

## REPORT

ON PROPOSED

# CANAL AND RAILWAY

ΪN

SCINDE,

BY

LIEUTENANT CHAPMAN;

WITH

ACCOMPANYING LETTERS

ВY

MAJOR H. B. TURNER AND H. B. E. FRERE, Esq.

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## INTRODUCTION.

THE meritorious young Officer whose two valuable Reports constitute the most important part of this No. of the Selections did not, it will be seen, long outlive their completion. On the 5th January the Government of Bombay received the following communication from Mr. H. B. E. Frere:—

No. 514 of 1853.

REVENUE DEPARTMENT.

From the COMMISSIONER IN SCINDE,

To the RIGHT HONORABLE LORD VISCOUNT FALKLAND,
Governor and President in Council, Bombay.

Dated 27th December 1853.

My Lord,

It is with feelings of the most sincere sorrow that I transmit, for the information of your Lordship in Council, the enclosed copy of a letter from Captain Hodgkinson, Deputy Magistrate in charge Suddur Station, Hydrabad, and extract of a letter from Captain Ethersey, Superintendent Indus Flotilla, giving an account of an accident to a boat on the river Indus, during the night of the 21st—22nd instant, which cost the lives of Lieutenant Chapman, Engineers, and of several of his establishment.

- 2. Lieutenant Chapman had examined the Lukkee Pass in company with Major Turner, in order to select the best line for a road over it; and, after parting from Major Turner, was on his way back to Kurrachee, to prosecute his survey of a line for a railway to Kotree, when the accident occurred.
- 3. Of the accident itself, I am unable to add any further details to those which will be found among the enclosures, except that I am informed four more of the Native followers got ashore, at some distance down the river, and reached Hydrabad, subsequent to the date of Captain Hodgkinson's letter.
- 4. It was from a faint hope that Lieutenant Chapman might have escaped in a similar manner, that I have forborne sooner to report this lamentable occurrence; but all hope is now, I regret to think, at an end—though the strictest search has hitherto failed to ensure the recovery of Lieutenant Chapman's body.
- 5. Of the extent of the loss the Public Service has sustained by Lieutenant Chapman's death, I need hardly inform your Lordship in Council; for the records of Government, and the high estimation in which he was held by every Officer of his own distinguished Corps, alike testify to professional abilities and

energy of no common order, of which he has left a less perishable monument in the new road over the Thull Ghaut. Nor do I think that the warmth of personal regard for a character in which manly frankness was combined with a singular amiability in every social relation, has more than its due weight, when I view the early death of this most promising and lamented young Officer as a public calamity to the province, the improvement of which had been, since he landed in it, the constant object of his professional labours,—labours which, your Lordship had lately an opportunity of judging, were as remarkable for the zeal as the judgment which directed them.

I have the honour to be, &c.

(Signed) H. B. E. FRERE, Commissioner in Scinde.

Commissioner's Office, Camp Moollane, Katcear, 27th December 1853.

(Copy.)

To the COMMISSIONER IN SCINDE,

On Circuit.

Dated Hydrabad, 22nd December 1853.

SIR,

I deeply regret that, in the absence of the Collector on Circuit, it falls to my lot to announce to you the melancholy fate which has in all probability befallen Lieutenant Chapman, of the Engineers, his Serjeant, and other public followers. Early this morning a messenger arrived in Hydrabad, with the intelligence that a boat from Sehwan, having on board Lieutenant Chapman, a Serjeant (name unknown), and 27 public and private followers, had sunk in mid-channel in the Indus, not far from the small village of Jam-ka-Loda, about 3 miles from Hydrabad. On arriving at the spot, I found Mr. Chapman's Hamall, a Puttewallah, and eleven Kalasees employed under Lieutenant Chapman, who had escaped. From their report it appears, that by desire of Mr. Chapman the boat got under weigh when the moon rose last night about 11 o'clock, and pursued its way to Kotree for about an hour, when she struck against a sunken tree, and immediately went under water,—four persons were washed off,—but she rose to the surface, and two hours elapsed before she finally sunk. Their cries for assistance were heard at length by the people in the village of Jam-ka-Loda, and a small boat put off to their assistance. The first rope thrown they missed; the second was caught, but it broke; and before a third could be procured the boat had disappeared. Fourteen, as above mentioned, were carried down by the current, and ultimately reached the shore; nothing has been heard or seen of the others. No bodies have been recovered, but I much fear little or no hope remains of their safety. I sent mounted Policemen down the banks, and also a boat across to the other side of the river, in case the current should have drifted them in that direction. Kardar of Dooaba, Foujdar, Russaldar of Police, and others, are still engaged in the search, but up to this moment no intelligence has been received of the missing. Should further intelligence reach me, I will report for your information or through the Collector at once. To the latter I have sent off an express with the melancholy tidings. It has been ascertained by sounding that the boat sank in about 10 feet water, and boats have been ordered from Kotree with grappling hooks, &c. to secure what can be recovered from the wreck. Whilst the slightest hope of their safety remains it would not be, I thought, advisable to make a formal report of the occurrence, but I deemed it my duty to make known to you at once what had occurred.

I have, &c.

(Signed) C. HODGKINSON, Captain,
Officiating Deputy Collector.

1 past 1 P. M.

(True copy)
(Signed) B. H. ELLIS,
Assistant Commissioner.

Subjoined is a brief statement of this lamented Officer's services:—

Lieutenant Chapman arrived from England in March 1844, and in the following June joined the Department of Roads and Tanks as a 2nd Assistant, and was placed in charge of the works on the Agra Road, from the foot of the Thull Ghaut to Chandore. In 1846 he submitted plans and estimates for the completion of the new road over the Thull Ghaut, a portion of it having been previously constructed by him to ascertain rates. The plans and estimates were sanctioned by Government on the 12th October 1846. The work was completed in May 1849, and a Special Committee of Engineer Officers was appointed to report upon it, which they did in the following terms:—

"The Committee, having most carefully inspected the whole line of Ghaut road, including every bridge and every drain most minutely throughout, are of opinion, that bearing in mind the amount of the general expenditure on these works, the construction is very perfect, and reflects the highest credit on Lieutenant Chapman."

In December 1849 Lieutenant Chapman forwarded, through the Superintendent of Roads and Tanks, to the Military Board, statistical tables regarding the traffic on the Thull Ghaut; and the Military Board, in forwarding them to Government, remarked:—"We cannot too highly praise the forethought, industry, and zeal which have led Lieutenant Chapman to take advantage of the opportunity afforded him of acquiring the information he has condensed into these valuable documents. Many an Officer, even if requested to collect it, would have raised difficulties, advancing want of time, establishment, or some such excuse; but this is a purely gratuitous contribution.

