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MADRAS RECORD OFFICE.

Government of Madras.

Public Works DEPARTMENT.

G.O. No. 558		Press Mis
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Dated	27	

Not to be folded or roughly handled

Read the following papers —

No 525 From the Acting Superintending Engineer, 4th Division, to the Chief Engineer for Irrigation, dated Madras, 18th November 1870, No. 3,424.

I HAVE the honour to forward, for the information of His Excellency the Governor in Council, the report on the feasibility or otherwise of acquiring an additional supply of pure water from the Cortilhar during the dry season, called

1 Report from Captain Scott, R.E., No 458, dated 10th November 1870
1 Plan

for in paragraph 3 of 17th August 1869, No 2,708
2 Captain Scott in this report enters fully into the subject, both with regards to the supply being received from the usual spring-channel, or in the novel mode proposed by Mr Assistant Engineer Bell

3. I quite concur with Captain Scott in the possibility of getting such a supply, but the quantity of water would be quite out of proportion to the heavy expense it would take to bring the water down from the head-works at the anicut to Madras

4 The channel or pipes would have to be kept quite clear of the two Cholaveram and Red Hill Tanks, as such a supply would be quite lost in such large reservoirs. If conveyed in an open channel there would be much wastage that, when delivered at Madras, the quantity would have dwindled down to something very small, as it could hardly be got down under a distance of 25 or 26 miles.

5. The supply, from experiments made at the sill of the under-slucce of the anicut, is only $1\frac{1}{2}$ millions of gallons per diem

6 The fall of the Cortilhar is so small, about 2 feet a mile, that the head of the proposed spring-channel would have to be carried very far up the river, and there would be a large annual expense to clear out this channel after heavy fresh in the river

7 Of the three points that Government more specially call for opinion are —
1st — Whether it can be made to flow naturally down the bed of the channel,
2nd — Or in cutting in the bed of the channel,
3rd — Or whether it would require to be artificially raised.

On the first and second points it could flow down the channel, but it would be better to cut a trench down the centre to confine it and not allow it to spread out; by taking it this way it would be of no use to get it to Madras, as it would be absorbed in the Cholaveram Tank and only keep up the supply in that reservoir, except the water is flowing through the sluice into the Red Hill Tank, which would never be the case in the hot weather, when this supply would be most required.

On the third point, in order to get anything like a large supply, the water would have to be collected on lower level than the sill of the head sluice and have to be lifted over this

8 In conclusion it appears, though a certain supply could undoubtedly be procured in the way suggested from the Cortilhar by a spring-channel, the supply would be small at the head, and there must be great wastage in conveying it in an open channel to Madras, which I consider, for reasons given above, must be kept quite separate from the present project. That, if brought down in pipes, it would cost so large a sum that the advantage gained would be quite inadequate to the cost

*Proceedings of the Madras Government Public Works Department,
25th February 1871*

From Captain A. de C. SCOTT, R.E., Executive Engineer, No. 6 or Madras Water Works Range, to the Superintending Engineer, 4th Division, dated Red Hills, 10th November 1870, No. 458

I HAVE the honour to inform you that, during the past season, in accordance with G. O., No. 2,708, of the 17th August 1869, I took measures to ascertain what quantity of water could be obtained from the Cortilliar river in dry weather by trenching the bed, and how such water could be best utilized for the supply of the tanks of the Madras Water Works and the town of Madras.

2 I have to report that, in my opinion, such a project is not feasible, that is to say the expenditure which would necessarily be incurred in conveying water from such a source to the reservoirs at Cholavaram and the Red Hills, or to Madras directly, would be out of all proportion to the benefit derived, as measured by the quantity which would be actually distributed.

3 While considering the question above proposed, I did not confine myself to the conditions enunciated, but endeavoured to ascertain whether any permanent construction could be devised for the collection and delivery of the water into the supply channel already excavated, which would answer in an economical point of view, and which, not requiring renewal after every fresh in the river, would have so far the advantage over the expedient of an open trench or channel mentioned in the G. O. above quoted, but the small inclination of the river bed prevents the economical application of every arrangement of the kind.

4 The Government have already had before them a scheme by Mr. Bell, Assistant Engineer, in which he proposes to attain the object in view by collecting the spring water at some distance above the outlet into the channel, but to all such arrangements the objection applies, that the result is incommensurate with the cost, and I have now only to record the observations which have been made, and the reasons which have led me to this conclusion.

5 A most cursory examination of the river in question during the dry season, as indeed of all other streams in this part of the country, is sufficient to satisfy any one that there is always available a considerable body of water below the surface of the sandy bed over which they usually flow. This is evidently derived not only from the surface, but also from the subsoil drainage of the land. In the case of the Cortilliar river, the bed is from 12 to 20 feet below the general surface of the country, but that bed consists of coarse loose sand for a further depth of from 8 to 14 or more feet, before the real formation of the country is reached, so that the bottom of the trough or drain into which water may flow is from 20 to 30 feet below the surface of the ground on either bank. This, which may be called the true bed of the river, has an inclination towards the sea, probably corresponding pretty nearly with that of the visible or sandy bed, and there is therefore a steady, though slow, movement of the drainage water which it contains in that direction. The supply of water from the subsoil, even in the dry season, appears to be always greater than the sandy bed can carry off, and this surplus forms the visible summer stream in contradistinction to that slower and invisible, but more considerable, one which pursues its course below the surface.

