

8724
Public Works (1896) Department.

G.O., No. 9649

DATED 30th October 1896

[Despatch Abstract.]

Revenue Inspectors. Pro: Revenue Depart-
ment sanctioning with remarks the inter-
tainment of certain additional — & persons
in the Godavari Dist. Comd. to S.E. Circle.

[illegible][illegible]

Government (1896) of Madras.
PUBLIC WORKS.

Spare copies.

SEPTEMBER.

Forwarding Proceedings approving, with remarks, the Superintending Engineer's proposal that he should be allowed a free hand in instituting measures for making good the damages caused by the late —, and sanctioning the grant of one month's pay to members of the petty establishment who were employed on works connected with the protection of the head works.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.

READ—the following papers:—

From Major W. L. C. BADDELEY, R.E., Superintending Engineer, II Circle, to the Chief Engineer for Irrigation, dated Bezwada, 13th August 1896, No. 1244 K.

I have the honour to submit a report upon the recent flood in the Kistna river.

2. The accompanying list of gauge readings taken between the 29th July and the 12th August shows the manner in which the river rose and fell. The maximum recorded level was 41.30, the previous highest flood being 40.01 in 1882.

3. On the 4th instant, as the river was still rising and the telegrams from Pagatur unfavourable, we prepared sand bags weighing from 170 to 250 lb. each, and with these, the sluices and head works were bunded to keep out the water which rose over the platforms from which the screw gearings are worked.

All low places were raised and where banks were being eaten away by the wash of the water, sand bags were packed in to form a revetment.

The tops of lock gates were raised by temporary arrangements of planks and sand bags, and every thing possible was done; about 15,000 bags were used. The head to be taken by the head sluices was fixed at not more than 14 feet, and the officers at various points down the canals were warned to open all escapes and be prepared to cut the banks when the water that came down the canals was more than they would safely carry. The new head sluice at Seetanagaram, although incomplete, proved invaluable for taking the head off the old sluice; had we not been able to hold up water in the chamber between the two sluices, we must have seriously damaged the canals below or allowed a dangerous head against the old head sluice.

4. During the 4th, 5th, 6th, the situation grew steadily worse, and when the retaining wall of the bank between the river and the canal on the Bezwada side began to settle down, I had doubts whether the river would not form a breach. If the wall had fallen, it would have been impossible to prevent the breach, the earth behind would have slipped forward into 25' of water, and the bank would have gone, leaving a wide gap through which the river would have poured into the main canal and thence over the delta system. On the western side, the leaks through the bank and left wing of the head sluice combined with the wash in the chamber dragged down the revetment and exposed the earth on the left bank, which we shall have difficulty in protecting for the remainder of the season. Soon after the strain on the works had ceased, more than half of the revetment on the right side of the chamber collapsed, thrusting out the retaining wall. We shall make temporary arrangements with Portland cement concrete in bags, and next year strong retaining walls must be built from sluice to sluice. If this had occurred while the flood was at its height, we could not have saved the Western delta canals. The front returns of the lock on the western side cracked and moved owing to settlement in the foundations. Arrangements are being made to shore up these portions, and it is hoped that this will be successful and enable navigation to be carried on for the remainder of the season.

5. It is not, I think, necessary that I should enter into further details of what was done to protect the head works, and I will, therefore, briefly state the damage done by the flood, as far as can be judged at present, and the measures that are, in my opinion, necessary to be taken if the Kistna district is not to run the risk of being reduced to the condition it was in fifty years ago; for the two deltas can only grow wet crops, and the destruction of the system of canals would deprive hundreds of thousands of people of the means of existence.

6. It must be remembered that the failure of the head works on either side of the river does not merely mean an appalling disaster that, after doing immense damage and causing great loss of life, will, in the course of a few years, be nearly forgotten; for it will be no question of repairs, the entire system in the delta affected will have to be reconstructed. The present works have taken over forty years to construct and they are rapidly approaching a stage when in any normal year at least 600,000 acres can be cultivated, giving a large revenue to Government and conferring great benefits upon more than a million of people. Considering, therefore, that we have been within a measurable distance of having both deltas wiped out, it is absolutely necessary to take steps to increase the margin of safety of the head works. I am of opinion that the present height of the head works on both sides of the river has been proved to be insufficient.

