Public Works (1897) Department.

Print verbatim

G.O., No. 270-I.

DATED 17 March 97

18/3/97

[Despatch Abstract.]

Design of Weirs and Regulators: Ordered that the Govt. of India be furnished with the criticisms & suggestions of the Chief Engineer for Irrigation and of certain other Officers on the results of Col. Clibborn's experiments on certain points in connection with the — for Irrigation Works.

Design of Weirs and Regulators: Forwarding Pro. embodying the criticisms and suggestions of the Chief Engineer for Irrigation and of certain other officers on the results of Col. Clibborn's experiments on certain points in connection with the — for Irrigation Works.

17/3/97

Inicd.

17/3/97

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

IRRIGATION.

Government {1897} of Madras.

PUBLIC WORKS.

Recd. } 1897. *Enclosures*

Regd. *Spare copies*

Letter, No. 271 I., 17th March 1897.

MARCH.

Design of Weirs and Regulators

Forwarding Proceedings embodying the criticisms and suggestions of the Chief Engineer for Irrigation and of certain other officers on the results of Colonel Clibborn's experiments on certain points in connection with the — for Irrigation works.

PUBLIC WORKS DEPARTMENT.

Irrigation.

LETTER—from

W. HUGHES, ESQ., B.A.,
Joint Secretary to the Government of Madras,
Public Works Department,
Irrigation Branch,

To

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

SIR,

With reference to your letter, No. 249 I., dated 10th December 1896, I am directed to inform you that the papers and diagrams therewith received were forwarded to the officers noted in the margin, there being no time to send them to other officers also; and to state that their criticisms and suggestions, together with those of the Chief Engineer for Irrigation, Madras, are embodied in Proceedings of Madras Government, No. 270 I., dated 17th March 1897, a copy of which I am desired to forward to you.

W. B. deWinton, Esq., Superintending Engineer, III Circle.

Lieut.-Colonel A. W. Smart, R.E., Superintending Engineer on Special Duty, Cauvery Completion Estimate, Tanjore.

I have the honour to be,
Sir,
Your most obedient servant,

(Signed) W. HUGHES,
Joint Secretary to Government,
Irrigation Branch.

FORT ST. GEORGE,
17th March 1897.

Exd. Shaik Karim.

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Government {1897} of Madras.

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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Read—the following papers :—

From W. B. deWINTON, Esq., Superintending Engineer, III Circle, to the Chief Engineer for Irrigation, dated Bellary, 17th February 1897, No. 3997 I.

In reply to G.O., No. 88 I., dated 22nd January 1897, which was received by me on 8th instant, I have the honour to state that I am so hard pressed with famine relief work just now, that I have neither the time nor the power to study these experiments carefully. I would respectfully suggest that the papers be sent to some officer who has more time at his disposal than I have at present.

2. I cannot honestly say, however, after a perusal of the papers that I could criticize them effectually with any amount of time at my disposal, because I do not think that the information given is sufficiently complete, nor the diagrams sufficiently intelligible to make such criticism possible. I should like to be present at the experiments before offering criticism that would be of any value.

3. The impression left upon my mind by a perusal of the papers and diagrams is that there is an air of unreality about the whole thing. It is difficult to believe that any trustworthy results can be obtained from experiments made under conditions which differ so widely from those existing in nature, both as to area of percolation and the incidence of the pressure. If experiments on the subject are considered necessary, I think it would be much better to spend money in building an experimental weir on sand and testing it under various heads and conditions. It would, of course, be an expensive proceeding, but not a difficult one, and it would at least give trustworthy results.

4. But, personally, I do not think that experiments of the kind are necessary. I believe it to be an established fact that there is no safer material to build on than sand if *you confine* it, and the best way to do this is to build curtain walls in front and rear of a work, along its entire width and extending on either flank to 10′ beyond ends of wings.

5. The best form for these walls, I believe, to be brick wells filled with concrete in Surki mortar, and they should be sunk to whatever more stable stratum underlies the sand, or at least to a depth of 10′ if no better foundation is met with above that depth.

6. They should be built quite distinct from the main body of the work, the front wall being just upstream of the front wings and connected with the work by an apron of 1′ of concrete on 2′ of puddle. The rear wall should be at end of rear floor and wings and just clear of them, and a third curtain wall about 5′ deep should be built at end of apron (or Talus). The work itself should be built on a solid block of concrete of uniform thickness.

7. It will thus be seen that I consider the form of weir shown in paragraph 13 of Colonel Clibborn's paper an excellent one, but I would omit the curtain wall under crest wall of weir as being unnecessary.

8. I will conclude with a few, I fear, very perfunctory remarks on some of the details of Colonel Clibborn's paper.

Paragraph 4—*Value of puddle to resist piping.*—It is not clear what permanent good, puddle on sand does in resisting piping (by which, I understand, the upward percolation of water and possibly sand, under pressure). If the sand beneath the puddle is first removed by water and the puddle subsides with it and leaves the concrete, the structure resting on the latter would eventually settle into the void thus formed, and the process would commence over again.

Colonel Clibborn has placed his puddle beneath the *front* apron of his typical weir to remove the area of percolation *downward* further away from the body of the work, and in this position it is of real service.

Paragraph 8—*Effect of temperature on pressure and discharge.*—My own observation of the flow of spring channels by night and by day, both in England and India, is that they run stronger by night than by day. I have known such channels in the neighbourhood of Bangalore run with diminishing volume until 10 to 11 A.M. and then cease altogether, as far as surface flow was concerned, till nightfall. If the pressure and discharge increased on cloudy days to the *same extent* as on days with bright sunshine, it is very inexplicable.

Paragraph 9—*Pressure capable of blowing sand through orifices.*—If a pressure of 3′ is capable, under ordinary conditions, of blowing sand out with the water, how is it that water passing through artificial filter-beds takes little or no sand with it? I examined such a filter bed a fortnight ago, which had 3′ of water on it and filtering material 3′ thick, comprised of 1½′ of sand, 6″ of small stone and 1′ of large stone. It was working with a head of 3′ 10″ and passing no sand.

