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MADRAS RECORD OFFICE.

Government of Madras.

Revenue DEPARTMENT.

G.O. No. 1982 Press
473. 474 Mis.
Dated 24 — 8 — 1867.

Not to be folded or roughly handled

Proceedings of the Madras Government, Revenue Department,
24th August 1867.

No. 473. Read the following Proceedings of the Madras Government in the Public Works Department:—

Requesting the Superintending Engineer of the 1st Division to furnish, in communication with the Collector of Godavery, the information required by the Government of India in connection with Major Haig's Report on the navigation of the Kanhan and Wynegunga rivers. } (Here enter 19th August 1867, No. 2,525.)

No. 474. ORDER THEREON, 24th August 1867, No. 1,982.

Miscellaneous. Communicated to the Revenue Board.

(True Extract.)

(Signed) F. H. WILKINSON,
Acting Under Secretary to Government.

To the Board of Revenue, with Proceedings Public Works Department, No. 2,525, with its two Enclosures (to be returned when no longer required.)

Exd. S. T. Augustin.

Proceedings of the Madras Government, Public Works Department, 19th August 1867.

No. 430. Read the following letter from the Secretary to the Government of India, Public Works Department, (Civil Works—Communications,) to the Secretary to the Government of Madras, in the Public Works Department, dated Simla, 11th July 1867, No. 506C:—

1. I am directed by the Governor General in Council to forward copies of a report and letter by Major Haig on the navigation of the Kanhan and Wynegunga rivers, and the question of increasing the supply of water for irrigation in the Godavery Delta.

Report dated 14th December 1866.
Letter dated 13th April 1867, No. 502.

2. The Government of India is not disposed to entertain any project for extensions of the Godavery navigation works till those now in hand are approaching completion; but His Excellency in Council will be glad to be informed, meanwhile, of the real facts of the case as regards the alleged short supply of water for irrigation in the delta. I am, therefore, to draw special attention to paragraphs 129 to 136 of the enclosed report, and to Major Haig's letter of 13th April, and to request that, with the permission of the Madras Government, information on this point may be supplied as early as practicable under some such heads as those suggested by Major Haig.

No. 431. ORDER THEREON, 19th August 1867, No. 2,525.

CIVIL WORKS, No. 55.

Forwarded to the Superintending Engineer of the 1st Division, who will, in communication with the Collector of the Godavery District, furnish the information required by the Government of India on the points noted in paragraph 132 of Major Haig's report, and referred to in paragraph 7 of that Officer's letter of the 13th April last, No. 502.

(True Extract.)

(Signed) J. H. M. SHAW STEWART, Major, R. E.,
Under Secretary to Government.

To the Superintending Engineer, 1st Division, with two Enclosures.
" Revenue Department, with do.

Exd. S. T. Augustin.

Report on the Navigation of the Kanhan and Wynegunga Rivers.

Dated 14th December, 1866.

From—Major F. T. Hale, R. E., *Sepdy. Engr., Upper Godavery Circle,*

To—*Secretary to Chief Commissioner, Central Provinces, in the P. W. Dept.*

Having *just arrived at this* place, (Doomagoodium) I have the *honour* to submit some rough notes on the navigation of the Kanhan and Wynegunga Rivers, which route I took at the suggestion of the Chief Commissioner on my way down from Nagpoor in preference to that of the Wurda.

KANHAN.

2. The first obstacle to navigation in the Kanhan is met with at Lahiree (Reddie in map); and having been given to understand by Mr. Low, Deputy Commissioner, that no boat could get through the rocks at this spot, I dawked to Mohoda, and thence walked up to inspect the river at Lahiree. I found, however, that there would be no difficulty in descending from Jooler in a canoe, and accordingly had one sent *up from* Mohoda, and in it commenced my voyage down river on 14th November.

3. A rough plan of the river at Lahiree is shewn below. The bed



is a mass of rock, with numerous channels through it from a little above Sookree to some distance below Lahiree. The worst place is at (*a*) where the passage is very narrow, with a fall of perhaps 5 feet in a length of 100 yards. I estimated the total fall in this rocky reach, 1½ mile in length, at 13 feet.

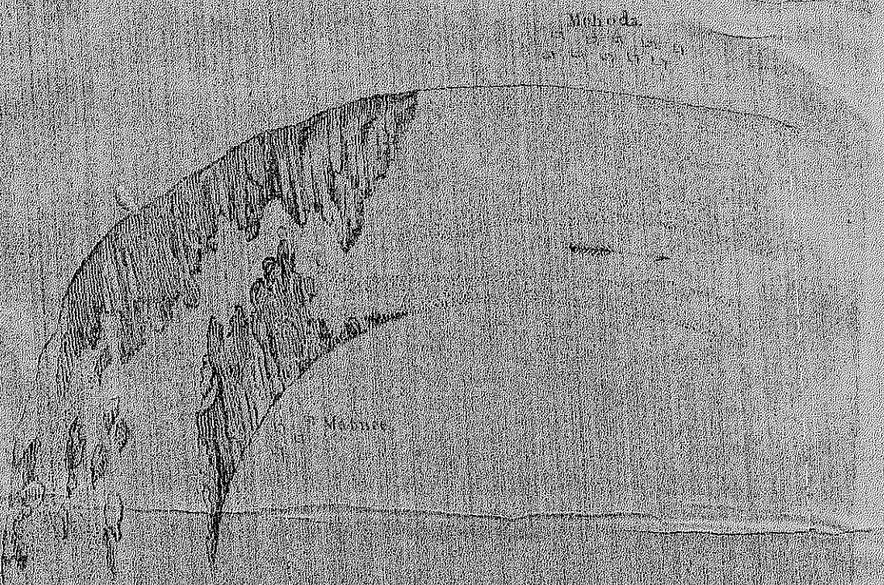
b

Navigation is doubtless practicable in a moderate flood, but it appears to be questionable whether mere blasting would make the passage practicable in the dry-weather navigation.

4. A few rocks are met with here and there down to Cheridie.

5. A mile below Cheridie the channel is much obstructed by large masses of rock for one-third mile. Fall in this distance probably 4 feet.

6. Opposite Matiree, just above Mohoda, the most formidable obstruction of the whole is met with. I give below a sketch of the position of the



rocks at this place. Owing to the manner in which the channel winds through them, it must be almost impossible to pass this spot in the monsoon, save during very high floods; and in the dry weather, when the river is low, the rush of water is so great, and the passage so tortuous, that it requires the utmost dexterity to prevent even a canoe being dashed against the rocks. The rocks being high, this is even a more impracticable spot than the reach at Lahiree above-mentioned.

7. On the whole, I am inclined to think that it may be found impracticable to render the 5 miles of river between Lahiree and Mohoda navigable in monsoon by clearing away rock in the bed.

I estimate the average fall at 4 or 5 feet per mile, and at two or three points it is very much greater than this. It may eventually be necessary to avoid this reach altogether by a canal. This, however, would not be an expensive work.

8. From a point about half a mile below Mohoda, the slope of the river suddenly changes; long deep pools, some of them miles in length, with short shallows between, and mostly quite clear of rock, succeed the rapids and rocky bars met with above Mohoda. From this point, in fact, down to the junction with the Wyneegunga, the Kanhan is an excellent navigation, and the fall cannot, I think, exceed 1½ foot per mile. A few rocks are met with, of no great consequence, at the points I shall now mention. I give a detail-ed description of them merely as a guide in future operations, that an Officer employed in clearing the channel may know where the obstructions are to be found; not that, in the case of nineteenths of those here specified, they are of the slightest importance, or in any way affect the question of the navigability of the river.

9. Half mile to ¾ mile below Mohoda there are large masses of rock mid-river, but with a board clear channel between them and the left bank.

10. Near Bhamoda (Bomboda in map) are a few small rocks of no importance.

11. About a mile below this the boat-men shewed a point on the bank, 22 feet above present water-level, above which they say floods never rise.

12. Just above Chicknа the floods have a tendency to cut out some very large masses which project from the right bank, but do no harm. River channel clear and good.

13. At Wandra (left bank) 4 or 5 rocks lie awkwardly in a good clear channel; a few lbs. of powder would remove them, and make the navigation perfectly good.

14. Half mile above Mohagaon a very few rocks lie off left bank, and should be removed. The cost trifling.

15. Near Wourna are one or two large low masses of soft crumbling rock, easily removable.

16. Half mile above Panmara, on left bank, the channel is much silted and obstructed by a number of low rocks scattered along a length of quarter mile. The rock, friable (schist) mostly, removable by crow-bar. A little below the village other masses run out from the bank which are more serious, as the stream hugs the bank and runs in among the rock. There is, however, a good channel outside of them in which a few detached rocks should be removed.

17. Three-quarter mile below Boregaon some low ridges of rock, which may be easily cleared away, cause much silting of the bed, with a fall of 1 foot in a short distance. See sketch below:—



18. Three-quarter mile lower down, some ridges run out from right bank, sloping across stream in an opposite direction to those last mentioned. They cause silt, and injure the summer channel, but do not prevent navigation.

19. A mile above Lohara some scattered rocks lie off left bank. They injure the channel and require removal.

20. Quarter mile further on, a few similar, but less in number, on the right bank.

21. A few small rocks lie off Ourmarra, right bank; 8 or 10 may require removal.

22. This completes my notes on the Kanhan. From Sookree downwards, this river is clearly divisible into two sections; the first, 5 miles in length, from Sookree to Mohoda, much obstructed by rock, and having a fall of probably 4 feet per mile; the second, 19 miles in length, from Mohoda to the mouth, having a very slight fall, probably not exceeding 1½ foot per mile, and a channel perfectly navigable in its present state, except during low stages of water, and then only obstructed at two or three points where blasting of small amount would be absolutely *necessary* to clear the passage.

23. Judging from Mr. DeGronsillier's account of the river above Sookree, I should suppose that the 18 miles above that place up to Kamptee are about as favourable for navigation as the 19 miles below Mohoda.

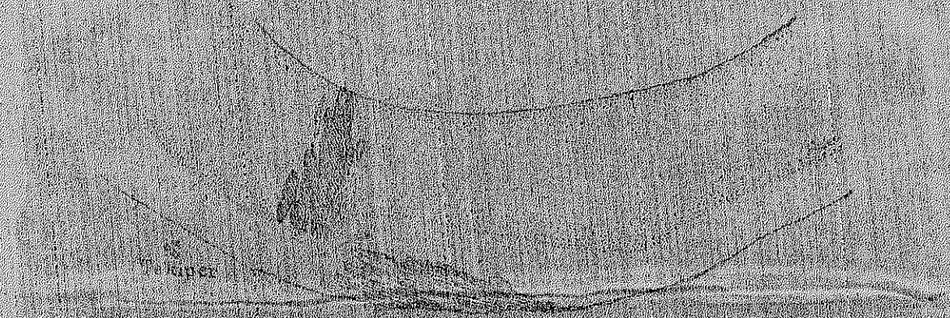
They appear at any rate to be as little obstructed by rock.

WYNEGUNGA.

24. I now come to the Wynegunga, on which I launched my canoe at Bhundara on the 16th November.

The Wynegunga at Bhundara, and for 3 miles below that place, to near the hill at the Korumbee, is much broader, and evidently has a much greater fall than at any point for 50 miles lower down. The shoals were very bad. The fall, I should suppose, not less than 3 feet per mile. A very few isolated rocks to be seen.