"The Chief Engineer avails himself of the present occasion to bring the subject of Lieutenant Chapman's claims again to notice, and we would strongly recommend that this Officer be appointed to the vacant 1st Assistantship in the Road and Tank Department, as he has shown remarkable ability, and, what is more to his credit, remarkable industry and zeal in the execution of the duties committed

to him at the Thull Ghaut; and we trust it will be considered a satisfactory circumstance that Government have it in their power to give an immediate and substantial mark of appreciation without creating any inconvenient special case."

Government replied to this by appointing Lieutenant Chapman 1st Assistant, declaring that "to mark the approbation with which Government views that Officer's persevering industry and professional ability, His Lordship in Council is pleased, as recommended by you (the Military Board), to appoint him to the vacant 1st Assistantship in the Road and Tank Department."

Amongst the works constructed by Lieutenant Chapman on the great Agra Road was the Undwell Bridge, having a single arch of 100 feet span, and respecting which the Military Board observed, in their letter to Government No. 6703, of the 16th August 1851:—"It is a most satisfactory fact, that a bridge of so large a span, built of rubble stone, should be thus proved to be perfectly trustworthy, and we trust it will lead to the construction of others in the same manner, in supersession of timber bridges.

"Lieutenant Chapman deserves great credit, and we would recommend that his name, and the cost of the bridge, be recorded on the structure, as proposed by the Superintendent of Roads."

In September 1851 Lieutenant Chapman went to England. He returned in October 1852, and in the following month was appointed to the special duty of inquiry and survey with a view to the construction of a navigable canal between the Indus and Kurrachee, which inquiry resulted in the two Reports now published.

The Reports on the canal and railway were received by Government on the 24th of November, and the requisite survey to enable Lieutenant Chapman to lay down a line for the proposed railway immediately sanctioned. On the receipt of the order to prosecute his survey, Lieutenant Chapman hastened down the Indus, when on the night of the 24th December the melancholy accident occurred which has deprived the Government and the province of Scinde of his services.

On the receipt of Mr. Frere's letter, Government expressed its regret by the following Resolution and Notification:—

#### RESOLUTION.

It is with much regret Government learn the loss of so accomplished and excellent an Officer; and with a view of commemorating his services, it resolves to call the road which Lieutenant Chapman constructed up the Thull Ghaut by his name.

#### Notification, General Department.

With the view of commemorating the services of the late Lieutenant Chapman, of the Engineers, the Right Honorable the Governor in Council has resolved that the road up the Thull Ghaut, constructed under the superintendence of that Officer, shall in future be called "Chapman Road Thull Ghaut."

By order, &c.

(Signed) C. J. ERSKINE,
Acting Secretary to Government.

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#### TERRITORIAL DEPARTMENT, REVENUE.

#### From the COMMISSIONER IN SCINDE,

To the RIGHT HONORABLE LORD VISCOUNT FALKLAND,

Governor and President in Council, Bombay.

Dated 16th November 1853.

My LORD,

During the past season Lieutenant Chapman was employed, under the orders noted From Government, No. 4711, of 12th July 1852.

Ditto, No. 5990, dated 11th Sepimproving the Kulleeree Canal between Tatta and

tember 1852.

Gharra, and thereby to give good water-carriage by river-

boats between Kurrachee and the Indus, without passing through the Delta.

2. In the course of the season it became manifest that works of considerable extent would be required; and therefore, at my request, Lieutenant Chapman extended his inquiries to the somewhat wider question of how the best communication could be secured between Kurrachee Harbour and the river Indus above the Delta.

3. I have now the honour to transmit a letter from Major Turner, Superintending
From the Superintending Engineer, forwarding the Reports in which Lieutenant
Chapman details the results of the season's work, and
the plans with which he illustrates them.

1st November 1853.

4. The first part of his Report details his propositions for securing good water communication by a canal to Jerruck, which he estimates will cost about fifty and a quarter lakhs of rupees, and make a direct return of 4 per cent.

- 5. The second part gives an approximate calculation of the cost and returns of a railway to Kotree, with a branch to Jerruck, which he estimates will cost about fifty-six and a half lakhs of rupees, and make a direct return of 5 per cent.
- 6. In both cases the estimate of cost appears to Major Turner ample to cover all possible contingencies, while the estimate of returns, which I have also gone over with the Superintending Engineer, appears to us to be much within the amount at which it might fairly have been set down.
- 7. Lieutenant Chapman has taken no credit for the certain increase of trade. The traffic, which, if the canal or railway now existed, must adopt its line, and would, as Lieutenant Chapman shows, pay 4 or 5 per cent., as the case might be, is increasing steadily at the rate of 20 per cent. per annum.

It will, in all probability, by the unaided result of causes now in operation, be 60 or 80 per cent. greater than at present before the line can be possibly opened, however speedily it may be commenced; and the making, and, still more, the opening of the line, will, of course, give it a vast impetus.

B

- 8. Nor has Lieutenant Chapman taken credit for anything which was not before him officially, e. g. the vast amount of Commissariat and other Government stores now in progress to the Punjaub, or expected, such as 10,000 barrels of porter this year, 3,000 tons of iron expected next season for a bridge at Attock—facts which might have materially swelled his prospective returns.
- 9. He might also have fairly taken credit for the saving his projects, if carried out, will effect in such heavy items of expense as wear and tear of tents and camp equipage, deterioration of stores by delay and exposure, and the saving in the local expenses of the Commissariat which will be possible when a vessel can discharge direct into a railway truck, which will a few hours afterwards deliver its contents on the river bank at Kotree,—a point to reach which at present occupies generally a month at least, and often much more.
- 10. I therefore consider Lieutenant Chapman's estimates quite on the safe side; and I believe he might, without rashness, have greatly enhanced the amount of his prospective returns.
- 11. As regards the extraordinary facilities which the line presents for either canal or railway, I may be allowed to add my testimony, as an unprofessional traveller, to the more competent testimony of both Engineer Officers. I have certainly never seen a country with superior facilities for the easy and cheap execution of such works.
- 12. Of the two projects I prefer the railway, as being the more perfect means of attaining the desired object, as regards position of the river terminus, speed, and cheapness; as the more profitable; the less liable to mishaps from unforeseen accidents, and caprices of the river; the more comprehensive, as regards the classes of traffic it will accommodate; but more especially because there is no rival or alternative means of communication which can compete with it: whereas the success of a canal would be the most certain means of ensuring the speedy rivalry of a railway.
- 13. Moreover, a railway would meet with ready support from capitalists at a distance, who would be less likely to view a canal as a favourable investment.
- 14. Such capitalists are, I believe, prepared to find the means of carrying out a railway over the line in question, as soon as they hear that the scheme is approved of and supported by Government as sound in itself, and that the Government of India is willing to extend to the undertaking the usual guarantee of interest.
- 15. Mr. Hardy Wells, a Civil Engineer now employed in the province, was so struck by the facilities for constructing a railway over the line in question, when he traversed it on duty last year, that he communicated his observations to friends at home, and supported them by sections of most of the watercourses, which Major Turner procured for him, and by Custom House and Traffic Returns. The result has been that a Company is now, as I learn from him, in course of formation in England, with a view to undertake the line, if supported by Government in the manner above alluded to.
- 16. I quite concur in the opinion expressed by Lieutenant Chapman, that if the line were entrusted to such a Company, under the guidance of a single Managing Director, unencumbered by a large Board of Directors at a distance, but with the aid and control elsewhere furnished by Government officials, the work might be completed with a speed and economy hitherto unknown in such undertakings; for this simple reason, that there is here a total absence of all adverse or conflicting interests, and of all competing modes of transit.
- 17. The next step to be taken is to obtain detailed plans and surveys, such as may show the precise line to be taken, and, as nearly as possible, the exact cost of the works.
- 18. In my separate letter of this date I have detailed the steps I have taken for the purpose of enabling Lieutenant Chapman to complete such surveys and estimates, in anticipation of the wishes of Government, by whom the steps taken will, I trust, be approved.

