

(1) Number of pages 56(2) Date of repair 12-2-73

(3) Initials of the Referencer _____

MADRAS RECORD OFFICE.

Government of Madras.

P. W. DEPARTMENT.

G.O. No. 3438

/2-13-

Press
Mis.

Dated 2 — // — 1868.

Not to be folded or roughly handled

*Proceedings of the Madras Government, Public Works Department,
2nd November 1868.*

No. 12. Read the following letter from the Secretary to Chief Commissioner, Central Provinces, Public Works Department, to the Secretary to Government of Madras, Public Works Department, dated Nagpore, 23rd September 1868, No. 320/3,940 :—

* C. P. No 311/3,807, dated 16th Sept. 1868.
Superintending Engineer, Upper Godavery Circle, No 144, dated 27th July 1868, with three Statements.

I am desired by the Chief Commissioner to forward you ten copies of printed papers marginally cited,* showing the progress made towards the completion of the Godavery scheme, and to express regret that only one copy of the plan can be forwarded.

No. 13. ORDER THEREON, 2nd November 1868, No. 3,435.

IRRIGATION, No. 2.

Ordered to be recorded.

(True Extract.)

(Signed) CHARLES A. ORR, Colneol, R. E.,
Secretary to Government.

To the Chief Engineer for Irrigation
..] Superintending Engineer, 1st Division.

Erd. S. T. Augustin.

Govt. of 1868 Madras

PUBLIC WORKS.

To
THE CHIEF ENGINEER FOR IRRIGATION

&c., &c., &

Dated November, 2nd.

Recd. End

G. O., 2nd November 1868, No. 3,435.

NOVEMBER.

Nos. 12-131

Godavery scheme.—Letter from the Government of Central Provinces forwarding papers showing the progress made towards the completion of the —, recorded

No. 320/340

SECRETARY TO CHIEF COMMISSIONER'S OFFICE, C. P., D. P. W.,

Nagpore, 23rd September 1868.

FROM

SECRETARY TO CHIEF COMMISSIONER,

PUBLIC WORKS DEPARTMENT,

CENTRAL PROVINCES.

To

Secy to Government of Madras
Public Works Department

SIR,

I am directed by the Chief Comm-
missioner to forward you 10 Copies of
Printed Papers Marginally Cited showing
the progress made towards the Completion
of the Godavery Scheme, and to express regret
that only one Copy of the Plan can be forwarded.

I have the honour to be,
Sir,

Your Obedt Servant

Major R. S. Pollard
Secy to Chief Commr C.P.W.

C.P. No 311/2807 of 16th Sept 1868
Suby Engineer U.G. Circle No 146
of 27th July 1868 with 3 statements

x

x 2111

by 2111

" The general result then of the operations up to the present time is that the canal with its locks is in working order ; the anicut is raised to such a height as to retain the water at the head of the Barrier 2 feet above its natural level, so as to afford as good navigation as is to be found in the open reaches above and below; and the obstructed part of the river channel below has been cleared to an extent to admit of navigation by steamers for 6 or 7 months, and by boats for the whole year " .

5. This progress the Chief Commissioner considers to be very satisfactory. The opening of this canal, is the first return for the money sunk in the undertaking; it will be interesting to watch the development of the boat traffic which will in all human probability follow the increased facility for navigation; and it is with pleasure Mr. Morris notes the fulfilment of the hopes held out by Major Haig on commencing work, that the 1st Barrier canal would be open for traffic by the monsoons of 1868.

6. All that can be said of the 2nd Barrier works is that a good start has been made. They differ from those of the 1st Barrier, inasmuch as they consist almost entirely of "masonry," and although but a very minute proportion of the whole mass of stone has been deposited in the anicut, an Engineer will not fail to realise from Major Haig's description the methodical and complete arrangements in progress to ensure a plentiful supply of material, as well as the care bestowed in maintaining a high sanitary condition amongst the workpeople; and from these augur well for the future success of the works, and the opening of the navigation to the foot of the 3rd Barrier.

7. Considering the difficulty of obtaining a qualified staff of Surveyors to carry out these important operations in a country little known, and generally covered with dense jungle, the Chief Commissioner thinks the progress made in Survey operations very good.

The estimate for the construction of a fair weather road from Chanda to the foot of the 3rd Barrier is almost ready for submission, indeed would ere now have been completed, but for an accident. The surveys for a canal to turn the 3rd Barrier have been completed, and the estimate is in hand, whilst Mr. Scott and his staff have obtained very full and complete data of the Wurdah river from the top of the 3rd Barrier, to Phoolgaon, on the Great Indian Peninsula Railway (190 miles); of the Wunna from its junction with the Wurdah near Soett, up to the great cotton mart of Hingunghat (21 miles); as well as 25 miles of the Pynegunga, — a very important tributary of the Wurdah joining it near Chanda.

8. The manner in which Major Haig proposes to utilize the Survey establishment in Hydrological observations during the monsoon recess has the Chief Commissioner's full approval, for, even should the data thus obtained not be turned to use in the Godavery navigation, yet any practical rules regarding the proportion of the whole rain-fall thrown off by the soil deduced from accurate observations on a large scale will be of great value, and will be received by the Profession as a very important addition to our Engineering knowledge.

9. After touching on the work executed, Major Haig offers a few remarks upon the 1st Barrier scheme as now under construction, and shows that the adoption of the present plan has brought some 200 miles of the river under navigation three years sooner than

would otherwise have been the case, had the project for the larger canal been at once accepted. Even should the increase of trade on the river demand, in course of time, the construction of the longer canal, the value of the present scheme as an alternative route compensates for the outlay on it, and secures permanence for the navigation, which by Major Haig's showing would always be liable to interruption from extraordinary floods.

10. The Chief Commissioner is aware that the method of turning this Barrier was long a disputed point, but he thinks the wisdom of that policy must now be admitted which has enabled the navigation to be opened to the foot of the 2nd Barrier three years earlier than it would otherwise have been, whilst it leaves to the traffic itself to prove, from the expansion and development induced by the minor improvement, the necessity for the heavier outlay and more complete navigation works.

11. The rates of work have also been noticed. Contrasting these with those ruling in Nimar the most expensive district in the Central Provinces, they are by no means out of the way, although they are higher than the normal rates of the Province generally.

	GODAVERY	NIMAR
Rubble masonry..	Rs 277 to 378	Rs 27 to 32
Cut-stone ..	" 230	" 250
Earthwork ..	" 10 96	" 8 75 to 11 25

Taking into account the drawbacks of the locality, the outbreaks of sickness which have occurred, and the miscellaneous charges that in a sparsely populated district must be incurred, the Chief Commissioner does not take exception to them, and it is satisfactory to record that Major Haig anticipates no rise in the estimated rate for dry masonry in the anicut of the 2nd Barrier.

12. In remarking on the condition of the river between the Barriers the Superintending Engineer asks permission to proceed at once to a limited extent with the clearance of channels through rocky beds, and with the construction of groins, pending the preparation of estimates.

The Chief Commissioner thinks that this may safely be left to the discretion of the Superintending Engineer, and he solicits the permission of the Government of India to place at his disposal a sum of Rs. 15,000 (debitable to the Godavery allotment) to be covered by estimates when his knowledge of the wants of the localities shall enable him to frame them on reliable data.

13. Mr. Morris observes that Major Haig is desirous of forming a separate Division for the removal of the shoals, and asks for the services of an Officer or Subordinate experienced in the navigation improvement works on the Ganges. If the services of a Subordinate are available the Officiating Chief Commissioner would be glad if they could be placed at the Superintending Engineer's disposal, but he

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is not prepared to recommend the formation of a separate Executive Division with its accompanying office charges. He thinks these clearance operations might be placed under either of the Executive Engineers, and worked as a Sub-Division of the 1st or 2nd Barrier Division.

14 The trade statistics will, the Chief Commissioner thinks, be read with interest. Being the first reliable returns of the kind that have been prepared on the Upper Godavery no comparison can be made with previous years; but the variety and nature of the articles show that the ground-work of a large import trade exists. The very small proportion which the value of the exports bears to that of the imports (Rs. 7,600 to Rs. 138,708) is, however, significant of the poverty of the district through which the river flows, and seems to point out that it is to the imports alone we must look for increase for some time to come. Already salt to the extent of 265 tons has found its way up the river, and it is to be hoped that the salt traders will largely avail themselves of the water route, and that the cheapness of carriage will be followed by an increased consumption of this most necessary article of food.

15 Closely connected with the traffic returns is the cost of water carriage. From the data he has collected on the river below the 1st Barrier Major Haig makes this with the river in its unimproved condition to stand as follows per ton per mile:—

Up-stream, 21 annas to 22 annas Down-stream, 09 pie to 10 anna. These rates the Superintending Engineer regards as high, and attributes this to three causes—

- (1) The use of small boats, necessitated by the strength of the current at certain places.
- (2) Prevalence of fever
- (3)—Want of a return load.

And he proposes the following remedial measures:—

- (1) The establishment of capstans to warp the boats over the difficult places.
- (2) The construction at Government expense of a better class of boat; these to be let out to the traders on a monthly rent, or to be paid for by instalments.
- (3) The establishment of a Medical Subordinate to afford aid to boats' crews stricken down by fever.

16. The Chief Commissioner feels some difficulty in dealing with this subject. If the returns continue to show a progressive development of traffic, the construction of a few pattern boats might give a stimulus to trade; but, on the other hand, it is not probable that the traders will long remain blind to the advantages of boats

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of greater capacity, and self-interest will gradually bring about their employment. If Major Haig learns that boat building is on the increase, he should use all legitimate influence to promote the introduction of a better pattern, and should he be successful the Chief Commissioner would then be prepared to take up the question of the establishment of capstan stations. At present he is not inclined to recommend either advantages for boats, or their construction in Government yards, as he feels assured that as improved wheeled carriage has everywhere in this country followed the construction of roads, so will a better class of boat follow on the improved navigation without the intervention of Government.

The employment of a Dresser and the establishment of depôts of simple medicines would, the Chief Commissioner thinks, tend to give the boatmen confidence, and is worth considering

17. In conclusion Mr Morris would solicit early orders in the subject of paras 12 and 13. The shoal operations cannot begin too soon, as it is at the time of freshes and half-flood that groins and spurs exercise the greatest effect, and if the services of an experienced Subordinate can be obtained he should be at work on the river as speedily as possible

I have the honor to be.

Sir,

Your most obedient Servant,

C. Charles Pollard Major R.E.

Secretary to the Chief Commissioner, P.W.D.

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No 106
649

FROM

MAJOR F. T. HAIG, R. E.,

SUPERINTENDING ENGINEER,

Upper Godavery Circle

TO

THE SECRETARY TO THE CHIEF COMMISSIONER,

DEPARTMENT PUBLIC WORKS,

Central Provinces,

Dated Dumagoodium, the 27th July 1868

SIR,

Your telegram calling for an immediate and special report upon the Godavery works reached me a week ago, but I was then constantly engaged upon works for the opening of the canal at this Barrier, and have been unable to attend to your requisition until now

I am not aware what is the precise nature of the information which the Government requires, but suppose they wish to know what is the present state of the works generally, and what progress has been made towards the completion of the whole scheme as at present defined

These points therefore I propose to illustrate, not entering much into details which as regards the operations of the past year have already been sufficiently given in my Annual Progress Report I shall add some suggestions in regard to future operations, and also give the statistics of the present river traffic.

2 Under existing orders all constructive operations have been limited to the 300 miles of river below the 3rd Barrier. The only work in hand above that Barrier has been the Surveys neces-

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sary for the preparation of estimates for the road from Chanda to the foot of the Barrier, the canal at the Barrier, and the improvement of the Wurdah up to Hingunghat. I will now describe the progress made under both heads, Construction and Survey

1st Barrier

3 The works at this Barrier it will be remembered consist of,

(1) An anicut near the head of the Barrier with—

(2) A canal of two miles in length furnished with a head or entrance lock, and scouring sluices, and a pair of tail-locks, which connect the navigation above the Barrier with that below, and—

(3) Clearing a channel through the rocky part of the river bed between the tail-locks and the terminus of the long canal (now in abeyance) a distance of 21 miles. I have already reported that the progress made with these works has been such that the canal was opened for traffic on the 16th instant. The actual state of each work is as follows—

(A)—The anicut having a total length of 1,700 yards, is built up to its full height and section for a length of 800 yards, and to within two feet of its full height; but not quite to its full section for the remaining 900 yards.

(B)—The head-lock is finished

(C)—The scouring sluices are finished

(D)—The canal is finished with the exception of a portion of the earthwork below the tail-locks, and in the regulating tank above

(E)—The tail-locks are finished sufficiently to admit of their use, but the gear for working the gates is not yet fitted up, and is replaced for the present by ropes and tackle

(F)—The flood embankments are not quite finished

(G)—A passage has been cleared through the rocky parts of the 21 miles of river below the tail-locks sufficiently to allow of navigation by steamers up to 1st February, and by boats for the whole year. I would limit this statement by adding that the steamers must have sufficient power, as the channel at present cleared is at two points still so narrow that the rush of water through it in certain states of the river intermediate between half-floods and low water is greater than our little steamers can stem. I mean that at times during two months, July and November, out of the seven months of steam navigation our present steamers will for this year be unable to make the ascent

4 Such in general terms is the degree of completeness as yet attained in the 1st Barrier works. Perhaps a more accurate idea of it may be formed from an inspection of the following statement

of the quantities of work done up to end of last month, and work yet remaining to be done

Names of Works	Description of work	Estimated quantity, cubic feet	Quantity done to the end of June, cubic feet	Quantity yet to be done, cubic feet	Approximate cost when complete, Rs	Cost up to end of June 1868, Rs	Approximate amount required to complete, Rs
1 Anicut ..	Rubble, Cut-stone	868,493	692,428	176,065	Rs 370,480	2,66,906	1,03,574
2 Protective works at head of island on which anicut abuts	Rubble	29,488	7,409	22,079	33,334	33,334	.
3 Scouring sluices	Rubble	81,407	81,407	.	183,410	1,29,584	2,205
4 Head-lock	Cut-stone	10,745	10,745	2,581	131,789	1,83,200	2,462
5 Canal	Rubble	248,803	248,803	.	185,662	2,03,587	12,010
6 Regulating tank on canal	Cut-stone	11,229	11,229	.	13,815	7,744	6,071
7 Tail-locks	Earthwork	15,977,524	15,186,072	791,452	176,342	1,42,581	33,761
8 Flood embankment	do	1,627,428	492,132	1,135,305	64,654	56,397	8,257
9 River improvements	Rubble	330,818	323,780	2,038	121,416	54,557	66,859
10 Shelter for establishment, workshops and stores	Cut-stone	9,568	7,200	2,368	78,308	6,392	.
11 1st Barrier tramway	Earth-work	7,758,427	6,576,397	1,182,030	55,600	54,929	671
12 Station improvements	Rock	1,954,693	930,763	1,023,930	9,447	9,447	...
	Mixed rock, gravel and shingle	2,992,762	1,822,572	1,170,190	14,62,836	12,20,574	2,42,262
	..	...	..	..	84,700	78,308	6,392
	..	..	..	..	55,600	54,929	671
	..	..	..	..	9,447	9,447	...
	Total ..	14,62,836	12,20,574	2,42,262			

5 The following Table, compiled from the foregoing, shows the total quantity of each description of work as per estimate, the quantity completed, and the proportion of the latter to the former.

Description of Work	Total cubic feet	Completed, cubic feet	Per cent
Rubble masonry	1,712,931	1,532,247	90
Cut-stone do	61,030	36,588	60
Earthwork	25,363,379	22,254,592	88
Mixed rock and gravel excavation	4,947,455	2,733,335	55

In regard to this statement, I would observe—

(1)—The total quantity of earthwork of various kinds actually completed is very much larger than that here shown, which does not

include the quantities in the different excavations, of which those for the locks varied from 20 to 50 feet in depth

(2)---The statement only shows the quantities of the principal descriptions of work. A great deal more of other kinds has been done which is not here exhibited

(3)---Of the 10 per cent of rubble masonry, and 40 per cent of cut-stone work yet remaining to be completed, almost all is in the unfinished part of the anicut

6. The general result then of the operations up to the present time is that the canal with its locks is in working order, the anicut is raised to such a height as to retain the water at the head of the Barrier two feet above its natural level, and so to afford as good navigation as is to be found in the open reaches of the river above and below, and the obstructed part of the river channel below the Barrier has been cleared to an extent to admit of navigation by steamers for six or seven months, and by boats for the whole year

7. It will, I hope, be satisfactory to the Government to learn that the navigation has been opened, though imperfectly as yet, to the foot of the 2nd Barrier. I shall return to the subject after describing the progress made at the other Barriers, but I cannot pass on to them without first placing on record a humble acknowledgment of the mercy vouchsafed by Almighty God in permitting us to bring our work thus far towards completion

2nd Barrier

8. The orders of the Government of India sanctioning the commencement of the 2nd Barrier works were received in March 1867. But one working season, and about a quarter of another, has therefore elapsed up to the present time since ground was first broken. As everything had to be done *ab initio*, the Government will not be surprised to learn that the work accomplished up to the present time is chiefly of a preparatory nature. The river works at this point consist of an anicut thrown across the Barrier near its lower end, which will raise the water above it to a height of 44 feet above that below, and thus submerge not only the whole of the 10 miles of rocky reach above, but also 2 miles more of a broad sandy bed with too steep a declivity for good navigation. The river channel below the anicut is deep and navigable at all times of the year. There is therefore no necessity for a canal. A flight of three locks at the left end of the anicut will connect the navigation below with that above the work

9. For some miles both above and below the site of the anicut, the river is confined between hills, which running sheer down into the water on the left bank, leave but a narrow strip of level land between them and the river on the right. This configuration of the ground does not conduce to the healthiness of the work-stations which are established on the right (Nizam's) bank---one at Neelum-

pilly immediately at the end of the anicut, the other at Enchampilly, about 1½ miles further down the river. The hill whence the stone of which the anicut is to be built is obtained, is a little above the line of anicut on the same bank, and the limestone quarries about a mile below the Enchampilly station. The whole of the intermediate strip of land, 3 miles long, has been cleared of forest to the foot of the hills, and in the neighbourhood of the anicut quarries the hill side has itself also been cleared nearly to the top. A road metalled and bridged, but not yet complete, connects the two work-stations. The quarries have been opened, and are connected by 2 miles of 4-8½ gauge railway with the anicut and workshops. The limestone and cutstone quarries are similarly connected by a lighter description of tramway with the deep channel on the left bank of the river. Accommodation for the whole of the establishments, as well as for stores and workshops has been erected, and lines capable of housing 2,800 workpeople. In fact all preparatory works have been completed, and were so far advanced that during the latter half of the past working season constructive operations in the river bed were commenced

Up to the present time 33,700 tons of stone have been deposited in the anicut 17,000 more are quarried and ready for transport, and 7,500 cubic feet of rubble masonry have been built in the foundations of the guard wall on the left bank. Now that the rise of the river has put a stop to further work in the bed, stone is being quarried and materials collected for next season's work.

10. Though the above description represents a smaller amount of progress than I had hoped to accomplish up to the present time, yet as it will generally be admitted that in works of this class, carried on in such a remote and uninhabited part of the country, where the first settlers must clear the very ground on which their houses are to be built, the first year must necessarily be occupied chiefly by works of a preparatory kind. I hope that the progress will on the whole not be thought unsatisfactory. The establishment have suffered severely from fever, especially the Europeans, but the experience at the 1st Barrier leads us to expect that this is a hindrance which will diminish year by year as the works advance. I am myself very well satisfied with the manner in which the operations are conducted by the present Executive Engineer

The petty contract system is in force in every part of them, down to the very smallest details, and no work, however trifling, is undertaken without a previously prepared and sanctioned estimate, and constant check upon the rates

11. With regard to the probable date of completion, I think we may reckon on all being finished by June 1871, that is to say, that by that time the river will be opened for navigation to the foot of 3rd Barrier,---330 miles from the sea

6

Clearing rock in river bed at Albaca, half way between 1st and 2nd Barriers

12 A channel which, for want of labour, it was necessary to limit to a width of 10 yards only, has been cleared through these rocks, a distance of about 2 miles. It will be navigable by boats for 9 or 10 months, and by steamers for about 7 months. About 50,000 cubic feet of rock were removed in the past season, and a bungalow for the subordinate in charge with cooly lines are almost completed.