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Paragraph 10—*Useful effect of curtain walls.*—There is no doubt, as stated above, that curtain walls are absolutely necessary for structures built on sand. What we want to know is the depth to which it is necessary to construct them to effectually prevent under-scour, and I do not think that any experiments with the apparatus shown are likely to give trustworthy information on that point.

Paragraph 11—*Special experiments.*—The results of the experiments recorded, which took in these instances a more practical form, give, it seems to me, conclusive evidence of the untrustworthy nature of the data obtained from the previous experiments.

Paragraph 12—*General points of interest.*—With regard to springs in floors, I may remark that we found it easy to plug springs occurring under severe pressure in the Periyár dam, by building round them so as to form a still-water well and then filling with fine portland cement concrete. The foundations were rock and the water brought up nothing with it.

9. I return all the papers forwarded with the Government Order under reply, and regret that I am not able to offer more valuable criticisms on the points raised.

From Lieutenant-Colonel A. W. SMART, R.E., Superintending Engineer on Special Duty, to the Chief Engineer for Irrigation and Joint Secretary to Government, Public Works Department, dated Tanjore, 23rd February 1897, No. 166.

With reference to G.O., No. 88 I., dated 22nd January 1897, I have the honour to state that I am of opinion that the experiments conducted by Lieutenant-Colonel Clibborn, Principal of the Roorkee Engineering College, are of considerable interest and value, but the value would have been considerably enhanced if the experiments

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had been conducted in such a way as to imitate the actual circumstances under which pressure takes place in weirs and anicuts. In figure No. 1 of the tracing accompanying, I give a plan, &c., of a cistern which would, in my opinion, have been preferable to the iron pipe actually used. The cost of the cistern and apparatus, provided a suitable site were chosen, would not be greater than that of the iron pipe, &c.

That the latter is not altogether suitable is recognised by Colonel Clibborn (*vide* paragraph 7 of his note).

2. The deduction made in paragraph 13 of the value of an upstream apron is, in my opinion, of great importance, but does not seen to have been made from the results of the experiments with the iron pipe. That such an apron enormously adds to the strength and solidity of a weir built in sand is confirmed, I believe, by experience. It certainly confirms my experience, but I would use neither puddle nor concrete (unless the quality can be guaranteed) in such a position. The apron should be solid with a deep curtain wall in front. I give in figure 2, what I consider an ideal section for a weir built in sand and unaccompanied by an overbridge. If there is a bridge, I am of opinion that the dam should be a removeable one, either wholly or partially, whatever the first cost, within reasonable limits, may be.

When in charge of the South Arcot District, two cases of failure came to my notice, where puddle and concrete had been used in the front of weirs to stop leakage and piping under the apron. If there is a leak, puddle is gradually washed out and if the concrete is not of first-rate quality, it rapidly disintegrates and disappears. The worst brickwork is preferable in such a place to a concrete on which absolute reliance cannot be placed. The upstream apron should be as solidly built as the one on the downstream, but need not be covered with stone, where such is more expensive than other materials.

No. 60 I.

Note by the Chief Engineer for Irrigation.

With reference to Colonel Clibborn's experiments, an account of which was forwarded with the Government of India letter No. 249 I., dated 10th December 1896, for the opinion and suggestions of selected officers, I beg to offer the following remarks.

2. The experiments add nothing to our knowledge of the laws under which the flow of water through sand takes place, but merely establish a co-efficient for the material experimented on. To obtain information of general use, it would be necessary to experiment with a building similar in section to an anicut and of the same materials, but deductions from such experiments would still be of limited value as the condition supposed in the discussion on the design of anicuts, viz., an unlimited depth of sand under the foundations, could not be represented. If any experiments are to be made in future I would suggest the use of a culvert built of materials likely to be used on work with the floor and sides left rough like the underside of foundations and the roof formed of concrete rammed down over the sand filling. There would be no difficulty in fixing a stand pipe and pressure gauges in the roof. Part of the building would probably have to be in cement as ordinary mortar would take a long time to set hard enough to stand a pressure of 20 feet of water. For succeeding experiments the roof would have to be broken up, screen walls built in the culvert, the sand refilled and the roof remade. I have at present no means of getting experiments made in this way or would do so.

3. Regarding the general discussion on the design of weirs such as that figured by Colonel Clibborn I may state generally that the utility of screen walls and solid floorings in front of weirs, and even bridges, in sandy rivers is fully recognized in this Presidency and that method of construction has been adopted in improving old works and building new ones. The old works have generally been built with a dry apron in front laid flat or sloping to the crest and in most cases this has been sufficient to prevent scour, while the deposit of silt in the river bed and between the stones of

the apron has aided largely in stopping filtration. When such a work leaks badly, it must be presumed that the leakage has had some ill-effect on the interior of the work and the front curtain should be made deeper and the flooring broader than would be required in a new work.

4. Filtration under a work built in sand cannot conceivably be prevented and all that one can aim at is to keep the sand in its place. This, of course, involves making the work of such a width or interposing so many or such deep impediments that the pressure where the water has its exit will be reduced below that at which the sand would blow. In a weir such as that under consideration the depth or rear floor increases more rapidly than the depth on crest and it would, therefore, be sufficient to consider the pressures with water standing at level of crest. In calculating the length of the line of filtration, it would be safe to take it from the bed above to the bed below *vid* the base of the curtain walls.

5. I beg to offer the following suggestions for design as the result of my experience. I take only the case of a weir with vertical overfall on to an apron laid at about the level of the river bed.

First.—The upstream face should be built with a batter of not less than 4 inches to a foot; a vertical face causes the water to cut down and forms eddies which may be injurious.

Second.—The front flooring need not be wide. It should generally be sufficient to make its width equal to the maximum. Probably its width need never exceed the depth of water in floods and might be reduced much below this if the velocity is not great. If further protection is thought necessary, a dry apron might be added. The filling under the flooring should be clean sand. If puddle is used, a portion of it is likely to pass into the sand, and its volume being thus reduced passages are left for water.

Third.—The chief use of the front curtain wall is to prevent piping and as a matter of secondary importance to reduce filtration. It need not be made very deep when the body wall is on a fairly deep foundation. In beds of coarse sand, such as is usually found in the Madras rivers, probably ten feet, is sufficient depth for foundations of curtain and bodywalls when built solid.