- 19. It is hardly necessary for me to bring to the favourable notice of your Lordship in Council the mode in which Lieutenant Chapman has performed his duty: the energy and accuracy with which his data have been collected, and the clear and comprehensive manner in which the results are stated, fully sustain the professional reputation he had previously acquired; while his conscientious abstinence from all over-sanguine statements cannot be too much commended.
- 20. The very satisfactory mode in which the duty entrusted to Lieutenant Chapman has been performed is, I believe, in no small degree owing to the effective support and assistance he has in every case met with, and the valuable advice he has received from Major Turner, the Superintending Engineer.

I have the honour to be, &c.

(Signed) H. B. E. FRERE,

Commissioner.

Commissioner's Office, Kurrachee, 16th November 1853.

No. 2654 of 1853.

Public Works.

REVENUE DEPARTMENT.

#### To the COMMISSIONER IN SCINDE.

Sir,

The projects I have now the honour to lay before you have been drawn up by Lieutenant Chapman, of the Engineers, specially appointed by Government, with the sanction of the Most Noble the Governor General of India, to the duty of making such a detailed survey of the country as would enable him to submit a project for "a constantly navigable channel between Kurrachee and the Indus."

- 2. Such a canal has been the great desideratum ever since the first occupation of Scinde by the British Government; and so far back as the year 1840 the late Lieutenant Colonel LeMessurier submitted a project for accomplishing it by opening the Kulleeree Canal and the Gharra Creek, which attracted some attention at the time, and was printed by the Supreme Government.
- 3. As the commerce and the traffic of the country have increased, so also have the risk and inconvenience of the existing means of communication become more apparent; and it has now become absolutely necessary to improve those means, in order to meet the urgent demands of Government and of the public, for the conveyance of stores and merchandize to the countries through which the Indus and the other rivers which fall into it flow, as well as to enable the produce of those countries to be brought to a market.
- 4. During the last two years the necessity for such means have become even more pressing: unusually heavy falls of rain and high inundations have closed the direct land route to the river for many months in each year, while the constant changes inseparable from all delta navigation threaten at no distant period to cut off the communication from Kurrachee to the river through the tidal creeks altogether; besides which, the opening of the harbour to English merchant shipping, arising from improved knowledge of its capabilities, has created a disposition to carry on trade direct with England, instead of through the port of Bombay.
- 5. Moreover, Government are in a variety of other ways directly interested in improving the means of communication: the existing state of matters cripples the enterprise of the cultivators, and in many places limits the extent of cultivation to the local demand. You will remember a fact brought forward in my Report on the Roads in Scinde, dated the 30th March 1852, that at Narree I found stocks of Government grain of three years' standing, which, though repeatedly submitted to public auction, nobody would buy, in consequence of the cost of conveying it to a market: the grain was eventually destroyed by the inundation of 1851. The effects of improved communication on cultivation were very clearly explained in a late American journal: wheat, valued in that country at \$49 50c. at the nearest market, if carried 330 miles by ordinary highway, cost in conveyance its full prime cost, and its value was therefore doubled; while if conveyed by railway the same distance it would have cost in carriage no more than \$5. In cheaper kinds of grain, the cost price, \$24 75c., would be expended in carriage, if conveyed only 160 miles by highway, whereas it would have cost \$2 40c. only to have conveyed it to the same distance by railway. In Scinde the

proportion the cost of conveyance bears to the price of grain on the spot where it is grown is much greater, and it could be easily proved, that in parts of the country at even short distances from markets where the demand is not limited by local consumption, the cost of carriage to that market is so great, that it is unprofitable to cultivate, and that the cultivation is therefore checked, and limited to the consumption of the immediate localities.

- 6. During the course of Lieutenant Chapman's inquiry, it became apparent that objections existed which were fatal to Lieutenant Colonel LeMessurier's project, or to any use being made of the greater part of the Kulleeree Canal; and as the cost of cutting a new canal would in any case be large, it was supposed that a railway might prove the less expensive of the two. Lieutenant Chapman's instructions were, therefore, modified, at your request, to the extent of requiring him to report on the most advantageous means of communication between Upper Scinde and Kurrachee, whether by railroad or canal.
- 7. Two distinct projects have been submitted: the 1st, for a canal from Jerruck on the Indus to Kurrachee Harbour, which has been framed from actual survey and careful measurement; the 2nd, for a railway from Kurrachee to Kotree on the Indus, drawn up, not from actual survey, but from a general knowledge of the country, derived, partly from personal examination, and partly from inquiry from others. Before, therefore, a railway could be commenced, a similar detailed survey must be made to that which has been completed for the canal, and the estimate for the railway now transmitted must be considered a mere approximation, prepared only for the purpose of comparison with that of a canal.
- 8. With respect to the canal project, a perusal of Lieutenant Chapman's Report will, I am confident, convince you, as it has me, that the best, if not the only safe position for the canal-head is the rocky bank of the river at Jerruck; that it will not be profitable to make use of any part of the Kulleeree, though the Kulleeree may be made more profitable by the proposed new canal; that the communication will be imperfect if the canal stop short at Gharra; and that to derive full advantage of it, it should undoubtedly be carried into Kurrachee Harbour, as proposed.
- 9. The section of the canal, the description of vessels to navigate it, and the position and dimensions of the locks, have all been judiciously determined; but if the locks are not long enough to take in the larger description of accommodation boat, they should to that extent be lengthened, as those boats are well adapted for the river work, and it would save much transhipping if they could be used in the canal as well.
- 10. At the commencement of the canal near Jerruck the cutting is necessarily heavy, in order to place the bed of the canal low enough to be fed by the river when at its lowest level, but from the eighth to the fifty-fourth mile it is almost impossible to conceive a more favourable line for a canal: the first level is carried 25 miles; the next, which is only 5 feet lower, extends  $25\frac{1}{3}$  miles further, where a second fall of 5 feet becomes necessary; and the third level extends to the thirty-first mile, close to Kurrachee. In parts of this portion the embankments are very heavy, but the nature of the ground will not admit of any better line.
- 11. Licutenant Chapman has given detailed plans of his canal-head and regulating lock. Plans for all the other works have been prepared roughly, and have been examined by me: they are in the same detail, and exhibit the same care and skill which has been displayed in the design for the canal-head.
- 12. The rates Lieutenant Chapman has adopted will, I believe, be found sufficient, with good superintendence; and I can perceive in the project no engineeing difficulty that has not been foreseen and provided for.
- 13. Having carefully examined the country through which it is proposed the railway shall pass, I can assure you that it is admirably adapted for such a work:

C

it consists of a number of level, or nearly level plains, with a generally hard and smooth surface. Abundant stone will be found along it for ballasting, as well as for stone blocks, should they (as I believe will be the case) be found preferable to wooden sleepers. I have not so high an opinion of the Scinde babool as Dr. Baynes has, having seen frequent instances of the destruction of the heart as well as of the sap wood by white-ants. The measured distance of the present road is 100½ miles, so that in taking 110 miles I conclude Lieutenant Chapman provides for extending it to Keeamaree, and the town, but even then 110 miles is a very ample allowance.

- 14. I approve of Lieutenant Chapman's proposal to extend the line of railway to Kotree: Hydrabad and Kurrachee are two of the three principal towns of Scinde, and should be united, and, for the reasons given in the 1st to 3rd paragraphs of his Report, I do not think any communication from Kurrachee to the river by railway short of Kotree would pay.
- 15. The two objections raised to Kotree as a terminus I do not consider of much moment: the Bahran has yet to be examined, and I believe, that at an inconsiderable distance to the west of the direct line, a rocky bed for the foundations of the bridge will be discovered, and there is no doubt that if the bank of the river above Kotree were faced with dry rubble, it would be quite safe. The cost of the measure is at present the difficulty: when a railway has been laid down from the hills, that difficulty will be removed.
- 16. Great credit is due to Lieutenant Chapman for the labour and forethought with which, in so short a time, he has succeeded in getting together so much valuable information, and for the business-like manner in which he has collated and arranged it. In neither of his projects has he made the most of the facts he had adduced : not only has he discarded all information not strictly official, but he has used the official returns with the greatest caution; and with the knowledge that it has been a very common practice in England, when framing traffic returns, to double all the existing traffic, and that the result has generally shown that the projectors have been by no means too sanguine, I am certain a much larger return might very fairly have been promised. For instance, the commerce of Scinde has been found, without the stimulus of improved means of communication, steadily to have increased at the rate of 20 per cent. per annum: the removal of all transit duties will certainly tend to increase the commerce still more rapidly; yet, notwithstanding the Deputy Collector asserts that by the time the railway could be opened (say four years hence) the trade will be doubled, Lieutenant Chapman has not taken any credit for even the ordinary per-centage of increase due to the years the railway must be in progress. So, again, with respect to taxing the boats: he proposes not more than the actual saving of food to the crews, whereas decrease of wear and tear, the absence of risk, saving of time, and consequent preservation of perishable goods, are all advantages, which would willingly be paid for.
- 17. In the single item of 10,000 casks of ale and porter now being sent to the Punjaub, I am confident a large profit could be shown, either in the canal or railway project; while, as the length of voyage would be decreased some twenty-four days, there would be a much better chance of its arrival at its destination in good order. In the Commissariat, too, the saving of expense would be immense, were there direct communication from the harbour to Kotree.
- 18. Many other sources of revenue derivable from the canal project are enumerated in the 85th paragraph of the Report, yet, in estimating the profits of the scheme, Lieutenant Chapman has omitted them all.
- 19. But, as the same principles have been adopted in estimating the returns from both schemes, their profits may, perhaps, safely be compared, and, as an investment for capital, the railway seems to promise the best. The chief objections to the canal are its terminus on the river being short of Kotree, and its liability to ruin in the event of a

railway being hereafter established: both these objections are irremediable, for there is no spot in the vicinity of Kotree fit for a canal-head; and in the present days of improvement, it would be wrong to promise a monopoly to the canal, when a few years hence will most probably show that a railway is absolutely necessary. As a matter of local improvement, I prefer the caual. The advantage of so large and certain a supply of Indus water is a benefit that in countries blessed with rain cannot be appreciated. Moreover, for the present wants of the province, and the existing race of people, I am inclined to believe the canal is best adapted; but, looking forward to a time when the railway will probably extend up the valley of the Indus to the Punjaub, I believe the railway from Kurrachee to the river ought to be adopted in preference to the canal.

- 20. Should you concur in the opinions I have expressed, I trust you will he able to induce Government to permit Lieutenant Chapman to make the requisite survey, to enable him to lay down a line for the railway this season, supplying him with the assistance he has represented to be necessary to enable him to do so.
- 21. I would also venture to express a hope, that as the Reports are of public interest, both in Scinde and in England, Government may be induced to print them, in which case I would send you a sketch map of the country, including Kotree, on a convenient scale.

I have the honour to be, &c.

(Signed) H. B. TURNER, Major, Superintending Engineer, Scinde.

Kurrachee, 15th November 1853.

## CANAL REPORT.

No. — of 1853.

From LIEUTENANT CHAPMAN, Engineers,
On Special Duty, Scinde,

To the SUPERINTENDING ENGINEER,

Scinde.

SIR.

Having been appointed, under the sanction of the Supreme Government,

From A. R. Young, Esq., Under-Secretary to the Government of India, to the Chief Secretary to Government, Bombay, No. 661, of 20th August 1852; and Mr. Chief Secretary Malet's letter, No. 7228 of 1852, dated November, to the address of the Chief Engineer, Bombay.

to the daty of "examining the ground between Kurrachee and the Indus, with a view to forming a constantly navigable channel," which instructions have since been extended, with the sanction of the Commissioner in Scinde, and yourself, to "a consideration of the most advantageous

means of communication between Upper Scinde and Kurrachee," I have now the honour to submit my Report, treating the subject according to the modified directions, and consequently embracing, in addition to the several means of communication by water which present themselves, the consideration of the comparative advantages derivable from the substitution of a railroad.

1. The Indus, the great commercial highway of Scinde, though invaluable as a means of communication from Jerruck upwards, is subject, in common with all delta rivers, to constant changes, both in the direction and depth of the many channels by which its waters are discharged into the sea, owing to their volume not being sufficiently concentrated, either in direction or power, to enable it to overcome the opposing force of tides and currents, which compel the deposition of the matter held in suspension by its waters, in the shape of bars and sand-banks, at its mouth.

But, in addition to the disadvantages to navigation which this characteristic implies, the Indus, for the last 100 miles nearly of its course, passes through a flat of deep alluvial soil, which offers no resistance to the action of the periodical floods; and here, again, the changes in its bed are so contant and considerable as to increase in a material degree both the risk and delay of transport.

2. It is owing, probably, to these peculiarities, that though Scinde appears always to have enjoyed a considerable coasting trade, no delta port, even under Native rule, has ever held its own for a sufficient length of time to gain importance.