25. From Korumbee to Kieree the navigation is good, with broad deep channel, except at one place a little above Tekipár, where some large masses of rock running out from both banks must make a very bad monsoon passage. In the dry weather the channel is rather winding, but deep and unobstructed. See sketch below:—



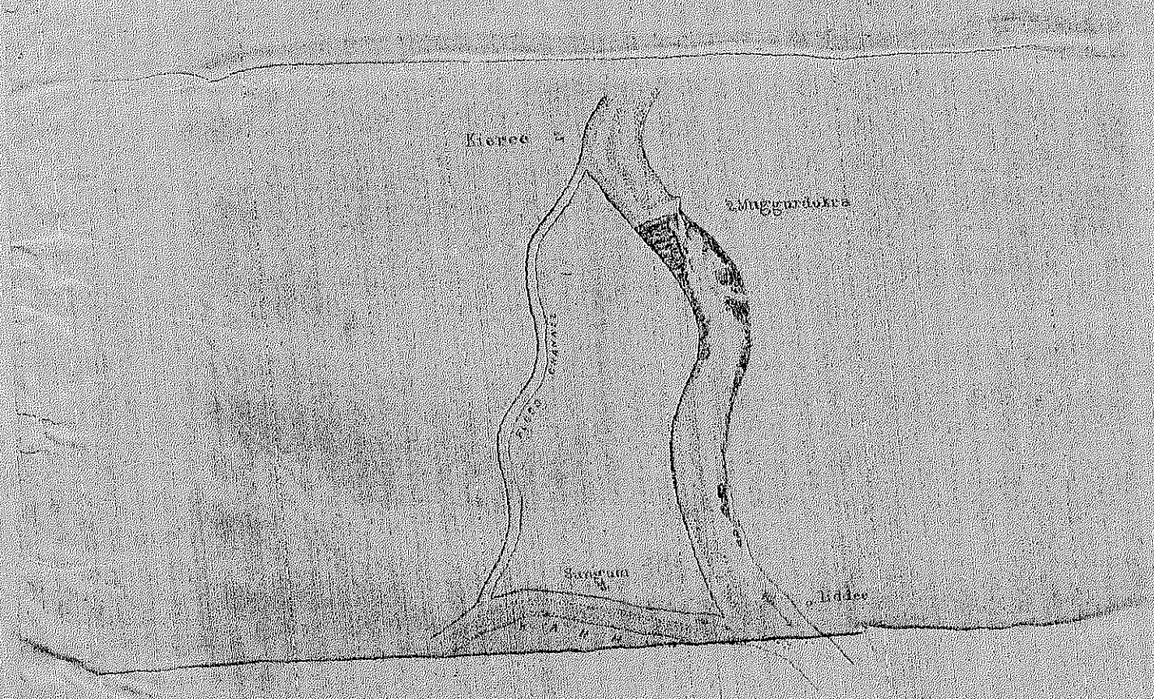
26. A mile or two lower down lies the great mass of rock to which the Chief Commissioner has given the name of the 2nd Barrier of the Wynegunga. A sketch given below.



The river here (at Muggurdokra) would have been completely barred across by an immense mass of rock running out from the right bank, had it not cut for itself a narrow passage round the extreme point on the left shore. Round this point, and through one other channel near it, the stream finds its way in the dry season. The passage is quite practicable for boats at this time of the year, but in the monsoon must be most perilous. Mr. Temple has described these rocks in his Minute on the Wynegunga, and the accompanying illustration will, with the remark that the rocks rise from 10 to 15 or 20 feet above summer level, give a sufficiently clear idea of the nature of this very formidable obstacle.

The obstruction does not extend over above half mile in length of the river. Below that, some large rocks project from the banks, but the passage mid-river is broad and deep. On the whole, however, I think, that the rocks here may justly be styled a Barrier, that is to say, that they constitute such an obstruction as no amount of blasting can effectually remove, and which it will be necessary to avoid in the monsoon by a lateral canal.

27. Mr. Temple has pointed out the curious flood-channel which may possibly be made use of for this purpose. This channel, which has probably been formed by the floods tearing open two drainage channels running into the Kanhan and Wynegunga, starts from a point half a mile above the Barrier, and joins the Kanhan about 2 miles from its mouth at a very favourable point. Its bed is many feet above the summer level in either river, but as this level in the Wynegunga would probably be raised some 20 feet by a weir across the river at Muggordokra, it is probable that this channel would require very little deepening to fit it for a canal to connect the pool above the weir with that below.



28. A few large rocks lie awkwardly in the large pool opposite Tiddee.

29. From Tiddee to Ambora the channel is good; at one or two places very few detached rocks.

30. At Ambora there are the remains of what seems to have once been a barrier of rock running right across river from a hill on either side. Portions of this barrier, which is merely a narrow ridge of rock about 20 yards wide, still remain, but with wide and deep channels between them. Mr. DeGrouilliers' description of these, "only narrow shoots for boats to go through" is most incorrect. A Man-of-war might pass through one or two of them without injury. Two at least are 50 to 80 yards in width, and very deep. There was no current through them when I passed, and the blasting away of one rock, at the expense of 100 or 200lbs. of powder, would make a passage 100 yards wide, if required. The rocks here are, in point of fact, of not the slightest importance.



31. Half mile below Ambora are a few rocks mid-river of no consequence.

32. One mile below Ambora, near Chota Ambora, the river is again crossed by a narrow ridge of rock similar to that at Ambora, but lower. For 200 yards in width the rock seldom appears above water, and there are many channels through it. A very trifling amount of blasting would suffice to clear the passage.

33. Similarly, at Chota Ambora, and for a short distance below, some low scattered rocks obstruct the passage, and should be removed.

They are very similar to those about Kivaka below 1st Barrier of the Godavery. The cost would be trifling; the *passage* is quite free enough as it is, but the rocks cause shoals and prevent that concentration of the stream in one channel which is necessary to good navigation.

34. A few similar occur at intervals along right bank to a point half mile above Weirrarh, where they end in a long groin of low rock running out 100 or 150 yards. This, however, in no way affects the navigation.

35. Just above Kochee, 5 or 6 rocks are dotted about the bed. They may be removed with a few lbs. of powder. The navigation from Ambora down to this point excellent.

36. Half mile below Sowergaon, where the channel passes from the right to the left bank, 3 or 4 lumps of rocks occur mid-river, and have a bad effect, deflecting the stream again towards the right bank, and so preventing its even flow. They may be removed at the cost of a few lbs. of powder.

37. A little further down, masses of rock project from the left bank, and tend also to deflect the stream and to cause shoals.

38. Half a mile above Balapoor a large rock mid-stream causes a shoal and divides the stream.

39. From quarter mile above Balapoor down to Sonder, the channel is more or less obstructed by rocks. Above Balapoor the obstruction is of a serious nature, the masses of rock being very large.

There is a fine straight passage mid-river between the rocks, 60 yards wide, which is quite sufficient for the dry, weather navigation, and which could easily be widened to 100 yards.

40. At Balapoor the channel passes over to the left bank, which it follows through large masses of rock. The passage is tortuous, but quite practicable down to Sonder. Thence it improves, becoming much wider, the rocks still occurring at intervals on each side.

41. Some heavy blasting will probably be required to make a good dry-weather channel above Sonder, and heavier still for the monsoon passage.

Below Sonder, comparatively little will be required for the dry weather, and much less than above that village for the monsoon passage.

42. A careful and detailed survey of this part of the river will be required, from above Balapoor down to Kappree. There is a considerable fall in this distance, perhaps 3 feet, in the rocks above Sonder.

Below Sonder, however, the channel is broad and deep.

43. Opposite Malchee some low rocks, level with the water, obstruct the channel and cause a shoal. Just below the village a single rock, which 5 lbs. of powder would entirely remove, stands one-third of the way out from the bank. It is dangerous for the monsoon navigation.

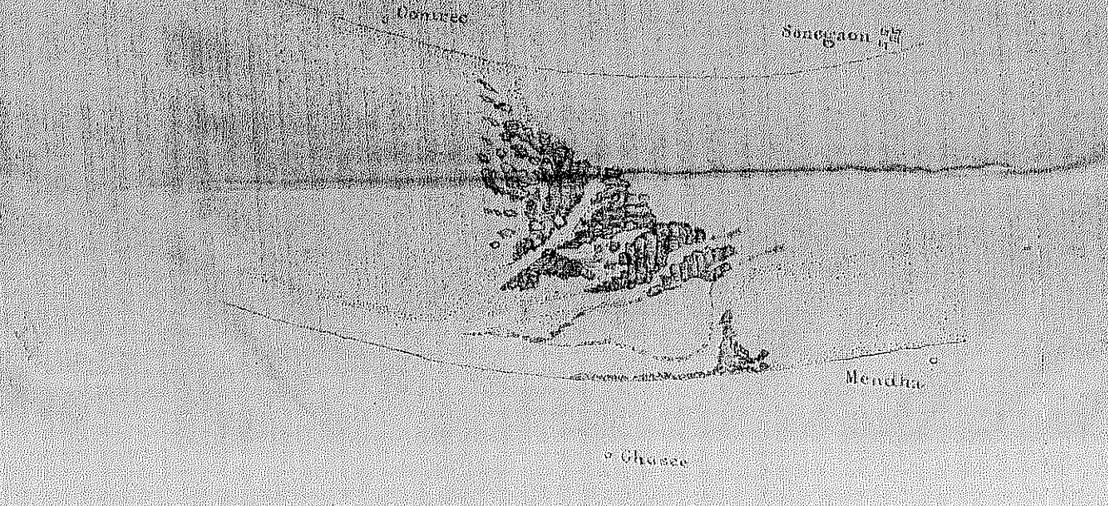
44. Off Ghosee, large masses extend out from the left bank, but leave fully a third of the width of river perfectly clear. The removal of the rock at Malchee, and of one more here, would give a clear channel 100 to 200 yards wide.

45. Off Jimnapoor (Joonapoor in map), some very awkward masses lie about the channel which is on the right bank.

A good deal of clearing will be required, but a perfectly good channel may be made at small cost. The channel should probably be cleared along the bank.

46. Thence a fine pool extends down to Sonegaon; five or six small rocks should be removed opposite the village.

47. At Ghosee there is a serious obstruction. A mass of rock, with three or four channels through it, slants from the left bank across to the right. It is highest on left bank, and gradually sinks to the level of the bed as it approaches the right. There is probably a perfectly uninterrupted passage along the right bank during monsoon. The deep channel, however, is on the left bank, and must be cleared there through the rock, probably on the right side of the little island shown in the sketch. The rocks rise about 8 feet above



summer-level on left bank. There are three or four passages through, with a fall of perhaps three feet in the dry season, but in the monsoon there is probably abundant vent for the stream, and no great rush through the channels on left bank by the time the river has risen 6 feet. Blasting only will be required here. A good survey required at this place.

48. Half-mile below Oomree, a low mass of rock, 60 or 70 yards long, lies out in the stream, which it divides causing a shoal. It is of no consequence to the monsoon navigation.

49. In the reach above Korumbee, where the channel is on the right bank, there are a few scattered rocks level with the water.

A fine navigation all the way down to Pohonee. A few small rocks above the village.

50. From Pohonee to Pohona, (left bank) is mostly a succession of deep pools, quite clear of rock, but above Pohona one or two bad shoals occur. The channel is very broad, flat, and shallow.

51. Three quarter mile below Etan, low rocks, seldom appearing above water, lie out 100 to 150 yards from left bank. The passage is tortuous, but there is plenty of water. Some clearing will be required.

52. Below Etan, the river begins to widen, the left bank cutting away, until at Diggoree, and thence, down to where the river turns sharp to the south, the width is very great. The channel, however, which follows the right bank, is good. A few rounded lumps of rock lie awkwardly in it where it crosses at Kyrena, from left to right bank, and should be removed. In the long pool above Morena, there are also a few low rocks of small size which must be cleared away.

53. One of the most necessary improvements to this part of the river will be the protection of the right bank by means of groins. The stream now plunges right on to the bank below Kyrena, and is rapidly cutting it away.

54. Below Balagur a large island is shown in the map. The western channel is now, however, quite silted up, and can only be practicable when there is a good flood in the river. There is thus but one channel in the dry season.

55. We may pause here to note that, from this point downwards, a change evidently takes place in the inclination of the river-bed.

From Bhundara down to this point, a distance of 50 miles, the slope cannot, I think, exceed 2 feet per mile, and very probably is not more than 1½ feet. I judge of course only by the eye, but from the great lengths of the still-water pools, and short length of the streams which connect them, and which have generally a very moderate slope, I do not think the inclination of the bed can exceed the amount stated. The navigation is on the whole excellent. Only at one or two points will any extensive clearing of rock be required (I except, of course, the Muggurdokra Barrier), and the rocks met with at various points, as registered above, are for the most part of trifling importance. In fact, I had no expectation of finding such a good navigation as now exists throughout the whole of this 50 miles of river. It compares favourably with some of the best parts of the Godavery below, and the slope of the bed cannot be much greater than in that river.

Below Coumree, however, which is near the head of the island above-mentioned, where the river, after running some miles in an easterly direction, suddenly bends due south, the fall evidently increases, and I should suppose may be as much as 2½ feet per mile, down to where the lowest barrier commences, some 60 miles above the mouth. The navigation in this lower-half of the river is consequently not so good as in the upper; shoals are more frequent, but still it is good, and with some clearing of rock, will answer all purposes of communication.