7. I will now proceed with the outline of the damage done:

River above anicut.—Left flood bank breached for about 450 feet in length, water passing into the valley of the Budameru and thence to the Collair lake. This bank protects the Nizam's Guaranteed State Railway and the East Coast Railway, the Ellore canal, and numerous villages and minor irrigation works; and it must be remade for the whole length of 10 miles of larger section, 12 feet wide at top with slopes of 2 to 1, the front slope being strongly pitched. I have given orders for the breach to be closed by a bank of at least this section; it will probably have to be larger, or a new alignment taken. It will be necessary to spend considerable sums on the proper maintenance of this bank, but this will be a trifle compared to the loss that will occur to the railways and canals from breaches. Had this bank breached lower down, I fear there would have been loss of life.

Right flood bank.—This gave anxiety, but it did not breach and has been patched up. If it breaches several feet of water would pass over the Southern Mahratta Railway near Tadepalli and the loss of life and damage done would be great. This bank also must be placed above suspicion. Work on these banks will be commenced as soon as the river permits.

Head sluice, Bezwada.—This must be raised *without adding more weight than absolutely necessary*, for the foundations are not on record, and though it stood the weight put upon it, the risk was one that was only taken owing to the emergency of the case. The weight distinctly reduced the shake and tremor in the sluice, which at one time was becoming excessive. A second regulator to form a chamber in which water can be raised to take the head off the sluice, is the only sound method of ensuring its stability; the advantage of this plan has also been proved at the Seetanagaram sluice. Moreover, the power of holding up water in rear of the sluices without wrecking the canals is of the greatest importance, and can be obtained in no other way. The parapet walls all round the nose and workshops will, of course, have to be raised to the same height as the parapet of the sluice. There is no difficulty in carrying out these works, but they will take some time to complete. Stoney's shutters should be used for the new regulator at Bezwada. Another great advantage of the double sluices will be that the canals will not be silted to the same extent that they have been on this occasion, as the quantity of water admitted through them will be much less. The flood water of the Kistna is always heavily charged with silt and it is a great advantage to let as little of it as possible into the canals.

Head lock, Bezwada.—The front gates must be raised and the lock converted from a single into a double one. It is not safe to trust to a single lock with such interests at stake.

Bank between the river and the Main canal.—This must be made stronger by facing with stone every part exposed to the action of water. The details of the work

to be done cannot at present be settled, but I have ordered some levelling to be commenced at once. The retaining wall of the bank between the river and the main canal, Bezwada, will require extensive repair and, perhaps, reconstruction.

Western delta—Head sluice.—This must be raised and all parapets round the tongues of earth connecting the sluice and lock must be treated in a similar manner. The new head sluice must be pushed on to completion and the chamber between the two sluices strongly floored, and it is certain that nothing but strong retaining walls will stand the action that goes on in this chamber. This chamber must be made absolutely reliable; if it had not been revetted we could not have held up water in it, and the Western delta canals would have had 13 feet of water down them, which would have caused serious damage. It is now impossible to hold up water in the chamber; the revetment did invaluable service and then failed, so if a heavy flood comes in September, we shall be compelled to pass more water down the canals than desirable.

Head lock.—This must be repaired, if possible, or the returns rebuilt; it must be converted into a double lock.

8. I now come to a question which requires much consideration. The effect of the railway bridge is to contract the waterway, as can be seen from the survey, and unless the bridge is lengthened by three spans of 300' on the eastern side, I fear that the anicut will some day be breached near the Bezwada under-sluices. The fall in the level of the river is revealing signs of damage to the anicut on the Bezwada side; but we cannot find out anything for certain for some months.