Fourth.—The rear masonry apron should extend not only beyond the sheet of falling water but beyond the line when the disturbance is so violent that it might displace a dry apron. With regard to thickness anything which will stand the constant concussion of the falling water is strong enough to stand the maximum upward pressure. The Madras weirs have usually no front curtain walls, but the aprons, although only 3 to 4 feet in thickness, are never blown up. The retaining wall of the apron should be at least as deep as the foundation of front wall and body and is usually made deeper. It should be so deep as to be well below possible scour if the second apron should be swept out.

Fifth.—The second apron is required chiefly to keep the sand in its place and should be of ample width. It is generally necessary to have a second retaining wall to prevent disturbance of the apron, but this need not be so deep as the others.

(Signed) W. HUGHES,
Chief Engineer for Irrigation.

Lower Anicut,
3rd March 1897.

No. 61 I.

Submitted to Government with reference to G.O., No. 88 I., dated 22nd January 1897.

(Signed) W. HUGHES,
Chief Engineer for Irrigation.

11th March 1897.

Initials of | Date returned. | attender.

ORDER—No. 270 I., dated 17th March 1897.

Ordered that the following letter be sent to the Government of India.

[Here enter No. 271 I., dated 17th March 1897.]

(True Extract.)

(Signed) W. HUGHES,
Joint Secy. to Government,
Irrigation Branch.

To the Chief Engineer for Irrigation.
„ W. B. deWinton, Esq., Superintending Engineer, III Circle.
„ Lieutenant-Colonel A. W. Smart, R.E., Superintending Engineer on Special Duty, Cauvery Completion Estimate, Tanjore.

Exd. Shaik Karim.

PUBLIC WORKS DEPARTMENT,
IRRIGATION BRANCH.

Public Works (1897) Department

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Present No: 2757

UNDER date the
Recd: 16.3.97
READ the following

Encls: 4 (10 Plans)

Letter from W. B. de Winton Esq., Supg. Engr., Third Circle. } (Hd. No. 3997-I dated 17-2-97).

Letter from Lt. Col. A.W. Smart R.E., Supg. Engineer, on special duty, Cauvy Completion Estimate, Tanjore. } (Hd. No. 166 dated 23-2-97).

Note by W. Hughes Esq. B.A., Chief Engineer for Irrigation. } (Hd. No. 60-I dated 3-3-97).

No. 61. Irg. 11-3-97

Submitted to Government with reference to G.O. No. 88-I, dated 22nd January 1897.

12P

Order thereon. No. 270 I. dt. 17.3.97

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× will be filled in before issue

2703

JH 10/3 97

JH 11.3.97

[illegible] 26.5/4/97

E. I. Form No 1—1,000—27-11-95.

[illegible]

938 I

No 3997 I

Superintending Engineer's Office, III circle, Bellary.
17th February 1897.

18

From

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The Chief Engineer for Irrigation, Madras.

Enclosures 7 +

+ Put back with the two copies of G O No 88 I of 22-1-97

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In reply to G. O. No 88 I dated 22nd January 1897, which was received by me on 8 instant, I have the honour to state that I am so hard pressed with famine relief work just now, that I have neither the time nor the power to study these experiments carefully. I would respectfully suggest that the papers be sent to some officer who has more time at his disposal than I have at present.

2

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there being no time to send them to other officials
Officers noted in the margin ^ and to
state that their criticisms, and sug-
-gestions together with those of the Chief
Engineer for Irrigation, Madras, are
embodied in P.M.G. No × I dated 17th
March 1897, a copy of which I am
desired to forward to you.

W. B. de Winton Esqr., Supg. Engr., Third Circle

Lt. Col. A. W. Smart R.E., Supg. Engr. on special duty, Cauvery Completion Estimate, Tanjore.

× will be filled in before issue

(2703)

[initials]
10/3/97

[initials]
11.3.97

[initials]
26.5/4/97

E. I. Form No 1—1,000—27-11-95.

[initials]

938 I

No. 3997 I
Superintending Engineer's
Office, III circle, Bellary.
17th February 1897.

1P

From

W. B. de Winton, Esq.,
Superintending Engi-
-neer, III circle.

To

The Chief Engineer
for Irrigation,
Madras.

Enclosures 7 +

+ Put back with the two copies of G.O. No 88 I of 22-1-97

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2.

Initials of | Date returned. | Initials of attender.

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du
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E. I. Form No 1—1,000—27-11-95.

LCW
10/3/97

9389

No 3997 I. Superintending Engineer's Office, III circle, Bellary.
17^th February 1897.

1P

From
W. B. de Winton, Esq,
Superintending Engineer, III circle.

To
The Chief Engineer
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Enclosures 7 +

× Put back with the
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2703

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E. I. Form No 1—1,000—27-11-95.

WCC
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938 I

No 3997 I

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2

Initials of | Date returned. | Initials of attender.

2. I cannot honestly say, how-
-ever, after a perusal of the papers
that I could criticize them effec-
-tually with any amount of time
at my disposal, because I do not
think that the information given
is sufficiently complete, nor the
diagrams sufficiently intelligible
to make such criticism possible.
I should like to be present at —
the experiments before offering cri-
-ticism that would be of any value.

3. The impression left upon
my mind by a perusal of the
papers and diagrams is that
there is an air of unreality about
the whole thing. It is difficult to
believe that any trustworthy results
can be obtained from experiments
made under conditions which differ
so widely from those existing in —
nature, both as to area of percolation
and the incidence of the pressure.
If experiments on the subject are

Considered

considered necessary, I think it
would be much better to spend
money in building an experimen-
-tal weir on sand and testing it
under various heads and condi-
-tions. It would of course be an
expensive proceeding, but not a
difficult one, and it would at
least give trustworthy results.

4. But, personally, I do not
think that experiments of the
kind are necessary. I believe it
to be an established fact that
there is no safer material to —
build on than sand if you con-
-fine it, and the best way to do
this is to build curtain walls in
front and rear of a work, along
its entire width and extending
on either flank to 10' beyond ends
of wings.