To prevent misconception I should perhaps explain that the rock in this piece of the river does not extend along the whole length mentioned, but occurs at intervals, and that it lies low, only rising to a height of 2 to 3 feet above low water level.

Surveys above 3rd Barrier

1st—Road from Chanda to the foot of 3rd Barrier

13 This survey was completed more than a month ago, and Mr Scott, the Assistant Engineer, under whose supervision it was carried out, reports, under date 4th instant, "Corporal Pollock, Overseer, has been preparing the estimate for the road under my instructions, and had it almost completed a short time ago, when his tent was struck by a storm, and the estimate destroyed. A second is now under preparation, and shall be submitted with the least possible delay." In a few weeks, therefore, I shall probably be able to submit this estimate.

Survey for Canal round 3rd Barrier

14 This Survey is also completed. Mr Assistant Engineer Sieveking has carried it out with great care, and in a most complete and satisfactory manner. He has only just returned to this Barrier, and has brought with him the whole of the materials for the preparation of the estimates, upon which he and another Assistant will now be employed during the monsoon months.

I hope by the end of the year the estimate will be ready for submission.

Survey of Wurdah above the 3rd Barrier

15 The Government of India directed that this river should be surveyed up to Hingunghat. The Chief Commissioner however decided that if possible the surveys should be continued up to the railway crossing at Poolgaum.

There was time and establishment sufficient for both 190 miles of the Wurdah, 21 miles of the Wunna (the tributary on which Hingunghat is situated), and 25 miles of the Pynegunga, have been very completely surveyed by Mr Scott and his subordinates. A longitudinal section has been obtained of the whole of these rivers, commencing from the head of the 3rd Barrier, checked by a return line of levels

of 138 miles in length. A rough sketch has been made of the entire length of the three rivers, showing the sandy and rocky shoals and configuration of the banks, and also detailed surveys of several portions of short length, aggregating about 15 miles, of special interest. 500 transverse sections of the summer channel have been taken between 3rd Barrier and Hingunghat, with numerous measurements of the discharge, and similar sections at longer distances apart between the mouth of the Wunna and Poolgaum. The result, I think, is that we are now in possession of full information respecting 236 miles of the Wurdah, and its tributaries above the 3rd Barrier, which are capable of improvement in various degrees; and accurate and reliable data have been obtained for the preparation of detailed estimates whenever the Government may desire them.

Mr Scott and his subordinates have thus accomplished in a very satisfactory manner the field work of the Survey, and are now engaged in reducing it to paper.

Hydrological observations in the Wurdah Valley

16 The Survey establishment employed upon the Wurdah in the dry season not having sufficient work to occupy them during the rains, it occurred to me that a part of it might with great advantage be employed in procuring reliable data upon a point respecting which we have as yet only general conclusions based upon observations in other countries to guide us, viz, the proportion of the total rain-fall which runs off by the rivers and water-courses, and which is available for storage. For this purpose the Bore river, a tributary of the Wunna, has been selected. Its catchment basin down to the point where the discharge of the river is being measured is about 180 square miles, lying on the southern slopes of the cluster of hills north of Hingunghat. With the sanction of the Chief Commissioner rain gauges so constructed as to contain the whole of one season's rain-fall have been set up at three points in this area, and a fourth at Hingunghat. Two Surveyors are stationed, who are engaged in recording hourly the heights of water in the river, and measuring the velocities of current. At the close of the rains the discharges having been computed and compared with the ascertained rain-fall, some satisfactory conclusions will, I hope, be afforded as to the relative proportions of the two.

Surveys of other Tributaries of the Godavery

17. No other surveys than that of the Wurdah have been undertaken. The 10,000 rupees granted by His Highness the Nizam for the survey of the main Godavery from Nassick to the confluence of the Pranheeta remain still available. It is much to be desired that we should know precisely what the navigable capabilities of this 600 miles of river really are, and I hope many years will not elapse before we have full information upon the subject.

On the Wynegunga nothing has been done. We know that there is a boat traffic to the extent of 1,068 tons per annum on the upper part of it, and that it is navigable by small boats, with the exception of two or three places where obstacles not of any very formidable nature exist to within 60 miles of its mouth, that it flows through a valley with a population of 2 millions, and that it may be connected by canal with the Wurdah immediately above the 3rd Barrier. Here for the present our information stops.

Summary of Progress

18 To sum up, the progress made with the Godavery scheme generally up to the present time is as follows --The navigation is now open from the Port of Cocanada to the foot of the 2nd Barrier, a distance of 232 miles, and it will probably be opened to the foot of the 3rd Barrier 300 miles in 3 years more.

All the surveys necessary to enable the Government to decide upon the various questions connected with the extension of the communication beyond the 3rd Barrier are complete, the estimate for the Chanda road is nearly finished, and those for the navigation works are about to be put in hand.

Remarks upon the 1st Barrier Scheme

19. As any discussion of the Wurdah navigation question is foreign to the objects of this report,* I shall in what I have now to say confine my remarks entirely to matters connected with the navigation below the 3rd Barrier. To return then to the lower or 1st Barrier, there are some considerations connected with the works now so far advanced towards completion to which I would direct attention.

1st --The Government will doubtless desire to know to what extent the "Short Canal" project is likely to prove an efficient substitute for the Long Canal, and whether the work already done in the blasting of rock and clearing of the navigable channel below the Barrier affords the means of judging as to the probable cost of this part of the project.

In the first place it is to be observed that the channel has as yet been cleared to only half its width, and it is now little more than a month since the river rose. We have therefore had little opportunity of judging of the state of the navigation, and we are certain that whatever that may be, it must be much inferior to what it will be when the passage is cut to its full width. At present the currents at two points are, as I have already said, greater than our little steamers can stem when the river is only a few feet above its summer level. When the river rises higher the difficulty disappears, as the water finds more vent, and is not so confined, and I believe such will be found to be the case also after the freshes have subsided, and the river has fallen to about its dry weather level. My belief then is

that when the river channel shall have been completed, to the full width now contemplated, though the current will be strong, and so far an obstruction to up-going boats and steamers, yet it will not be more than can be surmounted with some difficulty.

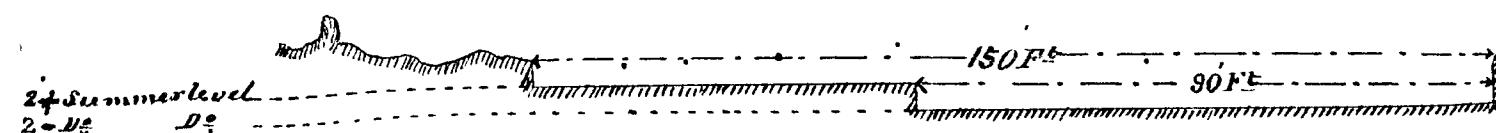
Perhaps this is as much as, in the present state of the river generally, we need desire. We shall have obtained a passage of this description at a cost of about three lakhs (locks included) instead of a much better one for perhaps 3 or 4 times as much. The saving thus effected has enabled us to proceed with the works at the 2nd Barrier, which might otherwise have been postponed for some years. The funds and establishment which would have been employed for the next two years on the long canal will now be available for such works, as may be required for the improvement of the navigation between the barriers, and we are enabled to bring 200 miles of navigation into operation some three years sooner than we could otherwise have done.

This last is, in my opinion, a very important point.

20 Next, as regards the probable cost of the rock clearing. Upon this point last season's work has supplied very reliable data. The cost has been much below what we anticipated. In the statement in para 4 it will be seen that the total quantity of rock, gravel, and shingle to be removed (as obtained by careful detailed measurements) is 4,947,455 cubic feet, and that of this, 2,753,335 cubic feet were removed this last season, leaving 2,194,120 cubic feet still to be done. Now the revised estimates of the 1st Barrier works have been nearly complete for some months past, its completion being delayed partly by the uncertainty of the rate to be charged for work of this class. In an abstract of it sent to me by the Executive Engineer in March last the estimated cost of the rock clearing in the river bed was entered Rs 2,89,000. On summing up however the expenditure in the last season, and comparing it with the work done, it is found that the former rate was nearly twice too high, and the total of this item in the estimate is now reduced to Rs 1,21,000 only.

21. We know then the cost per yard of this description of work, but I would observe that the actual quantity of rock which it will be necessary to remove can only be decided by actual observation of the effects of a certain amount of clearance.

The channel now being cleared is of the following section --



It is a channel within a channel; the larger one, 150 feet broad, is intended for the monsoon navigation, when steamers must have plenty of room; and its floor is to be cut down to 2 feet above the lowest summer level. The smaller channel in its centre which is for use in the low water months is to have a width of 90 feet only, and to be cut down to 2 feet below lowest summer level, so as to be navigable for the whole year. I believe that these dimensions will be generally found to be sufficient, but at a few points it is possible the high level channel may require enlargement. On the whole, I should suppose that the work required to bring the river passage into such navigable condition as above described will not in any case exceed 1½ lakh.

22. To what extent then, it may be asked, may we expect the river channel to be effective as a substitute for the canal?

I answer it was never intended as a *substitute*, save temporarily. It must always be an imperfect one. But it is a most valuable and important *addition* to the canal, an alternative route, which, as I have always insisted upon from the time when I first suggested it, the navigation could hardly be considered complete without. I am not going to revive by-gone controversies; but I wish simply to satisfy the Government that they have got their money's worth, that if the long canal is completed not a single rupee will have been thrown away in the execution of the shorter project. I have little more to say now in support of this position than I had in 1863, but my remarks may, perhaps, receive more attention than they did then.

23. The long canal runs for 17 out of 23 miles along the river bank, and the highest floods within our own observation of the last 20 years, rise from 8 to 15 feet above the ground in which it is cut. In such floods therefore the head of water on the bank would vary between these limits. But at many points the canal crosses deep depressions in the ground, gullies cut as much as 20 and 30 feet deep into the bank by old water-courses. At a few such points the head of water would be as much as 20 feet. Now my experience in works of this class satisfies me that when embankments which in ordinary years are scarcely exposed at all to the floods, are at rare intervals subjected to such pressures as these, there never can be absolute certainty as to their security unless they are made of dimensions much larger than any of those even contemplated for this canal. Embankments subjected to a constant head of water can always be made secure enough, but those only liable to such trial at long intervals are dry in their centre, and become the favourite haunt of rats and other vermin, whose burrows are always a source of danger.

21. But this is not all. It is certain that 50 years ago a flood 3 or 4 feet higher than any within my own recollection took place, and even this may not be the limit of such great inundations. Now, let one such flood breach the canal embankments, and though the damage would be less than what would commonly be supposed, it would almost certainly stop the navigation, and in this thinly populated part of the country could not be repaired under some months, and at a heavy expense. Such an accident might not occur above

once in 10 years, but when it did occur, it would cut the navigation in two, and at once put a stop to all traffic, save by means of an expensive portage, for which perhaps no facilities might be at hand. At any point on the river the liability to such a check would be a most serious defect, but most of all at this, the lowest Barrier. At the two upper Barriers no such accident could occur.

At the 2nd there is no canal, and at the 3rd the proposed line of canal runs along the river bank within reach of the floods for only 5 miles out of the 32, and the extreme head of water on the banks would be very much less than at the 1st Barrier. We thus find our line of navigation threatened at one point only, but that the most important, with a danger which it would be folly not to provide against. Now the alternative river route furnishes just the provision we require, and at an additional cost of only 3 or 4 lakhs, out of perhaps 80 or 100 lakhs.

The tail-locks of the short canal are situated only 2 miles below its head. There would be no difficulty in strengthening the banks for that distance if necessary, but a breach in them would be of little consequence.

With this canal then, and the river below, we should have a route which would provide for the navigation during its temporary suspension in the long canal. Can anyone, looking at the value and importance of the navigation, suppose that such a provision against accidents is not most necessary, or that it is not well worth the extra expense it involves.

This consideration has to my mind always justified the expense of the *addition* to the long canal of a pair of locks, and some miles of improved river navigation.

25. I will add one more consideration. If the short canal scheme thus provides an efficient temporary substitute for the canal, why, supposing the latter completed, go to the expense of shutting out the floods whose rare occurrence renders such a substitute necessary. It might be easier and better, as it would certainly be very much cheaper, to allow the great floods (such as that of 1818) to overflow the canal, than to shut them out. If so, we should have as an additional set-off against the cost of the short project, the saving effected by reducing the heights of the flood embankments, probably 2 lakhs.

26. The actual cost of the two locks and river improvement below, which form the alternative route, has been up to the present time as follows:—

	Rupees
Locks	1,42,581
River	54,557
	1,97,138

and the amount required to complete both is—

	Rupees
For Locks	33,761
„ River	66,859
	1,00,620

so that the total cost of the alternative route would be Rs 2,97,758. This amount includes all miscellaneous charges, but a small addition has to be made for cost of transport. Even if we allow for some additional blasting, the total will probably not exceed 3½ lakhs. And this addition to the cost of the scheme is not to be charged to this Barrier only; it is properly chargeable to the whole length of navigation, for the complete security of which it has been incurred.

27. I make these remarks not with the intention of bringing forward now any proposition respecting the Long Canal, but simply that the Government may know precisely how the case stands. Any action in regard to the Long Canal must be based upon much more extended observation and experience of the actual extent to which the Short Canal scheme is efficient than we now possess. The statistics I shall presently give will show that even in its natural state, as it existed last season, the river passage below the tail-locks was practicable for small boats during the whole year.

28. Some explanation is perhaps required of the reasons for cutting the smaller channel (in the centre of the larger one) through the rocks, down to such a level as to be navigable all the year, whereas the Government contemplated perhaps a navigation of only 5 or 6 months.

The reason is that the boat traffic already on the river shows that it will be navigated for the whole year.

The idea of a 5 or 6 months' navigation is out of date altogether. That I should ever have spoken of such a thing, must be regarded as a singular instance of an enthusiastic projector erring on the side of caution in his statements. The statistics of the present traffic will satisfy the Government that there will be no such limit to the use of the river as far as the 1st Barrier at least.

29. The revised estimates for both 1st and 2nd Barrier works are still incomplete. Those for the 1st Barrier have been delayed for want of the detailed measurements of the rock cuttings in the river channel, which there was not time to take in what little was left of the working season of 1866-67 after sanction for the prosecution of the works was received, and which could not therefore be made until the past hot season, and even then they were again delayed by my long absence up river, which prevented a final decision upon some points on which the Executive Engineer required advice. For the

2nd Barrier works any revised estimates prepared before now would have been simply worthless, for it was impossible to judge of the sufficiency or otherwise of the former rates until actual trial of the cost of the different kinds of work.

I think we have now satisfactory data to work upon, and will have the estimates completed during the present rains.

30. In regard to rates, I may mention that a very careful analysis of the past expenditure at 1st Barrier shows that the cost of the different descriptions of work has been as follows:—

DESCRIPTION OF WORK	Cost, inclusive of all ordinary charges	Cost, inclusive of all miscellaneous expenses of an exceptional character
	Per 100 cubic feet Rs.	Per 100 cubic feet Rs.
<i>Rubble Masonry</i>		
In anicut Contents 868,473 cubic feet	24	27 7
In Tail-lock Contents 325,331 cubic feet	27	31
In Head-lock Contents 248,803 cubic feet	31 25	36
In Scouring Sluice Contents 173,793 cubic feet	32 5	37 8
<i>Cut-stone</i>	194 to 200	223 to 230
<i>Earth-work</i>		
Canal (short) Contents 16,298,276 cubic feet	9 5	10 93

I do not think these rates will be found to compare unfavourably with those in other parts of Central India, considering the peculiar circumstances under which the works on this river are prosecuted. The cost of the cut-stone work has been very high, chiefly in consequence of the distance which the whole of the best description of stone had to be carried—21 miles, and the large size of all the stones used, with few exceptions each block being two feet thick, dressed and finished, and weighing from ½ ton to 3 tons. This stone is of first-rate quality. The earth-work includes all descriptions from alluvial soil on surface, to hard gravel, decayed rock, and some solid rock in excavations averaging 18 to 20 feet in depth. The figures above given are for the short canal. The rates in the portions of the long canal excavated were lower, the depths having been less, and the soil more favourable.

31. With regard to the 2nd Barrier works, the cost of the rough stone in the anicut upon which the sufficiency or otherwise of the estimate chiefly depends, has as yet been much below the estimated rate of Rs 6-8-0 per 100; and allowing for some increase and including all contingencies, I see no reason at present to expect that the original estimate will be exceeded.

State of the River between the Barriers.

32. The obstruction at the 1st Barrier being now removed, the condition of the river in the open reaches above and below, next claims attention. Below the Barrier the river is now navigated by small boats carrying only 4 or 5 tons for the whole year. Above the Barrier, between it and the 2nd Barrier, the navigation has hitherto been confined to Government steamers with large cargo boats in tow, and these have run for only 5 months, owing to the rocks at Albaca and two other places, which become impassable, save at considerable risk after November. Now, however, that the canal has been opened, boats of both descriptions may run, as far as Enchampilly, and a few private traders' boats have already passed. The navigation of this part of the river is generally better, indeed, I may say very much more favourable for boats than that below the 1st Barrier, the slope of the bed and the current being less. Only one of the three rocky reaches has however as yet been improved and the passage cut through it last year is but 10 yards in width, so that this next year the navigation may be impeded by the obstructions at these places; but if the Government should be pleased to allow us to proceed at once to a limited extent with the clearance of channels when required, pending the completion of estimates, we may be able to keep open such a passage as will suffice for the more immediate wants of the navigation.

As the traffic statistics at the end of another year will supply the most reliable information as to the time during which this, the 2nd reach of the river, is navigable, the Government will probably prefer to wait for these, and will care little for any opinion I may now express upon the subject, otherwise I should have little hesitation in affirming that this part of the river being on the whole a superior navigation to that below the Barrier, it will, like the latter, be available for traffic for the whole year.

33. Of the river above the 2nd Barrier we know less than of that below, and the only boat upon it at present is a small paddle boat built this last year. In this boat, however, I made two trips both up and down from Barrier to Barrier this last season, one in March the other in May, and the season was a favourable one for observation, the river being unusually low. I should say that, that part of the river will be found to be navigable in its natural condition by such small craft as now run to the 1st Barrier for 10 months, viz to 15th April.

All these statements regarding the different periods of navigation have reference, be it observed, to the river in its *natural* condition, rocks only being supposed to be removed, and do not take into account any improvement of the shoals.

34. I will now briefly state what measures I consider necessary for the improvement of the navigation between the Barriers, with a view to rendering it (1st) safe, and (2nd) practicable for a larger class of boats than now run to the 1st Barrier as well as for steamers.

35. In the first place, then, all rock in the navigable channel must of course be removed. There is so very little of this above the 2nd Barrier that we may for the present confine our attention to the river below that point. Below that Barrier there are in all 8 or 10 places where rock is met with. Of these there are only two where the obstruction is of a nature actually to limit the period of navigation, but in all clearing to a greater or less extent is required. I propose to have these carefully surveyed, and estimates prepared for the work required, but inasmuch as there is now an actual traffic upon the river which is more or less hampered by these obstructions, I would strongly urge that the permission given last year to proceed with the blasting at Albaca to an extent sufficient only for the more immediate and pressing wants of the navigation should be extended to the whole. At Albaca, which is by far the worst of them, we expended last year Rs 2,100, and for this sum we were enabled to clear a channel of small width which will be practicable for 9 months. There is little fear therefore that permission to proceed at once with similar clearance at other points could lead to any wasteful or excessive expenditure. I fully admit the wisdom, and indeed absolute necessity of requiring, as a general rule, detailed estimates before any expenditure is sanctioned, but I conceive that the present is one of the exceptional cases in which the rule may with advantage be set aside. The benefit and incidentally the saving resulting from the dispensation granted last year in this respect in regard to the Albaca rocks has been great, and had my request, strongly urged in 1863, that I might be permitted to expend a very small sum, not exactly in clearing rock, but in securing the river bank at points where it was being cut away, and large masses of rock underneath being exposed, been granted, the saving to Government would probably not have been less than 50,000 Rupees. Again and again this year have I sailed between such masses of rock which *must* now be removed, but which then lay under the bank of the river, and were not in the channel at all. And were I, in a similar manner, to be permitted this year to throw up a very few grains of stone for the protection of those parts of the banks which are now attacked by the stream in a way most injurious to the navigation, I have no doubt the saving incidentally would be very much greater than the sum I have mentioned.