I will now continue the register of the rocks requiring removal.

56. In the reach below Lariji are 4 or 5 masses of low-lying stones which have the worst effect, causing the water to spread over a large surface, and making the channel very shallow.

57. Just above Eershee there are a few scattered rocks under water which divide the stream.

58. Where the channel crosses the river below Eershee, it is obstructed by some large masses of rock.

A good deal of clearing will be required. A good survey will be necessary here. The rock is mostly in small lumps, easily removable without blasting.

59. From Lariji downwards, the river becomes narrower, more so than anywhere above. The banks are of a firm yellow clay. This piece of the river, however, contains broad flats where the bed is perfectly level, and the dry-weather channel of great width, the stream of an even depth and very shallow. Altogether, this is the most difficult piece with regard to ultimate improvement, as far as shoals are concerned, of any yet met with, unless it be the 3 miles immediately below Bhundara.

60. Half mile below Runmuchurn (opposite Mhenda), there is a dangerous rock mid-stream.

61. Half mile below Kurrakurra, some rocks run out from right bank into the pool, and may be dangerous in the still-water. They should be buoyed or marked.

62. A long pool ends one-fourth mile above Pepergaon, and the stream then crosses, in a narrowed channel, over pebbles, and amongst rocks, to the other side. The rocks are the out-lying lumps of large masses which extend from left bank opposite Pepergaon, where they rise 12 feet above water. Those in the channel are low, flat masses, awkwardly placed, some of them below water. The passage is good for boats, not for steamers. A good deal of blasting will be required, and a careful survey.

63. On to Nildza, the left bank is fringed with rock. One lump, very awkwardly situated, lies mid-river a mile above Nildza.

All this part of the river is a deep still pool, some miles in length, extending past Nildza and Pajgaon to a mile below the latter village.

64. Quarter mile below Nildza, a few large rocks are dotted about the bed. They are badly placed for the monsoon navigation, but offer no obstruction in dry weather. Both banks are lined with rocks.

65. All this part of the river is narrow, not above 400 to 450 yards in width.

66. Below Pajgaon, the river widens greatly, the stream following the right bank, until, near Ogarra, it is crossed and quite blocked by some very low rocks and bushes.

The rock is seldom to be seen, but the bushes which grow in it catch the sand and form a bar. My canoe was dragged through with difficulty. Some clearing will be required.

67. Ogara to Sagaon, the channel is wide and clear except at one place where there is a little rock.

68. Opposite Sagaon, a large mass lies mid-stream, which might be troublesome in the monsoon, but is not so now, there being plenty of room on both sides of it.

69. From Sagaon to Doroolee, the channel crosses to the right bank. At the corner, some awkwardly-placed low rocks should be removed. Opposite Doroolee, a large mass of rock mid-stream should be buoyed for the monsoon navigation.

70. Opposite Shivinee (Seonee) large masses are scattered about the bed. There is plenty of room and deep water in the dry weather, but some clearing will be necessary to make a good monsoon passage; a good passage may be made down right bank.

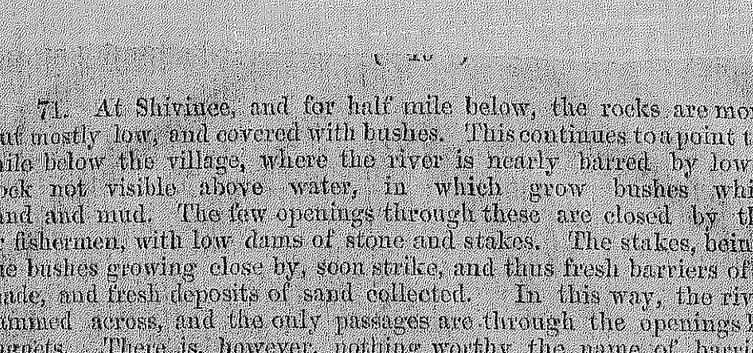
71. At Shivinee, and for half mile below, the rocks are more frequent, but mostly low, and covered with bushes. This continues to a point three-fourth mile below the village, where the river is nearly barred by low lumps of rock not visible above water, in which grow bushes which collect sand and mud. The few openings through these are closed by the demurs, or fishermen, with low dams of stone and stakes. The stakes, being cut from the bushes growing close by, soon strike, and thus fresh barriers of bushes are made, and fresh deposits of sand collected. In this way, the river is fairly dammed across, and the only passages are through the openings left for the bagnets. There is, however, nothing worthy the name of barrier, in the peculiar signification which attaches to the term on the Godavery. There is nothing that may not be cleared by digging and some blasting. A considerable part of the obstruction here, and at many other similar places, is due to the operations of successive generations of fishermen, whose traps and dams are to be met with at every mile almost of the whole river.

72. A good and careful survey is required of all the above part of the river from Ogara downwards.

73. From Devilgaon and Awurgaon, the channel clears, and so continues with a good fall down to the point where it turns sharp to the west, where the road, shown in the map, from Hurda to Wasser, crosses. Here large rocks commence; one very large mass lie mid-river, and rises 15 feet above water.

Probably this part of the river would be impassable in its present state during the monsoon.

Some heavy blasting would be required to clear a channel which would probably lie along the right bank. The water is deep, and much of the blasted rock might be thrown in where it falls.



The obstruction extends over only a very short distance, not above 300 yards. The removal of one or two large masses, containing perhaps $30 \times 20 \times 3 = 1{,}800$ cubic yards of rock, would suffice to form a channel.

The beautiful dark red rock seen in the 3rd Barrier of the Godavery is met with here also. The first seen in descending the river was at Shivinee.

74. Opposite Korsewlie, the channel is obstructed by two large masses of high rock, one of which should be removed.

75. One mile below the same village, another two similar masses. The passage is good in dry weather, but the channel generally shallow and broad.

76. At Koorodee the channel is again blocked by a few rocks under water with a thick growth of bushes. At such places as this the existence of rock can only be inferred from the fact of the bushes growing as they do on the bed. So far as my observation extends, such bushes are an unfailing indication of rock beneath, as it is only when they can twine their roots round the rocks that they are able to withstand the force of floods, which [illegible] them from their beds.

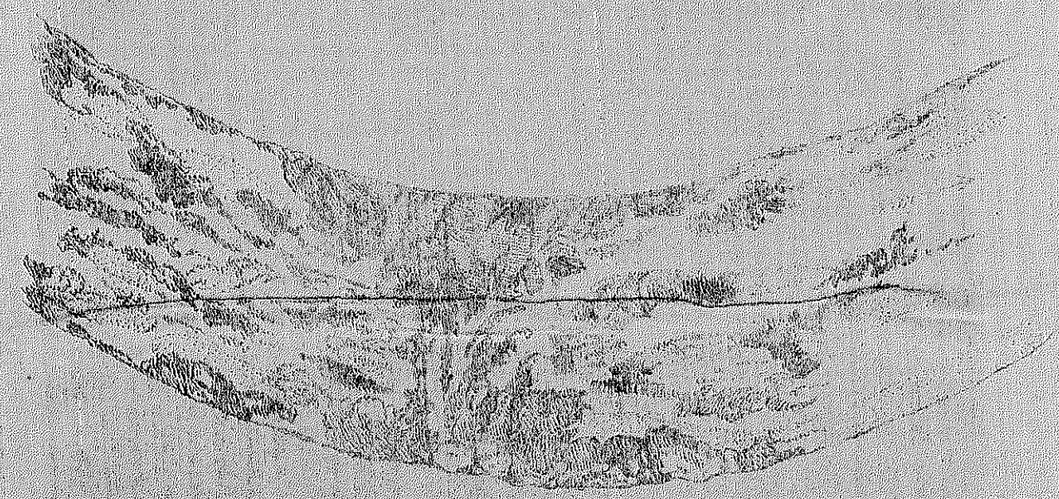
77. From Koorodee to Deoree, the channel keeps to the right bank. It is clear, except at a few points where there are a few insignificant rocks or bushes.

78. At the confluence of the Nuddee, next above the Kathan Nuddee, rocks are a good deal scattered about the channel.

Thence all is clear to the Kathan Nuddee, left bank.

GHURCHOOROOLEE BARRIER.

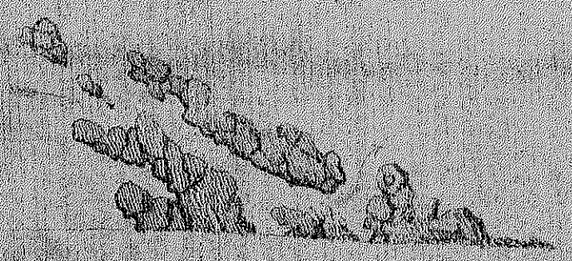
79. About half-mile below the Kathan Nuddee, rocky islands begin to be scattered thickly all over the river bed, the water flowing among them in several channels, but not with any great velocity. Opposite Ghurchooroolee, the rock closes in from both banks, and fairly bars the river across, the stream descending at this point by two rapids, in the upper of which it falls (as I judged by the eye) 6 feet in 100 yards, and in the lower 3 feet in the same distance, there being a pool of about the same length between.



In point of fact, the bed from where the rocks are first met with, down to a little below Ghurchooroolee, a distance of $2\frac{1}{2}$ miles, is a mass of rock, the tops of which only show themselves in the form of islands in the upper 2 miles, but which rises at last to a height of 10 to 20 feet above water near the banks near Ghurchooroolee, and dams the river across. I fear the obstruction at this place must be regarded as a barrier; the first of series which are met with from this point down to the mouth, and which will probably render it necessary to abandon this part of the river, and to connect that above with the Wurda and Pranhita by a canal.

We have here, at any rate, 2 miles of rock bed ending in an abrupt descent of 9 feet (if my estimate is correct) in 300 yards. The 2 miles above have a fall probably not less than 3 feet per mile. The total fall would thus be 15 feet in $2\frac{1}{2}$ miles, or less, which would give an average of 6 feet per mile, supposing a channel to be cut through the bed with an uniform slope. Such slope would be too great for navigation, so that, even if there were no other inducement arising from the existence of similar obstructions further down river, this alone would probably render a a lateral canal necessary. It must be remembered, however, that all my measurements are made by the eye, and an instrumental examination of the spot will be necessary to determine the actual conditions of the case. I entertain, however, little doubt that from this point downwards, the river will be found to be practicably unnavigable.

80. The Churchgoroolee Barrier passed, the channel is pretty clear of rock down to Dabgaon. Half mile below the village, the channel is much obstructed by large masses of high rock, through which there is a fall of 1½ or 2 feet. The masses are so large, and run out from the bank in such an awkward manner, that it is difficult to say what should be done.



81. The whole river from this point onwards to where it turns to the south, 4 miles, is obstructed every ½ mile by large masses of rock crossing the channel which winds through them. Much expensive blasting would be required to clear a proper channel.

82. At the corner where the river turns south, the rocks thicken. For a mile the bed is all rock, with a passage 50 or 60 yards wide through it, about 150 yards from the right bank. The fall all down this reach is considerable. The reach from the corner down to Sonapoor is also much obstructed. The channel lies along the left bank, from which large masses run out mid-river in a way fatal to any permanent improvement of the dry-weather channel and rendering monsoon navigation most perilous, if at all practicable.

83. From Sonapoor to Neelajnee, the channel is pretty clear; in fact, down to Donara, only occasional rocks are to be found.

84. Just below Donara the river is again barred across by low rocks and bushes, through which there is a fall of 4 or 5 feet in one-fourth mile. The rocks then recede towards the banks, leaving an open basin with rock bottom for half mile. Then comes another short bar of rock followed by another opening with rocky sides. The rock then closes in upon the channel again, leaving only a narrow passage, opening out gradually into a pool fringed with large rocks running out from both banks. This sort of pool continues, the water spreading over a wide surface, with rocks and islets through it, down to Kurroolee, where again occurs a bar of rocks and bushes, with one or two passages closed in the usual manner by the fishermen. The river continues thus onwards to Kooroor; the bed a mass of rock covered with water in which it shows itself in numerous projecting rocks and bushy islets scattered all over the bed.

85. The rocky reach above described, from Donara to Kooroor, 8 miles in length may, I think, properly be regarded as a barrier not improvable by means of clearing and blasting in the bed itself.