The unhealthiness of the climate alone, at certain periods of the year, has proved a sufficient check to European enterprise.

The necessity which exists for the improvement of the Communication.

- 3. Under our Government, Kurrachee, already a considerable town, the only harbour throughout the line of coast, and possessing at the same time great natural capabilities, has been selected as the capital of the province. It is, however, nearly 100 miles from the Hajamree month of the Indus, and this distance has to be made, when the season permits, by the open sea, otherwise by the so-called "tidal channels," "a series of muddy creeks" running parallel, nearly, to the coast-line.
- 4. Kurrachee, therefore, from its situation, is not so fully benefitted by the river communication as could be desired, nor do the districts reap to the full extent the advantages derivable from the establishment of a port on the coast. The improvement of their means of intercommunication becomes, then, a matter of the greatest importance to the prosperity of the province.
- 5. A reference to the map of Scinde will show how naturally, and with what a saving of distance, a direct communication might be formed between Kurrachee and Jerruck, or Kotree, on the Indus.
- 6. The object to be considered in this Report may, therefore, be defined as "the substitution of a direct and effectual means of communication between the Indus and Kurrachee for the uncertain, difficult, and tedious route which the river and its tidal channels at present afford"; or, in other words, supposing Kurrachee and Kotree the two points to be connected, "reducing the distance to be traversed from 230 to 110 miles"; and further, making available for its accomplishment a more certain, speedy, and efficient method of transport than now exists.
- 7. It would be superfluous in me to enlarge upon the advantages derivable to the upper provinces of India by the improvement of the Indus route, which the addition of this link would effect, or upon the importance which, both in a political and commercial sense, Kurrachee, now declared a port open during the mousoon, is quickly and surely assuming,—an importance derivable chiefly from her position with regard to the markets of Central Asia and the Punjaub, aided by the facilities which its harbour, even in an unimproved state, offers to a fast and steadily increasing trade. I shall, therefore, proceed to the consideration of the subject in hand.
- 8. As the direct communication between the Indus and Kurrachee may be effected either by water or by a railroad, I shall consider in the first instance, the comparative advantages of the different methods which present themselves for completing the communication by water, and having selected the one offering the greatest facilities, and generally best suited to the purposes in view, I shall consider that project in detail, and eventually contrast it, as far as I may be able without detailed surveys, with a railroad.
- 9. The different means of communication by water, which will at once be traced by a reference to the accompanying map, are as follows:
  - lst.—A communication between the Indus and the Gharra Creek, by the adoption and improvement of the present bed of the Kulleeree Canal.
  - 2nd.—The excavation of an entirely new line of canal from the river to the Gharra Creek.
  - 3rd.—I he construction of a continued line of fresh-water canal from the Indus to Kurrachee, with a direct and constant communication by means of locks, and guaranteeing to the port and town of Kurrachee an almost unlimited quantity of Indus water, which could be made applicable to the supply of the shipping, and to the purpose of general consumption.
- 10. The first project was reported upon in 1840 by the late Lieutenant Colonel LeMessurier, but some errors in the details of his design rendered

The Natural Facilities offered by position.

The object to be considered in this Report.

Remarks on the Contingent Advantages of any Project decided upon.

The means of effecting the Com-

The scheme of the Report.

The means available for completing the Communication by Water.

Remarks ou the same.

his arrangements defective, and an over-estimation of the breadth of the Kulleeree Canal very much modified the deductions drawn as to the advantages of making use of its channel.

11. My own opinion, after considering the matter carefully, is, that in contemplating any line of water communication between the river and Kurrachee, the Kulleeree, which now answers its purpose of an irrigation canal tolerably well, should in no way be interfered with. The very process which would be necessary to improve it for the purposes of navigation, i. e. the conversion of its sinuosities into nearly straight lines, would, by shortening the lines of its banks, reduce the extent of its operations in a very material degree, and at the same time produce an entire revolution in the arrangements of the cultivators dependent upon its waters. Moreover, the combination in the canal of both irrigation and navigation would render an establishment for the proper conduct of the former necessary, and thus induce an expenditure not at present incurred.

the Kullceree Canal.

Remarks on using

On the other hand, the advantage gained by the adoption of an excavation in soft soil, had in line, had in level, with a tortuous course, and a width of not more than 50 feet, are very inconsiderable; particularly when, as I shall afterwards show, no permanent connection with the river near the present head of the Kulleeree could be satisfactorily effected.

- 12. This leads to the consideration of the second project, of an entirely new canal, connecting the river and the creek.
- 13. The principal objection to which this project is open is its incompleteness; for even with a canal connecting the river and the creek, the constantly navigable channel contemplated in Mr. Chief Secretary Malet's letter already quoted is far from being attained.

Remarks on the 2nd Proposition.

As far as the creek is concerned, the navigation would be in a great measure dependent upon the tides; and a canal from Wagoda would still have to be constructed, to meet the requirements of a constant communication with Kurrachee.

A further objection to this project is the melancholy necessity which its conditions impose, of allowing a large volume of fresh water, already brought apwards of 50 miles in its course, to run to waste in the salt water of the creek, the value of which, if brought to Kurrachee, could scarcely be over-estimated.

14. Upon these grounds of objection, to which the two first projects are open, I am led to recommend the adoption of the 3rd, as being complete as a means of communication, and as conferring on the rising capital of Scinde the inestimable advantage of an almost unlimited supply of good and wholesome water, the continued want of which cannot but prove a very great drawback to her future prosperity.

Selection of the 3rd Project for a comparison with a Reilroad

- 15. I consequently proceed to the consideration in detail of "A Freshwater Canal direct to Kurrachee."
- 16. The first object to be attained in commencing operations last season was, necessarily, the selection of a permanent spot on the river for the construction of the works pertaining to a canal-head.

The position of the Canal-head.

- 17. After a long and careful examination of the right bank of the river, which included a reconnoitering survey of 90 miles in length, I was unable to fix upon a single spot between Tatta and Jerruck which gave any promise of stability.
- 18. The whole river bank, until within a few miles of Jerruck, consists of a soft alluvial deposit, which offers no resistance to the wayward action of the

stream; and the extent of the changes which take place in short periods of time is almost incredible.

Tatta, for example, according to a map accompanying Colonel LeMessurier's Report, was, in 1840, only  $2\frac{1}{2}$  miles from the river: this distance has since increased to more than 5 miles.

The Lukka Chuch, which at that time was connected with the river, and formed the feeder of the Kulleeree Canal, is now more than a mile removed from the present bank of the ludus, and a new channel for the canal supply, 2 miles in length, has been since opened into the Indus itself.

A little higher up the river, opposite Shaik Radun on the plan, an island, 4 miles in length by I mile in breadth, has been formed within the last six years; the new channel cut by the river being equally navigable with that of the original course.

Eligible spot belew Jerruck.