36. So much for the obstructions caused by rock. What I propose in regard to them is that careful estimates of the cost of their removal should be prepared as soon as possible, and that meantime

sanction should be granted for such an expenditure as may be needed for such improvements as are more immediately practicable, and most urgently required

37 Next come the shoals There are two ways of dealing with these, (1st) by means of temporary appliances, and (2nd) by means of works of a permanent character. I propose to try both, the first immediately, the second after careful study, survey, and estimate For the first I wish to have either an Officer or subordinate sent down who has some experience of the methods in use on the Ganges for keeping open navigable channels through the shoals I would confine him entirely to this work, and the general superintendence of the navigation, making it a separate Executive Division His duties would be to keep a good navigable depth of water over the shoals, and to afford other facilities which I shall presently specify, to all craft navigating the river

38 In regard to the permanent works for the improvement of the shoals, I shall not now enter into any discussion as to their probable cost, feasibility, or value I propose to depute an Officer for the study of the question, and for estimating the cost of one or two, for which typical shoals would be selected I would then propose to construct these upon sanctioned estimates, and to observe their effects for a year or two before any further steps are taken in the matter. If this does not now appear a reasonable proposition, I hope that in submitting, as I propose shortly to do, a list of the establishment required for the purpose, I shall be able to adduce such arguments as shall satisfy the Government upon the point

39. One more point has to be noticed in connection with the improvement of the river between the Barriers, the protection of the banks by means of groins where they are attacked, and cut away by the stream The very first essential to any permanent improvement of the low water navigation of the river is that it should be confined within banks absolutely fixed and unvariable in position Out of the 600 miles of river bank up to the foot of the 3rd Barrier (reckoning both sides), there are only about 70 that require attention in this respect. The proper way to deal with them would be to have a careful survey made of the whole (wherever the topographical map may be insufficient), and estimates for the works required prepared for submission to Government, but in the meantime the Superintending Engineer should be empowered to sanction emergent estimates up to a certain limit, say Rs 15,000 per annum, in cases when a much heavier expenditure and serious injury to the navigation can only be averted by prompt action

Present river traffic

40 I am now enabled for the first time to give some reliable statistics of the river traffic It is at present confined to the river below 1st Barrier. Registers of all boats passing up and down are

kept at three places by Agents appointed by the Deputy Commissioner, and the following statement has been compiled from returns furnished by them It shows the number of boats divided into two classes, Government boats and private boats, which arrived at the 1st Barrier from the Coast from May 1867 to May 1868, and the nature and tonnage of their cargoes* There are three points of debarkation in the 23 miles of river from Dumagoodium down to the lower end of the Long Canal, viz, Dumagoodium the head-quarters of Engineering operations, Budrachellum 15 miles lower down, the chief town of the district, and Gollagudium 9 miles further down, the lower terminus of the tramroad

The great bulk of the traffic consisted of Government stores brought up for the works, partly in the boats and steamers belonging to the Transport Division, and partly in private boats A part of these were unloaded at Gollagudium, the remainder at Dumagoodium

Of the private stores sent up, that is to say, of the articles of merchandize of all descriptions, the property of private traders sent up in their own or in hired boats, all were landed at either Budrachellum or Dumagoodium The statement shows the quantity received at each place

Statement showing the number of boats and their tonnage which arrived at the 1st Barrier from the Coast from 1st May 1867 to 31st May 1868

MONTHS		Private boats						Government boats		Total arrivals of boats per month	Total tonnage per month
		With Government stores		With private goods				With Government stores			
				Unloaded at Buth chellum		Unloaded at Duma Goodum					
		Boats	Tons	Boats	Tons	Boats	Tons	Boats	Tons	Number	Tons
May 1867	..	3	190	2	11	16	41	..	..	21	71½
June	..	..	..	2	9	4	8½	2	57½	8	75½
July	..	..	..	7	39½	3	8½	5	226½	12	273½
August	..	..	..	6	31	7	17½	5	310½	18	359½
September	..	..	..	3	14	1	2½	..	..	4	10½
October	..	..	..	2	11½	6	16	1	20	9	53½
November	..	..	..	19	136½	3	14½	7	18	29	168½
December	..	..	..	30	217	1	4	5	1½	42	496½
January	..	..	..	51	305	2	10	11	27½	64	402½
February	..	..	..	28	210	23	145	3	..	40	365
March	..	..	..	14	115½	4	18	7	18	25	151½
April	..	..	..	1	36½	3	14	5	12½	11	65
May	..	..	..	7	5	2	8	9	19	20	35½
June	..	..	..	..	..	2	8	5	12	7	..
1st June 1867 to 1st June 1868		150	1085½	60	321½	68	168½	23	888	..	246½

	Tons
The total imports by river were thus	* 2,462
viz Government stores	1,973
Private goods	489
The total number of arrivals in the year was boats 301	...
Of which 278 were private, containing	1,554
And 23 were Government boats	888
The average load of the private boats was therefore	56
And of the Government boats	386*

* After this report was finished an error of 150 tons in excess in the quantity of Government stores was discovered in the return furnished by the Transport and Supply Division It has not been corrected, as that would have involved too extensive an alteration of figures

The arrivals and imports by river in each quarter of the year were as follows.—

	Boats	Tons
1st quarter, June to August inclusive	41	708
2nd do Sept to Nov do	42	238
3rd do Decr. to Feby do	162	1 264
4th do March to May do	56	252
	301	2,462

This statement may be analysed as follows—

1st—Arrivals of boats towed by steamers

	No	Tons
1st quarter	12	594
2nd do	1	26
3rd do (in Decr only)	6	262
4th do	0	0
	19	882

2nd—Arrivals of boats worked by sail only

	No	Tons
1st quarter	29	114
2nd do	41	212
3rd do	156	1,002
4th do	56	252

Total ... 282 1,580

41 Hence it appears—

1st—That the river is worked by small sailing boats for the whole year.

2nd—That the third and fourth quarters of the year, viz from December to May are those in which the navigation by sail boats is busiest, the traffic in the 6 low water months having been (1254-326)—nearly 4 times as great as in the 6 monsoon months. The disproportion between the two will always be great, as the strong currents of the river during the monsoon make the upward passage difficult for sailing boats. In fact I have been quite surprised to find that any monsoon traffic by sail existed. Though I knew that some trips had been made, I nevertheless regarded them as mere temporary ventures, and did not expect that they would be repeated. That the boatmen of the Delta do not hesitate to encounter the hardships and difficulties of such a navigation, certainly augurs well for the future prospects of the river trade, for the difficulties above the 1st Barrier are far less than those below.

42. It may perhaps be supposed that the 489 tons of goods brought up for private trade were almost entirely for the use of the people employed upon the works. Such however is not the case. Of this quantity 321 tons were landed at Budrachellum, and were entirely for trade unconnected with the works. Of the remaining 168 tons a considerable part was for sale to the work-people.

43 I give in an Appendix two Tabular Statements of the articles composing the above traffic, with the exception of the Government stores. It will be found that they include a considerable

*Viz Cotton, Sugar and Jaggery, Salt, Wheat, Rice, other grains, Oil-seeds, Metals, English Cloths, Tobacco, Curry stuffs, Stationery, Tusa Silk Cocoons, Dyes, Opium, Woollen Blankets, Ghee, Gingely and Castor-oils, Cocoanuts, Salt fish, Tamaind, Onions, Garlic, &c, Europe Articles and Country Cloths

variety*. It is satisfactory to note among them 7,415 maunds, or 265 tons of salt. This was almost exclusively for sale to the people of the country, the work-people being separately supplied by the Government

Agency. Salted fish is another article included in the miscellaneous list which begins to come up in considerable quantities, and is much prized by the people. There is likely to be a considerable trade in it.

44 The value of the exports and imports as above shown was—

IMPORTS.				Rs
Government stores	...	...	...	1,04,832
Private goods	...	...	...	1,38,708
				2,43,540
EXPORTS				
Private goods	...	...	...	7,600
				2,51,140

If to the above we add the value of the timber rafted down past the 1st Barrier, coming chiefly from the upper river, viz. 19,162 logs valued at Rs 77,292, we have for the approximate value of the whole river trade, exclusive of some salt imported at Wadagudium, at the mouth of the Sebbry, and some small local traffic between the Barriers, as well as timber exported from the hills and other parts of the country below the 1st Barrier, Rupees 3,38,432.

45 I would now direct attention to the following considerations in connection with the above statistics.

1st.—there is already a traffic established upon the river.

2nd—That traffic is much the most active during the low water months.

3rd—It is carried on chiefly in small boats carrying about 5½ tons.

4th—The above figures show the traffic as it exists in the unimproved condition of the river. Not a single shoal has been touched in the way of improvement, and the passage through the 15 miles of rocky channel below this Barrier was last season most difficult and hazardous.

5th—There is as yet scarcely any return traffic down river. It is so trifling that it appears to have been altogether omitted in the returns at one of the places of registry. The exports from Dumagoodium amounted to 755 maunds, or 28 tons only. Details are given in the Appendix.

46 Of course, under such circumstances, the rates of carriage could not fail to be high. They were---

	Rs				Rs		
From Dowlaiswaram (the head of the Cocanada canal) to Dumagoodium							
120 miles, per bag of 164 lbs ...	1	2	0	to	1	4	0
From do to Budrachellum, 105 miles	0	14	0	to	1	2	0
From do to Gollagudium, 98 do	0	12	0	to	0	14	0

Or per ton per mile---			Anas		Anas	Mean
To Dumagoodium . . .	...		2-1	to	2-3	2-2
.. Budrachellum ...	..		1-9	..	2-4	2-2
.. Gollagudium ..	..		1-7	..	2-5	2-1

The rates charged for carriage down river were Rs 0-0-9 to Rs 0-1-6 per ton per mile. The proportion between these rates and those up stream are much what we should expect, viz, less than half the up river rate for carriage down.

47 In the present unimproved condition of the river then the actual rates of transport by boats carrying 5 to 6 tons only are---

Up river without a return load, 1½ to 2¼ annas

Down river ¾ to 1 anna

48 Of the cost of transport by steamer I have at present no satisfactory data. The cost by the present steamers, as shown in the periodical reports of the Transport Division does not include any charge for interest and depreciation of stock, while, on the other hand, it is largely increased by the unsuitability to the navigation of the present steamers and the unimproved state of the river, which of course tells much more upon large than upon small boats. I hope in another month one at least of the new steamers will be running, and with them more reliable results will be obtained.

Suggestions for facilitating the boat traffic, and reducing the present cost of Transport

49 The chief causes of the present high rates of carriage are---

1st ---The use of very small boats not well suited to the navigation

2nd ---The prevalence of fever in the cold months

3rd ---The want of a return load

The use of very small boats has arisen from the strong currents met with on two parts of the river below the 1st Barrier, and the difficulty of getting larger boats over the shoals. One of these places is the rocky reach immediately below the Barrier of which mention has already been made, and which is now in course of improvement; the other is the 12 miles of river below the confluence of the Sebbry, and chiefly the lower two miles of it. This part of the river has a much greater fall than the average, and the ascent is proportionately difficult. The shoals are

met with at several points. As regards them and the reach immediately below the Barrier, the remedies needed have already been indicated. To facilitate the ascent of the two miles of strong currents lower down, I propose for the present to anchor either one or two boats furnished with capstans to warp the boats over the most difficult points, and eventually as the traffic increases it may be advisable to place a steam tug on that part of the river to afford assistance.

50 In the next place, I propose to introduce a superior class of boats better adapted to the navigation than those in use. I calculate that we could build light iron boats, which could be worked by just the same crew as that which the present native boats require, and yet would carry twice to three times the load with the same draught of water. I would build a few such in our yard here, and either let them out for hire, or allow them to be paid for by a few annual instalments. As their superiority gradually becomes evident, private builders will be led to adopt the new models, and the aid of Government will no longer be necessary. I look upon this as a most important step towards reducing the present cost of transport. I shall give details when submitting a definite proposition upon the subject.

51. The prevalence of fever, chiefly among the hills through which the river runs for 40 miles, from November to January, is a serious check to the traffic at that time. I propose to arrange for the proper treatment of fever cases by placing a Dresser at the disposal of the Superintendent of Navigation, and making it an especial part of his duties to afford medical aid to the boat crews when required. The expense will be small, and may eventually be defrayed by the river tolls.

52 The small amount of the present down river traffic in comparison with that up river greatly increases the cost of the latter, as the whole cost of the trip must be borne by the up load alone. This is a source of expense which will diminish with the extension of the navigation inland, and the increased access to more populous and productive parts of the country. The opening of the navigation to the 2nd Barrier, which brings it within 40 to 60 miles distance of such places as Seroncha, Chennoor, Kalaiswarem, Muntina, &c, around the confluence of the Pranheeta and Warungal, with its estimated population of 20,000, will open new sources of export trade, and every facility should be given for the land transport which must connect such places with the river. On the north bank, I believe that the existing tracts through the forest country in the direction of Bustar may be improved to a slight extent with advantage; and that an increased trade by means of the Brinjaries, who bring down a part of the produce now exported, may be looked for in that direction. They now bring down wheat, and carry back salt.

53. From the Godavery Districts themselves, that is to say, the newly acquired districts lying along the north bank, but little traffic is to be expected at present. Their population has always been small, and it has been still further reduced by the extensive emigration which has taken place both into the Nizam's country on the south bank, and the Bustar State on the north in the course of the last two or three years

* * * * *

54 With regard to steamer traffic on the river, I shall shortly have to submit some proposals regarding the working of the new steamers, and the reorganization of the present Transport Division for the approval of Government. The Supply Division, I may mention, will soon be abolished altogether. The 2nd Barrier operations have been carrying on without any assistance from it, and the works at the 1st Barrier have now reached such a stage that the supply of food to the work-people may be left to private enterprise.

55 In concluding this rather lengthy, and I fear in some respects, superficial report, I should explain that it has been written without any distinct understanding as to the precise kind of information which the Government require, and at a time when I was more than usually unprepared with exact details of expenditure, statistics, &c. It moreover embraces such a variety of topics, that but little space could be devoted to each. I have consequently been obliged merely to indicate in general terms the present position of the Godavery scheme and the measures which appear necessary for its further prosecution, leaving details for future communications.

I have the honor to be,

Sir,

Your most obedient Servant,

F. HAIG, MAJOR, R.E.,

Suptdg. Engr., Upper Godavery Circle.

4th August 1868.

No 311
3807

FROM

THE SECRETARY TO THE CHIEF COMMISSIONER,

PUBLIC WORKS DEPARTMENT,

Central Provinces,

TO

THE SECRETARY TO THE GOVERNMENT OF INDIA,

PUBLIC WORKS DEPARTMENT,

Dated Nagpore, the 16th September 1868

SIR,

As the locks at the 1st Barrier of the Godavery are now sufficiently advanced to allow of boats passing through the canal, and reaching without hindrance the foot of the 2nd Barrier, a distance of 232 miles from the Coast, the Chief Commissioner deems this a fitting time to submit for the perusal of His Excellency in Council a report from Major Haig showing the progress made towards the completion of the Godavery scheme as contemplated, with some statistics of the present river traffic, and a few suggestions regarding future operations

2 The work in hand may be divided into—

CONSTRUCTIVE OPERATIONS and SURVEYS

3 The works have been limited to the 1st and 2nd Barriers, and the open reaches extending to the foot of the 3rd Barrier, some 300 miles inland, whilst the Survey operations include the 3rd Barrier and the upper rivers called the Wurdah and the Wunna.

4 Major Haig describes the work done and the present condition of the 1st Barrier very clearly, and thus summarises the result—

“ The general result then of the operations up to the present time is that the canal with its locks is in working order, the anicut is raised to such a height as to retain the water at the head of the Barrier 2 feet above its natural level, so as to afford as good navigation as is to be found in the open reaches above and below; and the obstructed part of the river channel below has been cleared to an extent to admit of navigation by steamers for 6 or 7 months, and by boats for the whole year.”

5. This progress the Chief Commissioner considers to be very satisfactory. The opening of this canal is the first return for the money sunk in the undertaking; it will be interesting to watch the development of the boat traffic which will in all human probability follow the increased facility for navigation; and it is with pleasure Mr. Morris notes the fulfilment of the hopes held out by Major Haig on commencing work, that the 1st Barrier canal would be open for traffic by the monsoons of 1868

6. All that can be said of the 2nd Barrier works is that a good start has been made. They differ from those of the 1st Barrier, inasmuch as they consist almost entirely of "masonry," and although but a very minute proportion of the whole mass of stone has been deposited in the anicut, an Engineer will not fail to realise from Major Haig's description the methodical and complete arrangements in progress to ensure a plentiful supply of material, as well as the care bestowed in maintaining a high sanitary condition amongst the workpeople; and from these augur well for the future success of the works, and the opening of the navigation to the foot of the 3rd Barrier

7. Considering the difficulty of obtaining a qualified staff of Surveyors to carry out these important operations in a country little known, and generally covered with dense jungle, the Chief Commissioner thinks the progress made in Survey operations very good

The estimate for the construction of a fair weather road from Chanda to the foot of the 3rd Barrier is almost ready for submission, indeed would ere now have been completed, but for an accident. The surveys for a canal to turn the 3rd Barrier have been completed, and the estimate is in hand, whilst Mr. Scott and his staff have obtained very full and complete data of the Wurdah river from the top of the 3rd Barrier, to Phoolgaon, on the Great Indian Peninsula Railway (190 miles); of the Wunna from its junction with the Wurdah near Soett, up to the great cotton mart of Hingunghat (21 miles); as well as 25 miles of the Pynegunga,—a very important tributary of the Wurdah joining it near Chanda

8. The manner in which Major Haig proposes to utilize the Survey establishment in Hydrological observations during the monsoon recess has the Chief Commissioner's full approval, for even should the data thus obtained not be turned to use in the Godavery navigation, yet any practical rules regarding the proportion of the whole rain-fall thrown off by the soil deduced from accurate observations on a large scale will be of great value, and will be received by the Profession as a very important addition to our Engineering knowledge

9. After touching on the work executed, Major Haig offers a few remarks upon the 1st Barrier scheme as now under construction, and shows that the adoption of the present plan has brought some 200 miles of the river under navigation three years sooner than

would otherwise have been the case, had the project for the larger canal been at once accepted. Even should the increase of trade on the river demand, in course of time, the construction of the longer canal, the value of the present scheme as an alternative route compensates for the outlay on it, and secures permanence for the navigation, which by Major Haig's showing would always be liable to interruption from extraordinary floods.

10. The Chief Commissioner is aware that the method of turning this Barrier was long a disputed point, but he thinks the wisdom of that policy must now be admitted which has enabled the navigation to be opened to the foot of the 2nd Barrier three years earlier than it would otherwise have been, whilst it leaves to the traffic itself to prove, from the expansion and development induced by the minor improvement, the necessity for the heavier outlay and more complete navigation works.

11. The rates of work have also been noticed. Contrasting these with those ruling in Nimar the most expensive district in the Central Provinces, they are by no means out of the way, although they are higher than the normal rates of the Province generally

		GODAVERY	NIMAR
Rubble masonry..	..	Rs 27.7 to 37.8	Rs 27 to 32
Cut-stone ..	..	" 230	" 250
Earthwork ..	...	" 10.96	" 8.75 to 11.25

Taking into account the drawbacks of the locality, the outbreaks of sickness which have occurred, and the miscellaneous charges that in a sparsely populated district must be incurred, the Chief Commissioner does not take exception to them, and it is satisfactory to record that Major Haig anticipates no rise in the estimated rate for dry masonry in the anicut of the 2nd Barrier

12. In remarking on the condition of the river between the Barriers the Superintending Engineer asks permission to proceed at once to a limited extent with the clearance of channels through rocky beds, and with the construction of groins, pending the preparation of estimates

The Chief Commissioner thinks that this may safely be left to the discretion of the Superintending Engineer, and he solicits the permission of the Government of India to place at his disposal a sum of Rs. 15,000 (debt to the Godavery allotment) to be covered by estimates when his knowledge of the wants of the localities shall enable him to frame them on reliable data

13. Mr. Morris observes that Major Haig is desirous of forming a separate Division for the removal of the shoals, and asks for the services of an Officer or Subordinate experienced in the navigation improvement works on the Ganges. If the services of a Subordinate are available the Officiating Chief Commissioner would be glad if they could be placed at the Superintending Engineer's disposal, but he

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is not prepared to recommend the formation of a separate Executive Division with its accompanying office charges. He thinks these clearance operations might be placed under either of the Executive Engineers, and worked as a Sub-Division of the 1st or 2nd Barrier Division.