5. The best form for these
walls I believe to be brick walls
filled with concrete in lieu mortar,

and

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5. The best form for these
walls I believe to be brick, walls
filled with concrete in ~~mortar~~ lime

and

and they should be sunk to whatever more stable stratum underlies the sand, or at least to a depth of 10' if no better foundation is met with above that depth.

6. They should be built quite distinct from the main body of the work, the front wall being just upstream of the front wings and connected with the work by an apron of 1' of concrete on 2' of puddle. The rear wall should be at end of rear floor and wings and just clear of them, and a third curtain wall about 5' deep should be built at end of apron (or Talus). The work itself should be built on a solid block of concrete of uniform thickness.

7. It will thus be seen that

that I consider the form of weir shewn in para 13 of Colonel Clibborn's paper, an excellent one, but I would omit the curtain wall under crest wall of weir as being unnecessary.

8. I will conclude with a few, I fear, very perfunctory remarks on some of the details of Colonel Clibborn's paper.

(1) Para 4. Value of puddle to resist piping:-

It is not clear what permanent good puddle on sand does in resisting piping (by which I understand the upward percolation of water and possibly sand under pressure). If the sand beneath the puddle is first removed by water and the puddle subsides with it and leaves the concrete, the structure resting on the latter would eventually settle into the

void

void thus formed and the process would commence over again.

Colonel Clibborn has placed his piddle beneath the front apron of his typical weir to remove the area of percolation downward further away from the body of the work and in this position it is of real service.

Para 8. Effect of temperature on pressure and discharge.

My own observation of the flow of spring channels by night and by day both in England and India is that they run stronger by night than by day. I have known such channels in the neighbourhood of Bangalore run with diminishing volume until 10 to 11 A. M and then cease altogether, as far as surface flow

flow was concerned, till night-fall. If the pressure and discharge increased on cloudy days to the same extent as on days with bright sunshine, it is very inexplicable.

Para 9. Pressure capable of blowing sand through orifices.

If a pressure of 3' is capable, under ordinary conditions, of blowing sand out with the water, how is it that water passing through artificial filter beds takes little or no sand with it? I examined such a filter bed a fortnight ago, which had 3' of water on it and filtering material 3' thick, comprised of 1½' of sand 6" of small stone and 1' of large stone. It was working with a head of 3'-10" and passing no sand.

I examined an adjoining filter which was dry for repairs and removed the strata to the floor

floor. The joints of the floor-pipes had a little sand in them but there was none in the pipes themselves. No doubt the head given was unusually high and the filter must have been choked (i.e. puddled) to some extent, but so is the bed of a canal or river in front of a weir.

Para 10 - Useful effect of curtain walls.

There is no doubt, as stated above, that curtain walls are absolutely necessary for structures built on sand. What we want to know is the depth to which it is necessary to construct them to effectually prevent under-scour and I do not think that any experiments with the apparatus shewn are likely to give trustworthy information on that point.

Para 11. Special Experiments.

The results of the experiment recorded, which took in these instances a more practical form, give, it seems to me, conclusive evidence of the untrustworthy nature of the data obtained from the previous experiments.

Para 12, General points of interest.

With regard to springs in floors, I may remark that we found it easy to plug springs occurring under severe pressure in the Periyar Dam, by building round them so as to form a still water well and then filling with fine Portland cement concrete. The foundations were rock and the water brought up nothing with it.

9. I return all the papers forwarded with the G. O. under reply and regret that I am not able to offer more valuable criticisms on the points raised.

I have the honour to be,
Sir
Your most Obedient Servant

[signature]
15.2.97

L.S. 13.2.97 Supt-dg Engineer, III circle

CHIEF ENGINEER
FOR IRRIGATION.
1897
No.........

Enclosures — 8

1. Diagram of water passage experiments, Kanki sand (Sheet no. I)
2. — do — do — (Sheet no 2)
3. — do — do — (Sheet no 3)
4. Plan of apparatus for testing the flow of water in sand. — (sheet no 4)
5. Khanki Weir – Chenab Canal Chart showing water pressures due to certain heads above Weir — (sheet no 5)
6. Diagram of experiment on sand from the Jamrao Weir.
7. * Copy of letter no. 1070, dated 15th July 1896, from the Principal, Thomason College, Roorkee.
8. Note by Colonel Clibborn on experiments made on the passage of water through the sand of the Chenab river at the Khanki Weir site.

* This has been sent with this Office No 3883 [illegible] 7/13-2-97 to the address of the head clerk P.W. Secretariat.

CHIEF ENGINEER
FOR IRRIGATION.
[illegible] 97
No. 7 — III

R.W. E.2 / 2757/97

Public Works (1897) Department.

CURRENT No. R 23 T. J.

Order

From

Lt Col A W Smart R.E.
Supdg Engineer, on Spl duty
Tanjore

No. 166

Dated 23d February 1897

Received 24. 2. 97

Enclosures 9

Spare copies

SUBJECT.

Designs of weirs and regul
Submits his remarks and
suggestions on the experiments
conducted by Lt Col. J
Clibborn I.S.C. in connection with
the —

BACK PAPERS.

No.	Date.

FURTHER PAPERS.

No.	Date.

№ 166 &P.

Office of the Superintending Engineer
Cauvery completion Estimates.
Tanjore. Dated 23rd February 1897.

From

Lt. Col. A. W. Smart R.E
Superintending Engineer on Spl duty
Tanjore.

To

The Chief Engineer
for Irrigation and
Joint Secretary to Government P.W.D.
Madras.

Sir,

With reference to G.O. № 88 I.
dated 22nd January 1897, I have the honour
to State that I am of opinion that the
experiments conducted by Lt. col. Clibborn,
Principal of the Roorkee Engineering
College, are of considerable interest
and value, but the value would have
been considerably enhanced if the
experiments had been conducted
in such a way as to imitate the
actual circumstances under which
pressure takes place in weirs and
anicuts

Encl. 9.

nuicate. In figure 1 of the tracing accompanying, I give a plan &c of a cistern which would, in my opinion, have been preferable to the iron pipe actually used. The cost of the cistern and apparatus, provided a suitable site were chosen, would not be greater than that of the iron pipe &c.