Whatever doubt may exist as to the propriety of the designation in this case, there can be no question of its applicability to the next obstacle met with.

HARUMBA BARRIER.

86. At the Chota Nuddee, just above Kooroor, the rocks thicken and soon close right across river opposite Harumba (Arumbat), forming a bar down which the river falls in a rapid 350 yards in length, a height of 10 feet, as I suppose. The rocks rise to a considerable height on the left of the main passage, and also in some places on the right. This is a true barrier, and is the point at which the lower end of the mass of rock of which the bed is composed begins. From Donara downwards, a distance of 13 miles,

87. From below this barrier, on past Markunda, to where the Kowtee rocks commence, the channel is wide and tolerably clear.

88. Kowtee is the point designated by the Chief Commissioner in his Minute, as the head of the "1st Barrier of the Wynegunga." I need not describe the river below this point. It is a succession of rocky barriers and rapids down to the confluence of the Wurda.

The worst rapids are at Bhoreghât and the Larolee Island. In the last of these, the descent of the rapid cannot, I should think, be less than 30 feet in 1½ mile. The stream runs here in numerous channels through a wilderness of trees and bushes rising out of the rock, the scene being one of the wildest imaginable. I was benighted in my canoe at the entrance of it, and for two hours had to thread my way in the dark through a maze of channels, the water rushing with great velocity through a tangled growth of grass and bushes.

INCLINATION OF THE BEDS OF THE WYNEGUNGA AND KANHAN, AND THEIR NAVIGABLE CAPABILITIES.

89. The foregoing detailed description of the river, tedious as it is, will be found of practical use whenever the work of improvement may be undertaken. It will, as already remarked, serve as a guide in selecting the places where clearing of rock is most required. I must now state the general conclusions at which I have arrived from this examination of the river as to the probable distribution of its fall, and its capability of navigation. I shall refer only to the Wynegunga below Bundara, and to the Kanhan as far up as Kamptee.

These two rivers I have now navigated, and though, in estimating their slope, I can judge only by the eye, still it must be remembered that I have now been for years thoroughly familiarized with the appearance of the Godavery for 300 miles where it has slopes from 1 to 2½ feet per mile, and it is not probable therefore that, within some such limits, I can be far wrong in guessing the probable inclination of the Wynegunga.

90. First, with regard to the Kanhan.—From Sookree to the mouth, there cannot be the slightest question of the distribution of the fall in this river. The bed is composed of two inclined planes, the first, 5 miles in length, with a considerable fall, which I estimate at 4 feet per mile, the second 19 miles in length, with a very slight fall, which I think cannot exceed 1½ feet per mile. And as the navigation above Sookree is described by Mr. DeGronsilliers as good and unobstructed, the slope of the 18 miles from that village to Kamptee is probably not above 2½ feet per mile. The following, then, would be a profile of the bed of the Kanhan.



91. Second, the Wynegunga.—The general distribution of the fall in this river also is very palpable to the eye.

Any one after passing through the succession of long deep pools connected by short shallow runs, which extend from the junction of the Kanhan for 47 miles down to the point at Howree, where the river bends sharply to the south, can tell after he has passed that point that the river thence downwards to Ghurchoorooloee, 40 miles in length, has a greater fall, for the pools are not so long, and the shallows with sharp currents more frequent. And, similarly, no one can pass from Ghurchoorooloee to Kowtee, and then from Kowtee to the mouth, without noticing that, while both these reaches have a greater inclination than either of those above, the lower has much the greatest fall of the two.

Now, I should estimate the fall of the 47 miles from the Kanhan to Howree at $1\frac{1}{4}$ feet per mile, and that of the next 40 miles at $2\frac{1}{2}$ feet. The levelling instrument must decide how for I am correct. Assuming, however, these to be the true slopes, let us see how we can account for the total fall between Kamptee and the mouth of the Wynegunga.

92. The level of the bed of the Kanhan at Kamptee above the sea has not, that I am aware of, been satisfactorily settled. I take it at 950 feet.

The height of the bed of the Pranhita above the sea we are certain of, two distinct series of levels closely agreeing having determined it. It is 350 feet. The rise in the 3rd Barrier up to the mouth of the Wynegunga has also been found to be at the rate of 4 feet per mile, or 104 feet in 26 miles, making the height of the bed at the confluence of the two rivers 454 feet above sea-level.

We have, therefore, a total fall to account for from Kamptee to the confluence with the Pranhita of 950—454 = 496 feet.

Of this we have as above shown—

1.—In the Kanhan—

		Feet.
18 miles, at $2\frac{1}{2}$ feet	... ...	45
5 ,, at 4 ,,	... ...	20
19 ,, at $1\frac{1}{4}$,,	... ...	27
2.—In the Wynegunga—		
47 miles, at $1\frac{1}{4}$ feet	... ...	83
40 ,, at $2\frac{1}{2}$,,	... ...	100
Total fall down to Ghurchoorooloee	...	275

leaving 496—275 = 221 feet to be accounted for in the 63 miles between Ghurchoorooloee and the mouth, which would give that piece of the river an inclination of $3\frac{1}{2}$ feet per mile. This would probably be distributed thus—

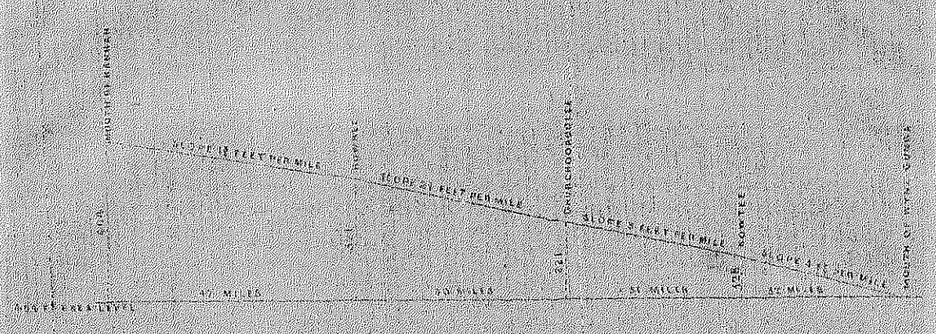
	Feet.
Ghurchoorooloee to Kowtee, 31 miles, at 3 feet per mile...	93
Kowtee to the mouth, 32 miles, at 4 feet... ...	128
Total ...	221

I should have been inclined to estimate the fall in both these last reaches above this, but if the level I have assumed for the bed of the Kanhan be correct, the fall may not be more. Even if the level referred to is 1,000 feet + sea, instead of 950 feet, the extra 50 feet would be easily accounted for in this last rocky reach of the river. This confirms my estimate of the slight fall in the two long reaches above Ghurchoorooloee.

93. Colonel Fife, in his Memorandum on the Wynegunga, assumes that the total fall in the last 76 miles of the river may be only 60 feet. He appears to have inferred this from some measurements, or rather guesses, of the falls at particular points, given in Mr. De Gronsillier's Report. This, however, is totally erroneous. To suppose that the fall in the most rocky

part of the whole river, where rapids sometimes extend for miles, is less than 1 foot per mile, is palpably wrong. Colonel Fife would never have entertained the idea for a moment if he had seen this part of the river. The fall certainly cannot be less than what I have stated.

94. I feel, therefore, very confident that the slopes of the Wynegunga approximate closely to those above given, which may be represented thus;—



95. This much, then, seems now very certain, that out of the 192 miles of river, from Kamptee to the mouth of the Wynegunga, or, in other words, to the 3rd Barrier of the Godavery, 123 are, both in regard to the gentle declivity of the bed, and their freedom from any serious obstructions, such as will afford good navigation, leaving 69 miles, of which 5 are in the Kanhan, which will require special works to complete the communication. Of course, longitudinal sections of the bed must be taken with the usual instruments before every body will be satisfied about this, and a certain amount of drawing paper must be covered with profiles and diagrams.

This appears to be inevitable. But the fact of the navigability of the Wynegunga and Kanhan, and their value for navigation as compared with the Godavery, is as certain as if we knew the profile and plan of every square yard of their beds.

96. It will be satisfactory to the Chief Commissioner to find that his estimate of the navigable capabilities of these two rivers, as set forth in his Minute on the subject, is quite confirmed by the more detailed examination of them which has now been made, excepting only that it now appears that the lower 69 miles must be regarded as unnavigable, in their natural condition, instead of the last 30 only, as he was led to conclude from the information then available. It will also appear in the sequel that, owing to the great head in which the extra 30 miles are situated, the extra cost of the works which this reach will render necessary, will be in a very much lower ratio to that of the works for the lower 30 miles, than that of the respective lengths of the two reaches.

97. Before proceeding further, I would guard against two possible misapprehensions which may arise from the perusal of the above account of these rivers: (1), that the estimate of the slopes of their beds, which leads to such highly favourable conclusions as to their navigable capabilities, is based upon very loose data, and therefore unworthy of reliance; and (2), that the long register of rocks above given shows that these rivers must in reality be much more obstructed than is here represented.

98. With regard to the slope of the bed, it is to be considered that we know for certain within 50 feet or so the total fall between Kamptee and the mouth of the Wynegunga. This cannot be more than 1,000—454=546 feet, which, on a total length, as shewn by the map, of 192 miles, gives an average

fall of 2·8 feet per mile. It is more probably $\frac{400}{102}$=2·5 feet. If Colonel Fife quotes correctly from Mr. Hanna's Report on the Kanhan Reservoir, it is only 2·2 feet. That this slope is not uniform is palpable to the most inexperienced eye, as any one can tell the difference between a series of rapids and 50 miles of still drip water pools. Hence it does not require much skill to distribute approximately the total fall between these parts of the river, which manifestly have a more gentle slope, and those which plainly have a considerable fall, and this is all that I have attempted to do. It is quite certain, then, that the distribution of the slopes cannot differ widely from that above given.

99. With regard to the extent of rock-clearing required all along the river, it will be observed that, out of the 53 places where rock is met with in the 130 miles between Kamptee and Ghurchooroolee, by far the greater part have the remark added that the rocks are of little importance, or that a very trifling amount of blasting will be required for their removal.

There are not above 3 or 4 of these where any considerable extent of clearing would be required for the monsoon navigation, and, as a rule, I believe that even less blasting will be necessary for the dry-weather navigation. The insignificance of the greater part of these obstructions can only be appreciated by actual inspection. I have, however, made a note of them all, with a view to their ultimate removal whenever that may be necessary in connexion with the reservoir system of improvement.

100. We have, then, in the Wynegunga and Kanhan Rivers, whose inclination varies between $1\frac{1}{2}$ and $2\frac{1}{2}$, or possibly 3 feet per mile. The slopes of the Godavery and Pranhita vary from 1 to 2 feet, and in one place below the 1st Barrier, for 10 miles the slope is as much as $2\frac{1}{2}$ feet. In regard, then, to this fundamental point, the slope of the bed, we may conclude that the Wynegunga and Kanhan will afford as good navigation as the rivers below.

101. I need not enlarge upon the value of this line of navigation which would connect the great stations of Kamptee and Nagpoor with the sea. The Chief Commissioner has already described the resources, trade, and population of the great valley drained by the Wynegunga and its affluents. There appears to be reason to conclude that, in addition to the line of navigation terminating at Kamptee, 85 miles more of the Wynegunga extending to the foot of the Sautpoora range, may be navigated, together with 40 miles of its most important tributaries. What I have now to do is, to state what works will probably be necessary for opening this navigation.

SKETCH OF WORKS REQUIRED FOR OPENING THE NAVIGATION.

102. Confining our attention in the first instance to the Kanhan from Kamptee to its mouth, and to the Wynegunga from thence to the confluence of the Wurdah, it is to be noted that, if my estimate of the fall is correct, there is one reach in each river which it will be necessary to avoid by canal. That in the Kanhan extends from Sookree to Mohoda, a length of 5 miles; and that in the Wynegunga, from Ghurchooroolee to the mouth, a distance of 63 miles by river, but of very much less by canal.

103. With regard to the first of these, accurate levels alone can determine whether it will be necessary, as I suppose, to abandon the river channel. It is possible that it may not be so, but in any case, even if a lateral canal should be found indispensable, the cost will not be great, the length being only 4 miles, and the width of river where the anicut would be placed some 400 or 500 yards.

A sufficient quantity of stone would probably be found in the bed on the spot to build a solid masonry dam similar to that at the 1st Barrier of the Godavery.

The works, then, at this point, will not be of an expensive character.