14 The trade statistics will, the Chief Commissioner thinks, be read with interest. Being the first reliable returns of the kind that have been prepared on the Upper Godavery no comparison can be made with previous years; but the variety and nature of the articles show that the ground-work of a large import trade exists. The very small proportion which the value of the exports bears to that of the imports (Rs 7,600 to Rs 138,708) is, however, significant of the poverty of the district through which the river flows, and seems to point out that it is to the imports alone we must look for increase for some time to come. Already salt to the extent of 265 tons has found its way up the river, and it is to be hoped that the salt traders will largely avail themselves of the water route, and that the cheapness of carriage will be followed by an increased consumption of this most necessary article of food.

15 Closely connected with the traffic returns is the cost of water carriage. From the data he has collected on the river below the 1st Barrier Major Haig makes this with the river in its unimproved condition to stand as follows per ton per mile—

Up-stream, 21 annas to 22 annas. Down-stream, 09 pie to 10 annas. These rates the Superintending Engineer regards as high, and attributes this to three causes—

- (1) The use of small boats, necessitated by the strength of the current at certain places.
- (2) Prevalence of fever.
- (3)—Want of a return load.

And he proposes the following remedial measures:—

- (1) The establishment of capstans to warp the boats over the difficult places.
- (2) The construction at Government expense of a better class of boat; these to be let out to the traders on a monthly rent, or to be paid for by instalments.
- (3) The establishment of a Medical Subordinate to afford aid to boats' crews stricken down by fever.

16 The Chief Commissioner feels some difficulty in dealing with this subject. If the returns continue to show a progressive development of traffic, the construction of a few pattern boats might give a stimulus to trade, but, on the other hand, it is not probable that the traders will long remain blind to the advantages of boats

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of greater capacity; and self-interest will gradually bring about their employment. If Major Haig learns that boat building is on the increase, he should use all legitimate influence to promote the introduction of a better pattern, and should he be successful the Chief Commissioner would then be prepared to take up the question of the establishment of capstan stations. At present he is not inclined to recommend either advantages for boats, or their construction in Government yards, as he feels assured that as improved wheeled carriage has everywhere in this country followed the construction of roads, so will a better class of boat follow on the improved navigation without the intervention of Government.

The employment of a Dresser and the establishment of depôts of simple medicines would, the Chief Commissioner thinks, tend to give the boatmen confidence, and is worth considering.

17. In conclusion Mr. Morris would solicit early orders in the subject of paras. 12 and 13. The shoal operations cannot begin too soon, as it is at the time of freshes and half-flood that groins and spurs exercise the greatest effect, and if the services of an experienced Subordinate can be obtained he should be at work on the river as speedily as possible.

I have the honor to be,

Sir,

Your most obedient Servant,

J. H. Charles Pollard Esq. R.C.

Secretary to the Chief Commissioner, P.W.D.

No. $\frac{106}{649}$

FROM

MAJOR F T. HAIG, R E,

SUPERINTENDING ENGINEER,

Upper Godavery Circle.

To

THE SECRETARY TO THE CHIEF COMMISSIONER,

DEPARTMENT PUBLIC WORKS,

Central Provinces,

Dated Dūmagoodium, the 27th July 1868

SIR,

Your telegram calling for an immediate and special report upon the Godavery works reached me a week ago, but I was then constantly engaged upon works for the opening of the canal at this Barrier, and have been unable to attend to your requisition until now.

I am not aware what is the precise nature of the information which the Government requires, but suppose they wish to know what is the present state of the works generally, and what progress has been made towards the completion of the whole scheme as at present defined

These points therefore I propose to illustrate, not entering much into details which as regards the operations of the past year have already been sufficiently given in my Annual Progress Report I shall add some suggestions in regard to future operations, and also give the statistics of the present river traffic.

2. Under existing orders all constructive operations have been limited to the 300 miles of river below the 3rd Barrier. The only work in hand above that Barrier has been the Surveys neces-

sary for the preparation of estimates for the road from Chanda to the foot of the Barrier, the canal at the Barrier, and the improvement of the Wurdah up to Hingunghat. I will now describe the progress made under both heads, Construction and Survey

1st Barrier

3 The works at this Barrier it will be remembered consist of,

(1) An anicut near the head of the Barrier with—

(2) A canal of two miles in length furnished with a head or entrance lock, and scouring sluices, and a pair of tail-locks, which connect the navigation above the Barrier with that below, and—

(3) Clearing a channel through the rocky part of the river bed between the tail-locks and the terminus of the long canal (now in abeyance) a distance of 21 miles. I have already reported that the progress made with these works has been such that the canal was opened for traffic on the 16th instant. The actual state of each work is as follows—

(A)—The anicut having a total length of 1,700 yards, is built up to its full height and section for a length of 800 yards, and to within two feet of its full height; but not quite to its full section for the remaining 900 yards.

(B)—The head-lock is finished

(C)—The scouring sluices are finished

(D)—The canal is finished with the exception of a portion of the earthwork below the tail-locks, and in the regulating tank above

(E)—The tail-locks are finished sufficiently to admit of their use, but the gear for working the gates is not yet fitted up, and is replaced for the present by ropes and tackle

(F)—The flood embankments are not quite finished

(G)—A passage has been cleared through the rocky parts of the 21 miles of river below the tail-locks sufficiently to allow of navigation by steamers up to 1st February, and by boats for the whole year. I would limit this statement by adding that the steamers must have sufficient power, as the channel at present cleared is at two points still so narrow that the rush of water through it in certain states of the river intermediate between half-floods and low water is greater than our little steamers can stem. I mean that at times during two months, July and November, out of the several months of steam navigation our present steamers will for this year be unable to make the ascent.

4 Such in general terms is the degree of completeness as yet attained in the 1st Barrier works. Perhaps a more accurate idea of it may be formed from an inspection of the following statement

of the quantities of work done up to end of last month, and work yet remaining to be done

NAMES OF WORKS	Description of work	Estimated quantity, cubic feet	Quantity done to the end of June, cubic feet	Quantity yet to be done, cubic feet	Approximate cost when complete	Cost up to end of June 1868	Approximate amount required to complete.
					Rs.	Rs.	Rs.
1 Anicut ..	Rubble	868,493	692,428	176,065	370,480	2,66,906	1,03,574
	Cut-stone	29,488	7,409	22,079			
2 Protective works at head of island on which anicut abuts	Rubble	81,407	81,407	.	33,334	33,334	.
3 Scouring sluices	Rubble	183,410	180,829	2,581	131,789	1,29,584	2,205
	Cut-stone	10,745	10,745	.			
4 Head-lock	Rubble	248,803	248,803	.	185,602	1,83,200	2,402
	Cut-stone	11,229	11,229	.			
5 Canal	Earthwork	15,977,524	15,186,072	791,452	2,13,597	2,03,587	12,010
6 Regulating tank on canal	do	1,627,428	492,132	1,135,305	13,815	7,744	6,071
7 Tail-locks	Rubble	330,818	328,780	2,038	176,342	1,42,581	33,761
	Cut-stone	9,508	7,200	2,308			
8 Flood embankment	Earth-work	7,758,427	6,576,397	1,182,030	64,654	56,397	8,257
	Rock	1,954,693	930,763	1,023,930	121,416	54,557	66,859
9 River improvements	Mixed rock, gravel and shingle	2,992,762	1,822,572	1,170,190			
10 Shelter for establishment, workshops and stores	..	..	..	..	84,700	78,308	6,392
11 1st Barrier tramway	..	..	..	..	55,600	54,929	671
12 Station improvements	..	..	..	..	9,447	9,447	..
Total ..					14,62,836	12,20,574	2,42,262

5 The following Table, compiled from the foregoing, shows the total quantity of each description of work as per estimate, the quantity completed, and the proportion of the latter to the former.

Description of Work	Total cubic feet	Completed, cubic feet	Per cent
Rubble masonry	1,712,931	1,532,247	90
Cut-stone do.	61,030	36,588	60
Earthwork	25,363,379	22,254,592	88
Mixed rock and gravel excavation	4,947,455	2,753,335	55

In regard to this statement, I would observe.—

(1)—The total quantity of earthwork of various kinds actually completed is very much larger than that here shown, which does not

include the quantities in the different excavations, of which those for the locks varied from 20 to 50 feet in depth

(2)---The statement only shows the quantities of the principal descriptions of work. A great deal more of other kinds has been done which is not here exhibited

(3)---Of the 10 per cent of rubble masonry, and 40 per cent of cut-stone work yet remaining to be completed, almost all is in the unfinished part of the anicut.

6 The general result then of the operations up to the present time is that the canal with its locks is in working order; the anicut is raised to such a height as to retain the water at the head of the Barrier two feet above its natural level, and so to afford as good navigation as is to be found in the open reaches of the river above and below; and the obstructed part of the river channel below the Barrier has been cleared to an extent to admit of navigation by steamers for six or seven months, and by boats for the whole year

7. It will, I hope, be satisfactory to the Government to learn that the navigation has been opened, though imperfectly as yet, to the foot of the 2nd Barrier. I shall return to the subject after describing the progress made at the other Barriers, but I cannot pass on to them without first placing on record a humble acknowledgment of the mercy vouchsafed by Almighty God in permitting us to bring our work thus far towards completion

2nd Barrier.

8 The orders of the Government of India sanctioning the commencement of the 2nd Barrier works were received in March 1867. But one working season, and about a quarter of another, has there fore elapsed up to the present time since ground was first broken. As everything had to be done *ab initio*, the Government will not be surprised to learn that the work accomplished up to the present time is chiefly of a preparatory nature. The river works at this point consist of an anicut thrown across the Barrier near its lower end, which will raise the water above it to a height of 44 feet above that below, and thus submerge not only the whole of the 10 miles of rocky reach above, but also 2 miles more of a broad sandy bed with too steep a declivity for good navigation. The river channel below the anicut is deep and navigable at all times of the year. There is therefore no necessity for a canal. A flight of three locks at the left end of the anicut will connect the navigation below with that above the work

9 For some miles both above and below the site of the anicut, the river is confined between hills, which running sheer down into the water on the left bank, leave but a narrow strip of level land between them and the river on the right. This configuration of the ground does not conduce to the healthiness of the work-stations which are established on the right (Nizam's) bank---one at Neelum-

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pilly immediately at the end of the anicut, the other at Enchampilly, about 1½ miles further down the river. The hill whence the stone of which the anicut is to be built is obtained, is a little above the line of anicut on the same bank, and the limestone quarries about a mile below the Enchampilly station. The whole of the intermediate strip of land, 3 miles long, has been cleared of forest to the foot of the hills, and in the neighbourhood of the anicut quarries the hill side has itself also been cleared nearly to the top. A road metalled and bridged but not yet complete, connects the two work-stations. The quarries have been opened, and are connected by 2 miles of 4-8½ gauge railway with the anicut and workshops. The limestone and cutstone quarries are similarly connected by a lighter description of tramway with the deep channel on the left bank of the river. Accommodation for the whole of the establishments, as well as for stores and workshops has been erected, and lines capable of housing 2,800 workpeople. In fact all preparatory works have been completed, and were so far advanced that during the latter half of the past working season constructive operations in the river bed were commenced

Up to the present time 33,700 tons of stone have been deposited in the anicut. 17,000 more are quarried and ready for transport, and 7,500 cubic feet of rubble masonry have been built in the foundations of the guard wall on the left bank. Now that the rise of the river has put a stop to further work in the bed, stone is being quarried and materials collected for next season's work

10 Though the above description represents a smaller amount of progress than I had hoped to accomplish up to the present time, yet as it will generally be admitted that in works of this class, carried on in such a remote and uninhabited part of the country, where the first settlers must clear the very ground on which their houses are to be built, the first year must necessarily be occupied chiefly by works of a preparatory kind. I hope that the progress will on the whole not be thought unsatisfactory. The establishment have suffered severely from fever, especially the Europeans, but the experience at the 1st Barrier leads us to expect that this is a hindrance which will diminish year by year as the works advance. I am myself very well satisfied with the manner in which the operations are conducted by the present Executive Engineer

The petty contract system is in force in every part of them, down to the very smallest details, and no work, however trifling, is undertaken without a previously prepared and sanctioned estimate, and constant check upon the rates

11. With regard to the probable date of completion, I think we may reckon on all being finished by June 1871, that is to say, that by that time the river will be opened for navigation to the foot of 3rd Barrier,---330 miles from the sea

Clearing rock in river bed at Albaca, half way between 1st and 2nd Barriers

12 A channel which, for want of labour, it was necessary to limit to a width of 10 yards only, has been cleared through these rocks, a distance of about 2 miles. It will be navigable by boats for 9 or 10 months, and by steamers for about 7 months. About 50,000 cubic feet of rock were removed in the past season, and a bungalow for the subordinate in charge with cooly lines are almost completed.

To prevent misconception I should perhaps explain that the rock in this piece of the river does not extend along the whole length mentioned, but occurs at intervals, and that it lies low, only rising to a height of 2 to 3 feet above low water level.

Surveys above 3rd Barrier

1st—Road from Chandra to the foot of 3rd Barrier.

13. This survey was completed more than a month ago, and Mr Scott, the Assistant Engineer, under whose supervision it was carried out, reports, under date 4th instant, 'Corporal Pollock, Overseer, has been preparing the estimate for the road under my instructions, and had it almost completed a short time ago, when his tent was struck by a storm, and the estimate destroyed. A second is now under preparation, and shall be submitted with the least possible delay.' In a few weeks, therefore, I shall probably be able to submit this estimate.

Survey for Canal round 3rd Barrier

14 This Survey is also completed. Mr Assistant Engineer Sieveking has carried it out with great care, and in a most complete and satisfactory manner. He has only just returned to this Barrier, and has brought with him the whole of the materials for the preparation of the estimates, upon which he and another Assistant will now be employed during the monsoon months.

I hope by the end of the year the estimate will be ready for submission.

Survey of Wurdah above the 3rd Barrier

15 The Government of India directed that this river should be surveyed up to Hingunghat. The Chief Commissioner however decided that if possible the surveys should be continued up to the railway crossing at Poolgaum.

There was time and establishment sufficient for both. 190 miles of the Wurdah, 21 miles of the Wunna (the tributary on which Hingunghat is situated), and 25 miles of the Pynegunga, have been very completely surveyed by Mr Scott and his subordinates. A longitudinal section has been obtained of the whole of these rivers, commencing from the head of the 3rd Barrier, checked by a return line of levels

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of 138 miles in length. A rough sketch has been made of the entire length of the three rivers, showing the sandy and rocky shoals and configuration of the banks; and also detailed surveys of several portions of short length, aggregating about 15 miles, of special interest. 500 transverse sections of the summer channel have been taken between 3rd Barrier and Hingunghat, with numerous measurements of the discharge, and similar sections at longer distances apart between the mouth of the Wunna and Poolgaum. The result, I think, is that we are now in possession of full information respecting 236 miles of the Wurdah, and its tributaries above the 3rd Barrier, which are capable of improvement in various degrees, and accurate and reliable data have been obtained for the preparation of detailed estimates whenever the Government may desire them.

Mr Scott and his subordinates have thus accomplished in a very satisfactory manner the field work of the Survey, and are now engaged in reducing it to paper.

Hydrological observations in the Wurdah Valley

16 The Survey establishment employed upon the Wurdah in the dry season not having sufficient work to occupy them during the rains, it occurred to me that a part of it might with great advantage be employed in procuring reliable data upon a point respecting which we have as yet only general conclusions based upon observations in other countries to guide us, viz, the proportion of the total rain-fall which runs off by the rivers and water-courses, and which is available for storage. For this purpose the Bore river, a tributary of the Wunna, has been selected. Its catchment basin down to the point where the discharge of the river is being measured is about 180 square miles, lying on the southern slopes of the cluster of hills north of Hingunghat. With the sanction of the Chief Commissioner rain gauges so constructed as to contain the whole of one season's rain-fall have been set up at three points in this area, and a fourth at Hingunghat on the Bore, where two Surveyors are stationed, who are engaged in recording hourly the heights of water in the river, and measuring the velocities of current. At the close of the rains the discharges having been computed and compared with the ascertained rain-fall, some satisfactory conclusions will, I hope, be afforded as to the relative proportions of the two.

Surveys of other Tributaries of the Godavery

17. No other surveys than that of the Wurdah have been undertaken. The 10,000 rupees granted by His Highness the Nizam for the survey of the main Godavery from Nassick to the confluence of the Pranheeta remain still available. It is much to be desired that we should know precisely what the navigable capabilities of this 600 miles of river really are, and I hope many years will not elapse before we have full information upon the subject.

On the Wynegunga nothing has been done. We know that there is a boat traffic to the extent of 1,000 tons per annum on the upper part of it, and that it is navigable by small boats, with the exception of two or three places where obstacles not of any very formidable nature exist to within 60 miles of its mouth, that it flows through a valley with a population of 2 millions, and that it may be connected by canal with the Wurdah immediately above the 3rd Barrier. Here for the present our information stops.

Summary of Progress

18 To sum up, the progress made with the Godavery scheme generally up to the present time is as follows:--The navigation is now open from the Port of Cocanada to the foot of the 2nd Barrier, a distance of 232 miles, and it will probably be opened to the foot of the 3rd Barrier 300 miles in 3 years more.

All the surveys necessary to enable the Government to decide upon the various questions connected with the extension of the communication beyond the 3rd Barrier are complete, the estimate for the Chanda road is nearly finished, and those for the navigation works are about to be put in hand.

Remarks upon the 1st Barrier Scheme

19. As any discussion of the Wurdah navigation question is foreign to the objects of this report,* I shall in what I have now to say confine my remarks entirely to matters connected with the navigation below the 3rd Barrier. To return then to the lower or 1st Barrier, there are some considerations connected with the works now so far advanced towards completion to which I would direct attention.

1st--The Government will doubtless desire to know to what extent the "Short Canal" project is likely to prove an efficient substitute for the Long Canal, and whether the work already done in the blasting of rock and clearing of the navigable channel below the Barrier affords the means of judging as to the probable cost of this part of the project.

In the first place it is to be observed that the channel has as yet been cleared to only half its width, and it is now little more than a month since the river rose. We have therefore had little opportunity of judging of the state of the navigation, and we are certain that whatever that may be, it must be much inferior to what it will be when the passage is cut to its full width. At present the currents at two points are, as I have already said, greater than our little steamers can stem when the river is only a few feet above its summer level. When the river rises higher the difficulty disappears, as the water finds more vent, and is not so confined, and I believe such will be found to be the case also after the freshes have subsided, and the river has fallen to about its dry weather level. My belief then is

that when the river channel shall have been completed to the full width now contemplated, though the current will be strong, and so far an obstruction to up-going boats and steamers, yet it will not be more than can be surmounted with some difficulty.

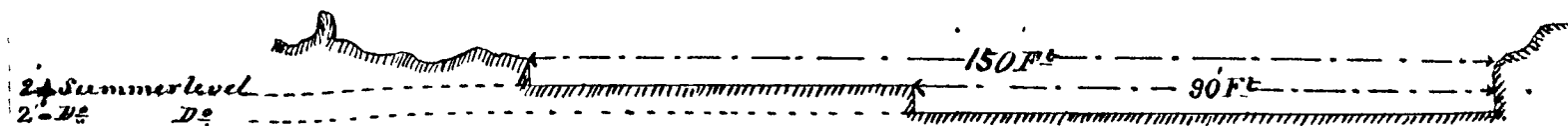
Perhaps this is as much as, in the present state of the river generally, we need desire. We shall have obtained a passage of this description at a cost of about three lakhs (locks included) instead of a much better one for perhaps 3 or 4 times as much. The saving thus effected has enabled us to proceed with the works at the 2nd Barrier, which might otherwise have been postponed for some years. The funds and establishment, which would have been employed for the next two years on the long canal will now be available for such works, as may be required for the improvement of the navigation between the barriers, and we are enabled to bring 200 miles of navigation into operation some three years sooner than we could otherwise have done.

This last is, in my opinion, a very important point.