That the latter is not altogether suitable is recognised by Col. Clibborn vide para 7 of his note.

2. The deduction made in para 13 of the value of an up stream apron is, in my opinion, of great importance, but does not seem to have been made from the results of the experiments with the iron pipe. That such an apron enormously adds to the Strength and Solidity of a weir built in Sand is confirmed, I believe, by experience. It certainly confirms my experience, but I would use neither puddle nor concrete, (unless the quality can be guaranteed) in such a position. The apron

Should

Should be Solid with a deep curtain wall in front. I give in figure 2, what I consider an ideal section for a weir built in sand and unaccompanied by an overbridge. If there is a bridge, I am of opinion that the dam should be a removable one, either wholly or partially whatever the first cost, within reasonable limits, may be.

When in charge of the South Arcot District, two cases of failure came to my notice, where puddle and concrete had been used in the front of weirs to stop leakage and piping under the apron. If there is a leak, puddle is gradually washed out and if the concrete is not of first rate quality, it rapidly disintegrates and disappears. The worst brickwork is preferable in such a place to a concrete on which absolute reliance cannot be placed. The upstream apron should be as

Solidly

solidly built as the one on the down
- stream, but need not be covered
with stone, where such is more
expensive than other materials.

CHIEF ENGR.
FOR IRRIGATION.
27.12.97
No. 2357

I have the honour to be,
Sir,
your most obedient Servt

Lt Col RE
Superintending Engineer
on Special duty

PWD 43/2757/97

No 60. I 10 P.

Note by Mr: W. Hughes, Chief Engineer for Irrigation.

With reference to Colonel Clibborn's experiments, an account of which was forwarded with the Government of India letter NO: 249. I. dated 10th December 1896 for the opinion and suggestions of selected officers I beg to offer the following remarks.

2. The experiments add nothing to our knowledge of the laws under which the flow of water through sand takes place but merely establish a coefficient for the material experimented on. To obtain information of general use, it would be necessary to experiment with a building similar in section to an anicut and of the same materials but deductions from such experiments would still be of limit-ed value as the condition supposed in the discussion on the design of anicuts viz an unlimited depth of sand un-der the foundations, could not be represented. If any experiments are to be made in future I would suggest the use of a culvert built of materials likely to be used on work with the floor and sides left rough like the under-side of foundations and the roof formed of concrete ram-med down over the sand filling. There would be no diffi-culty in fixing a stand pipe and pressure gauges in the roof. Part of the building would probably have to be in cement as ordinary mortar would take a long time to set hard enough to stand a pressure of 20 feet of water. For succeeding experiments the roof would have to be broken up, screen walls built in the culvert, the sand refilled & the roof remade. I have at present no means of getting experiments made in this way or would do so.

3. Regarding the general discussion on the design of weirs such as that figured by Colonel Clibborn I may state generally that the utility of screen walls and solid floorings in front of weirs, and even bridges, in sandy rivers is fully recognized in this Presidency and

that

that method of construction has been adopted in improving old works and building new ones. The old works have generally been built with a dry apron in front laid flat or sloping to the crest and in most cases this has been sufficient to prevent scour while the deposit of silt in the river bed and between the stones of the apron has aided largely in stopping filtration. When such a work leaks badly, it must be presumed that the leakage has had some ill-effect on the interior of the work and the front curtain should be made deeper and the flooring broader than would be required in a new work.

4. Filtration under a work built in sand cannot conceivably be prevented and all that one can aim at is to keep the sand in its place. This of course involves making the work of such a width or interposing so many or such deep impediments that the pressure where the water has its exit will be reduced below that at which the sand would blow. In a weir such as that under consideration the depth on rear floor increases more rapidly than the depth on crest and it would therefore be sufficient to consider the pressures with water standing at level of crest. In calculating the length of the line of filtration, it would be safe to take it from the bed above to the ~~level~~ bed below <u>via</u> the base of the curtain walls.

5. I beg to offer the following suggestions for design as the result of my experience. I take only the case of a weir with vertical overfall on to an apron laid at about the level of the river bed.

1st The up stream face should be built with a batter of not less than four inches to a foot- a vertical face causes the water to cut down and forms eddies which may be injurious.

2nd. The front flooring need not be wide. ~~It should generally be sufficient to make its width equal to the~~

struck out by E.I. vide slip attached

M.E.I.

Have you got the orig. draft note? the typed copy is the same as printed but I think a word has been omitted

29/3/97

Probably its width need never ex-
of water in floods and might be re-
ow this if the velocity is not great
ection is thought necessary a dry apron
The filling under the flooring
sand. If puddle is used a portion
to pass into the sand and its volume
ced passages are left for water.
of the front curtain wall is to pre-
d as a matter of secondary importance
ation. It need not be made very deep
wall is on a fairly deep foundation.
se sand such as is usually found in
ers probably 10 feet is sufficient
lations of curtain and bodywalls when

y apron should extend not only beyond the sheet of falling water but beyond the line when the disturbance is so violent that it might displace a dry apron. With regard to thickness anything which will stand the constant concussion of the falling water is strong enough to stand the maximum upward pressure. The Madras weirs have usually no front curtain walls but the aprons although only 3 to 4 feet in thickness are never blown up. The retaining wall of the apron should be at least as deep as the foundation of front wall & body and is usually made deeper. It should be so deep as to be well below possible scour if the second apron should be swept out.

5th. The second apron is required chiefly to keep the sand in its place and should be of ample width. It is generally necessary to have a second retaining wall to prevent disturbance of the apron but this

need

PURPOSE.	Initials of [illegible] taking	Date returned.	attender.

need not be so deep as the others.

W. Hughes

Chief Engineer for Irrigation.

Camp, Lower Anicut.

3rd March 1897.

P. W. 4.1 — 275/97

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P 23 J	23 2 97
original P. W. J	22 1 97

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No.	Date.

Public Works (1897) Department.

CURRENT No. R 7 111

Order

From Me Supt'g Engr. 3 Circle
Bellary

No. 3997-S

Dated 17 February 1897

Received 18 February 1897

Enclosures 7

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SUBJECT.