6 During the dry season which has past, the flow of water which was observable was carefully gauged by shutting off and plugging with clay all vents in the sluice of the anicut, as well as in that at the head of the supply channel, except one to which a gauge board was fitted. The depth of water flowing over the board was measured, and the discharge computed in the usual manner, and in this way it was found that the average quantity daily passing was only 1½ million gallons. It must be remarked, however, that the heading up of the water in the river necessary to give a free overfall from the waste board into the channel, would, by increasing the pressure on the bed, increase also the subterranean flow between the wells of the anicut, and thus diminish in an equal proportion the discharge gauged.

7. The mere interception of the summer flow of water promising but a small result, in accordance with the directions already received, the expedient of cutting a trench in the river bed was resorted to, but without producing any increase to the supply, and, in fact, the physical characteristics of the river precluded the possibility of any other result.

8 The plan which accompanies this report, and which represents the condition of the bed of the stream during the dry season, shows that, for a considerable distance above the site of the

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anicut recently constructed, there are pools and channels connecting them, which have been formed naturally. These vary in depth from 1 to 6 feet, and they have been traced to a distance of more than 3 miles above the head sluice to the supply channel leading to the reservoirs. It would thus appear that by a natural process that condition of things exists which would be produced by cutting an artificial channel in the sandy bed. The natural cuttings are filled with the spring water, and yet the effect in producing a flowing stream when measured over a gauge board, as above mentioned, is found to be inconsiderable.

9 It has been supposed that a trench could be cut in the bed of the river having a fall less than that of the bed, and yet sufficiently great to give a notable velocity to water collecting in it, and that as such an excavation would in its upward course enter into the sand more and more, it would pierce the water bearing stratum, and give rise to a considerable stream which would flow in the trench so cut.

10 There are two circumstances which in this case prevent the attainment of such a result. In the first place, the fall of the river is only at the rate of $2\frac{1}{2}$ feet per mile, and as the smallest inclination which could well be given to such a trench would be 2 feet per mile, it would only enter into the sand at the rate of $\frac{1}{10}$ ths of a foot in depth for every mile in length, and it would have to be seven miles long in order to reach the more copious springs. In the second place, the sand in which the trench is to be cut is so porous that water running in it would have a constant tendency to distribute itself. In every part of the course of the river the level at which the water stands or tends to stand, whether in the sand, or in natural pools, or in artificial trenches, is on any cross section of the bed the same, and the moment the surface of any such collection of water is raised by artificial means, it commences to disperse itself, and continues to do so till the balance is restored. This effect would certainly be produced in this case, and the water collecting in the trench could never accumulate beyond a certain point. It will be easily seen from such considerations that the scheme proposed is impracticable.

11 But though the water, as has been shown, cannot be made to collect at such a level as to flow by gravity into the supply channel, it would undoubtedly do so in any excavation in the river bed opposite to the head sluice, and there would be no difficulty in constructing a masonry chamber or well into which it might be received, and from which it could be pumped into the channel. The natural channels and pools found in the river bed might be improved by deepening the former and connecting the latter more effectually together, and there can be no doubt that if cost were no consideration, a supply of water could thus be thrown into the channel during the dry season, which would represent a daily consumption of 10 gallons per head of the population of Madras estimated at half a million.

12 The estimate made here of the quantity of water which would be available in the river does not rest on mere conjecture, for in order to obtain data which would assist in forming a judgment on the subject, an experiment was made by sinking a well 8 feet in diameter in the sand, the water from which was kept under by pumping, and it was found that from the area of filtering surface thus engaged, 25,000 gallons could be drawn during 24 hours. If we take into consideration the large surface which would be exposed by an excavation running up the river for, say a mile, the estimate made of the supply probably available is very moderate.

13 The objections to this scheme, which are it seems to me fatal, are —

1st —The cost of pumping, which would require the employment of a steam power.

2nd —The distance of the point of supply (the head sluice on the Cortilliar) from that of delivery (the tail of the municipal channel to Madras), involving enormous waste from evaporation and absorption in the interval.

3rd —The large annual cost of the maintenance of the collecting and delivery channels, the former in the bed of the river, the latter in the bed of the present supply channels, which would all be liable to destruction by every fresh in the river.

4th —The fact that if pumping is admitted at all into any scheme for supplementing the supply of water to Madras, it must be held to be unobjectionable as applied to the water of the

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Red Hill Tank, and we have available there below the sill of the municipal sluice at least 15 million cubic yards. There is obviously no comparison between the value of the river and the tank as sources of such supply in an economical point of view, the latter being in all respects the most suitable.