20 Next, as regards the probable cost of the rock clearing. Upon this point last season's work has supplied very reliable data. The cost has been much below what we anticipated. In the statement in para 4 it will be seen that the total quantity of rock, gravel, and shingle to be removed (as obtained by careful detailed measurements) is 4,947,455 cubic feet, and that of this, 2,753,335 cubic feet were removed this last season, leaving 2,194,120 cubic feet still to be done. Now the revised estimates of the 1st Barrier works have been nearly complete for some months past, its completion being delayed partly by the uncertainty of the rate to be charged for work of this class. In an abstract of it sent to me by the Executive Engineer in March last the estimated cost of the rock clearing in the river bed was entered Rs 2,89,000. On summing up however the expenditure in the last season, and comparing it with the work done, it is found that the former rate was nearly twice too high, and the total of this item in the estimate is now reduced to Rs 1,21,000 only.

21 We know then the cost per yard of this description of work; but I would observe that the actual quantity of rock which it will be necessary to remove can only be decided by actual observation of the effects of a certain amount of clearance.

The channel now being cleared is of the following section --



It is a channel within a channel; the larger one, 150 feet broad, is intended for the monsoon navigation, when steamers must have plenty of room; and its floor is to be cut down to 2 feet above the lowest summer level. The smaller channel in its centre which is for use in the low water months is to have a width of 90 feet only, and to be cut down to 2 feet below lowest summer level, so as to be navigable for the whole year. I believe that these dimensions will be generally found to be sufficient, but at a few points it is possible the high level channel may require enlargement. On the whole, I should suppose that the work required to bring the river passage into such navigable condition as above described will not in any case exceed 1½ lakh.

22. To what extent then, it may be asked, may we expect the river channel to be effective as a substitute for the canal?

I answer: it was never intended as a substitute, save temporarily. It must always be an imperfect one. But it is a most valuable and important addition to the canal, an alternative route, which, as I have always insisted upon from the time when I first suggested it, the navigation could hardly be considered complete without. I am not going to revive by-gone controversies, but I wish simply to satisfy the Government that they have got their money's worth, that if the long canal is completed not a single rupee will have been thrown away in the execution of the shorter project. I have little more to say now in support of this position than I had in 1863, but my remarks may, perhaps, receive more attention than they did then.

23. The long canal runs for 17 out of 23 miles along the river bank, and the highest floods within our own observation of the last 20 years, rise from 8 to 15 feet above the ground in which it is cut. In such floods therefore the head of water on the bank would vary between these limits. But at many points the canal crosses deep depressions in the ground, gullies cut as much as 20 and 30 feet deep into the bank by old water-courses. At a few such points the head of water would be as much as 20 feet. Now my experience in works of this class satisfies me that when embankments which in ordinary years are scarcely exposed at all to the floods, are at rare intervals subjected to such pressures as these, there never can be absolute certainty as to their security unless they are made of dimensions much larger than any of those even contemplated for this canal. Embankments subjected to a constant head of water can always be made secure enough; but those only liable to such trial at long intervals are dry in their centre, and become the favourite haunt of rats and other vermin, whose burrows are always a source of danger.

24. But this is not all. It is certain that 50 years ago a flood 3 or 4 feet higher than any within my own recollection took place, and even this may not be the limit of such great inundations. Now let one such flood breach the canal embankments, and though the damage would be less than what would commonly be supposed, it would almost certainly stop the navigation, and in this thinly populated part of the country could not be repaired under some months, and at a heavy expense. Such an accident might not occur above

once in 10 years, but when it did occur, it would cut the navigation in two, and at once put a stop to all traffic, save by means of an expensive portage, for which perhaps no facilities might be at hand. At any point on the river the liability to such a check would be a most serious defect, but most of all at this, the lowest Barrier. At the two upper Barriers no such accident could occur.

At the 2nd there is no canal, and at the 3rd the proposed line of canal runs along the river bank within reach of the floods for only 5 miles out of the 32, and the extreme head of water on the banks would be very much less than at the 1st Barrier. We thus find our line of navigation threatened at one point only, but that the most important, with a danger which it would be folly not to provide against. Now the alternative river route furnishes just the provision we require, and at an additional cost of only 3 or 4 lakhs, out of perhaps 80 or 100 lakhs.

The tail-locks of the short canal are situated only 2 miles below its head. There would be no difficulty in strengthening the banks for that distance if necessary, but a breach in them would be of little consequence.

With this canal then, and the river below, we should have a route which would provide for the navigation during its temporary suspension in the long canal. Can anyone, looking at the value and importance of the navigation, suppose that such a provision against accidents is not most necessary, or that it is not well worth the extra expense it involves?

This consideration has to my mind always justified the expense of the addition to the long canal of a pair of locks, and some miles of improved river navigation.

25. I will add one more consideration. If the short canal scheme thus provides an efficient temporary substitute for the canal, why, supposing the latter completed, go to the expense of shutting out the floods whose rare occurrence renders such a substitute necessary. It might be easier and better, as it would certainly be very much cheaper, to allow the great floods (such as that of 1818) to overflow the canal, than to shut them out. If so, we should have as an additional set-off against the cost of the short project, the saving effected by reducing the heights of the flood embankments, probably 2 lakhs.

26. The actual cost of the two locks and river improvement below, which form the alternative route, has been up to the present time as follows:—

	Rupees
Locks	1,42,581
River	54,557
	1,97,138

and the amount required to complete both is—

	Rupees
For Locks	33,761
„ River	66,859
	1,00,620

so that the total cost of the alternative route would be Rs 2,97,758. This amount includes all miscellaneous charges, but a small addition has to be made for cost of transport. Even if we allow for some additional blasting, the total will probably not exceed 3½ lakhs. And this addition to the cost of the scheme is not to be charged to this Barrier only, it is properly chargeable to the whole length of navigation, for the complete security of which it has been incurred.

27. I make these remarks not with the intention of bringing forward now any proposition respecting the Long Canal, but simply that the Government may know precisely how the case stands. Any action in regard to the Long Canal must be based upon much more extended observation and experience of the actual extent to which the Short Canal scheme is efficient than we now possess. The statistics I shall presently give will show that even in its natural state, as it existed last season, the river passage below the tail-locks was practicable for small boats during the whole year.

28. Some explanation is perhaps required of the reasons for cutting the smaller channel (in the centre of the larger one) through the rocks, down to such a level as to be navigable all the year, whereas the Government contemplated perhaps a navigation of only 5 or 6 months.

The reason is that the boat traffic already on the river shows that it will be navigated for the whole year.

The idea of a 5 or 6 months' navigation is out of date altogether. That I should ever have spoken of such a thing, must be regarded as a singular instance of an enthusiastic projector erring on the side of caution in his statements. The statistics of the present traffic will satisfy the Government that there will be no such limit to the use of the river as far as the 1st Barrier at least.

29. The revised estimates for both 1st and 2nd Barrier works are still incomplete. Those for the 1st Barrier have been delayed for want of the detailed measurements of the rock cuttings in the river channel, which there was not time to take in what little was left of the working season of 1866-67 after sanction for the prosecution of the works was received, and which could not therefore be made until the past hot season, and even then they were again delayed by my long absence up river, which prevented a final decision upon some points on which the Executive Engineer required advice. For the

2nd Barrier works any revised estimates prepared before now would have been simply worthless, for it was impossible to judge of the sufficiency or otherwise of the former rates until actual trial of the cost of the different kinds of work.

I think we have now satisfactory data to work upon, and will have the estimates completed during the present rains.

30. In regard to rates, I may mention that a very careful analysis of the past expenditure at 1st Barrier shows that the cost of the different descriptions of work has been as follows—

DESCRIPTION OF WORK	Cost, inclusive of all ordinary charges	Cost, inclusive of all miscellaneous expenses of an exceptional character
	Per 100 cubic feet Rs	Per 100 cubic feet Rs
<i>Rubble Masonry</i>		
In ancient ..	24	277
Contents 868,473 cubic feet ..	27	31
In Tail-lock ..	31 25	36
Contents 325,831 cubic feet ..	33 5	37 8
In Head-lock ..		
Contents 248,803 cubic feet ..		
In Scouring Sluice ..		
Contents 173,793 cubic feet ..		
<i>Cut-stone</i> ..	194 to 200	223 to 230
<i>Earth-work</i>		
Canal (short) ..	95	109
Contents 16,288,276 cubic feet ..		

I do not think these rates will be found to compare unfavourably with those in other parts of Central India, considering the peculiar circumstances under which the works on this river are prosecuted. The cost of the cut-stone work has been very high, chiefly in consequence of the distance which the whole of the best description of stone had to be carried—21 miles, and the large size of all the stones used; with few exceptions each block being two feet thick, dressed and finished, and weighing from ½ ton to 3 tons. This stone is of first-rate quality. The earth-work includes all descriptions from alluvial soil on surface, to hard gravel, decayed rock, and some solid rock in excavations averaging 18 to 20 feet in depth. The figures above given are for the short canal. The rates in the portions of the long canal excavated were lower, the depths having been less, and the soil more favourable.

31. With regard to the 2nd Barrier works, the cost of the rough stone in the anicut upon which the sufficiency or otherwise of the estimate chiefly depends, has as yet been much below the estimated rate of Rs 6-8-0 per 100, and allowing for some increase, and including all contingencies, I see no reason at present to expect that the original estimate will be exceeded

State of the River between the Barriers

32 The obstruction at the 1st Barrier being now removed, the condition of the river in the open reaches above and below, next claims attention. Below the Barrier the river is now navigated by small boats carrying only 4 or 5 tons for the whole year. Above the Barrier, between it and the 2nd Barrier, the navigation has hitherto been confined to Government steamers with large cargo boats in tow, and these have run for only 5 months, owing to the rocks at Albaca and two other places, which become impassable, save at considerable risk after November. Now, however, that the canal has been opened, boats of both descriptions may run as far as Enchampilly, and a few private traders' boats have already passed. The navigation of this part of the river is generally better, indeed, I may say very much more favourable for boats than that below the 1st Barrier, the slope of the bed and the current being less. Only one of the three rocky reaches has however as yet been improved and the passage cut through it last year is but 10 yards in width, so that this next year the navigation may be impeded by the obstructions at these places, but if the Government should be pleased to allow us to proceed at once to a limited extent with the clearance of channels when required, pending the completion of estimates, we may be able to keep open such a passage as will suffice for the more immediate wants of the navigation.

As the traffic statistics at the end of another year will supply the most reliable information as to the time during which this, the 2nd reach of the river, is navigable, the Government will probably prefer to wait for these, and will care little for any opinion I may now express upon the subject, otherwise I should have little hesitation in affirming that this part of the river being on the whole a superior navigation to that below the Barrier, it will, like the latter, be available for traffic for the whole year.

33 Of the river above the 2nd Barrier, we know less than of that below, and the only boat upon it at present is a small paddle boat built this last year. In this boat, however, I made two trips both up and down from Barrier to Barrier this last season, one in March the other in May, and the season was a favourable one for observation, the river being unusually low. I should say that, that part of the river will be found to be navigable in its natural condition by such small craft as now run to the 1st Barrier for 10 months, viz to 15th April.

All these statements regarding the different periods of navigation have reference, be it observed, to the river in its *natural* condition, rocks only being supposed to be removed, and do not take into account any improvement of the shoals.

34 I will now briefly state what measures I consider necessary for the improvement of the navigation between the Barriers, with a view to rendering it (1st) safe, and (2nd) practicable for a larger class of boats than now run to the 1st Barrier as well as for steamers.

35 In the first place, then, all rock in the navigable channel must of course be removed. There is so very little of this above the 2nd Barrier that we may for the present confine our attention to the river below that point. Below that Barrier there are in all 8 or 10 places where rock is met with. Of these there are only two where the obstruction is of a nature actually to limit the period of navigation, but in all clearing to a greater or less extent is required. I propose to have these carefully surveyed, and estimates prepared for the work required, but inasmuch as there is now an actual traffic upon the river which is more or less hampered by these obstructions, I would strongly urge that the permission given last year to proceed with the blasting at Albaca to an extent sufficient only for the more immediate and pressing wants of the navigation should be extended to the whole. At Albaca, which is by far the worst of them, we expended last year Rs 2,100, and for this sum we were enabled to clear a channel of small width which will be practicable for 9 months. There is little fear therefore that permission to proceed at once with similar clearance at other points could lead to any wasteful or excessive expenditure. I fully admit the wisdom, and indeed absolute necessity of requiring, as a general rule, detailed estimates before any expenditure is sanctioned, but I conceive that the present is one of the exceptional cases in which the rule may with advantage be set aside. The benefit and incidentally the saving resulting from the dispensation granted last year in this respect in regard to the Albaca rocks has been great, and had my request,--strongly urged in 1863, that I might be permitted to expend a very small sum, not exactly in clearing rock, but in securing the river bank at points where it was being cut away, and large masses of rock underneath being exposed,--been granted, the saving to Government would probably not have been less than 50,000 Rupees. Again and again this year have I sailed between such masses of rock which *must* now be removed, but which then lay under the bank of the river, and were not in the channel at all. And were I, in a similar manner, to be permitted this year to throw up a very few groins of stone for the protection of those parts of the banks which are now attacked by the stream in a way most injurious to the navigation, I have no doubt the saving incidentally would be very much greater than the sum I have mentioned.

36 So much for the obstructions caused by rock. What I propose in regard to them is that careful estimates of the cost of their removal should be prepared as soon as possible, and that meantime

sanction should be granted for such an expenditure as may be needed for such improvements as are more immediately practicable, and most urgently required

37. Next come the shoals. There are two ways of dealing with these, (1st) by means of temporary appliances, and (2nd) by means of works of a permanent character. I propose to try both, the first immediately, the second after careful study, survey, and estimate. For the first I wish to have either an Officer or subordinate sent down who has some experience of the methods in use on the Ganges for keeping open navigable channels through the shoals. I would confine him entirely to this work, and the general superintendence of the navigation, making it a separate Executive Division. His duties would be to keep a good navigable depth of water over the shoals, and to afford other facilities which I shall presently specify, to all craft navigating the river.

38. In regard to the permanent works for the improvement of the shoals, I shall not now enter into any discussion as to their probable cost, feasibility, or value. I propose to depute an Officer for the study of the question, and for estimating the cost of one or two, for which typical shoals would be selected. I would then propose to construct these upon sanctioned estimates, and to observe their effects for a year or two before any further steps are taken in the matter. If this does not now appear a reasonable proposition, I hope that in submitting, as I propose shortly to do, a list of the establishment required for the purpose, I shall be able to adduce such arguments as shall satisfy the Government upon the point.

39. One more point has to be noticed in connection with the improvement of the river between the Barriers, the protection of the banks by means of groins where they are attacked, and cut away by the stream. The very first essential to any permanent improvement of the low water navigation of the river is that it should be confined within banks absolutely fixed and unvariable in position. Out of the 600 miles of river bank up to the foot of the 3rd Barrier (reckoning both sides), there are only about 70 that require attention in this respect. The proper way to deal with them would be to have a careful survey made of the whole (wherever the topographical map may be insufficient), and estimates for the works required prepared for submission to Government, but in the meantime the Superintending Engineer should be empowered to sanction emergent estimates up to a certain limit, say Rs 15,000 per annum, in cases when a much heavier expenditure and serious injury to the navigation can only be averted by prompt action.

Present river traffic

40. I am now enabled for the first time to give some reliable statistics of the river traffic. It is at present confined to the river below 1st Barrier. Registers of all boats passing up and down are

kept at three places by Agents appointed by the Deputy Commissioner, and the following statement has been compiled from returns furnished by them. It shows the number of boats divided into two classes, Government boats and private boats, which arrived at the 1st Barrier from the Coast from May 1867 to May 1868, and the nature and tonnage of their cargoes. There are three points of debarkation in the 23 miles of river from Dumagoodium down to the lower end of the Long Canal, viz, Dumagoodium the head-quarters of Engineering operations, Budiachellum 15 miles lower down, the chief town of the district, and Gollagudium 9 miles further down, the lower terminus of the tramroad.

The great bulk of the traffic consisted of Government stores brought up for the works, partly in the boats and steamers belonging to the Transport Division, and partly in private boats. A part of these were unloaded at Gollagudium, the remainder at Dumagoodium.

Of the private stores sent up, that is to say, of the articles of merchandize of all descriptions, the property of private traders sent up in their own or in hired boats, all were landed at either Budiachellum or Dumagoodium. The statement shows the quantity received at each place.

up in their own or
chellum or Dumagoodium
at each place.

Statement showing the number of boats and their tonnage which arrived at the
1st Barrier from the Coast from 1st May 1867 to 31st May 1868

MONTHS	Private boats						Government boats		Total arrivals of boats per month	Total tonnage per month
	With Government stores		With private goods		With Government stores					
Boats		Tons		Boats		Tons		Boats	Tons	
May 1867	3	17	2	11	10	41	2	73	21	71
June	..	..	2	9	4	8	5	22	12	75
July	..	..	3	14	1	17	5	31	18	273
August	..	..	2	11	6	18	1	2	4	359
September	..	..	3	14	5	17	6	20	9	164
October	19	136	3	14	5	17	6	20	42	53
November	30	217	1	10	11	27	..	..	29	168
December	51	363	25	148	3	18	..	..	42	490
January	28	210	4	18	5	19	2	2	64	402
February	14	115	3	14	5	12	2	3	40	365
March	1	36	2	8	9	19	2	3	25	151
April	..	..	2	8	5	14	..	..	11	63
May	..	..	2	8	5	14	..	..	20	55
June	15	108	6	32	68	168	23	885	7	246
1st June 1867 to 1st June 1868	151	1085	61	321	68	168	23	885	..	2462

Tons
* 2462

The total imports by river were thus

viz Government stores

Private goods

The total number of arrivals in the year was boats 301

Of which 278 were private, containing

And 23 were Government boats

The average load of the private boats was therefore

And of the Government boats

* After this report was finished an error of 150 tons in excess in the quantity of Government stores was discovered in the return furnished by the Transport and Supply Division. It has not been corrected, as that would have involved too extensive an alteration of figures.

The arrivals and imports by river in each quarter of the year were as follows.—

	Boats	Tons
1st quarter, June to August inclusive	41	708
2nd do Sept to Novr do	42	238
3rd do Decr to Feby. do	162	1,264
4th do, March to May do	56	252
	301	2,462

This statement may be analysed as follows —

1st.—Arrivals of boats towed by steamers

	No	Tons.
1st quarter ...	12	594
2nd do ...	1	26
3rd do (in Decr only) ...	6	262
4th do ...	0	0
	19	882

2nd—Arrivals of boats worked by sail only

	No	Tons
1st quarter ...	29	114
2nd do ...	41	212
3rd do ...	156	1,002
4th do ...	56	252

Total ... 282 1,580

41 Hence it appears—

1st—That the river is worked by small sailing boats for the whole year

2nd—That the third and fourth quarters of the year, viz. from December to May are those in which the navigation by sail boats is busiest, the traffic in the 6 low water months having been (1254-326)—nearly 4 times as great as in the 6 monsoon months. The disproportion between the two will always be great, as the strong currents of the river during the monsoon make the upward passage difficult for sailing boats. In fact I have been quite surprised to find that any monsoon traffic by sail existed. Though I knew that some trips had been made, I nevertheless regarded them as mere temporary ventures, and did not expect that they would be repeated. That the boatmen of the Delta do not hesitate to encounter the hardships and difficulties of such a navigation, certainly augurs well for the future prospects of the river trade, for the difficulties above the 1st Barrier are far less than those below.

42 It may perhaps be supposed that the 489 tons of goods brought up for private trade were almost entirely for the use of the people employed upon the works. Such however is not the case. Of this quantity 321 tons were landed at Budrachellum, and were entirely for trade unconnected with the works. Of the remaining 168 tons a considerable part was for sale to the work-people.

43 I give in an Appendix two Tabular Statements of the articles composing the above traffic, with the exception of the Government stores. It will be found that they include a considerable variety*. It is satisfactory to note among them 7,415 maunds, or 265 tons of salt. This was almost exclusively for sale to the people of the country, the work-people being separately supplied by the Government Agency. Salted fish is another article included in the miscellaneous list which begins to come up in considerable quantities, and is much prized by the people. There is likely to be a considerable trade in it.