Views of Coll J W Ottley RE.
late Inspector General of Irrigation
about Coll. Clibborn's experimental
design of weirs and Regulators
for Irrigation works —
Returns papers re —

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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

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IRRIGATION,

FOR THE MONTH OF MARCH 1897.

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1 Subjects.	2 Numbers and Dates of Proceedings.	3 Date of Report to Secretary of State for India.	4 Numbers and Dates of previous Proceedings.
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1 Subjects.	2 Numbers and Dates of Proceedings.	3 Date of Report to Secretary of State for India.	4 Numbers and Dates of previous Proceedings.
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1 Subjects.	2 Numbers and Dates of Proceedings.	3 Date of Report to Secretary of State for India.	4 Numbers and Dates of previous Proceedings.
			(*Continued*). 1st Aug. 1896, No. 417 I. 26th June 1896, No. 540 I. 3rd Feb. 1896, No. 112 I. 18th Jan. 1896, No. 66/60 I. 11th Oct. 1893, No. 857 I. 10th April 1891, No. 324 I. 26th Sept. 1888, No. 3030 W.
Irrigation Revenue.—Communicating to officers concerned note by the Chief Engineer for Irrigation reviewing the statements submitted by the Board of Revenue showing the — derived from all irrigation works during the fasli year 1305 (1895–96).	1897. 22nd Mar., No. 303 I.	...	.....
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1 Subjects.	2 Numbers and Dates of Proceedings.	3 Date of Report to Secretary of State for India.	4 Numbers and Dates of previous Proceedings.
Fixing a pipe across Rushikulya canal.—Revised estimate of Rs. 1,550 for — at 19¾ miles to pass Rajahkomma channel, Rushikulya project, sanctioned with remarks.	1897. 23rd Mar., No. 311 I.	...	.....
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Aqueduct.—Revised estimate of Rs. 5,600 for constructing an — and bridge in lieu of Pungaliyur outlet on the Chithrachavady channel, Coimbatore division, sanctioned.	29th Mar., No. 325 I.	...	16th June 1896, No. 513 I.
Excess expenditure.—Authorising the Examiner of Public Works Accounts to pass the — incurred on the work "Raising and strengthening the bund of Mundakolathur tank" in the North Arcot division.	29th Mar., No. 326 I.	...	.....

1 Subjects.	2 Numbers and Dates of Proceedings.	3 Date of Report to Secretary of State for India.	4 Numbers and Dates of previous Proceedings.
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Pallapalliem channel case.—Recording letter from the Superintending Engineer, IV Circle, forwarding copy of the judgment of the District Court in the — Coimbatore division, and drawing the attention of officers of the Department to certain parts of the judgment asserting the right of Government to control the distribution of water for irrigation purposes.	29th Mar., No. 328 I.	...	.....
Excess outlay.—Authorising the Examiner of Public Works Accounts, with remarks, to pass the — incurred on certain works in the Ganjám division.	31st Mar., No. 330 I.	...	17th Dec. 1896, No. 1065 I. 10th Jan. 1894, Nos. 13–14 I.
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GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

TABULAR STATEMENT OF MISCELLANEOUS PROCEEDINGS AND MATTERS OF ROUTINE,

IRRIGATION,

FOR THE MONTH OF MARCH 1897.

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September, I Circle, recorded with reference to the orders on the statement for October and November 1896.	1st Mar. 1897, No. 213 I.	22nd Jan. 1897, No. 87 I. 4th Dec. 1896, No. 1026 I. 24th Oct. 1896, No. 868 I. 5th Oct. 1896, No. 805 I. 4th July 1896, No. 562 I. 20th Aug. 1896, No. 715 I. 3rd Sept. 1896, No. 744 I.
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Land.—Notification for the acquisition of — required for excavating Pedamallam channel, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	2nd do. do. No. 217 I.	.....
Land.—Notification for the acquisition of — required for closing breaches in the Vasista right bank in 15th mile, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	2nd do. do. No. 218 I.	.....
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September 1896, III Circle, recorded with reference to G.O., No. 197 I., dated 24th February 1897.	3rd do. do. No. 222 I.	24th Feb. 1897, No. 197 I. & file.
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September 1896, V Circle, recorded with reference to G.O., No. 198 I., dated 24th February 1897.	3rd do. do. No. 223 I.	24th Feb. 1897, No. 198 I. & file.
Objectionable items.—Orders on statement of — in the accounts of Executive Engineers remaining unremedied to end of October and November 1896, IV Circle.	3rd do. do. No. 224 I.	4th Jan. 1897, No. 12 I. & file.

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Land.—Directing the Head Assistant Collector, Kistna, to procure the temporary occupation and use of certain — for strengthening the banks of Gudapadu branch of Medur channel.	6th Mar. 1897, No. 225 I.	.....
Land.—Notification for the acquisition of — required for Durbha revetment at Godilanka set, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	6th do. do. No. 226 I.	.....
Land.—Notification for the acquisition of — required for Macherla tank bed, Kistna district, ordered to be published in the *Fort St. George Gazette.*	6th do. do. No. 227 I.	.....
Land.—Notification for the acquisition of — required for the proposed Atchanta minor branch of Atchanta channel, Bank canal, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	6th do. do. No. 228 I.	.....
Land.—Notification for the acquisition of — required for a drainage channel, Sangam project, ordered to be published in the *Fort St. George Gazette.*	9th do. do. No. 235 I.	.....
Korugal anicut.—Ordered that the Resident at Hyderabad be requested to bring the fact of the non-opening of the scouring sluices of the — by His Highness the Nizam's authorities on 15th January last, as agreed upon, to the notice of that Government in order that a recurrence of it may be prevented.	9th do. do. No. 241 I.	4th June 1896, No. 331 I. 5th Nov. 1896, No. 573 I. 5th Nov. 1896, Origl. Nos. 928–29 I. 4th June 1896, Origl. Nos. 475–76 I.
The Resident at Hyderabad addressed ...	9th do. do. No. 242 I.	.....
Acquisition of trees.—Notification for the acquisition of 31 trees for improving the supply channel to Yerramasamudram tank, Salem district, ordered to be published in the *Fort St. George Gazette.*	9th do. do. No. 243 I.	.....
Progress Report.—E Form — of the (Periyár works) Madura division for January 1897, ordered to be forwarded to the Government of India.	10th do. do. No. 244 I.	.....
Forwarded	10th do. do. No. 245 I.	.....
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September 1896, IV Circle, recorded with reference to G.O., No. 224 I., dated 3rd March 1897.	10th do. do. No. 246 I.	3rd March 1897, No. 224 I. 4th Jan. 1897, No. 12 I. 13th Aug. 1896, No. 680 I. 1st Dec. 1896, No. 1018 I. 13th Oct. 1896, No. 828 I. 30th Sept. 1896, No. 794 I.
Land.—Notification for the acquisition of — required for the Allur swamp drainage channel affluent No. 2, Nellore district, ordered to be published in the *Fort St. George Gazette.*	10th do. do. No. 247 I.	.....