9. The survey I attach to this letter shows how very much the river has been contracted by the bridge and north training bank, and when it is considered that the bulk of the water passes through the nine spans commencing from the northern side, the reason for the heavy scouring action that now is going on below the apron, near the Bezwada under-sluices, is not far to seek. The bridge has twelve spans,—the spans 1, 2, 3 commencing from the right bank, do comparatively little work; 4, 5, 6, 7 and 8 pass the bulk of the water; 9, 10, 11 and 12 do more than 1, 2 and 3, but much less than the centre spans.

10. It is an axiom for the proper situation of an anicut that there shall be the freest possible escape for the water in rear; but what is the case at Bezwada? The original spread of the river has been throttled by the bridge and training bank, and during the flood the velocity of the water passing through the centre spans of the bridge was so great that, looking down upon it from the bridge, the effect was not that of water passing rapidly under a bridge, but more like the effect observed when water is discharged through an under-sluice.

The effect of this contraction is to produce back currents and whirlpools, which last year scoured out a hole 50 feet deep in the place referred to, and this scour hole will have increased this year, for, during the flood, the back currents and disturbance near the under-sluices were most marked.

As a proof of the evil effect produced by the bridge and training bank, I may observe that, since the construction of the bridge, a shoal of sand has been steadily increasing in size close to the north protection bund.

11. I must also point out that if the scour I allude to works back and takes down the under-sluices, it may cause a breach into the canal, which disaster would be equivalent to the failure of head works, and the consequences would be most serious as the Eastern delta system would be destroyed.

12. It appears to me from an examination of the survey that the water passing over the anicut, which is 3,700 feet average length during floods, pass into a basin which is contracted at its mouth by the fact that the centre spans of the bridge pass the bulk of the water. How far this tends to raise the level of the water above the anicut I cannot say, but about the back currents and disturbance and consequent danger it causes to the anicut, there is not a shadow of a doubt in my mind. I may remark that this is no new theory of mine. I have considered the protection bund a danger to the anicut ever since I have been in charge of the circle, and the state of the river below the anicut on the Bezwada side during the flood was such as to convince me that the interests of the anicut demand a freer escape of water in rear of it. The matter, in my opinion, is one that must be decided chiefly from the point of view of

the responsible Irrigation officers. To allow the bridge to continue in its present state is to court disaster to the Eastern delta system. I must also state my earnest conviction that the danger is one that will increase every year so long as the bridge is allowed to remain as it is.

13. *Flood banks below the anicut.*—On the eastern side serious breaches have occurred which will be attended to when possible; the banks will be made up, new alignments being necessary in places where the lankas or river margins have been washed away, as they must have been, in many places. The banks must be made stronger and be set back as far as possible; for, of course, these banks can only stand spill water. The amount of damage done to our conservancy works must be very great, but nothing is, as yet, definitely known.

On the western side, the flood banks below Kollur at the end of the first reach of the Bank canal have suffered severely, and here again the measures necessary and the extent of damage can only be known when the river subsides.

14. *Canals, Eastern delta—Main canal.*—Uninjured, but badly silted. *Bundur canal.*—Uninjured as far as Kankipad except for the breaches purposely made. The other reaches more or less damaged. There will be a great deal of work to do, but nothing special except in the first reach, where a powerful escape is an absolute necessity.

Ellore canal.—Conditions uncertain, as the water from the breach in the left flood bank of the Kistna attacked it, and also the Tammileru came down in flood. The canal is breached.

Ryves' canal.—Breached, but if nothing very serious happens it can soon be put right. Serious scours in rear of the regulator.

Canals, Western delta—Main canal.—Uninjured.

Commamur canal.—Uninjured.

Nizampatam canal.—Said to be breached at lower end.

Bank canal.—Damaged in places below first reach.

15. I cannot say that we are at the end of our troubles with these canals. The silt question alone is a serious one to face with six hundred thousand acres under cultivation, which will wither if the water-supply fails; but the main point has been gained, and that is the safety, for the time, of the head works. I say "for the time" advisedly, because I have doubts whether the head works in their present state would stand a flood of the same violence that they have just withstood.