*Viz Cotton, Sugar and Jaggery, Salt, Wheat, Rice, other grains, Oil-seeds, Metals, English Cloths, Tobacco, Curry stuffs, Stationery, Tusa, Silk Cocoons, Dyes, Opium, Woollen Blankets, Ghee, Gingelly and Castor-oils, Cocoanuts, Salt fish, Tamul and Onions, Garhe, &c, Europe Articles and Country Cloths.

44 The value of the exports and imports as above shown was—

	Rs
IMPORTS	1,04,832
Government stores	1,38,708
Private goods	2,43,540
EXPORTS	7,600
Private goods	2,51,140

Total exports and imports ... If to the above we add the value of the timber rafted down past the 1st Barrier, coming chiefly from the upper river, viz. 19,162 logs valued at Rs 77,292, we have for the approximate value of the whole river trade, exclusive of some salt imported at Wadagudium, at the mouth of the Sebbry, and some small local traffic between the Barriers, as well as timber exported from the hills and other parts of the country below the 1st Barrier, Rupees 3,38,432.

45 I would now direct attention to the following considerations in connection with the above statistics

1st—there is already a traffic established upon the river

2nd—That traffic is much the most active during the low water months

3rd—It is carried on chiefly in small boats carrying about 5½ tons

4th—The above figures show the traffic as it exists in the unimproved condition of the river. Not a single shoal has been touched in the way of improvement, and the passage through the 15 miles of rocky channel below this Barrier was last season most difficult and hazardous.

5th—There is as yet scarcely any return traffic down river. It is so trifling that it appears to have been altogether omitted in the returns at one of the places of registry. The exports from Dumagoodium amounted to 755 maunds or 28 tons only. Details are given in the Appendix.

46 Of course, under such circumstances, the rates of carriage could not fail to be high. They were---

From Dowlaiswaram (the head of the Cocanada canal) to Dumagoodium	Rs		Rs
120 miles, per bag of 164 lbs ...	1 2 0	to	1 4 0
From do to Budrachellum, 105 miles	0 14 0	to	1 2 0
From do to Gollagudium, 98 do	0 12 0	to	0 14 0

Or per ton per mile---

	Annas	Annas	Mean
To Dumagoodium ...	2-1	to	2-3
.. Budrachellum ..	1-9	..	2-4
.. Gollagudium ...	1-7	..	2-5

The rates charged for carriage down river were Rs 0-0-9 to Rs 0-1-0 per ton per mile. The proportion between these rates and those up stream are much what we should expect, viz, less than half the up river rate for carriage down.

47 In the present unimproved condition of the river then the actual rates of transport by boats carrying 5 to 6 tons only are---

Up river without a return load, 1½ to 2½ annas

Down river ¾ to 1 anna

48 Of the cost of transport by steamer I have at present no satisfactory data. The cost by the present steamers, as shown in the periodical reports of the Transport Division does not include any charge for interest and depreciation of stock, while, on the other hand, it is largely increased by the unsuitability to the navigation of the present steamers and the unimproved state of the river, which of course tells much more upon large than upon small boats. I hope in another month one at least of the new steamers will be running, and with them more reliable results will be obtained.

Suggestions for facilitating the boat traffic, and reducing the present cost of Transport

49 The chief causes of the present high rates of carriage are---

1st ---The use of very small boats not well suited to the navigation.

2nd ---The prevalence of fever in the cold months

3rd ---The want of a return load

The use of very small boats has arisen from the strong currents met with on two parts of the river below the 1st Barrier, and the difficulty of getting larger boats over the shoals. One of these places is the rocky reach immediately below the Barrier of which mention has already been made, and which is now in course of improvement, the other is the 12 miles of river below the confluence of the Sebbry, and chiefly the lower two miles of it. This part of the river has a much greater fall than the average, and the ascent is proportionately difficult. The shoals are

met with at several points. As regards them and the reach immediately below the Barrier, the remedies needed have already been indicated. To facilitate the ascent of the two miles of strong currents lower down, I propose for the present to anchor either one or two boats furnished with capstans to warp the boats over the most difficult points, and eventually as the traffic increases it may be advisable to place a steam tug on that part of the river to afford assistance.

50 In the next place, I propose to introduce a superior class of boats better adapted to the navigation than those in use. I calculate that we could build light iron boats, which could be worked by just the same crew as that which the present native boats require, and yet would carry twice to three times the load with the same draught of water. I would build a few such in our yard here, and either let them out for hire, or allow them to be paid for by a few annual instalments. As their superiority gradually becomes evident, private builders will be led to adopt the new models, and the aid of Government will no longer be necessary. I look upon this as a most important step towards reducing the present cost of transport. I shall give details when submitting a definite proposition upon the subject.

51 The prevalence of fever, chiefly among the hills through which the river runs for 40 miles, from November to January, is a serious check to the traffic at that time. I propose to arrange for the proper treatment of fever cases by placing a Dresser at the disposal of the Superintendent of Navigation, and making it an especial part of his duties to afford medical aid to the boat crews when required. The expense will be small, and may eventually be defrayed by the river tolls.

52 The small amount of the present down river traffic in comparison with that up river greatly increases the cost of the latter, as the whole cost of the trip must be borne by the up load alone. This is a source of expense which will diminish with the extension of the navigation inland, and the increased access to more populous and productive parts of the country. The opening of the navigation to the 2nd Barrier, which brings it within 40 to 60 miles distance of such places as Seroncha, Chennoor, Kalaiswarem, Muntina, &c., around the confluence of the Pranheeta and Warungal, with its estimated population of 20,000, will open new sources of export trade, and every facility should be given for the land transport which must connect such places with the river. On the north bank, I believe that the existing tracts through the forest country in the direction of Bustar may be improved to a slight extent with advantage; and that an increased trade by means of the Brinjaries, who bring down a part of the produce now exported, may be looked for in that direction. They now bring down wheat, and carry back salt.

53. From the Godavery Districts themselves, that is to say, the newly acquired districts lying along the north bank, but little traffic is to be expected at present. Their population has always been small, and it has been still further reduced by the extensive emigration which has taken place both into the Nizam's country on the south bank, and the Bustar State on the north in the course of the last two or three years.

* * * * *

54. With regard to steamer traffic on the river, I shall shortly have to submit some proposals regarding the working of the new steamers, and the reorganization of the present Transport Division for the approval of Government. The Supply Division, I may mention, will soon be abolished altogether. The 2nd Barrier operations have been carrying on without any assistance from it, and the works at the 1st Barrier have now reached such a stage that the supply of food to the work-people may be left to private enterprise.

55. In concluding this rather lengthy, and I fear in some respects, superficial report, I should explain that it has been written without any distinct understanding as to the precise kind of information which the Government require, and at a time when I was more than usually unprepared with exact details of expenditure, statistics, &c. It moreover embraces such a variety of topics, that but little space could be devoted to each. I have consequently been obliged merely to indicate in general terms the present position of the Godavery scheme and the measures which appear necessary for its further prosecution, leaving details for future communications.

I have the honor to be,
Sir,

Your most obedient Servant,

F. HAIG, MAJOR, R.E.,
Suptdg. Engr., Upper Godavery Circle.

4th August 1868.

No 311
3807

FROM

THE SECRETARY TO THE CHIEF COMMISSIONER,
PUBLIC WORKS DEPARTMENT,
Central Provinces,

TO

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

Dated Nagpore, the 16th September 1868.

SIR,

As the locks at the 1st Barrier of the Godavery are now sufficiently advanced to allow of boats passing through the canal, and reaching without hindrance the foot of the 2nd Barrier, a distance of 232 miles from the Coast, the Chief Commissioner deems this a fitting time to submit for the perusal of His Excellency in Council a report from Major Haig showing the progress made towards the completion of the Godavery scheme as contemplated, with some statistics of the present river traffic, and a few suggestions regarding future operations

2 The work in hand may be divided into—

CONSTRUCTIVE OPERATIONS and SURVEYS

3 The works have been limited to the 1st and 2nd Barriers, and the open reaches extending to the foot of the 3rd Barrier, some 300 miles inland; whilst the Survey operations include the 3rd Barrier and the upper rivers called the Wundah and the Wunna.

4 Major Haig describes the work done and the present condition of the 1st Barrier very clearly, and thus summarises the result:—

"The general result then of the operations up to the present time is that the canal with its locks is in working order.
"the anicut is raised to such a height as to retain the water
"at the head of the Barrier 2 feet above its natural level,
"so as to afford as good navigation as is to be found in the
"open reaches above and below; and the obstructed part of
"the river channel below has been cleared to an extent to
"admit of navigation by steamers for 6 or 7 months, and
"by boats for the whole year"

5. This progress the Chief Commissioner considers to be very satisfactory. The opening of this canal is the first return for the money sunk in the undertaking; it will be interesting to watch the development of the boat traffic which will in all human probability follow the increased facility for navigation; and it is with pleasure Mr. Morris notes the fulfilment of the hopes held out by Major Haig on commencing work, that the 1st Barrier canal would be open for traffic by the monsoons of 1868.

6. All that can be said of the 2nd Barrier works is that a good start has been made. They differ from those of the 1st Barrier, inasmuch as they consist almost entirely of "masonry," and although but a very minute proportion of the whole mass of stone has been deposited in the anicut, an Engineer will not fail to realise from Major Haig's description the methodical and complete arrangements in progress to ensure a plentiful supply of material, as well as the care bestowed in maintaining a high sanitary condition amongst the workpeople; and from these augur well for the future success of the works, and the opening of the navigation to the foot of the 3rd Barrier.

7. Considering the difficulty of obtaining a qualified staff of Surveyors to carry out these important operations in a country little known, and generally covered with dense jungle, the Chief Commissioner thinks the progress made in Survey operations very good.

The estimate for the construction of a fair weather road from Chanda to the foot of the 3rd Barrier is almost ready for submission, indeed would ere now have been completed, but for an accident. The surveys for a canal to turn the 3rd Barrier have been completed, and the estimate is in hand; whilst Mr. Scott and his staff have obtained very full and complete data of the Wurdah river from the top of the 3rd Barrier, to Phoolgaon, on the Great Indian Peninsula Railway (190 miles); of the Wunna from its junction with the Wurdah near Soett, up to the great cotton mart of Hingunghat (21 miles), as well as 25 miles of the Pynegunga,—a very important tributary of the Wurdah joining it near Chanda.

8. The manner in which Major Haig proposes to utilize the Survey establishment in Hydrological observations during the monsoon recess has the Chief Commissioner's full approval, for even should the data thus obtained not be turned to use in the Godavery navigation, yet any practical rules regarding the proportion of the whole rain-fall thrown off by the soil deduced from accurate observations on a large scale will be of great value, and will be received by the Profession as a very important addition to our Engineering knowledge.

9. After touching on the work executed, Major Haig offers a few remarks upon the 1st Barrier scheme as now under construction, and shows that the adoption of the present plan has brought some 200 miles of the river under navigation three years sooner than

would otherwise have been the case, had the project for the larger canal been at once accepted. Even should the increase of trade on the river demand, in course of time, the construction of the longer canal, the value of the present scheme as an alternative route compensates for the outlay on it, and secures permanence for the navigation, which by Major Haig's showing would always be liable to interruption from extraordinary floods.

10. The Chief Commissioner is aware that the method of turning this Barrier was long a disputed point, but he thinks the wisdom of that policy must now be admitted which has enabled the navigation to be opened to the foot of the 2nd Barrier three years earlier than it would otherwise have been, whilst it leaves to the traffic itself to prove, from the expansion and development induced by the minor improvement, the necessity for the heavier outlay and more complete navigation works.

11. The rates of work have also been noticed. Contrasting these with those ruling in Nimar the most expensive district in the Central Provinces, they are by no means out of the way, although they are higher than the normal rates of the Province generally.

	GODAVERY	NIMAR
Rubble masonry..	Rs. 27.7 to 37.8	Rs. 27 to 32
Cut-stone ..	" 230	" 250
Earthwork ..	" 10.96	" 8.75 to 11.25

Taking into account the drawbacks of the locality, the outbreaks of sickness which have occurred, and the miscellaneous charges that in a sparsely populated district must be incurred, the Chief Commissioner does not take exception to them, and it is satisfactory to record that Major Haig anticipates no rise in the estimated rate for dry masonry in the anicut of the 2nd Barrier.

12. In remarking on the condition of the river between the Barriers the Superintending Engineer asks permission to proceed at once to a limited extent with the clearance of channels through rocky beds, and with the construction of groins, pending the preparation of estimates.

The Chief Commissioner thinks that this may safely be left to the discretion of the Superintending Engineer, and he solicits the permission of the Government of India to place at his disposal a sum of Rs. 15,000 (debitable to the Godavery allotment) to be covered by estimates when his knowledge of the wants of the localities shall enable him to frame them on reliable data.

13. Mr. Morris observes that Major Haig is desirous of forming a separate Division for the removal of the shoals, and asks for the services of an Officer or Subordinate experienced in the navigation improvement works on the Ganges. If the services of a Subordinate are available the Officiating Chief Commissioner would be glad if they could be placed at the Superintending Engineer's disposal, but he

is not prepared to recommend the formation of a separate Executive Division with its accompanying office charges. He thinks these clearance operations might be placed under either of the Executive Engineers, and worked as a Sub-Division of the 1st or 2nd Barrier Division

14 The trade statistics will, the Chief Commissioner thinks, be read with interest. Being the first reliable returns of the kind that have been prepared on the Upper Godavery no comparison can be made with previous years; but the variety and nature of the articles show that the ground-work of a large import trade exists. The very small proportion which the value of the exports bears to that of the imports (Rs. 7,600 to Rs. 138,708) is, however, significant of the poverty of the district through which the river flows, and seems to point out that it is to the imports alone we must look for increase for some time to come. Already salt to the extent of 265 tons has found its way up the river, and it is to be hoped that the salt traders will largely avail themselves of the water route, and that the cheapness of carriage will be followed by an increased consumption of this most necessary article of food.

15 Closely connected with the traffic returns is the cost of water carriage. From the data he has collected on the river below the 1st Barrier Major Haig makes this with the river in its unimproved condition to stand as follows per ton per mile —

Up-stream, 2 1 annas to 2 2 annas. Down-stream, 0 9 pie to 1 0 anna. These rates the Superintending Engineer regards as high, and attributes this to three causes—

- (1) The use of small boats, necessitated by the strength of the current at certain places
- (2) Prevalence of fever
- (3)—Want of a return load.

And he proposes the following remedial measures —

- (1) The establishment of capstans to warp the boats over the difficult places
- (2) The construction at Government expense of a better class of boat, these to be let out to the traders on a monthly rent, or to be paid for by instalments
- (3) The establishment of a Medical Subordinate to afford aid to boats' crews stricken down by fever.

16. The Chief Commissioner feels some difficulty in dealing with this subject. If the returns continue to show a progressive development of traffic, the construction of a few pattern boats might give a stimulus to trade; but, on the other hand, it is not probable that the traders will long remain blind to the advantages of boats

of greater capacity; and self-interest will gradually bring about their employment. If Major. Haig learns that boat building is on the increase, he should use all legitimate influence to promote the introduction of a better pattern, and should he be successful the Chief Commissioner would then be prepared to take up the question of the establishment of capstan stations. At present he is not inclined to recommend either advantages for boats, or their construction in Government yards, as he feels assured that as improved wheeled carriage has everywhere in this country followed the construction of roads, so will a better class of boat follow on the improved navigation without the intervention of Government.

The employment of a Dresser and the establishment of depôts of simple medicines would, the Chief Commissioner thinks, tend to give the boatmen confidence, and is worth considering

17. In conclusion Mr. Morris would solicit early orders in the subject of paras. 12 and 13. The shoal operations cannot begin too soon, as it is at the time of freshes and half-flood that groins and spurs exercise the greatest effect; and if the services of an experienced Subordinate can be obtained he should be at work on the river as speedily as possible.

I have the honor to be,

Sir,

Your most obedient Servant,

Asst. Charles Pollard Major R.E.
Secretary to the Chief Commissioner, P.W.D.

317

No 106
649

FROM

MAJOR F. T. HAIG, R. E.,

SUPERINTENDING ENGINEER,

Upper Godavery Circle

TO

THE SECRETARY TO THE CHIEF COMMISSIONER,

DEPARTMENT PUBLIC WORKS,

Central Provinces,

Dated Dumagoodum, the 27th July 1868

SIR,

Your telegram calling for an immediate and special report upon the Godavery works reached me a week ago, but I was then constantly engaged upon works for the opening of the canal at this Barrier, and have been unable to attend to your requisition until now.

I am not aware what is the precise nature of the information which the Government requires, but suppose they wish to know what is the present state of the works generally, and what progress has been made towards the completion of the whole scheme as at present defined

These points therefore I propose to illustrate, not entering much into details which as regards the operations of the past year have already been sufficiently given in my Annual Progress Report. I shall add some suggestions in regard to future operations, and also give the statistics of the present river traffic

2 Under existing orders all constructive operations have been limited to the 300 miles of river below the 3rd Barrier. The only work in hand above that Barrier has been the Surveys neces-

Original in the file

sary for the preparation of estimates for the road from Chanda to the foot of the Barrier, the canal at the Barrier, and the improvement of the Wurdah up to Hingunghat I will now describe the progress made under both heads, Construction and Survey

1st Barrier

3 The works at this Barrier it will be remembered consist of,

(1) An anicut near the head of the Barrier with—

(2) A canal of two miles in length furnished with a head or entrance lock, and scouring sluices, and a pair of tail-locks, which connect the navigation above the Barrier with that below, and—

(3) Clearing a channel through the rocky part of the river bed between the tail-locks and the terminus of the long canal (now in abeyance) a distance of 21 miles I have already reported that the progress made with these works has been such that the canal was opened for traffic on the 16th instant. The actual state of each work is as follows:—

(A)---The anicut having a total length of 1,700 yards, is built up to its full height and section for a length of 800 yards, and to within two feet of its full height; but not quite to its full section for the remaining 900 yards

(B)---The head-lock is finished

(C)---The scouring sluices are finished

(D)---The canal is finished with the exception of a portion of the earthwork below the tail-locks, and in the regulating tank above.

(E)---The tail-locks are finished sufficiently to admit of their use, but the gear for working the gates is not yet fitted up, and is replaced for the present by ropes and tackle

(F)---The flood embankments are not quite finished

(G)---A passage has been cleared through the rocky parts of the 21 miles of river below the tail-locks sufficiently to allow of navigation by steamers up to 1st February, and by boats for the whole year. I would limit this statement by adding that the steamers must have sufficient power, as the channel at present cleared is at two points still so narrow that the rush of water through it in certain states of the river intermediate between half-floods and low water is greater than our little steamers can stem. I mean that at times during two months, July and November, out of the seven months of steam navigation our present steamers will for this year be unable to make the ascent.

4 Such in general terms is the degree of completeness as yet attained in the 1st Barrier works. Perhaps a more accurate idea of it may be formed from an inspection of the following statement

of the quantities of work done up to end of last month, and work yet remaining to be done

NAMES OF WORKS	Description of work	Estimated quantity, cubic feet	Quantity done to the end of June, cubic feet	Quantity yet to be done, cubic feet	Approximate cost when complete	Cost up to end of June 1868	Approximate amount required to complete
					Rs	Rs	Rs
1 Anicut ..	Rubble	868,493	692,428	176,065	370,480	2,66,906	1,03,574
	Cut-stone	29,488	7,409	22,079			
2 Protective works at head of island on which anicut abuts	Rubble	81,407	81,407		33,334	33,334	
3 Scouring sluices	Rubble	183,410	180,829	2,581	131,759	1,29,584	2,205
	Cut-stone	10,745	10,745				
4 Head-lock	Rubble	248,803	248,803		185,662	1,83,200	2,462
	Cut-stone	11,229	11,229				
5 Canal	Earthwork	15,977,524	15,186,072	791,452	2,15,597	2,03,587	12,010
6 Regulating tank on canal	do	1,627,428	492,132	1,135,305	13,815	7,744	6,071
7 Tail-locks	Rubble	330,818	328,780	2,038	176,342	1,42,581	33,761
	Cut-stone	9,568	7,200	2,368			
8 Flood embankment	Earthwork	7,758,427	6,576,397	1,182,030	64,654	56,397	8,257
	Rock	1,954,693	930,763	1,023,930	121,416	54,557	66,859
9 River improvements	Mixed rock, gravel and shingle	2,992,762	1,822,572	1,170,190			
10 Shelter for establishment, workshops and stores	..	..	..	..	84,700	78,808	6,892
11 1st Barrier tramway	..	..	..	..	55,600	54,929	671
12 Station improvements	..	..	..	..	9,447	9,447	..
Total ..					14,62,836	12,20,574	2,42,262

5 The following Table, compiled from the foregoing, shows the total quantity of each description of work as per estimate, the quantity completed, and the proportion of the latter to the former.