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Objectionable items.—Orders on statement of — in the accounts of Executive Engineers remaining unremedied to end of October and November 1896, VI Circle.	11th Mar. 1897, No. 248 I.	13th Feb. 1897, No. 151 I. 24th Nov. 1896, No. 993 I. 24th Oct. 1896, No. 866 I. 2nd Oct. 1896, No. 797 I. 24th April 1896, No. 369 I. 6th July 1896, No. 571 I. 20th Aug. 1896, No. 712 I. 7th Aug. 1896, No. 653 I. 22nd July 1896, No. 600 I. & file.
Suit.—Authorising, with remark, the defence at the public expense of Original — No. 709 of 1896 on the file of the District Munsif's Court at Tirumangalam brought by piece-worker Iyaloo Naidu for recovery of certain sum for work alleged to have been done by him on the Periyár channel excavation in the 1st reach.	11th do. do. No. 249 I.	.....
Reserve stock.—Sanctioning a limit of Rs. 3,500 for the — at the Periyár Head works, Madura division.	16th do. do. No. 261 I.	2nd Oct. 1896, No. 2838 W.
Land.—Notification for the acquisition of — required for complete repairs to Kallakuru branch, Weyeru canal, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	16th do. do. No. 262 I.	.....
Land.—Notification for the acquisition of — required for closing the breach in the Kistna left bank near Ibharampatam, Kistna district, ordered to be published in the *Fort St. George Gazette.*	16th do. do. No. 263 I.	.....
Land.—Notification for the acquisition of — required for assignment in exchange for service inam land taken up for the new Balighattam channel, Vizagapatam district, ordered to be published in the *Fort St. George Gazette.*	16th do. do. No. 264 I.	.....
Land.—Notification for the acquisition of — required for a road leading to the inspection bungalow at Porumamilla, Cuddapah district, ordered to be published in the *Fort St. George Gazette.*	16th do. do. No. 265 I.	.....
Periyár Works.—The progress report of the — for the quarter ending 31st December 1896, recorded.	16th do. do. No. 266 I.	.....
Land.—Notification for the acquisition of — required for excavating a supply channel for Karivedu and Kolathur tanks, Pálár anicut system, ordered to be published in the *Fort St. George Gazette.*	16th do. do. No. 267 I.	.....
Land.—Notification for the acquisition of — required for extending the weir of the tank in the Amanakkampatti village, Salem district, ordered to be published in the *Fort St. George Gazette.*	17th do. do. No. 276 I.	.....

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Objectionable items.—Orders on statement of — in the accounts of Executive Engineers remaining unremedied to end of October and November 1896, II Circle.	18th Mar. 1897, No. 278 I.	20th Jan. 1897, No. 81 I. 9th Oct. 1896, No. 814 I. 10th Sept. 1896, No. 755 I. 4th Aug. 1896, No. 636 I. 9th July 1896, No. 579 I. 13th Aug. 1896, No. 672 I.
Petition from the inhabitants of Sriprankanellur and other villages in the Srívaikuntam taluk, Tinnevelly district, praying that the northern bank of the Tambraparni river near their villages be raised to the level of the southern bank, recorded with reference to G.O., No. 72, Revenue, dated 5th February 1897.	18th do. do. No. 280 I.	19th March 1896, No. 3083 W. 24th March 1896, No. 1984 I. 20th April 1896, No. 1985 I. 21st May 1896, No. 4869 W. 5th June 1896, No. 337 D. 3rd July 1896, No. 6172 W. 6th July 1896, No. 751 D. 14th July 1896, No. 2271.
Staff boat of the Collector of Gódávari.—Proceedings, Revenue Department, sanctioning the sale of the — and referring to the Public Works Department the question of constructing a new boat for the Collector, communicated to the Chief Engineer for Irrigation for necessary action.	18th do. do. No. 281 I.	.....
Financial results of irrigation operations.—Government of India letter forwarding copies of a pamphlet showing the — throughout India for, and to close of the year 1895–96, communicated to officers concerned.	18th do. do. No. 282 I.	6th March 1896, No. 231 I. 14th Jan. 1896, Nos. 35–36 I. 11th Feb. 1896, No. $\frac{154}{A}$ I.
Progress reports of the Periyár works.—Government of India letter stating that the submission of the quarterly— may be discontinued, recorded.	18th do. do. No. 283 I.	4th Jan. 1897, No. 213 I.
Land.—Notifications for the acquisition of —required for excavating Medur and Krishnapuram branch channels, Kistna delta system, ordered to be published in the *Fort St. George Gazette.*	18th do. do. No. 284 I.	.....
Land.—The notification for the acquisition of — in Kumbakónam taluk required in connection with the execution of improvements to the Lower anicut, Lower Coleroon anicut system, approved, in G.O., No. 598 I., dated 22nd July 1896, ordered to be cancelled.	18th do. do. No. 285 I.	.....
Protective bund at Rajahmundry.—Proceedings, Local and Municipal Department, communicating to the Municipal Council, Rajahmundry, the Chief Engineer's note on the proposed — for such further action as may be necessary, communicated to Superintending Engineer, I Circle.	18th do. do. No. 286 I.	12th Dec. 1896, No. 4825 C. 28th May 1896, No. 462 I. & file.