14 I do not consider it necessary to enter minutely into the details of the cost of pumping the water from the bed of the river, but a rough calculation gives the following results—
The lift has been assumed at 10 feet, and the quantity of water to be pumped in 24 hours 10 million gallons—

The number of horse power required is thirty
The cost at 1,400 Rupees per horse power is
The cost of fixtures and masonry work

RS
42,000
25,000
67,000

And the total cost
for about five

LS
6,900
2,000

Total annual expenses 8,900

The annual expenditure would be represented by the cost of coals and working for about five months in the year, and this would be—
150 days' fuel, at 46 Rupees per day
Management and sundries, depreciation of engine, etc

15 The distance of the head of the supply channel on the Cortilliar river from Madras is about 26 miles, and it is difficult to estimate, even approximately, the loss of water which would be due to absorption by the soil and evaporation if the supply were taken from the former point, but undoubtedly it would be considerable, and not less than 50 per cent on such a daily quantity as 10 million gallons.

16 The water would necessarily have to be conducted to Madras in a small channel of suitable capacity cut in the bed of the existing supply channels, and along the margin of the two tanks, for it would be useless to discharge it into the tanks themselves, as the loss from evaporation would absorb nearly the whole supply. Each fresh in the river would not only obliterate the channels in its own bed, but also those in the supply channel, which would be used to carry the river water at a considerable velocity, and it may therefore be assumed that at least once a year the whole would have to be re-excavated.

17 The sill of the lowest vent in the water tower, through which the supply for Madras is to pass into the municipal channel, is at the level of the crest of the old calingulah of the Red Hill Tank, so that there will always be in that tank a body of water equal to about 17 million cubic yards, which cannot be rendered available except by pumping, but which if pumping is resorted to can be utilized with the greatest ease. Moreover, the distance between the points of supply and delivery would in this case be only 8 miles. So long, therefore, as the supply at hand here is not disposed of, it would seem to be useless to discuss any scheme involving pumping from a more distant and precarious source.

18. It remains to consider that plan for obtaining water from the river which consists in forming a collecting space some distance above the point where the supply channel takes off, and leading the supply thus gathered in pipes to the channel. The water in this case would flow through the pipe under pressure of the head due to the inclination of the bed of the river, or in other words it would be necessary to place the reservoir in the bed at such a distance above the channel that even when sunk to the level of the springs the water in it should still stand some feet higher than the bottom of the supply channel.

19. The arrangement proposed by Mr Bell, and already alluded to, is of this kind. It will be seen from his report that he suggests the building of a tunnel of brick-in-chunam crossing the bed of the river one or more times, provision is to be made for admitting the spring-water into the tunnel through the sides, and as it collects it is led off in pipes, about eighteen inches in diameter, laid in the bed of the river with a slight inclination to the supply channel. Mr Bell anticipates that 400 yards of tunnelling will afford a supply which will keep an 18-inch pipe flowing full, but as he does not state what the inclination of this pipe is actually to be, the corresponding dis-

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charge cannot be calculated. The pipes are to be of earthenware, the joints set in cement or clay. The tunnel is to be of 9-inch brick-work, egg-shaped, the foundation and top in cement.

20 The first point to be noted is the effect which the small inclination of the bed of the river, we are dealing with, has on the details of this project when considered practically. The fall, as already stated, is $2\frac{1}{10}$ feet per mile, and the lower edge of the pipe outlet must be on the level of the sill of the head sluice to the supply channel in order to discharge into it. The bottom of the tunnel is to be 10 feet below the surface of the river bed, and an easy calculation shows that this tunnel must be placed at a distance of $5\frac{1}{2}$ miles from the channel up the river in order that a pipe laid from the sluice with an inclination of only one foot per mile may enter the bottom. Such a length of pipe would be out of the question, therefore the tunnel could not be built at the depth contemplated, and would have to rest on the sand, as the clay lies usually from 10 to 11 feet below the surface, or on a foundation of concrete or masonry 4 feet deep.

21 Under these circumstances the objections to the scheme under review may be summarized as follows—

1st—The difficulty in building a tunnel 400 yards in length in such a situation would be very great, and the expense incurred would be in proportion.

2nd—The tunnel would in time fill with silt and fine sand, and clearing it out would be a difficult matter.

3rd—The earthenware pipes when receiving full, if only 18 inches in diameter, would, with the greatest fall which could be given to them, discharge only $1\frac{1}{2}$ million gallons per diem, and in the upper portion of their course they would be difficult and expensive to lay.

22 The peculiarly unfavourable conditions under which any method of collection of the spring water, on the principle just described, must be applied to the river in question, render it impossible to suggest any modifications of Mr Bell's arrangement, which it would probably ever be worthwhile to carry into execution. It may be suggested, however, that a system of wells 8 or 10 feet in diameter, connected by horizontal iron pipes, might advantageously be substituted for the expensive tunnel; and these might be sunk in any number which would be found necessary. Data obtained by experiment would lead to the inference that 250 such wells would give a supply of 10 million gallons in 24 hours, and this could be led to the channel in pipes laid horizontally. As the spring water stands at a level $1\frac{1}{2}$ feet below the river bed, it may be assumed that the water in a pipe $2\frac{1}{2}$ miles in length would flow under a pressure due to a head of 6 feet, and under such conditions it would require a circular drain 3 feet in diameter to discharge the above quantity.

It is clearly improbable that circumstances would ever justify the expenditure which would be necessary in carrying out such a project, or any other of the kind referred in this paper.

No 22.

No. 526.

Note by the Chief Engineer for Irrigation.