Description of Work	Total cubic feet	Completed, cubic feet	Per cent
Rubble masonry	1,712,931	1,532,247	90
Cut-stone do	61,030	36,588	60
Earthwork	25,363,379	22,254,592	88
Mixed rock and gravel excavation	4,947,453	2,753,335	55

In regard to this statement, I would observe —

(1)---The total quantity of earthwork of various kinds actually completed is very much larger than that here shown, which does not

4
include the quantities in the different excavations, of which those for the locks varied from 20 to 50 feet in depth

(2)---The statement only shows the quantities of the principal descriptions of work. A great deal more of other kinds has been done which is not here exhibited.

(3)---Of the 10 per cent of rubble masonry, and 40 per cent of cut-stone work yet remaining to be completed, almost all is in the unfinished part of the anicut

6 The general result then of the operations up to the present time is that the canal with its locks is in working order; the anicut is raised to such a height as to retain the water at the head of the Barrier two feet above its natural level, and so to afford as good navigation as is to be found in the open reaches of the river above and below; and the obstructed part of the river channel below the Barrier has been cleared to an extent to admit of navigation by steamers for six or seven months, and by boats for the whole year

7 It will, I hope, be satisfactory to the Government to learn that the navigation has been opened, though imperfectly as yet, to the foot of the 2nd Barrier. I shall return to the subject after describing the progress made at the other Barriers, but I cannot pass on to them without first placing on record a humble acknowledgment of the mercy vouchsafed by Almighty God in permitting us to bring our work thus far towards completion.

2nd Barrier.

8 The orders of the Government of India sanctioning the commencement of the 2nd Barrier works were received in March 1867. But one working season, and about a quarter of another, has therefore elapsed up to the present time since ground was first broken. As everything had to be done *ab initio*, the Government will not be surprised to learn that the work accomplished up to the present time is chiefly of a preparatory nature. The river works at this point consist of an anicut thrown across the Barrier near its lower end, which will raise the water above it to a height of 44 feet above that below, and thus submerge not only the whole of the 10 miles of rocky reach above, but also 2 miles more of a broad sandy bed with too steep a declivity for good navigation. The river channel below the anicut is deep and navigable at all times of the year. There is therefore no necessity for a canal. A flight of three locks at the left end of the anicut will connect the navigation below with that above the work.

9 For some miles both above and below the site of the anicut, the river is confined between hills, which running sheer down into the water on the left bank, leave but a narrow strip of level land between them and the river on the right. This configuration of the ground does not conduce to the healthiness of the work-stations which are established on the right (Nizam's) bank---one at Neelum.

5
pilly immediately at the end of the anicut, the other at Enchampilly, about 1½ miles further down the river. The hill whence the stone of which the anicut is to be built is obtained, is a little above the line of anicut on the same bank, and the limestone quarries about a mile below the Enchampilly station. The whole of the intermediate strip of land, 3 miles long, has been cleared of forest to the foot of the hills, and in the neighbourhood of the anicut quarries the hill side has itself also been cleared nearly to the top. A road metalled and bridged, but not yet complete, connects the two work-stations. The quarries have been opened, and are connected by 2 miles of 4-8½ gauge railway with the anicut and workshops. The limestone and cutstone quarries are similarly connected by a lighter description of tramway with the deep channel on the left bank of the river. Accommodation for the whole of the establishments, as well as for stores and workshops has been erected, and lines capable of housing 2,800 workpeople. In fact all preparatory works have been completed, and were so far advanced that during the latter half of the past working season constructive operations in the river bed were commenced.

Up to the present time 33,700 tons of stone have been deposited in the anicut. 17,000 more are quarried and ready for transport, and 7,500 cubic feet of rubble masonry have been built in the foundations of the guard wall on the left bank. Now that the rise of the river has put a stop to further work in the bed, stone is being quarried and materials collected for next season's work.

10 Though the above description represents a smaller amount of progress than I had hoped to accomplish up to the present time, yet as it will generally be admitted that in works of this class, carried on in such a remote and uninhabited part of the country, where the first settlers must clear the very ground on which their houses are to be built, the first year must necessarily be occupied chiefly by works of a preparatory kind. I hope that the progress will on the whole not be thought unsatisfactory. The establishment have suffered severely from fever, especially the Europeans, but the experience at the 1st Barrier leads us to expect that this is a hindrance which will diminish year by year as the works advance. I am myself very well satisfied with the manner in which the operations are conducted by the present Executive Engineer.

The petty contract system is in force in every part of them down to the very smallest details, and no work, however trifling, is undertaken without a previously prepared and sanctioned estimate, and constant check upon the rates.

11. With regard to the probable date of completion, I think we may reckon on all being finished by June 1871, that is to say, that by that time the river will be opened for navigation to the foot of 3rd Barrier,---330 miles from the sea.

Clearing rock in river bed at Albaca, half way between 1st and 2nd Barriers

12 A channel which, for want of labour, it was necessary to limit to a width of 10 yards only, has been cleared through these rocks, a distance of about 2 miles. It will be navigable by boats for 9 or 10 months, and by steamers for about 7 months. About 50,000 cubic feet of rock were removed in the past season, and a bungalow for the subordinate in charge with cooly lines are almost completed.

To prevent misconception I should perhaps explain that the rock in this piece of the river does not extend along the whole length mentioned, but occurs at intervals, and that it lies low, only rising to a height of 2 to 3 feet above low water level.

Surveys above 3rd Barrier

1st—Road from Chanda to the foot of 3rd Barrier

13 This survey was completed more than a month ago, and Mr Scott, the Assistant Engineer, under whose supervision it was carried out, reports, under date 4th instant, "Corporal Pollock, Overseer, has been preparing the estimate for the road under my instructions, and had it almost completed a short time ago, when his tent was struck by a storm, and the estimate destroyed. A second is now under preparation, and shall be submitted with the least possible delay." In a few weeks, therefore, I shall probably be able to submit this estimate.

Survey for Canal round 3rd Barrier

14 This Survey is also completed. Mr Assistant Engineer Sieveking has carried it out with great care, and in a most complete and satisfactory manner. He has only just returned to this Barrier, and has brought with him the whole of the materials for the preparation of the estimates, upon which he and another Assistant will now be employed during the monsoon months.

I hope by the end of the year the estimate will be ready for submission.

Survey of Wurdah above the 3rd Barrier

15 The Government of India directed that this river should be surveyed up to Hingunghat. The Chief Commissioner however desired that if possible the surveys should be continued up to the railway crossing at Poolgaum.

There was time and establishment sufficient for both. 190 miles of the Wurdah, 21 miles of the Wunna (the tributary on which Hingunghat is situated), and 25 miles of the Pynegunga, have been very completely surveyed by Mr Scott and his subordinates. A longitudinal section has been obtained of the whole of these rivers, commencing from the head of the 3rd Barrier, checked by a return line of levels

of 138 miles in length. A rough sketch has been made of the entire length of the three rivers, showing the sandy and rocky shoals and configuration of the banks, and also detailed surveys of several portions of short length, aggregating about 15 miles, of special interest. 500 transverse sections of the summer channel have been taken between 3rd Barrier and Hingunghat, with numerous measurements of the discharge, and similar sections at longer distances apart between the mouth of the Wunna and Poolgaum. The result, I think, is that we are now in possession of full information respecting 236 miles of the Wurdah, and its tributaries above the 3rd Barrier, which are capable of improvement in various degrees, and accurate and reliable data have been obtained for the preparation of detailed estimates whenever the Government may desire them.

Mr Scott and his subordinates have thus accomplished in a very satisfactory manner the field work of the Survey, and are now engaged in reducing it to paper.

Hydrological observations in the Wurdah Valley

16. The Survey establishment employed upon the Wurdah in the dry season not having sufficient work to occupy them during the rains, it occurred to me that a part of it might with great advantage be employed in procuring reliable data upon a point respecting which we have as yet only general conclusions based upon observations in other countries to guide us, viz, the proportion of the total rain-fall which runs off by the rivers and water-courses, and which is available for storage. For this purpose the Bore river, a tributary of the Wunna, has been selected. Its catchment basin down to the point where the discharge of the river is being measured is about 180 square miles, lying on the southern slopes of the cluster of hills north of Hingunghat. With the sanction of the Chief Commissioner rain gauges so constructed as to contain the whole of one season's rain-fall have been set up at three points in this area, and a fourth at Hingunghat. On the Bore, where two Surveyors are stationed, who are engaged in recording hourly the heights of water in the river, and measuring the velocities of current. At the close of the rains the discharges having been computed and compared with the ascertained rain-fall, some satisfactory conclusions will, I hope, be afforded as to the relative proportions of the two.

Surveys of other Tributaries of the Godavery.

17. No other surveys than that of the Wurdah have been undertaken. The 10,000 rupees granted by His Highness the Nizam for the survey of the main Godavery from Nassick to the confluence of the Pranheeta remain still available. It is much to be desired that we should know precisely what the navigable capabilities of this 600 miles of river really are, and I hope many years will not elapse before we have full information upon the subject.

On the Wynegunga nothing has been done. We know that there is a boat traffic to the extent of 1,068 tons per annum on the upper part of it, and that it is navigable by small boats, with the exception of two or three places where obstacles not of any very formidable nature exist to within 60 miles of its mouth, that it flows through a valley with a population of 2 millions, and that it may be connected by canal with the Wurdah immediately above the 3rd Barrier. Here for the present our information stops.

Summary of Progress

18. To sum up, the progress made with the Godavery scheme generally up to the present time is as follows:—The navigation is now open from the Port of Cocanada to the foot of the 2nd Barrier, a distance of 232 miles, and it will probably be opened to the foot of the 3rd Barrier 300 miles in 3 years more.

All the surveys necessary to enable the Government to decide upon the various questions connected with the extension of the communication beyond the 3rd Barrier are complete, the estimate for the Chanda road is nearly finished, and those for the navigation works are about to be put in hand.

Remarks upon the 1st Barrier Scheme

19. As any discussion of the Wurdah navigation question is foreign to the objects of this report,* I shall in what I have now to say confine my remarks entirely to matters connected with the navigation below the 3rd Barrier. To return then to the lower or 1st Barrier, there are some considerations connected with the works now so far advanced towards completion to which I would direct attention.

1st.—The Government will doubtless desire to know to what extent the "Short Canal" project is likely to prove an efficient substitute for the Long Canal, and whether the work already done in the blasting of rock and clearing of the navigable channel below the Barrier affords the means of judging as to the probable cost of this part of the project.

In the first place it is to be observed that the channel has as yet been cleared to only half its width, and it is now little more than a month since the river rose. We have therefore had little opportunity of judging of the state of the navigation, and we are certain that whatever that may be, it must be much inferior to what it will be when the passage is cut to its full width. At present the currents at two points are, as I have already said, greater than our little steamers can stem when the river is only a few feet above its summer level. When the river rises higher the difficulty disappears, as the water finds more vent, and is not so confined, and I believe such will be found to be the case also after the freshes have subsided, and the river has fallen to about its dry weather level. My belief then is

* The Secretary's telegram directed that the report should be confined to the works at the three Barriers.

that when the river channel shall have been completed to the full width now contemplated, though the current will be strong, and so far an obstruction to up-going boats and steamers, yet it will not be more than can be surmounted with some difficulty.

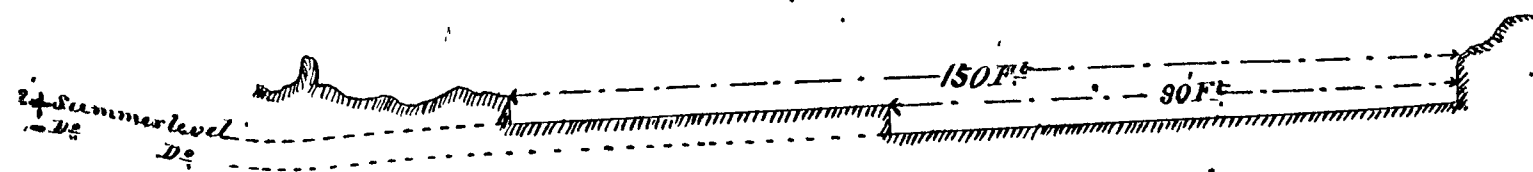
Perhaps this is as much as, in the present state of the river generally, we need desire. We shall have obtained a passage of this description at a cost of about three lakhs (locks included) instead of a much better one for perhaps 3 or 4 times as much. The saving thus effected has enabled us to proceed with the works at the 2nd Barrier, which might otherwise have been postponed for some years. The funds and establishment which would have been employed for the next two years on the long canal will now be available for such works, as may be required for the improvement of the navigation between the barriers, and we are enabled to bring 200 miles of navigation into operation some three years sooner than we could otherwise have done.

This last is, in my opinion, a very important point.

20. Next, as regards the probable cost of the rock clearing. Upon this point last season's work has supplied very reliable data. The cost has been much below what we anticipated. In the statement in para. 4 it will be seen that the total quantity of rock, gravel, and shingle to be removed (as obtained by careful detailed measurements) is 4,947,455 cubic feet, and that of this, 2,753,335 cubic feet were removed this last season, leaving 2,194,120 cubic feet still to be done. Now the revised estimates of the 1st Barrier works have been nearly complete for some months past, its completion being delayed partly by the uncertainty of the rate to be charged for work of this class. In an abstract of it sent to me by the Executive Engineer in March last the estimated cost of the rock clearing in the river bed was entered Rs. 2,89,000. On summing up however the expenditure in the last season, and comparing it with the work done, it is found that the former rate was nearly twice too high, and the total of this item in the estimate is now reduced to Rs. 1,21,000 only.

21. We know then the cost per yard of this description of work, but I would observe that the actual quantity of rock which it will be necessary to remove can only be decided by actual observation of the effects of a certain amount of clearance.

The channel now being cleared is of the following section:—



It is a channel within a channel; the larger one, 150 feet broad, is intended for the monsoon navigation, when steamers must have plenty of room, and its floor is to be cut down to 2 feet above the lowest summer level. The smaller channel in its centre which is for use in the low water months is to have a width of 90 feet only, and to be cut down to 2 feet below lowest summer level, so as to be navigable for the whole year. I believe that these dimensions will be generally found to be sufficient, but at a few points it is possible the high level channel may require enlargement. On the whole, I should suppose that the work required to bring the river passage into such navigable condition as above described will not in any case exceed 1½ lakh.

22 To what extent then, it may be asked, may we expect the river channel to be effective as a substitute for the canal?

I answer: it was never intended as a *substitute*, save temporarily. It must always be an imperfect one. But it is a most valuable and important *addition* to the canal, an alternative route, which, as I have always insisted upon from the time when I first suggested it, the navigation could hardly be considered complete without. I am not going to revive by-gone controversies; but I wish simply to satisfy the Government that they have got their money's worth, that if the long canal is completed not a single rupee will have been thrown away in the execution of the shorter project. I have little more to say now in support of this position than I had in 1863, but my remarks may, perhaps, receive more attention than they did then.

23. The long canal runs for 17 out of 23 miles along the river bank, and the highest floods within our own observation of the last 20 years, rise from 8 to 15 feet above the ground in which it is cut. In such floods therefore the head of water on the bank would vary between these limits. But at many points the canal crosses deep depressions in the ground, gullies cut as much as 20 and 30 feet deep into the bank by old water-courses. At a few such points the head of water would be as much as 20 feet. Now my experience in works of this class satisfies me that when embankments which in ordinary years are scarcely exposed at all to the floods, are at rare intervals subjected to such pressures as these, there never can be absolute certainty as to their security unless they are made of dimensions much larger than any of those even contemplated for this canal. Embankments subjected to a constant head of water can always be made secure enough, but those only liable to such trial at long intervals are dry in their centre, and become the favourite haunt of rats and other vermin, whose burrows are always a source of danger.

21 But this is not all. It is certain that 50 years ago a flood 3 or 4 feet higher than any within my own recollection took place, and even this may not be the limit of such great inundations. Now let one such flood breach the canal embankments, and though the damage would be less than what would commonly be supposed, it would almost certainly stop the navigation, and in this thinly populated part of the country could not be repaired under some months, and at a heavy expense. Such an accident might not occur above

once in 10 years, but when it did occur, it would cut the navigation in two, and at once put a stop to all traffic, save by means of an expensive portage, for which perhaps no facilities might be at hand. At any point on the river the liability to such a check would be a most serious defect, but most of all at this, the lowest Barrier. At the two upper Barriers no such accident could occur.

At the 2nd there is no canal, and at the 3rd the proposed line of canal runs along the river bank within reach of the floods for only 5 miles out of the 32, and the extreme head of water on the banks would be very much less than at the 1st Barrier. We thus find our line of navigation threatened at one point only, but that the most important, with a danger which it would be folly not to provide against. Now the alternative river route furnishes just the provision we require, and at an additional cost of only 3 or 4 lakhs, out of perhaps 80 or 100 lakhs.

The tail-locks of the short canal are situated only 2 miles below its head. There would be no difficulty in strengthening the banks for that distance if necessary, but a breach in them would be of little consequence.

With this canal then, and the river below, we should have a route which would provide for the navigation during its temporary suspension in the long canal. Can anyone, looking at the value and importance of the navigation, suppose that such a provision against accidents is not most necessary, or that it is not well worth the extra expense it involves?

This consideration has to my mind always justified the expense of the *addition* to the long canal of a pair of locks, and some miles of improved river navigation.

25 I will add one more consideration. If the short canal scheme thus provides an efficient temporary substitute for the canal, why, supposing the latter completed, go to the expense of shutting out the floods whose rare occurrence renders such a substitute necessary. It might be easier and better, as it would certainly be very much cheaper, to allow the great floods (such as that of 1818) to overflow the canal, than to shut them out. If so, we should have as an additional set-off against the cost of the short project, the saving effected by reducing the heights of the flood embankments, probably 2 lakhs.

26 The actual cost of the two locks and river improvement below, which form the alternative route, has been up to the present time as follows —

	Rupees
Locks	1,42,581
River	54,557
	1,97,138

and the amount required to complete both is---

	Rupees
For Locks	33,761
„ River	66,859
	1,00,620

so that the total cost of the alternative route would be Rs. 2,97,758. This amount includes all miscellaneous charges, but a small addition has to be made for cost of transport. Even if we allow for some additional blasting, the total will probably not exceed 3½ lakhs. And this addition to the cost of the scheme is not to be charged to this Barrier only; it is properly chargeable to the whole length of navigation, for the complete security of which it has been incurred.

27. I make these remarks not with the intention of bringing forward now any proposition respecting the Long Canal, but simply that the Government may know precisely how the case stands. Any action in regard to the Long Canal must be based upon much more extended observation and experience of the actual extent to which the Short Canal scheme is efficient than we now possess. The statistics I shall presently give will show that even in its natural state, as it existed last season, the river passage below the tail-locks was practicable for small boats during the whole year.

28. Some explanation is perhaps required of the reasons for cutting the smaller channel (in the centre of the larger one) through the rocks, down to such a level as to be navigable all the year, whereas the Government contemplated perhaps a navigation of only 5 or 6 months.

The reason is that the boat traffic already on the river shows that it will be navigated for the whole year.

The idea of a 5 or 6 months' navigation is out of date altogether. That I should ever have spoken of such a thing, must be regarded as a singular instance of an enthusiastic projector erring on the side of caution in his statements. The statistics of the present traffic will satisfy the Government that there will be no such limit to the use of the river as far as the 1st Barrier at least.

29. The revised estimates for both 1st and 2nd Barrier works are still incomplete. Those for the 1st Barrier have been delayed for want of the detailed measurements of the rock cuttings in the river channel, which there was not time to take in what little was left of the working season of 1866-67 after sanction for the prosecution of the works was received, and which could not therefore be made until the past hot season, and even then they were again delayed by my long absence up river, which prevented a final decision upon some points on which the Executive Engineer required advice. For the

2nd Barrier works any revised estimates prepared before now would have been simply worthless, for it was impossible to judge of the sufficiency or otherwise of the former rates until actual trial of the cost of the different kinds of work.