16. I think I have now given a fairly clear outline of the events of the last few days, and I trust that the Government will allow me a free hand in carrying out such works as are absolutely essential for safety. The collection of materials should be begun at once, for the river will not be dry before March and we have only three months in each year to get in foundations or carry out repairs to the anicut and head works.

Plans and estimates for all necessary works will be prepared as soon as possible, but in some cases it will be advisable that I should issue orders for commencing work in anticipation of sanction, and I beg that my action in such cases may be approved.

17. I have already been informed by wire by the Chief Engineer, Public Works Department, that eight upper subordinates will be posted to the circle for work in connection with flood damages. The permanent staff will have to do all they know to restore irrigation and save crops.

18. In conclusion I have to state that work at Bezwada and Seetanagaram has been carried on night and day from the 1st to the 10th, and I trust that Government will be pleased to sanction a reward of one month's pay to the petty establishment employed at Bezwada and Seetanagaram on work connected with the protection of the head works, for they all worked hard and cheerfully, and their services were of the greatest value during an exceedingly anxious time. I append a list of the establishment so employed with their wages.

19. This report is merely a preliminary to the detailed accounts which I will submit as soon as pressure of work enables the Divisional officers to send in their reports to me.

ENCLOSURE.

Gauge Readings at Bezvada.

Pagatur.	Bezvada.	Date.
26	32.65	6 A.M., 29th July 1896.
40	35.05	" 30th "
43	36.83	" 31st "
48	38.25	" 1st Aug. "
49	39.55	" 2nd "
47	39.85	" 3rd "
50	40.05	" 4th "
53	40.70	" 5th "
54	41.20	" 6th "
	41.30	6 P.M., 6th "
50	41.30	6 A.M., 7th "
42	40.55	" 8th "
36	39.25	" 9th "
33	37.05	" 10th "
32	35.65	" 11th "
29	34.15	" 12th "

NOTE.—The Pagatur readings are received by telegrams from Kurnool. The crest of the anicut is 23.00. Previous highest F.L. 40.04 in 1882.

From the Executive Engineer, Kistna Northern Division, to the Superintending Engineer, II Circle, dated 7th September 1896, No. 304 S.E.

With reference to your No. 1404 K.N., dated 27th August 1896, I have the honour to forward a list of men belonging to the petty establishment, Head-quarter sub-division, whom I recommend for a gratuity of one month's pay for services rendered during the recent floods.

ENCLOSURE.

STATEMENT giving names and salaries of the Petty Establishment employed in Bezvada and Seetanagaram recommended for reward of one month's pay for service during the late flood.

Name.	Rank.	Salary.	Remarks.
M.R.Ey. Ch. Venkataramiah Naidu	Anicut Superintendent	Rs. A. P. 120 0 0	
" M. Buchirazupantulu	Boat Superintendent	50 0 0	
P. Seshayya	Lock Superintendent, Bezvada	15 0 0	
Syed Murtaza	Anicut lascar	7 0 0	
K. Ramaswamy	Do.	6 0 0	
Khasim Khan	Do.	7 0 0	
<i>Lock and Anicut Establishment charged to Works.</i>			
J. Anjanayulu	Anicut lascar	6 0 0	
M. Gopalaswamy	Do.	7 0 0	
Kajamiah	Do.	6 0 0	
Mahomed Esuff	Do.	7 0 0	
Nurahamud	Do.	6 0 0	
Shaik Hamud China	Lock lascar, Bezvada	6 0 0	
Shaik Mohiddin, Guntur	Anicut lascar	6 0 0	
Syed Buran	Do.	6 0 0	
Syed Alli	Lock lascar, Bezvada	6 0 0	
M. Varadappa	Anicut lascar	8 0 0	
K. Venkataraddi	Do.	6 0 0	
Ch. Venkataswamy	Do.	6 0 0	
T. Venkataswamy	Lock lascar, Bezvada	8 0 0	
A. Venkayya	Anicut lascar	6 0 0	
M. Veeraswamy	Lock lascar, Seetanagaram	8 0 0	
Shaik Hamud	Do. do.	6 0 0	
Shaik Siliman	Do. do.	6 0 0	
<i>Steamer crew.</i>			
N. Naganna	Sarang	22 8 0	Monthly wages calculated at daily rates given by the Workshop Superintendent for a month of 30 days.
C. Venkataswamy	Driver	22 8 0	
Syed Gouse	Lascar	10 5 0	
Y. Subbayya	Do.	10 5 0	
M. Petha Ramsing	Do.	9 6 0	
K. Seshayya	Do.	9 6 0	
M. China Ramsing	Do.	9 6 0	
B. Atchanna	Do.	9 6 0	
M. Chin Appadu	Do.	8 7 0	
K. Veerappa	Punt tindal	10 0 0	
Total		436 9 0	