CAPTAIN SCOTT's full and clear report on the subject of supplementing the supply of Madras during the dry season, by collecting water from the sandy bed of the Cortilliar, contains little on which it is necessary for me to remark. That there is a considerable quantity of water is well known, and a fair approximation to the quantity in motion below the surface has been obtained by the measures detailed in paragraph 6 of the Executive Engineer's letter. No doubt some water was passing under the anicut, but the quantity so escaping gauging was probably small compared with that which was passed into the channel, because it would be the produce of a comparatively small extent of the river bed. I do not think that any large quantity of water is derivable from land springs. The water available is that which is contained in the sand itself, and only a part of this can practically

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be extracted. If the level of the water below the surface of the sand were ascertained at intervals at any time after the cessation of the freshes, and if at a subsequent date another set of observations were made, and if also the quantity of water in a cubic foot of sand were ascertained, there would be good data for calculating the total quantity available in any given extent of the river bed. It would then be necessary to see at what inclination water would begin to leave the sand, and it would be found that a large part of the total contents of the sand strata is practically fixed except so far as it is liable to dissipation by evaporation

2. The collection of all available water could, I think, be most readily accomplished by building a wall across the river down to a nearly water-tight stratum of soil, and by placing on the up-stream side of this a bank of stone of large size next the wall, with successive layers of smaller and smaller stone, down to fine gravel, over it. By connecting this filter with a well all the water in motion could be drawn off. Were the water-tight subsoil far below the surface a double row of wells with puddle between them would be substituted for the wall up to 3 feet below the surface of the sand.

3. Captain Scott properly points out that there are, or will be, 15 to 17 millions of cubic yards, equivalent to, say, 2,600 millions of gallons, or 17 millions of gallons daily for five months in the Red Hills Lake below the level of the town supply sluice sill, and that it would be far more economical to utilize this water, which is within 10 miles of Madras, by pumping, than to bring water some 30 miles (including the channels in the river) from the Cortilliar. No scheme not involving pumping would answer, and I may add that it has always appeared to me that, if the water-supply of Madras had been limited to the quantity required for drinking and culinary purposes, and if this had been pumped to a suitable level, filtered at the Red Hills, and delivered thence by pipes, a more efficient arrangement than that under execution would have been secured at a less cost than that of the sanctioned scheme, while a constant instead of an intermittent supply would have been obtained.

FORT SAINT GEORGE,
2nd February 1871

(Signed) J. MULLINS, Major, R.E.,
Chief Engineer for Irrigation.

No. 527.

ORDER THEREON, 25th February 1871, No. 558.

IRRIGATION, No 32.

THE Government consider that the investigations made in accordance with the instructions contained in G. O. of the 17th August 1869, No 2,708, show that, while there is a very considerable subterranean flow of water in the Cortilliar during the dry season, which is not at present utilized, the works, which would be necessary to render this supply available, would be too costly to make it expedient to sanction their execution.

2 His Excellency the Governor in Council desires to express his approval of the manner in which Captain Scott has conducted the investigations, which have enabled the Government to come to a decision on this subject.

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25th February 1871.*

3. The papers will be communicated to the Municipal Commission of Madras.
(True Extract.)

Major, R.E.,

Joint-Secretary to Government.

To the Superintending Engineer, 4th Division
" Chief Engineer for Irrigation
" Municipal Commissioners, Madras
" Editor's Table.

any quantity of water which is raised from the Cortilliar river in dry weather, by trenching the bed, and how such water could be best utilised for the supply of the Tanks of the Madras Water Works and the Town of Madras.

2. *I have to report that in my opinion such a project is not feasible, that is to say the expenditure which would necessarily be incurred in conveying water from such a source to the reservoirs at Bholavaram and the Red Hills, or to Madras directly, would be out of all proportion to the benefit derived, as measured by the quantity which would be actually distributed.*

While

that, if the water-supply of Madras had been limited to the quantity required for drinking and culinary purposes, and if this had been pumped to a suitable level, filtered at the Red Hills, and delivered thence by pipes, a more efficient arrangement than that under execution would have been secured at a less cost than that of the sanctioned scheme, while a constant instead of an intermittent supply would have been obtained.

FORT SAINT GEORGE,
2nd February 1871

(Signed) J MULLINS, Major, R E,
Chief Engineer for Irrigation.

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458.

Madras Water Works Office
Red Hills 10th November 1870.

From

Captain A. de B. Scott R.E.
Executive Engineer &c. &c.
Madras Water Works Range.

To

The Superintending Engineer
4th Division.

Sir,

I have the honor to inform you that during the past season, in accordance with G.O. of the 17th August 1869, I took measures to ascertain what quantity of water could be obtained from the Cortiliar river in dry weather, by trenching the bed, and how such water could be best utilized for the supply of the Tanks of the Madras Water Works and the Town of Madras.

2. I have to report that in my opinion such a project is not feasible, that is to say the expenditure which would necessarily be incurred in conveying water from such a source to the reservoirs at Cholavaram and the Red Hills, or to Madras directly, would be out of all proportion to the benefit derived, as measured by the quantity which would be actually distributed.

W. H. L.

3. While considering the question above proposed I did not confine myself to the conditions enunciated, but endeavoured to ascertain whether any permanent construction could be devised for the collection and delivery of the water into the supply channel already excavated, which would answer in an economical point of view, and which, not requiring renewal after every fresh in the river, would have so far the advantage over the expedient of an open trench or channel mentioned in the G. O. above quoted; but the small inclination of the river bed prevents the economical application of every arrangement of the kind.