- 19 This rottenness of bank, and liability to constant change, manifests itself throughout, until the northern bend of the river, below Jerruck, is reached. Here the limestone bills which skirt the river from Jerruck downwards recede inland in the direction of Ponda, and a very eligible spot for a canal-head occurs; but it is, unfortunately, though from a different cause, as much liable to speedy change as the bank already passed. The reason of the want of permanency in this otherwise favourable locality is found in the existence of a deep bend in the river below Jerruck, the operation of which will be best understood from the annexed diagram.
- 20. The action of the stream impinging upon A is fast eating away the bank at that point, and the silt is naturally deposited on the opposite bend, between A and B. The continuation of this action must result in the gradual destruction of the apex A, C, E, and the silting up of SB, until the river works out for itself a natural and easy course in the direction A E.

So great is the opposition met with by the river on this abrupt curve, that notwithstanding the outlet afforded by the channel of the Pinaree at Bunna, and by the floods in that direction, the water during inundation at A stands 3 feet higher, with reference to the low-water marks at the respective places, than at Jerruck, and from this a judgment may be formed of the power brought into action for the gradual removal of the obstacle encountered.

Under these circumstances, in my opinion, it would not be prudent to risk the construction of the heavy works required at the canal-head, which might in a few years be rendered ineffective at this point; but rather advisable to extend the canal across the bend to Jerruck, where the reach of the river gives every promise of permanency, in the occurrence of limestone hills on either bank.

Canal-head fixed at Jerruck.

21. Immediately below the town of Jerruck, a very favourable spot exists for the construction of a canal-head, where the presence of rock at the water's edge will very much facilitate general operations.

Advantages of that locality considered. The saving of distance effected, hy cutting off the bend of the river, is no less than 6 miles, which would make a very material difference in the upriver passage; and it is to be considered as very advisable that the important works at the head of a canal should be situated close to a large town, the head quarters of a Government revenue establishment, where assistance to any extent, in case of necessity, would always be procurable.

The location of the head at Jurruck is, moreover, highly advantageous, as rendering easy the attainment of a very important object, in the facility offered for the construction of a waste-weir near Lukilatfoola, for the

purpose of returning the water into the river, and preventing the flooding of the country below, should any accident occur in the lock-gates at the height of inundation.

- 22. Under these circumstances, I have no hesitation in recommending Jerruck as the most fit place for the head of a canal communication with Kurrachee.
- 23. The main object of the canal is the establishment of a cheaper, more expeditious, and more certain means of transport for every description of merchandize between the port of Kurrachee and the interior, than the present imperfect river communication affords; but in most instances, and especially in this country, where seldom more than one means of communication between two points exists, and that is almost invariably constructed at the expense of Government, due regard must be paid, in framing a new design, to the political as well as commercial advantages obtainable, so that in considering the arrangements necessary for the completion of the present project, provision must be made for uniting with it a more expeditious mode of conveyance than tracking will supply, adapted to postal purposes, and the movement of troops, stores, &c.; but which might, at the same time, be made subservient to the general requirements of the travelling portion of the community.

24. This latter object can only be effected by the introduction of steamers on the canal, well adapted, from their speed and accommodation, to the object in view, with flats, to be used, as on the Indus, when occasion requires. Small fast iron boats, somewhat similar to those employed in passenger traffic on the Thames, varying from 30 to 40 horse-power, with a length of 100, and a beam of not more than 18 feet, would best answer the purpose: they should, however, be constructed on the screw principle, with a view to saving the width due to the paddle-boxes, and diminishing at the same time the errosive action of their waves on the canal banks.

- 25. The most obvious means of ensuring the full benefit of the canal to the general traffic is to admit, without restriction, at least for the present, every description of Native craft now used in the navigation of the river, so that no drawback to its advantages may exist in the necessity of breaking bulk at the head.
- 26. As the draught of the steamers above described will always be less than that of the Native river craft, the depth of water necessary in the canal may be at once determined from a consideration of what is required by the latter.

From a return furnished me (Appendix A) by Captain Ethersey, it appears that the largest of the Native river craft is by measurement 1,400 maunds burthen, drawing when empty 2 feet, and when laden 4 feet 2 inches of water: adding, then, to the latter measurement 1 foot for contingencies, which is somewhat more than is usual in England, and again 10 inches (vide Appendix G) as an allowance for the deposit of silt, and for evaporation, the depth of water required in the canal may be fixed at from 6 feet throughout. Allowing, again, 1 foot for the height of the banks above the ordinary water level, 7 feet will be the depth of excavation below the formation ground line.

27. As the breadth necessary to be given to the canal at the bottom, and the width of the locks, are to a certain extent dependent upon one another, they may with advantage be considered together.

The dimensions of the latter may be deduced from data already fixed, and those of the former may be determined from the breadth required for The consideration of the uses to which the Canal is to be applied, with a view to determining its dimensions.

ing its dimensions.

Political application to be considered.

The necessity for employing Steam-ers.

Their dimensions.

Benefit to general Public.

The depth of the Canal.

The breadth of the Canal and its Locks. the lock-gates, an allowance being made on either side for the retirement of the foot of the banks. The excess over this by the side slopes at the surface would be a sufficient provision for the contingencies of the navigation.

The beam of the largest Native vessel now used on the river varies from 19 to 21 feet: each lock-chamber would, therefore, require a width of at least 22 feet, which would be ample for the accommodation of the steamers above described. Allowing, then, 8 feet for the thickness of the central lock wall, and 3 feet on either side to clear the base of the slopes, the breadth of the canal at the bottom will stand thus:—(22+3) 2+8=58 feet: adding to this the base of the interior slopes at  $1\frac{1}{2}$  to 1, or 18 feet, the total top width of the excavation for the canal becomes 79 feet, and the breadth of the water at its surface 76 feet.

The length of the Locks.

28. The length of the locks, again, is entirely dependent upon the steamers employed; and to accommodate those recommended above, including the rudder, 130 feet is the least length that can be assigned. This length, which is great, would act disadvantageously, where a necessity for economising the expenditure of water existed; but as in this case the Indus may be regarded as capable of affording an unlimited supply, the objection has little weight beyond the small increase of expenditure for lengthening the lock walls.

29. The tow-path on either side should be 12 feet broad, including a small drain on the outer, and a slightly raised edge on the inner side; the former to keep the canal free from the silt brought with the surface drainage, and the latter to give a foot-hold to the horse in tracking.

Reference to Sections\* of the Canal.

The Tow-path.

30. The section of the canal as above determined will be found on reference to Plate 10.\* Some of these arrangements are necessarily liable to modification, in the case of aqueducts, &c., on the score of economy; but as these considerations are connected with the engineering details, and are independent of the general description, and adaptation of the project to its requirements, they will be treated of under the proper head.

Reference to the Plan.

31. On referring to the accompanying map of the country between Kurrachee and Jerruck, the canal will be found indicated by a broad black line.