(Signed) H. T. KEELING,
Ex. Engr., Kistna Northern Divn.

No. 1556 K.N.

Forwarded to the Chief Engineer for Irrigation with reference to his telegram, dated 26th August 1896, and in continuation of letter, No. 1244 K., dated 13th August 1896.

(Signed) W. L. C. BADDELEY, Major, R.E.,
Suptg. Engineer, II Circle.

11th September 1896.

No. 172 I.

Submitted to Government with reference to paragraph 2 of G.O., No. 669 I., dated 12th August 1896.

2. The Superintending Engineer gives in sufficient detail, in the above letter, the result of the late heavy floods in the Kistna, and the measures that were taken during their continuance for the preservation of the head works and the irrigation works below them. He asks to be allowed a free hand in instituting measures for making good the damages done, and guarding against their occurrence again. Considering the enormous interests concerned, it appears essential that this request may be granted. The conclusions Major Baddeley has come to, are sound and the proposals made by him may be carried out.

3. As regards the effect the railway bridge has had, and apparently will continue to have, in imperilling the safety of the anicut and head works and the whole of the Kistna delta system, the undersigned is in concord with the Superintending Engineer's views. The Government of India, the undersigned has been informed by the Consulting Engineer for Railways, has ordered Mr. Upcott, who arrived in Bombay yesterday, to proceed direct to Bezvada and consider this question, together with the Superintending Engineer and the Agent of the East Coast Railway. Their conjoint report may be awaited.

(Signed) R. R. E. DRAKE-BROCKMAN, Col., R.E.,
Chief Engineer for Irrigation.
17th September 1896.

ORDER—No. 789 I., dated 29th September 1896.

The Superintending Engineer's proposals recommended by the Chief Engineer for Irrigation are approved, but the departure from financial rules will be restricted as much as possible.

2. His Excellency the Governor in Council is pleased to accord the grant of one month's pay, amounting to Rs. 436-9-0, to the members of the petty establishment, referred to in paragraph 18 of the Superintending Engineer's letter.

3. The report regarding the Kistna Railway bridge referred to in paragraph 3 of the Chief Engineer's endorsement will be awaited.

4. A copy of these Proceedings will be forwarded to the Government of India.

[Here enter No. 790 I., dated 29th September 1896.]

(True Extract.)

(Signed) R. R. E. DRAKE-BROCKMAN, Col., R.E.,
Secretary to Government,
Irrigation Branch.

To the Superintending Engineer, II Circle.
" Chief Engineer for Irrigation.
" Chief Engineer, Public Works Department.
" Consulting Engineer for Railways.
" Examiner, Public Works Accounts.

ENDORSEMENT—No. 790 I., dated 29th September 1896.

Forwarded accordingly.

(By order.)

Col., R.E.,
Secretary to Government,
Irrigation Branch.

No 789 I. dated 29th Sept. 1896

PUBLIC WORKS DEPARTMENT,
IRRIGATION BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Under date the

Read the following

Letter from the Super. Engineer, Second Circle. (H.E. No. 1244-K dated 13 Aug. 1896)
Endorsement from do (H.E. No. 1556-KN dated 11 Sept. 1896)
Endorsement by the Chief Engr. for Engr. (H.E. No. 172-I dated 17 Sept. 1896)

13 Submitted to Government for
reference to para 2 of G.O. No. 669-
dated 12 August 1896.

2. The Superintending Engineer gives in sufficient detail in the above letter the result of the late heavy floods in the Kistna, and the measures that were taken during their course for the preservation of the Head Works and the irrigation works below them. He asks to be allowed a free hand in instituting measures for making good the damages done, and guarding against their occurrence again. Considering the enormous interests concerned, it appears essential that this request be granted. The conclusions

This having been dropped
from order it was sent to
Sent again in accordance.

