March/79.

To all Superintending Engineers.
To the Chief Engineer for Irrigation.
" Revenue Department.

15 Rd of Revenue Dec 14-3-79.

Exd. C. Howarth.
20 Spare Copies

Note Revised [illegible] 11 & 12 [illegible]

4/12/19

Revenue Dept
No 2153.

Mis

IRRIGATION.

Subt. of (1870) [illegible]

PUBLIC WORKS.

[illegible] SUPERINTENDING ENGINEERS.

[illegible]

[illegible]

[illegible]

[illegible] 11 March [illegible] 1

[illegible] February 1879, No [illegible]

Rec'd 12-3-79 No. 967 [illegible]

FEBRUARY.

[illegible]

[illegible]

967