Regulation Lock

32. Immediately below Jerruck, where the canal leaves the river, the works necessary at the head, for the purpose of regulating the supply of water at all heights of the river, and for the admission and discharge of vessels, as well as buildings for the establishment, will have to be constructed. The proposed arrangements for the "Regulating Lock," being of somewhat complicated nature, are shown in detail in Plates 9 and 10.

Course of Canal described.

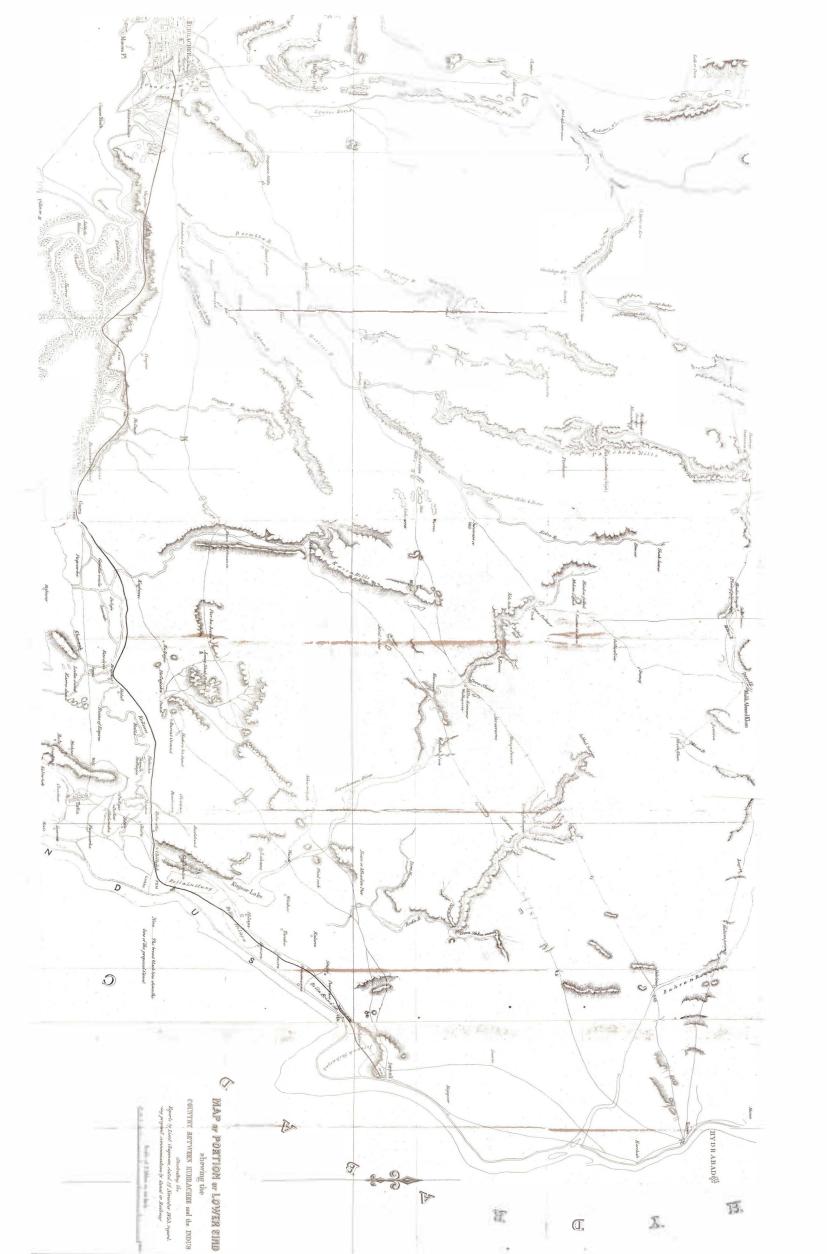
33. From Jerruck the canal first crosses the plain to the south of the town, in a nearly direct line, to the opposite bend of the river, where it passes along the foot of the limestone hills which there skirt its banks, and regains the flat surface of the country some 2 miles above the village of Sonmeanee.

Dam and Escape-Weir.

- At the point marked W on the plan,\* a dam with flood-gates across the canal, and a waste-weir on its southern bank, will be constructed, with a view to throwing again into the river any flood-water which accident or carelessness might admit into the canal, and so to guard against injury by inundation to the country below.
- 34. From Sonmeanee to near the village of Lukka the canal runs parallel to the course of the river, through a country almost level, and in every way favourable to its construction.

let Lock.

- 35. At Lukka advantage is taken of a narrow gorge between two limestone hills, at the termination of the low range from Ililaya, to construct a
- \* The detailed plans are not printed, but a map is appended of the country generally between the Indus and Kurrachee, which, for purposes of general reference, is considered sufficient.



lock, giving a fall of 8 feet, which again assimilates, as nearly as possible, the level of the canal line to the surface of the country.

36. At the same place the Kattian irrigation channel, a secondary feeder of the Kulleeree Canal, passes close on the line, and arrangements will be made here, by means of a sluice, for increasing the supply of water in the Kulleeree during the dry season to such extent as may hereafter be considered advisable.

Feeding the Kulleeree Canal.

37. From Lukka the canal continues its course, north of the Kulleeree, to the Runn Pitteanee River, the high-water line of which determines, thus far, the level of its bed. Having crossed this river by an aqueduct 780 feet in length, a lock with a fall of 5 feet brings the bottom of the canal to the lowest level which the high-water line of the Mullear River, the next standard, will admit of. It then proceeds through Gharra, and by embankments across the flats near Wuttogee, to Pimpree, at which place it passes through the hills, over the river by an aqueduct 1,000 feet in length, and then, following the line of the Gharra Creek, eventually emerges from its bed through the hills, a little to the north of Wagoda; whence, passing over the Mullear River channels by an aqueduct 1,750 feet in length, it takes a direct line for Kurrachee, and ultimately, having made a third descent by lock of 9 feet on passing through the rising ground, to the SE. of of cantonments, it reaches the shallow bay to the eastward of Kemaree Island, with its bottom 3 feet 6 inches above the ordinary high-water line.

Runn Pittenneo Aqueduct, and Lock No. 2.

Pimpree River

Mullear River

Lock No. 3.

General Remarks

on Canal Line.

The necessity of choosing the Gharra Creek Line regretted.

38. From its head to Pimpree, a question could hardly arise as to the line the canal should take, the ground being most favourable, and neither the cuttings (except near the head, where they must of necessity be deep,) nor embankments being on any part heavy. But a great point would have been gained could the lengthy embankment along the Gharra Creek have been avoided, by carrying the canal either through the hills by Jemedar-ke-Landi, or across into the Mullear valley, and so on through the same place to Kurrachee. The trial levels, however, taken for the purpose of judging of the feasibility of either direction, showed such heavy cuttings, and so much difficulty in the arrangements for passing the Mull-ar River, there on high ground, as to render both these lines economically, if not absolutely, impracticable.