17.9.96

Major Baddeley has come to a sound, and the proposals made by him may be carried out.

3. As regards the effect the Railway bridge has had, and apparently will continue to have, in imperilling the safety of the Ancient and Head Works, and the whole of the Krishna Delta System, the undersigned is in concord with the Superintending Engineer's views. The Government of India, the undersigned has been informed by the Consulting Engineer for Railways, has ordered Mr. Upcott, who arrived in Bombay yesterday, to proceed direct to Bezwada and consider this question together with the Superg. Engineer and the Agent of the East Coast Railway. Their conjoint report may be awaited.

No. 789. I. of 29th Sept 1896.

Order Thereon.

The Superg. Engineer's proposals recommended by the Chief Engineer for Irrigation are approved but

the departure from financial rules will be restricted as much as possible.

2. ^{His Excellency the Governor} ~~The Right Honble the Governor~~ in Council is pleased to accord the grant of one month's pay amounting to Rupees 436-9-0 to the members of the petty establishment referred to in para 18 of the Superg. Engineer's letter.

3. The report regarding the Railway bridge referred to in para 18 of the Chief Engineer's endorsement will be awaited.

4. A copy of these Proceedings will be forwarded to the Govt.

checked
12/11/96
To The Superg. Engineer, Second Circle.
Chief Engineer for Irrigation.
Chief Engineer, Public Works Dept.
Consulting Engineer for Railways.
Examiner, Public Works Accounts.

Recd
31/8/96

No. 790. I. of 29th Sept 1896.

Forwarded accor

33
When requested whether this may come to the notice of the Honble the Governor for the Govt. of India.
10/10/96
Recd
10/10/96

PUBLIC WORKS DEPARTMENT,
IRRIGATION BRANCH.

Read the following:—

H. E. the Governor
The Hon. Mr. Blair C. I. E.
The Hon. Mr. C. I. E.

Letter from the S. E. II Luck
of 13 Aug 1906 No 1244 K.
reporting on the late heavy
floods in the Krishna River.

FOR ORDERS.

1. I think these recommendations should be ap-
proved.
2. Mr. Brockman does not mention Major
Baddley's proposal to grant a month's pay
to the party establishment, the members of
which worked night & day for 10 days. I
think this recommendation should be accepted.
If my Hon. colleagues agree with me, I would
suggest that sanction be given by Telegraph.
This kind of recognition has so much more
effect, it gives quickly. (See para. 15)

15. 8. 96

18/8/96

18/8/96

I am to be sure all
necessary steps to put the
works in the condition & restore
them to their former state.
The Government have been
pleased to grant a
month's pay to the party
establishment.

The Superintending Engineer
gives in sufficient detail in
this above letter the result of
the late heavy floods in the
Krishna, and the measures ^{that} have
been taken during its continuance
for the preservation of the Head
works, and the irrigation works
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the enormous interests
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may be granted. The Com-
missioner Major Baddley
has come to our aid
and the proposals made
by him may be carried out.

FOR ORDERS.

As regards the effect
the Railway Bridge has
had and apparently will
continue to have in im-
pairing the safety of the
Ancient & Head work, and
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Delta system, I am
in accord with his views.
The Govt of India, I have
been informed by the for-
mer Surveying Engineer for Railways
has ordered Mr. K. P. C. C.
who arrived in Bombay
yesterday to proceed direct
to Durgam and consider
this question together with
the Superintending Engineer of
the E. C. Railway.
Their conjoint report may
be awaited.

Ordered

17/10
96

Public Works (189 6) Department.

CURRENT No. 8678

Order

From The Chief Engineer
for Irrigation

No. 172.J.