4. The Government have already had before them a scheme by Mr. Bell Assistant Engineer, in which he proposes to attain the object in view, by collecting the spring water at some distance above the outlet into the channel. But to all such arrangements the objection applies, that the result is incommensurate with the Cost, and I have been made, and the reasons which have led me to this conclusion.

5. A most cursory examination of the river in question during the dry season, as indeed of all other streams in this part of the Country, is sufficient

117
to satisfy any one that there is always available a considerable body of water below the surface of the sandy bed over which they usually flow. This is evidently derived not only from the surface, but also from the subsoil drainage of the land. In the case of the Bartelliar river, the bed is from 12 to 20 feet below the general surface of the country; but that bed consists of coarse loose sand for a further depth of from 8 to 14 or more feet, before the real formation of the country is reached; so that the bottom of the trough or drain into which water may flow, is from 20 to 30 feet below the surface of the ground on either bank. This which may be called the true bed of the river has an inclination towards the sea, probably corresponding pretty nearly with that of the visible or sandy bed and there is therefore a steady though slow movement of the drainage water which it contains in that direction. The supply of water from the subsoil, even in the dry season, appears to be always greater than the sandy bed can carry off, and this surplus forms the visible summer stream in contradistinction to that slower and invisible but more considerable one which pursues its course below the surface.

During

b. During the dry season which has past, the flow of water which was observable was carefully gauged by shutting off and plugging with clay all vents in the sluice of the annicut, as well as in that at the head of the supply channel, except one to which a gauge board was fitted. The depth of water flowing over the board was measured, and the discharge computed in the usual manner, and in this way it was found that the average quantity daily passing was only $\frac{1}{4}$ Million gallons.

It must be remarked however, that the heading up of the water in the river necessary to give a free overfall from the waste board into the channel, would be increasing the pressure on the bed increase also the subterranean flow between the wells of the annicut, and thus diminish in an equal proportion the discharge gauged.

7. The mere interception of the summer flow of water promising but a small result, in accordance with the directions already received, the expedient of cutting a trench in the river bed was resorted to, but without producing any increase to the supply; and in fact the physical characteristics of the river precluded the possibility of any other result.

8. The plan which accompanies this report and which represents the condition of the bed of the stream during the dry season, shows that for a considerable distance

15 ✓ 8
distance above the site of the annicut recently constructed, there are pools, and channels connecting them, which have been formed naturally. These vary in depth from 1 to 6 feet, and they have been traced to a distance of more than 3 miles above the head sluice to the supply channel leading to the Reservoir. It would thus appear that by a natural process that condition of things exists, which would be produced by cutting an artificial channel in the sandy bed. The natural cuttings are filled with the spring water, and yet the effect in producing a flowing stream when measured over a gauge board as above mentioned, is found to be inconsiderable.

9. It has been supposed that a trench could be cut in the bed of the river having a fall less than that of the bed, and yet sufficiently great to give a notable velocity to water collecting in it, and that as such a deep cavation would in its upward course enter into the sand more and more, it would pierce the water bearing stratum, and give rise to a considerable stream which would flow in the trench so cut.

There

10.

There are two circumstances which in this case prevent the attainment of such a result:— in the first place, the fall of the river is only at the rate of $2\frac{8}{10}$ feet per mile, and as the smallest inclination which could well be given to such a trench would be 2 feet per mile, it would only enter into the sand at the rate of $\frac{8}{10}$ of a foot in depth for every mile in length, and it would have to be seven miles long in order to reach the more copious springs:— in the second place, the land in which the trench is to be cut is so porous, that water running in it would have a constant tendency to distribute itself. In every part of the course of the river the level at which the water stands or tends to stand, whether in the sand, or in natural pools, or in artificial trenches, is on any cross section of the bed the same; and the moment of the surface of any such collection of water is raised by artificial means, it commences to disperse itself, and continues to do so till the balance is restored. This effect would certainly be produced in this case, and the water collecting in the trench could never accumulate beyond a certain point.

It

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It will be easily seen from such considerations that the scheme proposed is impracticable.

11. But though the water as has been shown cannot be made to collect at such a level as to flow by gravity into the supply channel, it would undoubtedly do so in any excavation in the river bed opposite to the head sluice and there would be no difficulty in constructing a masonry chamber or well into which it might be received, and from which it could be pumped into the channel. The natural channels and pools found in the river bed might be improved by deepening the former and connecting the latter more effectually together, and there can be no doubt that if cost were no consideration, a supply of water could thus be thrown into the channel during the dry season, which would represent a daily consumption of 10 gallons per head of the population of Madras estimated at $\frac{1}{2}$ a million.

12. The estimate made here of the quantity of water which would be available in the river does not rest on mere conjecture for in order to obtain data which would assist in forming a

a judgment on the subject, an experiment was made by sinking a well 8 feet in diameter in the sand the water from which was kept under pressure by pumping and it was found that from the area of filtering surface thus engaged, 25000 gallons could be drawn during 24 hours. If we take into consideration the large surface which would be exposed by an excavation running up the river for say a mile, the estimate made of the supply probably available is very moderate.