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Irrigation works in Baluchistan.—Government of India review of the revenue report of the — for 1895–96, communicated to the Chief Engineer for Irrigation.	18th Mar. 1897, No. 287 I.	20th March 1896, No. 272 I.
Land.—Notification for the acquisition of — required for the embankment of the supply channel to the Gúdalúr tank, Chingleput district, ordered to be published in the *Fort St. George Gazette.*	19th do. do. No. 289 I.	.....
Land.—Directing the Head Assistant Collector, Kistna District, to procure the temporary occupation and use of certain — required for strengthening the banks of Ryves' canal.	19th do. do. No. 290 I.	.....
Flood bank of the Tambraparni river.—Proceedings, Revenue Department, passing orders on the question of raising the height of the old — between Srívaikuntam and Appankoil villages, Tinnevelly district, in order to prevent damage being done by floods, communicated to the Superintending Engineer, VI Circle, for necessary action.	19th do. do. No. 291 I.	.....
Land.—Notification for the acquisition of — required for the diversion of the Bank canal, Geddilanka Set, Gódávari delta system, ordered to be published in the *Fort St. George Gazette.*	19th do. do. No. 292 I.	.....
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September 1896, VI Circle, recorded with reference to G.O., No. 248 I., dated 11th March 1897.	19th do. do. No. 293 I.	11th March 1897, No. 248 I. & file.
Land.—Notification for the acquisition of —required for the extension of the bund of Dalapathisamudram tank, Tinnevelly district, ordered to be published in the *Fort St. George Gazette.*	19th do. do. No. 294 I.	.....
Engineering works of the Gódávari delta.—Authorising the Superintendent, Government Press, to forward a copy each of volumes I and II of the — to the Director of the Philadelphia Museums, free of cost.	19th do. do. No. 295 I.	.....
Diversion of the French channel at Pillanka.—Government of India letter pointing out that, as the estimate for the — in the Gódávari Eastern division has been classed as remunerative, a report on its remunerative character should be submitted, communicated to Superintending Engineer, I Circle, with remarks.	20th do. do. No. 296 I.	10th Feb. 1897, Nos. 133–34 I.
Funds.—Proceedings, Local and Municipal Department, requesting the Accountant-General to place, at the disposal of the Public Works Department, a sum of Rs. 675 as contribution made by the Gódávari District Board towards the cost of constructing certain ballacuts in the district, communicated to Superintending Engineer, I Circle, with remarks.	20th do. do. No. 297 I.	26th Feb. 1897, No. 202 I.

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
E Form Progress Report of the Periyár works.—Government of India letter stating that the submission of the monthly — may be discontinued, communicated to the Chief Engineer for Irrigation.	22nd Mar. 1897, No. 298 I.	9th Feb. 1897, Nos. 123–24 I.
Objectionable items.—The statement of — in the accounts of Executive Engineers remaining unremedied to end of September 1896, II Circle, recorded with reference to G.O., No. 278 I., dated 18th March 1897.	22nd do. do. No. 310 I.	18th March 1897, No. 278 I. & file.
Land.—Notification for the acquisition of — required for excavating Rameswaram lanka channel, Gódávari district, ordered to be published in the *Fort St. George Gazette.*	25th do. do. No. 319 I.	.....
Petition.—The ryots of Manur and other villages in Tinnevelly taluk informed in reply to their — for a sluice being opened in the Zemin Veeranam anicut, that no action can be taken as the Zemindar of Uthumalai has a right to the water taken off from the anicut which was constructed at his cost.	25th do. do. No. 320 I.	16th Oct. 1895, No. 71 T.N.
G.O., No. 93 I., dated 22nd January 1897.—Letter from Superintending Engineer, I Circle, reporting that — has been transferred to Superintending Engineer, II Circle, as the acquisition of land therein ordered is intended for the Ellore canal, Kistna district, recorded.	26th do. do. No. 322 I.	22nd Jan. 1897, No. 93 I.
Korugal anicut.—Ordered that the Resident at Hyderabad be requested to move the Nizam's Government to issue instructions to their subordinates for the due observance by them, of the rules mutually agreed upon by the two Governments in the matter of the periodical opening of the scouring sluices of the —, Bellary division.	26th do. do. No. 323 I.	10th Feb. 1897, No. 5 B.L. 4th June 1896, R. No. 331 I. 16th Nov. 1896, R. No. 57. 9th March 1897, R. No. 146 I. 4th June 1896, Nos. 475–77 I. 5th Nov. 1896, No. 928 I.
The Resident at Hyderabad addressed ...	26th do. do. No. 324 I.	.....
Objectionable items.—Orders on statement of — in the accounts of Executive Engineers remaining unremedied to end of December 1896, V Circle.	29th do. do. No. 329 I.	24th Feb. 1897, No. 198 I. 3rd March 1897, No. 223 I. 19th Dec. 1896, No. 1077 I. 24th Nov. 1896, No. 994 I. & file.
Funds.—The sum of Rs. 600 ordered by the Local and Municipal Department to be placed at the disposal of the Public Works Department for restoring the breaches in a portion of road No. 70 along the Coleroon right bank, Shiyali taluk, ordered to be treated as an addition to the Provincial grant for the current year under "43. Minor Works and Navigation."	31st do. do. No. $\frac{331}{A}$ I.	.....

Subjects.	Number and Date of Order.	Numbers and Dates of previous Orders.
Cultivation under the Kurnool-Cuddapah canal.—Proceedings of the Board of Revenue submitting letter from the Collector of Cuddapah reporting the cause of increase in the area of — in fasli 1305, recorded with reference to G.O., No. 303 I., dated 22nd March 1897.	31st Mar. 1897, No. 332 I.	.....
Funds.—The sum of Rs. 70 ordered by the Local and Municipal Department to be placed at the disposal of the Public Works Department for constructing a flight of steps to the Attili channel near Tetaly, Gódávari district, ordered to be treated as an addition to the current year's grant under "Provincial 43. Minor Works and Navigation."	31st do. do. No. $\frac{334}{A}$ I.	.....