Dated 17th Sept 1896.

Received 29.9.96

Enclosures 5

Spare copies.

SUBJECT.

Reports on the
damages done
by the floods in
the Krishna in
August 1896.

[illegible]

G.O.	No.	Department.	Date.
	.		

Receipt
~~CURRENT~~ No. 263K.

From The Supg Engineer
2nd file

No. 1244 K

Dated 13. 8. 96

Received

Enclosures 3

Spare copies

SUBJECT.

Report on the heavy floods
in the Krishna in August
1896

[illegible][illegible]

Supg. Engineer's Office,
2nd Civil, Berwada,
13th August 1896.

Major W. L. C. Baddeley R. E.
Superintending Engineer,
Zambesi.

The Chief Engineer,
for Irrigation,
Madras.

Encls: 3
1 list of game mammals in,
1 Survey of the
1 list of birds.
3 (will follow)

I have the honour to submit
a report upon the recent flood in the
Hishia river.

2. The accompanying list of gauge readings taken between the 29th July and the 12th Augt shows the manner in which the river rose and fell. The maximum recorded level was 41.30, the previous highest flood being 40.04 in 1882.

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The tops of lock gates were raised by temporary arrangements of planks and sand bags and everything possible was done; about 15,000 bags were used. The head to be taken by the head sluices was fixed at not more than 14 feet and the officers at various points down the Canals were warned to open all escapes and be prepared to cut the banks when the water that came ~~to~~ down the Canals was more than they would safely carry. The new head sluice at Seethanagar, although incomplete, proved invaluable for taking the head off the old sluice; had we not been able to hold up water in the chamber between the two sluices, we must have seriously damaged the Canals below or allowed a dangerous head against the old head sluice.

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ruin would not form a breach. If the wall had fallen, it would have been impossible to prevent the breach, the earth behind would have stepped forward into 25' of water, and the bank would have gone, leaving a wide gap through which the ruin would have poured into the main Canal and thence over the Delta system.

On the Western side, the leaks through the bank and left wing of the head sluice combined with the wash in the chamber dragged down the revetment and exposed the earth on the left bank, which we shall have difficulty in protecting for the remainder of the season. Soon after the strain on the works had ceased, more than half of the revetment on the right side of the Chamber collapsed, thrusting out the retaining wall. We shall make temporary arrangements with Portland Cement ^{concrete} in bags and next year strong retaining walls must be built from sluice to sluice. If this had occurred while the flood was at its height, we could not have saved the ^{W delta} Canals. The front returns of the lock on the Western side cracked and moved owing to settlement in the foundations. Arrangements are being made to shore up these portions, and it is hoped that this will be successful and enable navigation to be carried on.

ge on for the remainder of the season.

5. It is not, I think, necessary that I should enter into further details of what was done to protect the head works, and I will therefore briefly state the damage done by the flood, as far as can be judged at present, and the measures that are, in my opinion, necessary to be taken if the River is not to run the risk of being reduced to the condition it was in fifty years ago; for the two deltas can only grow wet crops and the destruction of the system of canals would deprive hundreds of thousands of people of the means of existence.

6. It must be remembered that the failure of the head works on either side of the river does not merely mean an appalling disaster, but that after doing immense damage and causing great loss of life, will in the course of a few years be nearly forgotten, for it will be no question of repairs, the entire system in the Delta affected will have to be reconstructed. The present works have taken over forty years to construct and they are rapidly approaching a stage when in any normal year at least 600,000 acres can be cultivated, giving a large revenue to Government and conferring great benefits upon more than a million of people. Considering, therefore, that we

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have been within a measurable distance of having both deltas wiped out, it is absolutely necessary to take steps to increase the margin of safety of the head works. I am of opinion that the present height of the head works on both sides of the river has been proved to be insufficient.