104. The Barrier on the Wynegunga is of a more formidable character, and will require more expensive works.

I entertain no doubt that the levels will shew that Ghurchooroolee must be regarded as virtually the head of this Barrier. In the 31 miles between this point and Kowtee, there are at least two rocky reaches which appear to be

incapable of improvement by means of mere blasting and clearing in the bed. Of the impracticable nature of the next 32 miles from Kowtee to the mouth, there has never been any question. I take it, therefore, that we have to choose between two methods of dealing with the lower 63 miles of the river, either by a series of anicuts or dams with locks in the river bed, similar to that at the 2nd Barrier of the Godavery, or by a lateral canal. And whichever plan we may adopt, it is essential that it should include the connection of the Wynegunga navigation with that of the Wurdah and Godavery by means of the 3rd Barrier (Godavery) Canal, or whichever work may be adopted for carrying the navigation past that Barrier.

105. Now, as to the first of these methods, a series of anicuts, Colonel Fife has proposed to throw an anicut across the Pranhita, just below the junction of the Wynegunga and Wurdah, at a point where the bed is 28 feet below the level of the rock on the crest of the 3rd Barrier at Daroor, 7 miles higher up; and he calculates that the water thus dammed up would submerge some miles (it does not appear how many) of the rocky bed of the Wynegunga, and 7 miles of that of the Wurdah, the water standing back on a level with that on the crest of the 3rd Barrier.

Without at all questioning Colonel Fife's ability to plan and construct such a work, I must say that an anicut blocking up 28 feet out of 40 of perpendicular height of flood-section, in a river with a fall of 4 feet a mile, is a work which I should think twice about before I ventured to propose it. But assuming the practicability of such a work, it is easy to shew that the money it would cost would yield immensely superior results if expended in a different plan. What would the effect of that anicut be? It would submerge and render navigable the upper 7 miles of the 3rd Barrier and $\frac{28}{4}$ = 7 miles of the Wynegunga Barrier. It would in no way benefit the Wurdah above the 3rd Barrier, and its beneficial effect would be limited to 7 miles only of the Wynegunga. It would shorten the 3rd Barrier Canal by 5 or 6 miles, which, however, is a comparatively unimportant consideration. To effect all this would require an anicut 28 feet in height and three quarter mile long.

106. Now, suppose that, instead of this, we go 7 miles further up the 3rd Barrier, and place our anicut on its crest, and thence lead a canal off from the *left* bank in the direction of the Wynegunga, in the same way as it has been proposed to lead one from the right bank down to the foot of the 3rd Barrier, we gain at once the following important advantages:—

1st.—The anicut would be only 500 yards long, instead of 1,350.

2nd.—Its height would be only 18 feet instead of 28.

3rd.—It would retain the water at a level of 28+18=46 feet above the bed at the mouth of the Wurdah, instead of only 28 feet.

4th.—It would dam the water back 36 miles up the Wurdah, making the whole of that length of river a still-water pool, and submerging the worst shoals in that river; whereas, Colonel Fife's anicut would leave the Wurdah in its natural condition without affecting its level, or benefiting it in any degree.

107. As to the effect of this anicut on the Wynegunga, we must now suppose the canal carried up (in point of fact it would be carried *down* from the head of Barrier) to the head of the Wynegunga Barrier, and compare it in connexion with its anicut at top of 3rd Barrier, with Colonel Fife's series of anicuts up the Wynegunga. As an anicut of say 20 feet in height would be required across the Wynegunga at the head of the canal, we should then have, even supposing the Barrier to extend no further up river than Kowtee, 30 miles—

In favour—

1 anicut 20 feet high, and $\frac{1}{2}$ mile long.
1 ,, 18 ,, and $\frac{1}{4}$,, and 30 miles of canal.

Against—

1 anicut 28 feet high, and $\frac{3}{4}$ mile,
And $3\frac{1}{2}$ anicuts 28 ,, and $\frac{1}{2}$,, long.

I leave out the leckage, as that would be the same in vertical height in both cases, though the locks in the river-bed at each anicut, would, with their accompanying sluices, be far more expensive than in the canal.

There would thus be 30 miles of canal against 3½ anicuts 28 feet high, and ½ mile long. If the canal cost Rs. 40,006 a mile, the total would be 12 lakhs. Would two of the 3½ anicuts be built for that sum? I should think it very doubtful. So that, independently of any other objections which might be cited, I think it will probably be found that the series of anicuts would be a much more expensive plan than the canal. And if, as I have little doubt, not 30 but 60 miles of river must be treated in one or other way, the advantages of the canal method are greatly increased, to say nothing of the irrigation which it would afford to a considerable tract of country quite prepared to benefit by it.

108. If, as I suppose, the river must be abandoned below Ghurchooroolee, the connection of the navigation with the rivers below would, I should think, be best effected by leading off a canal from the right bank at that town, and carrying it down to the Wurdah above the originally proposed 3rd Barrier Anicut. The levels are evidently favourable for such a canal.

From Ghurchooroolee to Kowtee by river is 31 miles, with a fall of not less than 93 feet. Hence the ground on the bank at Kowtee must be this much lower than at Ghurchooroolee, or 58 feet lower than the water-level then, assuming the height of the bank to be 35 feet.

The direct distance across country between the two places being but 15 miles, there is plainly a rapid fall in the ground from north to south. Supposing now an anicut 20 feet in height built opposite Ghurchooroolee, and a canal cut thence direct from Kowtee, the water would, if carried on a dead level, be level with the surface of the country at a distance of only 2½ miles from the head, if the fall in the country was uniform; but as there is a low water-shed further south, this distance would be increased by a few miles. Thus it is evident that there would only be a very short distance of heavy cutting, and that very soon the water-level in the canal would so command the whole country, that there would be ample choice of route. The map shows a river coming down from the north to the west of Rajghur, and falling into the Wynegunga at Ghatkool. I have examined this river west of Rajghur, where it has a fine square well-shaped channel 50 yards wide, and think it may not improbably be found possible to use it for navigation, reducing its fall where required by dams with locks.

If so, the canal would probably be led into it in some such direction as that shewn in the accompanying Sketch Map, and the navigation, after following the course of the river down to Ghatkool, would then be taken by canal down to the Wurdah. It is possible that a more direct cut might be made to this river from the anicut, as shewn by the dotted line.

There would be altogether 221 + 20 − 48 = 193 feet of lockage between Ghurchooroolee and the Wurdah, or 33 feet more than that in the proposed 3rd Barrier Canal.

109. It seems probable that, in this manner, the navigable part of the Wynegunga above Ghurchooroolee may be connected with the Wurdah and Godavery below. The length of artificial canal required would not exceed 32 miles by the longest route, or 27 by the shorter. The longest of these is just the length of the proposed 3rd Barrier Canal.

110. Objections may possibly be found, after thorough examination of the ground, to the use of the river, which I shall call the Mhool River for the present, as it flows past that town, which is, I believe, the head-quarters of the District for navigation. In the Delta all the main lines of navigation are formed by thus improving natural drainages, the advantage being that a large channel is thus obtained for little or no cutting. But it may be found impossible so to control the floods of a river draining so large an extent of country as that referred to, as to render it a safe and secure navigation. It will probably be necessary, wherever practicable, to tank some of the water of this river and its tributaries, the whole of which may of course be used

for navigation. A site which would probably be suitable for such a purpose, on the Andaree Nuddee, a branch which falls in a few miles above Pamoorna, was some years ago pointed out to me by Sir A. Cotton, as a likely one for the formation of a small reservoir for the summer navigation of the Godavery.

A reservoir formed here, as I have shewn in the accompanying map, and replenished by an additional supply which might probably be led into it by a cut from the Eraie Nuddee (on which Chanda is situated) would both help to restrain the floods of the Mhool River below the confluence of the Andaree, and afford a store of water which might be led down to Chanda, and after supplying the wants of that town and some irrigation in the neighbourhood, afford also the water to a navigable canal which might then connect Chanda with the Wurdah.

It might be sufficient to dam the Eraie Nuddee at its mouth, and to turn a sufficient quantity of water into it, furnishing it with a boat-lock to connect it with the Wurdah, as shown in the map. Or it might be thought better to extend the aqueduct which would thus supply Chanda in the form of a boat-canal down to the upper end of the still-water-pool formed by the 3rd Barrier Anicut. This arrangement is shewn in the map.

In this way, the important town of Chanda would be supplied with an abundance of good water, and placed in direct connection with the Port of Coconada; boats loading and unloading at its quays.

111. Some irrigation would be afforded in connection with this project. The water led off from the Wynegunga at Ghurchooroolee would command the whole of the country between the Wurdah and Wynegunga, as well as a large extent on the east bank of the Wynegunga (supposing an irrigation canal cut on that bank) south of a line drawn east and west through Mhool. I have sketched on the map a few lines shewing the direction which the irrigating channels would probably follow. I have no means of estimating the extent of land that would thus benefit, or the probable increase of revenue. There are some important towns on both sides of the Wynegunga, and everywhere the people are ready to make use of the water. Rice is grown all over the country now; some fine large fields of sugar-cane are to be seen wherever there is tank water available. I was struck with the rich well-cultivated appearance of the valley of the Mhool River.

112. The extension of the navigation up the Mhool River, by means of a few dams with boat-locks, as far as Gurboree, would probably be an adjunct, though an insignificant one, of the above project.

113. Such, then, would be a rough outline of the project which, judging from present information, and my own inspection of the river, I should think the most promising for turning what, following the nomenclature adopted by the Chief Commissioner, may be termed the 1st Barrier of the Wynegunga.

It includes, in connection with the works at the 3rd Barrier of the Godavery, the improvement of some 40 miles of the Wurdah, and the extension of the navigation to the town of Chanda. As this brings us up the Wurdah about half way to Hingenghât, I may add a few remarks upon the extension of the navigation in that direction.

114. It is quite true that the Valley of the Wynegunga is, in respect of extent, population, and resources, of much higher importance than that of the Wurdah, but I do not think that, on that account, there should be any hesitation about the extension of the navigation up the Wurdah to the highest practicable point, so as to give that valley the full benefit of the communication with the coast. Were there any comparison between the cost of the works required for this purpose above Chanda, and that of those for the opening of the Wynegunga, it might be a question whether one scheme ought not to be postponed until the completion of the other. But the Wurdah, as far as the mouth of the Wunna Nuddee, which comes down from Hingenghât, is so singularly and exceptionally well adapted by nature for navigation, that there is reason to believe that the works required for its improvement will be comparatively inexpensive. The Wunna also has a fall of only 2 feet per

mile from its mouth to Hingenghât; and even if it should be found impracticable to store water in the hills where it takes its rise, sufficient for the navigation of the Wurdah, there can be no doubt that the trifling quantity required for lockage, supposing the Wunna to be converted into a series of pools by means of dams, could easily be provided. It will of course be a question in what manner the navigation of the upper part of the Wurdah should be perfected; but among the alternative plans, that of a small reservoir situated somewhere on its head waters should certainly not be overlooked. When the question is taken up, I think a site might be looked for in three different parts of its valley,—in the southern slopes of the hills, north of Hingenghât; on the northern face of the same range, and on the northern slopes of the hills which bound the Berar Valley on the south. The Beemra, a small tributary of the Wurdah, rises in those hills and joins the Wurdah some 10 miles south of Natchingam.

The practicability of storing water in the hills which shed the water of their northern slopes into the Beemra, and of extending the navigation for boats up the Wurdah and Beemra into Berar, should certainly be investigated. Such a scheme may be found to be not only practicable, but to combine with navigation a considerable amount of remunerative irrigation also.

115. To return to the Wynegunga. It will be observed that my remarks have been confined to that part of it below the junction of the Kanhan only, but the Wynegunga project in its completeness, as sketched out by the Chief Commissioner in his Minute, includes the navigation of 80 miles more of the river up to the foot of the Sautpooras, and some 40 miles of its tributaries.

It will be desirable that the river above Bhundara should be carefully examined in some such way as has now been done for it below that point. There is reason to believe that the obstructions, if there are any, will be found to be of no more importance than those in the open parts of the river below.

The Muggurdokra Barrier is the only place where works of an expensive kind may be found to be necessary.

Such works certainly would be necessary for the monsoon navigation, but it is questionable whether they would be so for that of the dry weather. When I descended the river, the passage through the Barrier itself was made without the slightest difficulty; the channel was quite wide enough, and being very deep, there was little or no current.