I think we have now satisfactory data to work upon, and will have the estimates completed during the present rains.

30. In regard to rates, I may mention that a very careful analysis of the past expenditure at 1st Barrier shows that the cost of the different descriptions of work has been as follows ---

DESCRIPTION OF WORK	Cost, inclusive of all ordinary charges	Cost inclusive of all miscellaneous expenses of an exceptional character
	Per 100 cubic feet Rs.	Per 100 cubic feet Rs.
<i>Rubble Masonry</i>		
In aicut ..	24	27 7
Contents 868,473 cubic feet ..	27	31
In Tail-lock ..	31 25	36
Contents 325,331 cubic feet ..	32 5	37 8
In Head-lock ..	194	223
Contents 248,803 cubic feet ..	to 200	to 230
In Scouring Sluice ..		
Contents 173,793 cubic feet ..		
<i>Cut-stone</i>		
<i>Earth-work</i>		
Canal (short) ..	95	10 96
Contents 16,258,276 cubic feet ..		

I do not think these rates will be found to compare unfavourably with those in other parts of Central India, considering the peculiar circumstances under which the works on this river are prosecuted. The cost of the cut-stone work has been very high, chiefly in consequence of the distance which the whole of the best description of stone had to be carried—21 miles, and the large size of all the stones used, with few exceptions each block being two feet thick, dressed and finished, and weighing from ½ ton to 3 tons. This stone is of first-rate quality. The earth-work includes all descriptions from alluvial soil on surface, to hard gravel, decayed rock, and some solid rock in excavations averaging 18 to 20 feet in depth. The figures above given are for the short canal. The rates in the portions of the long canal excavated were lower, the depths having been less, and the soil more favourable.

31. With regard to the 2nd Barrier works, the cost of the rough stone in the anicut upon which the sufficiency or otherwise of the estimate chiefly depends, has as yet been much below the estimated rate of Rs 6-8-0 per 100; and allowing for some increase, and including all contingencies, I see no reason at present to expect that the original estimate will be exceeded.

State of the River between the Barriers.

32 The obstruction at the 1st Barrier being now removed, the condition of the river in the open reaches above and below, next claims attention. Below the Barrier the river is now navigated by small boats carrying only 4 or 5 tons for the whole year. Above the Barrier, between it and the 2nd Barrier, the navigation has hitherto been confined to Government steamers with large cargo boats in tow, and these have run for only 5 months, owing to the rocks at Albaca and two other places, which become impassable, save at considerable risk after November. Now, however, that the canal has been opened, boats of both descriptions may run as far as Enchampilly, and a few private traders' boats have already passed. The navigation of this part of the river is generally better, indeed, I may say very much more favourable for boats than that below the 1st Barrier; the slope of the bed and the current being less. Only one of the three rocky reaches has however as yet been improved and the passage cut through it last year is but 10 yards in width, so that this next year the navigation may be impeded by the obstructions at these places, but if the Government should be pleased to allow us to proceed at once to a limited extent with the clearance of channels when required, pending the completion of estimates, we may be able to keep open such a passage as will suffice for the more immediate wants of the navigation.

As the traffic statistics at the end of another year will supply the most reliable information as to the time during which this, the 2nd reach of the river, is navigable, the Government will probably prefer to wait for these, and will care little for any opinion I may now express upon the subject, otherwise I should have little hesitation in affirming that this part of the river being on the whole a superior navigation to that below the Barrier, it will, like the latter, be available for traffic for the whole year.

33 Of the river above the 2nd Barrier we know less than of that below, and the only boat upon it at present is a small paddle boat built this last year. In this boat, however, I made two trips both up and down from Barrier to Barrier this last season, one in March the other in May, and the season was a favourable one for observation, the river being unusually low. I should say that, that part of the river will be found to be navigable in its natural condition by such small craft as now run to the 1st Barrier for 10 months, viz to 15th April.

All these statements regarding the different periods of navigation have reference, be it observed, to the river in its *natural* condition, rocks only being supposed to be removed, and do not take into account any improvement of the shoals.

34 I will now briefly state what measures I consider necessary for the improvement of the navigation between the Barriers, with a view to rendering it (1st) safe, and (2nd) practicable for a larger class of boats than now run to the 1st Barrier as well as for steamers.

35. In the first place, then, all rock in the navigable channel, must of course be removed. There is so very little of this above the 2nd Barrier that we may for the present confine our attention to the river below that point. Below that Barrier there are in all 8 or 10 places where rock is met with. Of these there are only two where the obstruction is of a nature actually to limit the period of navigation, but in all clearing to a greater or less extent is required. I propose to have these carefully surveyed, and estimates prepared for the work required, but inasmuch as there is now an actual traffic upon the river which is more or less hampered by these obstructions, I would strongly urge that the permission given last year to proceed with the blasting at Albaca to an extent sufficient only for the more immediate and pressing wants of the navigation should be extended to the whole. At Albaca, which is by far the worst of them, we expended last year Rs 2,100, and for this sum we were enabled to clear a channel of small width which will be practicable for 9 months. There is little fear therefore that permission to proceed at once with similar clearance at other points could lead to any wasteful or excessive expenditure. I fully admit the wisdom, and indeed absolute necessity of requiring, as a general rule, detailed estimates before any expenditure is sanctioned, but I conceive that the present is one of the exceptional cases in which the rule may with advantage be set aside. The benefit and incidentally the saving resulting from the dispensation granted last year in this respect in regard to the Albaca rocks has been great, and had my request,--strongly urged in 1863, that I might be permitted to expend a very small sum, not exactly in clearing rock, but in securing the river bank at points where it was being cut away, and large masses of rock underneath being exposed,--been granted, the saving to Government would probably not have been less than 50,000 Rupees. Again and again this year have I sailed between such masses of rock which *must* now be removed, but which then lay under the bank of the river, and were not in the channel at all. And were I, in a similar manner, to be permitted this year to throw up a very few groins of stone for the protection of those parts of the banks which are now attacked by the stream in a way most injurious to the navigation, I have no doubt the saving incidentally would be very much greater than the sum I have mentioned.

36. So much for the obstructions caused by rock. What I propose in regard to them is that careful estimates of the cost of their removal should be prepared as soon as possible, and that meantime

sanction should be granted for such an expenditure as may be needed for such improvements as are more immediately practicable, and most urgently required

37 Next come the shoals There are two ways of dealing with these, (1st) by means of temporary appliances, and (2nd) by means of works of a permanent character. I propose to try both, the first immediately, the second after careful study, survey, and estimate For the first I wish to have either an Officer or subordinate sent down who has some experience of the methods in use on the Ganges for keeping open navigable channels through the shoals I would confine him entirely to this work, and the general superintendence of the navigation, making it a separate Executive Division His duties would be to keep a good navigable depth of water over the shoals, and to afford other facilities which I shall presently specify, to all craft navigating the river

38 In regard to the permanent works for the improvement of the shoals, I shall not now enter into any discussion as to their probable cost, feasibility, or value I propose to depute an Officer for the study of the question, and for estimating the cost of one or two, for which typical shoals would be selected I would then propose to construct these upon sanctioned estimates, and to observe their effects for a year or two before any further steps are taken in the matter If this does not now appear a reasonable proposition, I hope that in submitting, as I propose shortly to do, a list of the establishment required for the purpose, I shall be able to adduce such arguments as shall satisfy the Government upon the point

39. One more point has to be noticed in connection with the improvement of the river between the Barriers, the protection of the banks by means of groins where they are attacked, and cut away by the stream The very first essential to any permanent improvement of the low water navigation of the river is that it should be confined within banks absolutely fixed and unvariable in position Out of the 600 miles of river bank up to the foot of the 3rd Barrier (reckoning both sides), there are only about 70 that require attention in this respect The proper way to deal with them would be to have a careful survey made of the whole (wherever the topographical map may be insufficient), and estimates for the works required prepared for submission to Government, but in the meantime the Superintending Engineer should be empowered to sanction emergent estimates up to a certain limit, say Rs 15,000 per annum, in cases when a much heavier expenditure and serious injury to the navigation can only be averted by prompt action

Present river traffic

40. I am now enabled for the first time to give some reliable statistics of the river traffic It is at present confined to the river below 1st Barrier Registers of all boats passing up and down are

kept at three places by Agents appointed by the Deputy Commissioner, and the following statement has been compiled from returns furnished by them It shows the number of boats divided into two classes, Government boats and private boats, which arrived at the 1st Barrier from the Coast from May 1867 to May 1868, and the nature and tonnage of their cargoes There are three points of debarkation in the 23 miles of river from Dumagoodium down to the lower end of the Long Canal, viz, Dumagoodium the head-quarters of Engineering operations, Budrachellum 15 miles lower down, the chief town of the district; and Gollagudium 9 miles further down, the lower terminus of the tramroad.

The great bulk of the traffic consisted of Government stores brought up for the works, partly in the boats and steamers belonging to the Transport Division, and partly in private boats A part of these were unloaded at Gollagudium, the remainder at Dumagoodium

Of the private stores sent up, that is to say, of the articles of merchandize of all descriptions, the property of private traders sent up in their own or in hired boats all were landed at either Budrachellum or Dumagoodium The statement shows the quantity received at each place

up in their own or in the
chellum or Dumagoodium

The statement of

at each place

Statement showing the number of boats and their tonnage which arrived at the
1st Barrier from the Coast from 1st May 1867 to 31st May 1868

MONTHS.	Private boats						Government boats		Total arrivals of boats per month	Total tonnage per month
	With Government stores		With private goods				With Government stores			
			Unloaded at Budrachellum	Unloaded at Dumagoodium						
				Boats	Tons	Boats				
May 1867	3	19½	2	11	16	41	2	57½	21	71½
June	..	..	2	9	4	8½	3	226½	3	75½
July	..	..	7	39½	3	8½	5	310½	12	273½
August	..	..	6	31	7	17½	..	..	18	359
September	..	..	..	14	1	24	1	26	4	16½
October	..	..	..	11½	6	16	..	..	9	53½
November	..	..	2	11½	7	18	..	..	29	168½
December	..	..	19	136½	3	14½	6	262½	42	496½
January	..	..	30	217	1	5	..	..	64	402½
February	..	..	51	365	2	10	..	..	40	305
March	..	..	23	210	25	148	..	..	25	151½
April	..	..	14	115½	4	18	7	18	11	65
May	..	..	1	30½	3	14	2	3	20	35½
June	..	..	7	5	2	8	5	12½	7	246½
1st June 1867 to 1st June 1868	150	1085½	60	321½	68	168½	23	888	..	..

Tons

* 2,462

The total imports by river were thus
viz Government stores

Private goods
The total number of arrivals in the year was boats 301
Of which 278 were private, containing
And 23 were Government boats
The average load of the private boats was therefore
And of the Government boats

Tons
* 2,462

1,973

489

1,554

888

56

386

* After this report was finished an error of 150 tons in excess in the quantity of Government stores was discovered in the return furnished by the Transport and Supply Division It has not been corrected, as that would have involved too extensive an alteration of figures

The arrivals and imports by river in each quarter of the year were as follows :—

	Boats.	Tons
1st quarter, June to August inclusive	41	708
2nd do Sept. to Novr do	42	238
3rd do Decr to Feby do	162	1,264
4th do March to May do	56	252
	301	2,462

This statement may be analysed as follows —

1st—Arrivals of boats towed by steamers

	No	Tons
1st quarter ...	12	594
2nd do ...	1	26
3rd do (in Decr only) ...	6	262
4th do ...	0	0
	19	882

2nd—Arrivals of boats worked by sail only.

	No	Tons
1st quarter ...	29	114
2nd do ...	41	212
3rd do ...	156	1,002
4th. do ...	56	252

Total ... 282 1,580

41 Hence it appears—

1st.—That the river is worked by small sailing boats for the whole year.

2nd—That the third and fourth quarters of the year, viz from December to May are those in which the navigation by sail boats is busiest, the traffic in the 6 low water months having been (1254-326)—nearly 4 times as great as in the 6 monsoon months. The disproportion between the two will always be great, as the strong currents of the river during the monsoon make the upward passage difficult for sailing boats. In fact I have been quite surprised to find that any monsoon traffic by sail existed. Though I knew that some trips had been made, I nevertheless regarded them as mere temporary ventures, and did not expect that they would be repeated. That the boatmen of the Delta do not hesitate to encounter the hardships and difficulties of such a navigation, certainly augurs well for the future prospects of the river trade, for the difficulties above the 1st Barrier are far less than those below.

42 It may perhaps be supposed that the 489 tons of goods brought up for private trade were almost entirely for the use of the people employed upon the works. Such however is not the case. Of this quantity 321 tons were landed at Budrachellum, and were entirely for trade unconnected with the works. Of the remaining 168 tons a considerable part was for sale to the work-people.

43 I give in an Appendix two Tabular Statements of the articles composing the above traffic, with the exception of the Government stores. It will be found that they include a considerable variety*. It is satisfactory to note among them 7,415 maunds, or 265 tons of salt. This was almost exclusively for sale to the people of the country, the work-people being separately supplied by the Government Agency. Salted fish is another article included in the miscellaneous list which begins to come up in considerable quantities, and is much prized by the people. There is likely to be a considerable trade in it.

*Viz Cotton, Sugar and Jaggery, Salt, Wheat, Rice, other grains, Oil-seeds, Metals, English Cloths, Tobacco, Curry stuffs, Stationery, Tusa, Silk Cocoons, Dyes, Opium, Woollen Blankets, Ghee, Gingelly and Castor-oils, Cocoanuts, Salt fish, Tamarind, Onions, Garlic, &c, Europe Articles and Country Cloths

44 The value of the exports and imports as above shown was—

	Rs
IMPORTS.	
Government stores ...	1,04,832
Private goods ...	1,38,708
	2,43,540

EXPORTS	
Private goods ...	7,600
	2,51,140

Total exports and imports ...

If to the above we add the value of the timber rafted down past the 1st Barrier, coming chiefly from the upper river, viz. 19,162 logs valued at Rs 77,292, we have for the approximate value of the whole river trade, exclusive of some salt imported at Wadagudium, at the mouth of the Sebbry, and some small local traffic between the Barriers, as well as timber exported from the hills and other parts of the country below the 1st Barrier, Rupees 3,38,432.

45. I would now direct attention to the following considerations in connection with the above statistics

1st—there is already a traffic established upon the river.

2nd—That traffic is much the most active during the low water months

3rd—It is carried on chiefly in small boats carrying about 5½ tons

4th—The above figures show the traffic as it exists in the unimproved condition of the river. Not a single shoal has been touched in the way of improvement, and the passage through the 15 miles of rocky channel below this Barrier was last season most difficult and hazardous

5th.—There is as yet scarcely any return traffic down river. It is so trifling that it appears to have been altogether omitted in the returns at one of the places of registry. The exports from Dumagoodium amounted to 755 maunds, or 28 tons only. Details are given in the Appendix.

46 Of course, under such circumstances, the rates of carriage could not fail to be high. They were---

	Rs				Rs		
From Dowlaiswaram (the head of the Cocanada canal) to Dumagoodium 120 miles, per bag of 164 lbs	1	2	0	to	1	4	0
From do to Budrachellum, 105 miles	0	14	0	to	1	2	0
From do. to Gollagudium, 98 do	0	12	0	to	0	14	0

Or per ton per mile---			Annas		Annas	Mean
To Dumagoodium ...	...	...	2-1	to	2-3	2-2
„ Budrachellum ...	...	...	1-9	..	2-4	2-2
„ Gollagudium ...	...	...	1-7	..	2-5	2-1

The rates charged for carriage down river were Rs 0-0-9 to Rs 0-1-0 per ton per mile. The proportion between these rates and those up stream are much what we should expect, viz, less than half the up river rate for carriage down.

47. In the present unimproved condition of the river then the actual rates of transport by boats carrying 5 to 6 tons only are---

Up river without a return load, $1\frac{3}{4}$ to $2\frac{1}{4}$ annas

Down river $\frac{3}{4}$ to 1 anna

48. Of the cost of transport by steamer I have at present no satisfactory data. The cost by the present steamers, as shown in the periodical reports of the Transport Division does not include any charge for interest and depreciation of stock, while, on the other hand, it is largely increased by the unsuitability to the navigation of the present steamers and the unimproved state of the river, which of course tells much more upon large than upon small boats. I hope in another month one at least of the new steamers will be running, and with them more reliable results will be obtained.

Suggestions for facilitating the boat traffic, and reducing the present cost of Transport

49 The chief causes of the present high rates of carriage are---

1st ---The use of very small boats not well suited to the navigation.

2nd ---The prevalence of fever in the cold months

3rd ---The want of a return load

The use of very small boats has arisen from the strong currents met with on two parts of the river below the 1st Barrier, and the difficulty of getting larger boats over the shoals. One of these places is the rocky reach immediately below the Barrier of which mention has already been made, and which is now in course of improvement; the other is the 12 miles of river below the confluence of the Sebbry, and chiefly the lower two miles of it. This part of the river has a much greater fall than the average, and the ascent is proportionately difficult. The shoals are

met with at several points. As regards them and the reach immediately below the Barrier, the remedies needed have already been indicated. To facilitate the ascent of the two miles of strong currents lower down, I propose for the present to anchor either one or two boats furnished with capstans to warp the boats over the most difficult points; and eventually as the traffic increases it may be advisable to place a steam tug on that part of the river to afford assistance.

50 In the next place, I propose to introduce a superior class of boats better adapted to the navigation than those in use. I calculate that we could build light iron boats, which could be worked by just the same crew as that which the present native boats require, and yet would carry twice to three times the load with the same draught of water. I would build a few such in our yard here, and either let them out for hire, or allow them to be paid for by a few annual instalments. As their superiority gradually becomes evident, private builders will be led to adopt the new models, and the aid of Government will no longer be necessary. I look upon this as a most important step towards reducing the present cost of transport. I shall give details when submitting a definite proposition upon the subject.

51 The prevalence of fever, chiefly among the hills through which the river runs for 40 miles, from November to January, is a serious check to the traffic at that time. I propose to arrange for the proper treatment of fever cases by placing a Dresser at the disposal of the Superintendent of Navigation, and making it an especial part of his duties to afford medical aid to the boat crews when required. The expense will be small, and may eventually be defrayed by the river tolls.

52 The small amount of the present down river traffic in comparison with that up river greatly increases the cost of the latter, as the whole cost of the trip must be borne by the up load alone. This is a source of expense which will diminish with the extension of the navigation inland, and the increased access to more populous and productive parts of the country. The opening of the navigation to the 2nd Barrier, which brings it within 40 to 60 miles distance of such places as Seroncha, Chennai, Kalaiswaram, Muntina, &c, around the confluence of the Pranheeta and Warungal, with its estimated population of 20,000, will open new sources of export trade, and every facility should be given for the land transport which must connect such places with the river. On the north bank, I believe that the existing tracts through the forest country in the direction of Bustar may be improved to a slight extent with advantage; and that an increased trade by means of the Brinjaries, who bring down a part of the produce now exported, may be looked for in that direction. They now bring down wheat, and carry back salt.

STATEMENT

MONTHS.										No of Boats.		Cotton		Sugar and Jaggery		Salt		Wheat		Rice.		Different kinds of Grain		Oil Seed		Metals		English Cloths		Europe Articles		Country Cloths.		Jen Ropes	Ghee, Gingely Oil, and Lamp Oil.		Cocoanuts.		Miscellaneous such as, Chillies, Tamarind, Onion, Garlick, and Vegetables &c.		Total.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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STATEMENT shewing Articles Exported, from Doonageodiem to the Coast and Nizam's Country, from 1st May 1867 to the end of June 1868.

STATEMENT shewing Articles Exported, from the Port of Calcutta																																					
MONTHS.	No of Boats	Wheat.		Rice		Diffeent kinds of Grains.		Europe Cloths		Tobacco		Horns, and Skins		Timber		Cocoanuts		Miscellaneous		Country Cloths.		Sugar		Oil Seeds		Metals.		Europe Articles		Stationery		Ghee and Oils		Cattle.		Total.	
		Maunds	Rupees.	Maunds.	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees.	Maunds	Rupees	Maunds	Rupees	Maunds	Rupees.	Maunds	Rupees.		
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February	...	...	...	...	...	...	...	...	...	...	...	...	60,505	41,220	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40,055 0	30,472	
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