13. The objections to this scheme which are it seems to me fatal are, —
1st The cost of pumping which would require the employment of a steam power.
2^d The distance of the point of supply (the Head sluice on the Cortelliar) from that of delivery (the tail of the municipal channel to Madras) involving enormous waste from evaporation and absorption in the interval.
3^d The large annual cost of the maintenance of the collecting and delivery channels, the former in the head of the river, the latter in the head of the present channels, which would all be liable to destruction by every fresh in the river.

The

174/3
4th The fact that if pumping is admitted at all in any scheme for supplementing the supply of water to Madras it must be held to be unobjectionable as applied to the water of the Redhill Tank, and we have available there below the sill of the Municipal sluice at least 15 million Cubic yards. There is obviously no comparison between the value of the River and the Tank as sources of such supply, in an economical point of view, the latter being in all respects the most suitable.

14. I do not consider it necessary to enter minutely into the details of the cost of pumping the water from the head of the river, but a rough calculation gives the following results.
The lift has been assumed at 10 feet and the quantity of water to be pumped in 24 hours 10 million gallons.

The number of horse power required is thirty.
The cost at 1400 Rupees per horse power is Rs. 42,000.
The cost of fixtures & masonry work Rs. 25,000.
And the total cost Rupees 67,000.

The annual expenditure would be represented by the cost of coals and working for about five months in the year and this would be:

150 days fuel at 46. Rupees per day Rs 6,900
Management and sundries }
Depreciation of Engine 8% } ————— 2,000

Total annual expenses ————— 8,900.

15. The distance of the head of the supply channel on the Cortelliar river from Madras is about 26 miles, and it is difficult to estimate even approximately the loss of water which would be due to absorption by the soil and evaporation if the supply were taken from the former point, but undoubtedly it would be considerable, and not less than 50 per Cent on such a daily quantity as 10 million gallons.

16. The water would necessarily have to be conducted to Madras in a small channel of suitable capacity cut in the bed of the existing supply channel, and along the margin of the two tanks, for it would be useless to discharge it into the tanks themselves as the loss from evaporation would

would absorb nearly the whole supply. Each fresh in the River would not only obliterate the channels in its own bed but also those in the supply channel which would be used to carry the river waters at a considerable velocity, and it may therefore be assumed that at least once a year the whole would have to be re-excavated.

17. The sill of the lowest vent in the water tower through which the supply for Madras is to pass into the Municipal Channel is at the level of the crest of the old Calingula of the West Hill Tank, so that there will always be in that tank a body of water equal to about 12 million Cubic yards, which cannot be rendered available except by pumping, but which if pumping is resorted to can be utilised with the greatest ease. Moreover the distance between the points of supply and delivery would in this case be only 8 miles. So long therefore as the supply at hand here is not disposed of, it would seem to be useless to discuss any scheme involving pumping from a more distant and precarious source. Jf

18.

It remains to consider that plan for obtaining water from the river which consists in forming a collecting space some distance above the point where the supply channel takes off, and leading the supply thus gathered in pipes to the channel. The water in this case would flow through the pipe under pressure of the head due to the inclination of the bed of the river or in other words it would be necessary to place the reservoir in the bed at such a distance above the channel that even when sunk to the level of the springs the water in it should still stand some feet higher than the bottom of the supply channel.

19.

The arrangement proposed by Mr. Bell and already alluded to is of this kind. It will be seen from his report that he suggests the building of a tunnel of brick in Chunan crossing the bed of the river one or more times, provision is to be made for admitting the spring water into the tunnel through the sides and as it collects it is led off in pipes about eighteen inches in diameter laid in the bed of the river with a slight inclination

21012

to the supply channel. Mr. Bell anticipates that 400 yards of tunnelling will afford a supply which will keep an eighteen inch pipe flowing full, but as he does not state what the inclination of this pipe is actually to be the corresponding discharge cannot be calculated. The pipes are to be of earthen ware, the joints set in cement or clay. The tunnel is to be of nine inch brick work, egg shaped, the foundation and top in cement.

20.

The first point to be noted is the effect which the small inclination of the bed of the river we are dealing with, has on the details of this project when considered practically. The fall as already stated is $2\frac{8}{10}$ feet per mile, and the lower edge of the pipe outlet must be on the level of the sill of the head sluice to the supply channel in order to discharge into it. The bottom of the tunnel is to be 10 feet below the surface of the river bed - and an easy calculation shows that this tunnel must be placed at a distance of $5\frac{1}{2}$ miles from the channel up the river in order that a pipe laid from the sluice with an inclination of only one foot per mile may enter the bottom. Such a length of pipe

pipe would be out of the question, therefore the tunnel could not be built at the depth contemplated and would have to rest on the sand, as the clay lies usually from ten to eleven feet below the surface or on a foundation of concrete or masonry four feet deep.

21. Under these circumstances the objections to the scheme under review may be summarised as follows:

1st The difficulty in building a tunnel ^{so} long in length in such a situation would be very great and the expense incurred would be in proportion.

2nd The tunnel would in time fill with silt and fine sand and clearing it out would be a difficult matter.