The approach, however, where the stream crosses from the right to the left bank, running along the face of the great mass of rock of which the Barrier consists, was awkward at one place where a single rock only of small size require to be removed. For navigation, from 15th October to May, I very much doubt whether anything more than a little blasting would be necessary. In the monsoon, when the river is full, the case is different; this Barrier must then be one of the most dangerous parts of the whole river.

116. With regard, then, to the works that will be necessary either in the river bed, or for conducting the navigation past those parts of it where the Barriers lie, the following will probably be required if both monsoon and dry-weather navigation are contemplated:—

1st.—An anicut with lateral canal and locks at the 1st or lowest Barrier of the Wynegunga.

2nd.—An anicut with similar canal and locks at 2nd or Muggurdokra Barrier; the canal in this case not being above 5 miles in length at the utmost, possibly not more than 2 miles.

3rd.—Another anicut with locks, or possibly with a short lateral canal, at the Mohoda Barrier of the Kanhan.

4th.—Rock clearing at various points along both rivers, and doubtless also in the other navigable affluents.

117. But now, supposing these works to have been constructed, what shall we have gained? We shall have nearly 300 miles of river navigable,—for what length of time? This is a question to which I am perhaps not in a position as yet to give a positive reply, but I have little doubt that the answer

should be three and a half months. On the Kanhan, and on the upper part of the Wynegunga, there may possibly be occasional interruptions even during that time. Upon this point the Chief Commissioner is probably already in possession of better information than I am. Judging, however, from what I saw of the river in November, I think I cannot be far wrong in assuming that the navigation, without any addition to the stream from artificial sources, will be limited to a period of three months in the Kanhan, and perhaps three and a half in the Wynegunga. To what purposes, then, would the river be applied, supposing it to be available to this extent for navigation?

The local traffic which already exists would doubtless be largely increased. Boats would be used instead of the canoes now in use. I doubt, however, whether there would be any important increase of such traffic without the aid of steam. Steam-power is essential to the monsoon navigation of the Godavery, at least for the first three months of it; and it will doubtless be found so for the Wynegunga, which has a greater fall and current. Much more will it be necessary for the export and import trade with the coast: for the monsoon navigation, then, of the Wynegunga and its tributaries, steam-power must be employed.

118. It would not be necessary, I think, for this purpose, that any locks but those at the Muggurdokra Barrier and the Mohoda Barrier in the Wynegunga should be made large enough for steamers. Those in the canal at the lower, or Ghurchoorooloe Barrier, might probably be made for boats only.

With so large an extent of river as 300 miles to ply in, steamers might be stationed on the Wynegunga, and work in conjunction with other steamers below the 3rd Barrier of the Godavery, without difficulty or any important increase of the cost of transport. Supposing, then, the works enumerated in 116th para. to be constructed, the locks in the canal at the lower Barrier being boat-locks only, and those at the other two Barriers large enough for steamers, export and import, as well as local traffic, would be practicable for three to three and half months.

119. It appears to me, however, questionable whether, though perfectly practicable, such a traffic would be commercially profitable; or, if it were so, whether the high rates which it would be necessary to charge would not operate to confine the traffic within very narrow limits, and so greatly to diminish the value of the communication to the country. If the steamers are to be unemployed for eight or nine months of the year, the charges to cover interest in the capital invested in them must be a large addition to the cost of transport. Without expressing a decided opinion upon this point, which, in the present state of our information, would perhaps not be possible, there seems to be at any rate no question that the dry-weather navigation of the Wynegunga and its affluents must be of incomparably superior importance, supposing it to be practicable, to that of the monsoon months, and this has led me to consider whether it might not be advisable to confine our attention in the first instance to the means of rendering the river navigable during the dry season rather than to those for opening it during the rains.

120. Before entering upon this question, I would observe that the doubt above expressed, as to the Valley of the Wynegunga as a communication during the monsoon, is in no way inconsistent with that advocacy which I have always maintained of the importance of the rivers below for navigation at that time of the year. The two cases are very different. Starting from Chanda, supposing the 3rd Barrier Canal completed, we have first of all about 40 miles of river navigable at all times of the year; and after passing the 3rd Barrier, we find the united waters of the Wynegunga and Wurdah flowing in a channel no wider than that of the former river, and with only half the fall, 1 foot per mile. These exceedingly favourable conditions continue down to the confluence of the Pranhita with the main Godavery, where the volume of the stream is at once doubled by the contribution of that river, and only 30 miles lower down the Indrabutty falls in, making an important addition to the stream.

This line of navigation is, therefore, practicable for boats and steamers for several months of the year. The Wynegunga, which contributes only a part of the total discharge of the rivers below, has a much greater fall. Its period of navigation is, therefore, proportionately limited.

121. With regard, then, to the dry-weather navigation of the Wynegunga and its tributaries, I would offer the following points for consideration, simply as a contribution towards the thorough discussion of the whole question.

As I descended the river, I was several times struck with the fact that, contrary to what is the case on the rivers below, many of the places where the heaviest rock-clearing will be necessary would require far less work to open a practicable passage for the dry-weather navigation than to clear one for the monsoons.

There will of course be times during the rains when the floods rise so high as to submerge all, or almost all, the rocks; and at such times the navigation would be unobstructed, but such occasions are rare, and are confined in all probability to a few days only of the flood season.

I refer now to the average condition of the river at that season, and I observed that at nearly all the most obstructed places (the lowest Barrier of course excepted), it would require more blasting to render the passage safe during floods than in the dry-weather. The reason is that, at such places, large masses of rock are so thickly strewn about the bed, that to make a passage sufficiently direct for a steamer or a boat to follow, when there is a strong current in the river, would require the removal of much more rock than would be necessary merely to improve a somewhat winding channel, such as is to be found in all of them, and which neither steamer nor boat would have any difficulty in navigating when the current is slack. I believe that the detailed surveys which will be required at such points will show this to be the case. Reference is made to it in some of the notes in the commencement of this Report.

122. In the next place, I would refer to what I have already remarked about the second or Muggurdokra Barrier.

It appeared to me that very little would be required to make this part of the river, so utterly impassable as it must be in the flood season, perfectly passable for eight or nine months of the year. I found two deep passages through it with an almost imperceptible current in November, and thought that, with a very little improvement, these would answer all purposes for the greater part of the year.

123. It is questionable whether the same would be the case at the Mohoda Barrier in the Kanhan, but it certainly would be so as regards the rocks at Mohoda itself, and for 4 miles above it. Those immediately below Sonkeo, at the upper end of this rocky reach, are more formidable, *but could certainly be sufficiently cleared at small expense for the descending* navigation. For the ascent some special provision would have to be made, (which, as the length would not be above 200 yards or so, could, I think, be contrived) to assist steamers, certainly boats, in the ascent.

124. Now, I think, with the fact before us of the very limited duration of the flood navigation, and the probability that were that in the first instance to be abandoned, and our object were to render the river navigable *for the other part of the year*, a large sum which would be necessary to render navigation practicable for the shorter period would not be required to open the river for the longer period, it becomes a matter for careful investigation whether the very same, or nearly the same, outlay that would be required for a three months' navigation might not, if otherwise expedient, give us a six months' navigation, or more. I mean that it is a question for consideration whether the money that would be required for artificial canals, and locks at the Muggurdokra and Mohoda Barriers, as well as for the blasting of rock required only for the monsoon navigation, might not, with much greater advantage, be expended in storing the water which would give us a longer navigation at another time of the year.

125. One important consideration bearing upon this question is this, that a three months' navigation, say from February to April inclusive, supposing the available depth of water to be such as would afford really cheap carriage, would be of much higher value than three months of the monsoon navigation from July to September, for two reasons: *first*, that the current being much less than in the flood season, there would be much less hindrance to the ascent of the river by steamer, and boat traffic without the aid of steam would be perfectly practicable; *second*, that at this time of the year, the crops would be just ready for export, instead of having to wait six months for carriage during the monsoon.

This one consideration it appears to me would be decisive, supposing we have our choice of the two ways of dealing with the river. Must it not be allowed that the superiority of the dry-weather navigation to that of an equal period of the monsoon would justify the outlay of a larger sum to obtain it?

126. But what if it should be found that the same outlay would give much more than three months' navigation in the dry season? That is to say, if the cost of the works at the Muggurdokra and Mohoda Barriers, and the blasting of rock in other places, which works might be dispensed with, would provide water enough for five or six months?

At Muggurdokra the river is about half a mile wide. The lockage would probably be about 25 feet, and it might be found possible to manage with not more than a mile of canal, though this mile would be heavy cutting.

The width of the Godavery at its 2nd Barrier at the site of the anicut is 1,000 yards, and the lockage 41 feet. There will be no canal, but the rise of the floods is 70 feet above summer level against, probably, only 40 in the Kanhan.

The estimate for the 2nd Barrier Godavery Works is 11½ lakhs, which the Committee consider insufficient. Probably the cost of those at Muggurdokra would not be less than this.

Those at the Mohoda Barrier, where dimensions and difficulties are all in a scale of about one-half those at Muggurdokra, might cost 6 lakhs.

Blasting for monsoon navigation might amount to 2 lakhs.

Altogether, the cost of the works above specified, which would be required for the monsoon, but may probably be dispensed with for the dry-season, navigation, might amount to 20 lakhs, or, including establishments, 24 lakhs.

127. Colonel Fife's estimate for the Pench Reservoir to contain 1,457,700,000 cubic yards of water is 16 lakhs, inclusive of establishments. This reservoir would supply a stream of 675,000 cubic yards per hour for three months, or of 506,000 cubic yards per hour for four months, or of 405,000 cubic yards per hour for five months.

Now, if any one of these volumes should be found sufficient for navigation, there can, I think, be no doubt of the superiority of this mode of treating the river to the other. I think it probable that 500,000 cubic yards per hour would be sufficient with the help of a little stone-work for contracting the channel at a few points where the stream spreads over too large a surface, but of course the question must be more fully investigated.

128. If, then, it shall be found that the works above specified as specially required for the monsoon navigation only be dispensed with, and dry-weather navigation only is contemplated, I think the mode of dealing with the river by applying the money thus saved to the formation of a reservoir should be first investigated.

129. But another question deserving of enquiry is this,—whether the natural supply of water in the Godavery is not already insufficient for the requirements of the irrigated lands of the Delta. It was quite certain from the first, that the time must come, sooner or later, according to the rate of increase of the area of irrigated land in the Delta, when the Godavery must be replenished from artificial sources to supply the water required for the

hot-weather cultivation. So far back as 1856, I pointed out in my first Report on the river, that the natural discharge of the Godavery is altogether inadequate to the demands of the Delta. The anicut at Dowlaishwarum commands at least 1,000,000 acres, and the rate allowed for the monsoon irrigation, when the rain of course supplies in part the water required, has always been a cubic yard per acre per hour.

Thus the minimum required for the first crop would be 1,000,000 cubic yards per hour. For the second, or hot-weather crop, a larger quantity is, I believe, necessary. As the discharge of the river is not above 1,000,000 cubic yards at Dowlaishwarum on the 1st January, and gradually decreases from that time to 200,000 cubic yards in the beginning of June, it is inevitable that either an extra supply must be thrown in from reservoirs, or the second crop must be sacrificed, with a corresponding loss of revenue over the greater portion of the Delta. In a district whose revenue, chiefly derived from the irrigated land, already amounts to 49 lakhs per annum, though only a part of the land commanded by the anicut has yet been watered, it is evident that the loss of the second crop must involve a very considerable sacrifice of revenue, and I have repeatedly urged the subject upon the attention of Government. Sooner or later we shall have to deal with it, and I believe the time has come when it should be made the subject of careful enquiry. I know that, years ago, the hot-weather supply was sometimes insufficient, and I have been informed that there have more than once been remissions of revenue in consequence. The following notification is, however, the first public recognition of the fact that I have yet seen, though it is very possible that there may have been such during the two years I have been absent from the country. It is extracted from a recent number of the *Godavery District Gazette*, and is dated 26th November 1866:—

"1st.—Notice is hereby given that, owing to the scarcity of water in the River Godavery, there will be none available for Dalwa or second crop cultivation in the current year in No. 1 Range, comprising the Ramachandrapur Taluk, Cocanada and Coringa Divisions.

"2nd.—All channels in that range will be closed, except the Cocanada and Samalcotta main canals, which will be open alternately for navigation only.