7. I will now proceed with the outline of the damage done.

River above Anicut

Left flood bank breached for about 450 ft. in length, water passing into the valley of the Budameru and thence to the Leollair lake. This bank protects the N. G. S. Railway and the E. C. Railway, the Ellone Canal, and numerous villages and minor irrigation works, and it must be remade for the whole length of 10 miles of larger section, 12 feet wide at top with slopes of 2 to 1, the front slope being strongly pitched. I have given orders for the breach to be closed by a bank of at least this section, it will probably have to be larger, or a new alignment taken. It will be necessary to spend considerable sums on the proper maintenance of this bank, but this will be a trifle compared to the loss that will occur to the Railways and canals from breaches. Had this bank

bank breached lower down I fear there would have been loss of life.

Right flood bank

This gave anxiety but it did not breach and has been patched up. If it breaches several feet of water would pass over the S. M. Railway near Tadepalli and the loss of life and damage done would be great. This bank also must be placed above suspicion. Work on these banks will be commenced as soon as the river permits.

Head Sluice - Bezawada

This must be raised without adding more weight than absolutely necessary. For the foundations are not on record and though it stood the weight put upon it, the risk was one that was only taken owing to the emergency of the case. The weight distinctly reduced the shake and tremor in the sluice which at one time was becoming excessive. A second regulator to form a chamber in which water can be raised to take the head off the sluice is the only saved method of ensuring its stability, the advantage of this plan has also been seen been proved at the Sektanagaram Sluice. Moreover the power of holding up water in rear of the

the sluices without wrecking the Canal is of the greatest importance, and can be obtained in no other way. The parapet walls all round the nose and workshop will of course have to be raised to the same height as the parapet of the sluice. There is no difficulty in carrying out these works but they will take some time to complete. Storey's shutters should be used for the new regulator at Bezawada. Another great advantage of the double sluices will be that the Canals will not be silted to the same extent that they have been on this occasion; as the quantity of water admitted through them will be much less. The flood water of the Krishna is always heavily charged with silt and it is a great advantage to let as little of it as possible into the Canals.

Head lock - Bezawada

The front gates must be raised and the lock converted from a single into a double one. It is not safe to trust to a single lock with such interests at stake.

Bank between the River & the main Canal

This must be made stronger by facing with stone every part exposed to the action of water. The details of the work to be done cannot at present be settled, but I have ordered some revetment to be commenced at once. The retaining wall ~~for~~ of the farm between the river & the main Canal Bezawada will

will require extensive repair and perhaps reconstruction.

Western Delta Head Sluice

This must be raised and all parapets round the tongues of earth connecting the sluice and lock must be treated in a similar manner. The new head sluice must be pushed on to completion and the chamber between the two sluices strongly floored, and it is certain that nothing but strong retaining walls will stand the action that goes on in this chamber. This chamber must be made absolutely reliable; if it had not been remedied, we could not have held up water in it and the Western Delta Canals would have had 13 ft. of water down them, which would have caused serious damage. It is now impossible to hold up water in the chamber; the revetment did invaluable service and then failed, so if a heavy flood comes in Sept. we shall be compelled to pass more water down the Canals than desirable.

Head lock

This must be repaired if possible, or the returns rebuilt; it must be converted into a double lock.

8. I now come to a question which requires much consideration. The effect of the Railway bridge is to contract the water way, as can be seen from the Survey, and unless the bridge is lengthened by 3 spans of 300' on the Eastern side, I fear that the Ancient will some day be breached near the Begwada undersluices. The fall in the level of the river is revealing signs of damage to the Ancient on the Begwada side, but we cannot find out anything for certain for some months.

9. The Survey I attach to this letter shows how very much the river has been contracted by the bridge and North training bank, and when it is considered that the bulk of the water passes through the nine spans commencing from the Northern side, the reason for the heavy scouring action that now is going on, below the apron, near the Begwada undersluices, is not far to seek. The bridge has 12 spans, the spans 1, 2, 3, commencing from the right bank do comparatively little work, 4, 5, 6, 7 and 8, pass the bulk of the water, 9, 10, 11, and 12, do more than 1, 2, & 3, but much less than the centre spans. 10. It is an axiom for the proper situation of an ancient that there shall be the freest possible escape for the water in rear