3rd The larger the pipes when receiving silt if only 18 inches in diameter would with the greatest fall which could be given to them discharge only $1\frac{1}{4}$ million gallons per diem, and in the upper portion of their course they would be difficult and expensive to lay.

22. The peculiarly unfavourable conditions under which any method of collection or disposal

21/3
on the principle just described, must be applied to the river in question, renders it impossible to suggest any modifications of Mr. Bell's arrangement - which it would probably never be worth while to carry into execution. It may be suggested however that a system of wells eight or ten feet in diameter, connected by horizontal iron pipes, might be advantageously be substituted for the expensive tunnel; and these might be sunk in any number which would be found necessary; data obtained by experiment would lead to the inference that such wells would give a supply of 10 million gallons in 24 hours, and this could be led to the Channel in pipes laid horizontally. As the spring water stands at a level $1\frac{1}{2}$ feet below the river bed it may be assumed that the water in a pipe $2\frac{1}{2}$ miles in length would flow under a pressure due to a head of six feet, and under such conditions it would require a circular drain $3\frac{1}{2}$ feet in diameter to discharge the above quantity.

It is clearly improbable that circumstances would

would ever justify the expenditure which
would be necessary in carrying out such a project
or any ^{other} of the kind referred to in this paper.

I have the honor to be
Sir

Your most Obedt servant

Adm. Scott.

Captain R.E.

Executive Engineer M.D.D.

Supt. Engr. Office
Madras 18th November 1870

L. L. Milneson R.E.
Sg. Superintending Engineer & M.D.D.

John Mullins R.E.
Chief Engineer for Irrigation

I have the honor to forward for the infor-
mation of the Governor in Council
the feasibility or otherwise of acquiring
a supply of pure water from the
tanks the dry season, called for
by the August 1869 - No. 2708.
Captain Scott in this report enters
subject both with regards to the
received from the usual spring
in the novel mode proposed by
Capt Engineer Bell

I quite concur with Captain Scott in
the propriety of getting such a supply, but the quantity
of water would be quite out of proportion to the
heavy expense it would take to bring the water
down from the head works, at the distance to
Madras.

The channel or pipes would have to
be kept quite clear of the two Choluvaram and
Red Hill Tanks, as such a supply would be
quite lost in such large reservoirs.

Executed

The Key center Engineer
Madras water works
to the Supt Engineer
H. Division -

Date 6/10/82
Recd { New Embellish
1892
1/52 1/37 1/57 1/71
1/458
1/453

Gives explanation
as to the quantity of water
to be obtained from the
Cortellian during the
dry seasons.

Sd/- J. C. (Official) D. 27/11/70
 Madras 13 November 1870

1: 3424

From, Colonel L. E. Wilkerson R B
Ag. Superintending Engineer 4th Div.

To, Major John Mullins R E.
Chief Engineer for Irrigation

Ch,

Enclosures 2
1 Report from
Capt Scott R B
No 458 dated 10
November 1870
1 Plam

2 I have the honor to forward for the information of His Excellency the Governor in Council,
3 the report on the feasibility or otherwise of acquiring
4 an additional supply of pure water from the
5 Cortinaur during the dry season, called for
6 in Part 3 of 17th August 1869 No. 2708.
7 Captain Scott in this report enters
8 fully into the subject both with regards to the
9 supply being received from the usual spring
10 channel, or in the novel mode proposed by
11 Mr. Assistant Engineer Bell.
12 I quite concur with Captain Scott, in
13 the possibility of getting such a supply, but the quantity
14 of water would be quite out of proportion to the
15 heavy expense it would take to bring the water
16 down from the head works, at the United to
17 Madras.
18 The channel or pipes would have to
19 be kept quite clear of the two Choleraeum and
20 Red Hill Tanks, as such a supply would be
21 quite lost in such large reservoirs.

If conveyed in an open channel, there would be much wastage that when delivered at Madras, the quantity would have dwindled down to something very small, as it could hardly be got down under a distance of 25 or 26 miles.

5 The supply from experiments made at the sill of the under sluice of the munnicut is only $1\frac{1}{4}$ millions of gallons per diem.

6 The fall of the Cortelliar is so small about 2 feet a mile that the head of the proposed spring channel would have to be carried very far up the river, and there would be a large annual expense to clear out this channel after heavy fresh in the river.

7 Of the three points that Government more specially call for opinion are

1st, whether it can be made to flow naturally down the bed of the channel.

2nd, or in cutting in the bed of the channel.

3rd, or whether it would require to be artificially raised.

On the 1st and 2nd points it could flow down the channel, but it would be better to cut a trench down the centre to confine it, and not allow it to spread out, by taking it this way, it would be of no use to get it to Madras, as it would be absorbed in the Cholavaram Tank, and only keep up the supply in that reservoir except ~~when~~ the water is flowing through the sluice

2905
sluice into the Red Hill Tank which would never be the case in the hot weather when this supply would be most required

On the 3rd point in order to get ^{any} like a large supply, the water would have to be collected at a lower level than the sill of the head sluice and have to be lifted over this.

8 In conclusion it appears that a certain supply could undoubtedly be procured in the way suggested from the Cortelliar by a spring channel, the supply would be small at the head, and there must be great wastage in conveying it in an open channel to Madras, which I consider for reasons given above must be kept quite separate from the present project. That if brought down in pipes, it would cost so large a sum that the advantage gained would be quite inadequate to the cost.