"3rd.—The Tassildar and Sub-Magistrates concerned are, therefore, directed to give due publicity to this notice throughout their respective talooks or divisions, discouraging cultivators from making any attempts to grow Dalwa or any other second crop, which require water from anicut channels."

COCONADA; } J. FRASER,
26th November, 1866. } *Collector.*

From measurements already made, I believe the supply of water in the Godavery this year to be about an average one, and I am informed by the Executive Engineer here that it is much more than there was last year. In all probability, therefore, the deficiency then led to similar results.

130. Now, here we have a distinct intimation that the cultivation under the anicut has already extended so far that there is a large deficiency in the water-supply, so large that in three important talooks, comprising, I should suppose, about one-fourth or one-fifth of the whole irrigated area, the growth of the second crop must be prohibited. What loss of revenue does that represent?

131. I doubt, however, whether even this shows the whole state of the case. It is deserving of enquiry whether even in those portions of the Delta not thus deprived of the second crop, the available water in the hot months is not applied, in part at least, to the growth of crops requiring less water than others which, were there a sufficient supply, would be more remunerative.

132. At any rate, I submit that there are now grounds for a full enquiry into the question of the water-supply in the Delta, and the Madras

Government, so directly interested in it will, no doubt, be ready to afford full information. Such an enquiry might probably come under the following heads:—

1st.—Whether there have been already losses of revenue from deficiency of water-supply, and to what amount.

2nd.—The extent of the present deficiency, and in what month it begins to be felt.

3rd.—Its probable rate of annual increase.

4th.—The estimated total deficiency of the water-supply for the second crop, when the whole of the Delta lands shall have been brought under irrigation.

133. On receipt of such information, which doubtless could be obtained in the course of two or three months, the Government will be in a position to decide whether the demands of the Delta alone will not render it advisable to take immediate steps for storing an extra supply of water. Should such prove to be the case, the formation of the Pench reservoir (should that site be selected) either of the full size for which it has been projected, or, possibly, in the first instance, of only such capacity as the immediate demands of the Delta may require, would apply the best possible test to the question of the suitability of that method of improvement to the Godavery and its affluents. This is the course I have always advocated. I have never been a projector of great reservoirs. I have always suggested that, in the application of this novel method of river improvement, we should proceed with the utmost caution, storing, in the first instance, only such a quantity of water as we know to be actually required for irrigation purposes, and then observing its effect on the navigable condition of the river down which it must pass to its ultimate destination. I cannot conceive any more simple, more cautious, more safe method of putting to a practical test a plan of improvement which has received the sanction of the first Engineers in America, which would have been tried there ere now had it not been for the Civil War, and which, even in this country, is admitted by a few to be deserving of investigation.

134. I have recommended this mode of procedure, not because of any doubts in my own mind as to the success of the reservoir system, but out of regard for the very natural and reasonable doubts of those who, not being accustomed to professional questions of the kind, may object to an expenditure upon works, the ultimate success of which appears to them to be doubtful. If the water is really and immediately required for irrigation purposes, there can be no risk of loss in storing, and so applying it.

135. I would not be understood, from what I have just said, to deprecate the construction of such a reservoir as the Pench, supposing that there is a reasonable probability of its water being utilized for irrigation. Looking to the requirements both of the lands immediately under it in the Nagpoor Valley and of those in the Delta, it is probable that the whole of its contents would be required within a very short time for this purpose. I quite expect that the result of enquiries in the Delta will shew that that District alone could consume the whole of the water. If so, the Government would, I should hope, feel no reluctance in sanctioning the construction of such a reservoir.

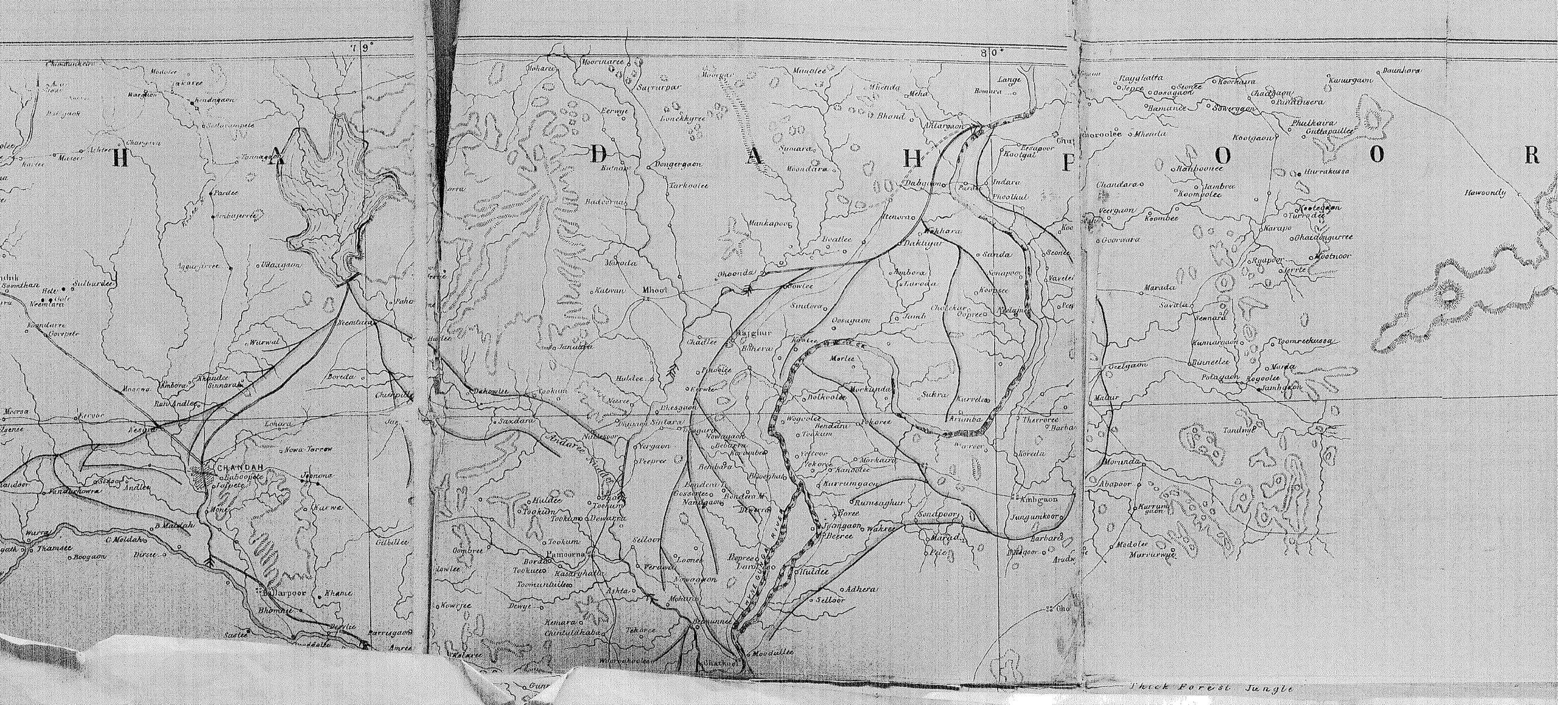
136. If the result of enquiry into the present and prospective condition of the water-supply for irrigation in the Delta should be to show the necessity for storing at once a certain quantity of water for supplementing the summer discharge of the river, the construction of a reservoir for this purpose, and the application of its water in this manner, would fall in with the plan above suggested for dealing with the Wynegunga. The hot months, when the additional supply will be required, will be those when the navigation of the Wynegunga will be of the most value. The large expenditure still to be incurred to open the navigation up to Chanda, will probably require that the whole of the allotments available for the Godavery for some years to come should be devoted to that line of navigation alone. To carry out the

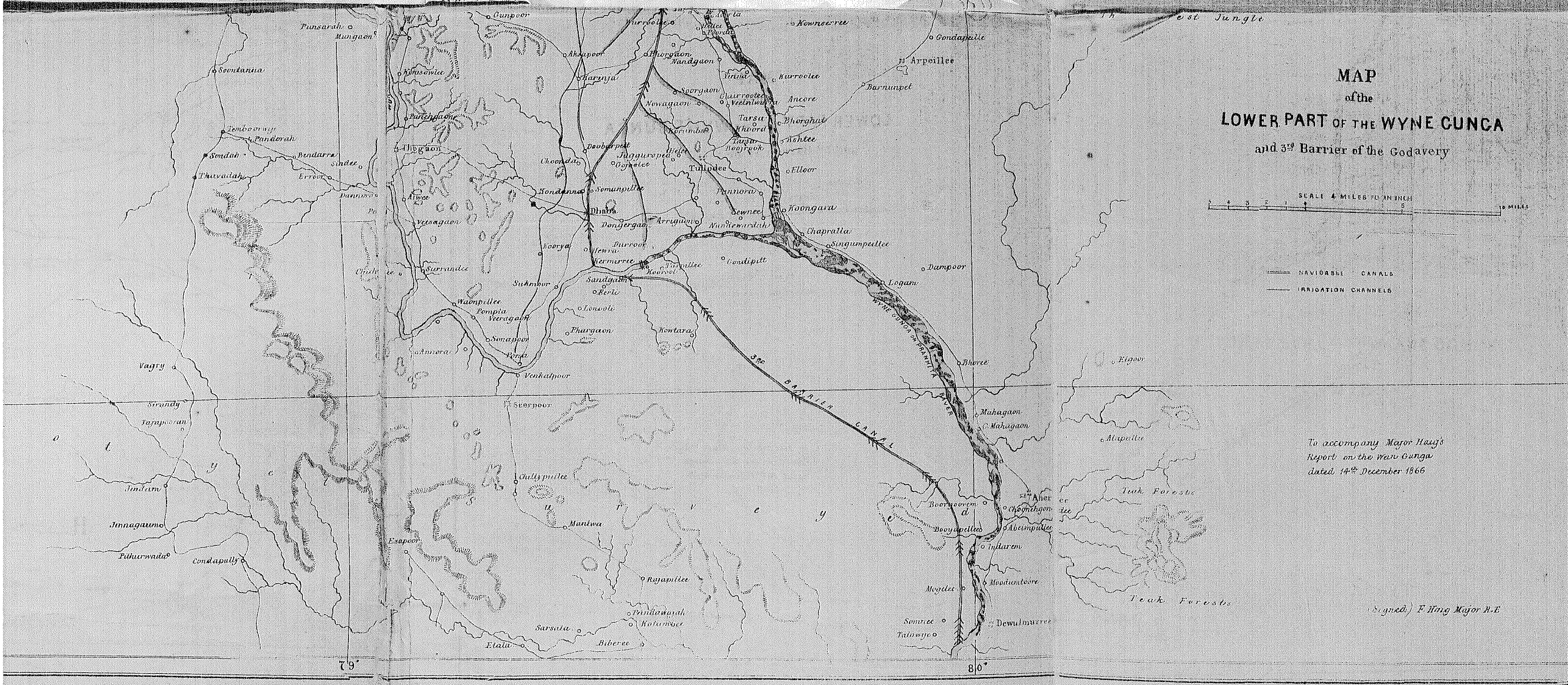
Wynegunga project in its entirety, as sketched out by the Chief Commissioner, may be financially impossible for a long time to come, and doubtless the Government will not embark in such an undertaking until fully satisfied of its practicability, or rather, of the value of the navigation when opened; in other words, of the practicability of navigating the Wynegunga during the dry months.

The construction of a reservoir of a capacity sufficient to supply the present wants of the Delta lands, would be a comparatively inexpensive undertaking, while at the same time a safe and remunerative one, and such a reservoir, when once in operation, would speedily afford most conclusive proof as to the practicability, or otherwise, of rendering the river navigable by such means, and so remove all doubt as to the advisability of expending large sums upon its improvement.

137. Should this course be followed, and the result be that all the unobstructed portions of the Wynegunga should be found to be navigable during the time that the reservoir is in operation, the next work would be to clear the rocks requiring removal in the open parts of the bed, on the completion of which there would be a continuous line of navigation from Kamptee and the Upper Wynegunga down to the head of the Ghurchooroolee Barrier. From that point to the Wurdah, at the head of the 3rd Barrier of the Godavery, the communication would have to be temporarily made by land, by means of the ordinary fair-weather cart-tracks, until funds should be available for the completion of the whole line of navigation by the construction of the canal from Ghurchooroolee to Dhaba above suggested, for turning the Barrier. This is the order in which I should be disposed to recommend that the work of opening the Wynegunga navigation should proceed. On any other plan the work must, I should suppose, be postponed for many years, and after all would not be based upon such satisfactory data as this would afford.

138. It will be desirable that the necessary levels for determining the actual fall of the different sections of the Wynegunga and Kanhan, as above described, should be taken at once, and with these might be combined a survey of the 2nd or Muggurdokra Barrier, and of the Mohoda Barrier in the Kanhan, together with that of four or five of the most rocky reaches in the open parts of the bed between the Barriers. For this purpose, Supervisor D. Venkatarutnum, who has had much experience in this kind of work, would be a very suitable person, and with the assistance of two qualified Surveyors of a lower grade, and a small staff of classies and peons, might finish the survey in a single season. The Supervisor, who is, I believe, now attached to a Division not far from Nagpoor, might be trusted to state the exact establishment he would require for this purpose. If he should be appointed to this work, I could send him detailed instructions for his guidance.


79°
80°
H A
D A H P
O O R
CHANDAH
Thamsee
Ballarpoor
Khanie
Bhomrie
Sasulee
Amrie
Pardee
Sudburdee
Kundaree
Covepte
Warwal
Khandee Sinnara
Rand Andlee
Kesrie
Nowa Tarrow
Jeenona
Andlee
Kurwe
Gilbellee
Dirsee
Roogaon
Moorumaree
Sawrapar
Eerwye
Lonekhyree
Dongergaon
Tarknalee
Mahoree
Mahoola
Kalwan
Mhoot
Janulgaon
Hulalee
Dehowlee
Saxdara
Nirsee
Diesgaon
Nilkanth
Vergaon
Peepree
Hulalee
Tookum
Pewaree
Oombree
Lawlee
Bamoorna
Tookuree
Kasarghatta
Toomunbulee
Ashta
Dewye
Kewrjee
Kemara
Chintulakabad
Wilayetkhoree
Seiloor
Veravee
Mohurra
Bhimunee
Khairee
Moodullee
Gunj
Moorumaree
Sawrapar
Eerwye
Lonekhyree
Dongergaon
Tarknalee
Mahoree
Hadowna
Mahoola
Kalwan
Mhoot
Janulgaon
Hulalee
Dehowlee
Saxdara
Nirsee
Diesgaon
Nilkanth
Vergaon
Peepree
Hulalee
Tookum
Pewaree
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Kemara
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Manalee
Meha
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Allarvaon
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Bomara
Chut
Kaotgal
Dabgaon
Indara
Perim
Theolkul
Mankapur
Ateneva
Bhatlee
Dakigar
Sunda
Sconee
Vavetee
Koe
Ambera
Kaveda
Vanapoor
Korpee
Sindoree
Oosayaon
Tamb
Chalekar
Oopree
Kelapee
Kalgaon
Rajghur
Bhera
Jowlee
Morlee
Pimpulee
Kewree
Markunde
Kotkvolee
Sukra
Kurrdee
Wagvolee
Jhendani
Tokoree
Arumba
Thevaree
Harba
Nowagaon
Bebuna
Kanoolee
Kurrumgaon
Runsaghur
Sondpoor
Kinhgaon
Jungumkoor
Barhanee
Dhegaon
Arudy
Tho
Bandoora
Bhoophatee
Deeree
Bopree
Dandeo
Huldee
Adheree
Selloor
Raigalatta
Sepee
Goosagaon
Kowrsara
Ramanee
Sowergaon
Chaigaon
Pindrasera
Phulkaira
Guttapallee
Kumurgaon
Daunhara
Hawoondly
Chandara
Rathpooree
Jambree
Koompolee
Veergaon
Koombee
Goorwara
Hiwrakussa
Kootegaon
Turrada
Narapo
Ghaddegurree
Kootnoor
Ryapoor
Kerrie
Marada
Savitla
Sennara
Kumurgaon
Toomreekussa
Bunnelee
Potagaon
Kogoolee
Jambgaon
Murda
Malur
Momnda
Abapoor
Kurrumgaon
Modolee
Murvurwye
Tandmp
Thick Forest Jungle



MAP
of the
LOWER PART OF THE WYNE GUNGA
and 3rd Barrier of the Godavery
SCALE 4 MILES TO AN INCH
10 MILES
NAVIGABLE CANALS
IRRIGATION CHANNELS
To accompany Major Haig's
Report on the Wain Gunga
dated 14th December 1866
(Signed) F. Haig Major R.E.
3rd BARRIER CANAL
WYNE GUNGA OR PRANHITA RIVER
Teak Forests
79°
80°

Report on the Navigation of the Kanhan and Wynegunga Rivers.

Calcutta:
PUBLIC WORKS DEPARTMENT PRESS,
1867.

No. 502, dated 13th April, 1867.

From—Major F. T. Haig, R. E., *Supdg. Engr., Upper Godavery Circle,*

To—*Secretary to Chief Commissioner of Central Provinces, in the P. W. Dept.*

I have the honour to acknowledge receipt of your No. 151—1869 of 5th April, forwarding copy of the Chief Commissioner's letter submitting my Report on the Wynegunga to the Government of India. It was not my intention to have reverted at the present moment to the Wynegunga question, but as my Report, together with Mr. Temple's Minute, of 18th September 1866, will probably be sent to the Secretary of State among the papers referred to in para. 11 of the orders of Government of India, No. 195 C of 8th March 1867, I lose no time in once more calling attention to a very important question connected with the general subject.

2. I greatly regret that the Chief Commissioner in his letter, of which you have now sent me a copy, has entirely omitted all reference to the very important fact which I so much dwelt upon in my Report, that the water-supply in the Godavery Delta is already insufficient for the requirements of irrigation, and that my urgent recommendation that this point should be made the subject of immediate investigation has failed to meet with the support of the Chief Commissioner. I feel bound, however, again pointedly to draw attention to the fact, because, first, of its important bearing upon the question of the improvement of the navigation by means of reservoirs, and, second, because there is no need whatever for deferring enquiry into it until the orders of the Secretary of State upon the general project shall have been received.

I must be excused for insisting upon this point. I have now got hold of a fact, or rather of an official and public notification of a fact, the existence of which I was before aware of, though I could adduce no authoritative statements in support of it, and I must hold up this fact to the light, and urge its importance until some enquiry is made.

3. Surely that notification which I extracted from the Rajahmundry *Gazette*, and gave at length in para. 129 of my Report of 14th December 1866, on the Wynegunga, is of the utmost importance in connexion with the reservoir question. I * shall re-produce it in an Appendix to this letter.

* I find the *Gazette* has been left behind at Doomagoodium.

We have in it a distinct avowal by the Collector of the Godavery District that the summer discharge of the river is now so wholly insufficient for the irrigation that it is necessary to prohibit second crop cultivation in three talooks. The water-rate for one crop is Rs. 3 an acre, for two crops, Rs. 4. Now I have made no assertions as to there being a loss of revenue owing to this deficiency in the water-supply, but what I have said, and would now reiterate is this. Is it not worth while, is it not rather plainly obligatory upon us to enquire whether the prohibition of second crop cultivation in three important talooks of the delta is attended with a loss of revenue or not? Should not such enquiry embrace further, the following very obvious questions, what loss of revenue has there hitherto been, if any, from this cause? At what rate is the present acknowledged insufficiency of the water-supply likely to increase? Cultivation is extending year by year with the extension of the distributary canals, but not above 700,000 acres are now watered out of the whole 1,000,000, or 1,200,000 commanded by the anicut. When the whole tract shall have been brought under wet cultivation, to what extent will the river supply in the dry months fall short of the demands of the second crop cultivation?

4. Surely these are points which have the most important bearing possible upon the reservoir question. What is the present position of that question? It is regarded as purely theoretical and speculative. However specious in appearance, it has never yet been tested by actual trial.

Discussion has gained for it a few advocates, but the scheme of "making a river" by pouring it out of a tank is still thought by practical men visionary.

No one, however, denies that, *if practicable*, it would so enormously enhance the value of the Godavery navigation that all controversy, as to the extent to *which the rivers should be opened out, would at once be at an end.* Let it but be demonstrated that the Godavery, the Wynegunga, and Wurda may be navigated the whole year round, or even for 10 months of the year, and it *would be considered a matter of no consequence, whether it cost £500,000,* or £5,000,000 to make them so. That the value of such a navigation to the country would be far in excess of its cost, no one would be disposed to deny.

So long as this point is left in doubt, so long as the Government disbelieves in the practicability of such a scheme, there must be constant hesitation and endless checks to the progress of the undertaking.

5. Now from one side it is satisfactory to think, we are steadily advancing *to a practical test of the navigable capabilities of the river.* The shallow draught steamers, one of which may now be on the way out will, when placed upon the river, very soon show what use may be made of it in its *natural condition.* What an *amount of disappointment, doubt,* and delay would have been saved, had such steamers been ordered when first I asked for them in 1861.

However in 1868, we may hope to see them running. They will tell us what can be done with the river without any increase to its summer volume from artificial sources.

But however satisfactory the results of this test may prove, they will only show the more strongly how vastly the value of the communication would be increased were it practicable to use vessels of greater draught. If the steamers now building drew 2 feet of water instead of 1 foot, their resistance would only be increased one-seventh, though their tonnage would be doubled, and the tonnage available for *power* much more than doubled.

Hence a large reduction in the cost of carriage, the fundamental consideration in the whole matter.

I am not, however, going to weary the Government with a discussion of this somewhat ominous topic, but what I wish to point out is this. If it is true that the Godavery Delta is already in want of water for summer irrigation, about which the Collector's notification leaves no room for doubt, and if such want is already causing a loss of revenue, and likely to cause very much heavier loss, which is matter for enquiry, then we have in our hand the means of testing without risk of loss, the efficacy or inefficacy of the reservoir system of river improvement. If there is a sacrifice of revenue from want of water, it must pay to store that water, and pour it into the river for use in the delta, and as it travels down to the delta, its effects upon the navigation can be ascertained. We shall then know beyond possibility of doubt the cost of storing a certain quantity of water, the benefit derived to the navigation from the use of such water, the total extra supply which the delta must have for its summer wants, whence we may infer the total probable amount of benefit the navigation will receive if the storage of water be limited only to the requirements of the delta lands, and can determine whether, considering that these improvements of the navigation will cost the State *nothing* (as the water-rates *alone will pay the interest*), it may not be worth while to pour a yet larger quantity into the river for the navigation sake only.

6. I beg to say again, I am not assuming anything as proved in this matter beyond this, that the present water-supply is insufficient for the delta irrigation.

But I submit that there is a strong *primâ facie* case for investigation, and that such investigation is fraught with such important consequences that it should be entered upon without delay. It may bring to light facts which will give an entirely new complexion in the minds of many to the whole Godavery

question, and show that an experiment which will set at rest all doubts upon the subject, may be conducted without possibility of loss, nay, with the advantage of saving what *may* now be an annually recurring and increasing loss of revenue to the State.

I hoped that I had made this plain enough in my Report on the Wynegunga, and my disappointment at finding that the point has altogether failed *to attract attention, and that the matter is likely to be shelved for another year* at least, must be my excuse for again pointedly drawing attention to it. Its investigation will commit the Government to nothing. What is now wanted is *simply to ascertain facts, and I would submit that the investigation may well* be conducted, pending the reply of the Secretary of State to the questions now to be submitted to him.

7. I have already indicated the main heads of the enquiry which, as proposed in my Report, might be addressed to the Madras Government. I will add one more point. Sir W. Denison cherished a scheme for constructing a second anicut across the Godavery about 40 miles above the present one at Dowlaishwarum, and watering from it a large extent of country, partly delta land, above the level of the other.

If irrigation works should now be carried out on a large scale, this scheme might receive attention.

If so, what increase to the summer supply of the river, already insufficient for the delta lands, would it involve.

8. I would suggest that the Madras Government should be addressed upon the subject generally, and requested to furnish the information under some such heads as those above suggested, which may enable the Government to determine whether steps should be taken for the construction of one or more reservoirs in the Wurda or Wynegunga Valleys, the primary object of which should be the supply of the present or prospective water demands of the delta irrigation, and the secondary, but ultimately most important, the settlement of the *vexata quæstio* of the reservoir system.

Ms. Eng. 1982.

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