I have the honor to be
Sir

Your most obedient st.

Wm Wiersa Col RB
Supg. Buzs. H. W. D.

practically be extracted. If the level of the water below the surface of the sand were ascertained at intervals at any time after the cessation of the freshes, and if at a subsequent date another set of observations were made; & if also the quantity of water in a cubic foot of sand were ascertained, then would be good data for calculating the total quantity available in any given extent of the river bed. It would then be necessary to see at what inclination water would begin to leave the sand, and it would be found that a large part of the total contents of the sand strata is practically fixed except so far as it is liable to dissipation by evaporation.

2. The collection of all available water could, I think, be most readily accomplished by building a wall across the river down to a nearly watertight stratum of soil, & by placing on the upstream side of this a bank of stone of large size next the wall, with successive layers of

smaller

smaller & smaller stones down to fine gravel over it. By connecting this filter with a well all the water in motion could be drawn off & were the watertight subsoil far below the surface a double row of wells with puddle between them would be substituted for the wall up to 3 feet below the surface of the sand.

3. Captain Scott properly points out that there are & will be 15 to 17 millions of cubic yards, equivalent to say 2600 millions of gallons or 17 millions of gallons daily for 5 months, in the Hills Lake below the level of the Town supply since all, & that it would be far more economical to utilize this water, which is within 10 miles of Madras by pumping, than to bring water some 30 miles (including the channels in the river) from the Colletar. & a scheme not involving pumping would answer, and I may add that it has always appeared to me that, if the water supply of Madras had been limited to

to the quantity required for drinking and culinary purposes, and if this had been pumped to a suitable level, filtered at the Red Hills, and delivered thence by pipes, a more efficient arrangement than that under execution would have been secured at a less cost than that of the sanctioned scheme, while a constant instead of an intermittent supply would have been obtained.

W. L. Williams
 Chief Engineer for Irrigation
 The Secretary to Government
 P. W. Dep.
 Fort St. George
 2nd February 71

Public Works Department
 No 558
 Order of the Madras Government
 Under date the 25th Feb 71
 Read the following

for { H.E. No 22 of 2nd February 1871
 The Government consider that the investigations made in accordance with the instructions contained in P.O. of the 17th August 1869, No 2708, show that, while there is a very considerable quantity of water in the Barliar during the dry season, which is not at present utilized (except to a partial extent) the works which would be necessary to render ^{the same} ~~the same~~ available would be too costly to make.

No 526
 6th Feb 71 P. W. Dep.

to the quantity required for drinking
culinary purposes, and if this had
led to a suitable level, filtered at the
and delivered thence by pipes, a more
arrangement than that under execution
have been secured at a less cost than
of the sanctioned scheme, while a continuous
of an intermittent supply would have
obtained.

1st St George
2nd February 71

Chief Engineer for
The Secretary to Govt

P. M. Dep.

1871
The Chief Engineer
for Irrigation

The Secretary to
Government

Dated 2nd
Feb 71

No 22
Capt 3
Note on Captain Scott's
report on the subject of sup-
plementing the supply of
Madras during the dry
season by collecting water
from the sand bed of
the Coleroon

No 558 24 Feb 71

Public Works Department
No 558

Proceedings of the Madras Government
Under date the 25th Feb 71
Read the following

From The Chief Engineer for
Irrigation. } H.E. No 22 of 2nd February 1871

It is my great care to
report. I would recommend
it to the Government
to be the Government
the selection of the
S. M. Ferrar's flow

The Government con-
sider that the investi-
gations made in accordance
with the instructions con-
tained in G.O. of the
17th August 1869 No 5708
show that, while there is
a very considerable quantity
of water in the Coleroon
during the dry season,
which is not at present
utilized (except to a
partial extent) the works
which would be necessary
to render the whole available
would be too costly to
make.

to make it expedient to
sanction their execution.

(5)

ed 2. His Excellency the
Governor in Council
as desired to express his
approval of the manner
in which Captain Scott
has conducted the inves-
tigation which have
enabled the Government
to come to a decision on
this subject.

by 7/4/21

Enc

3. The paper will
be communicated
to the Municipal
Commissioner of Mad.

35
4

The Capt. & Major & ...
" Capt. & Major for ...
Municipal Commissioners
Editor's Table

July 14 1863

Pro 17 August 1863

39

make it expedient to
 sanction their execution.
 &c. His Excellency the
 Governor in Council
 decided to express his
 approval of the manner
 in which Captain Scott
 has conducted the inves-
 tigation, which has en-
 abled the Government
 to come to a decision on
 this subject.

by 7/4/71

Per

3. The paper will
 be communicated
 to the Municipal
 Commission of Mad.

25/1/71

1/577
 Govt. of 1871 Madras.
 PUBLIC WORKS.

To The Superintending Engr
 4th Division

Date
 Recd

G O. 25 Feb 1871, No. 558.

Nos. 525 @ 527

Under the heading 'Receives'...
 The Government has
 been informed that
 the water supply in
 the dry season is
 being improved by
 the construction of
 a new reservoir.

Editor's Table
 Date 1/5/71