The Sections\*

39. The levels will be fully understood by referring to the accompanying sections,\* but the following general abstract will show clearly the fall of the country, and the manner in which it has been disposed of:—

Below Datum or Permaneut Bench Mark, Jerruck.

Assumed lowest level of the water of the Indus for canal supply (see Section*)	Pt. 20	In. 0
High-water sea level at Kurrachee, about	51	6
Fall to be disposed of	31	6
Accomplished by-		
No. 1 Lock, at Lukka, with a fall of 8 feet.		
No. 2 Lock, at Runn Pitteanee River,, 5 ,,		
No. 3 Lock, near Kurrachee "9 "	22	0
Remaining	9	6
Deduct depth of water in canal	6	0.
Height of canal bottom above high-water mark, on		
arrival at Kurrachee	3	<b>6</b> ^

The disposal of the Fall of the Country.

<sup>\*</sup> See foot-note at page 14.

The result of the Field Works.

40. A memorandum in the Appendix marked II gives the result of the levelling operations, and shows the degree of accuracy attained under circumstances which necessitated rather hurried work.

The length of the Canal.

41. The canal from Jerruck to Kurrachee covers a distance of 92 miles 3,157 feet, and the communication with the harbour extends its length to 95 miles 1 furlong and 108 yards.

The connection of the Canal with the Harbour.

- 42. Having now brought the canal to its terminus at Kurrachee, the best method of effecting a communication with the harbour, by means of which the necessity of land carriage in the transfer of goods may be obviated, remains to be considered.
- 43. The manner in which it is proposed to attain this object is illustrated in Plate 8,\* which shows the principal portion of Kurrachee Harbour.
- 44. The canal, as before stated, arrives at the water's edge of the shallow bay to the eastward of Kemaree, with its bottom 3 feet 6 inches above ordinary high-water level.

Canal Basin, Wharf Pier, and Dock. Here, at the points DB in the plan,\* it is proposed to construct a lock, with a fall of 9 feet 6 inches, which will drop the canal boats into an excavated basin 1,500 feet by 500, with a depth of 6 feet of water, being separated from a second dock, 1,500 feet by 300, having a depth of water at high tides of 15 feet, by a wharf pier, 40 feet in breadth; the former being for the reception of the river boats, and deriving its supply of water from the canal itself, and the latter, being adapted to the accommodation of the coasting vessels, and small craft from the harbour, and being furnished with salt water by a cut through the bay and Kemaree Island to the harbour, which would form at the same time the connecting link between the deep water off Kemaree Point and the canal tail.

The proposed Cut.

45. The inner basin is calculated to accommodate upwards of 300 boats, of the ordinary size of river craft, and the centre pier would afford wharf room for 15 to 20 vessels at one time. The transhipment of the cargoes could be easily and economically effected by cranes, fixed at certain intervals, and working a few feet over the half breadth of the roadway.

The dimensions of the outer dock have been reduced, on account of its connection with the harbour itself.

- 46. The side-retaining and wharf walls of the inner basin would have to be rendered impervious to water, with a view to keeping the water in the lock chamber as sweet as possible.
- 47. In lowering boats into the basin, the fresh water would be passed off by sluices through the side walls of the lock, and be then available for irrigation and ordinary purposes.
- 48. Drinking water would be drawn from the canal above lock No. 3, and could from that point be laid on to most houses in cantonments, or to reservoirs in the town; but it would require to be raised a few feet for the supply of the new barrack, hospitals, and the upper stories of dwelling houses.
- 49. The water for the use of the shipping would be carried from above lock No. 3 by pipe, along the embankment of the bay cut, to Kemaree and the harbour.

The recovery of the Land covered by the Bay by degrees, without further material expenditure. N.B.—As the proposed cut passes through the Chinee Creek, and then along the deep water channel, which, before the construction of the mole, formed the tide-way of the greater part of the bay, it might be

made available, in conjunction with the long contemplated bund across

the mouth of the creek, for the drainage, and ultimate recovery, of the whole of the bay from the sea.

The cut being completed to a depth of 15 feet, with an embankment on either side, the whole of the water might be gradually withdrawn, through sluices left for the purpose in its banks.

By drawing off, and allowing the next tide to renew the whole of the water occasionally, stagnation would be prevented; and by decreasing, by degrees, the quantity allowed to pass in at certain intervals, small surfaces only of mud round the edge of the bay need be subjected to the process of evaporation at one time, and the bad effect which the sudden exposure of a large extent of slimy soil to the action of the sun might be supposed to to have on the salubrity of the neighbourhood, would be in a great measure, if not entirely avoided.

50. As, during the progress of the inquiry into the canal project, that of a railway has been so prominently brought forward, I have thought it advisable not to enter so minutely into the details of the canal (the drawing out of elaborate plans and estimates for aqueducts, for example,) as would necessitate an extensive establishment, and at the same time cause great delay in the completion of the report; but I have endeavoured rather to lay the project as soon as possible before Government, wanting in no essential which would materially affect the scheme in comparing it with a railroad, still involving no work which would be useless for the same purpose; and thus to afford means of arriving at a conclusion as to the comparative advantages of the two proposals, without any great preliminary expenses on either.

51. Keeping this intention in view, the sections, which were taken with great care, have also been carefully calculated, and cut-stone bench marks have been established at the points shown on the plan, which will be available for reference at any stage of the work.

- 52. The aqueducts, instead of drawing a detailed plan for each, have been roughly estimated, taking the Solami aqueduct on the Ganges Canal as a general guide, and making the necessary allowances for the difference in dimensions, cost of labour, &c.
- 53. The watercourses have been classified by the areas of their highwater sections, and then arranged under three different heads, (showing the manner in which they will be disposed of,) according to their situations with regard to the canal bed. The classification of the watercourses will be found on reference to Appendix to Estimates E and F.
- 54. Of these arrangements, as well as for the small locks, the basin, dock, &c., I have rough plans drawn out, from which they have been estimated; but as they involve neither complicateness nor difficulty in their details, it does not appear necessary to submit them in form.
- 55. The regulation lock at the head, being an important work, and complicated in its arrangements, from having to provide for a rise and fall, and to withstand a head of water 20 feet in height, requires to be drawn in detail. It is shown in Plates 9 and 10.
- 56. The object of the double set of lock-gates is to ensure the large gates being in a state of efficiency whenever the river may rise, whilst the smaller gates will be available at all times, except during the inundation, and can of course be worked with much greater ease than the large ones.
- 57. The cut to the harbour will be a work of considerable labour and difficulty; but, as the project would not be complete without it, and it will

Canal Estimate; General Remarks.

Sections.

Aqueducts.

Watercourses.

Rough Plans not forwarded.

The Regulation Lock at Head.

The object of the double Lock-gates.

The Cut.

very greatly enhance the value of the communication, I would strongly recommend its adoption.

58. The bed of the bay immediately below the water is composed chiefly of a heavy blue clay, well adapted for the necessary embankments. I propose to line the cut with teak-wood piles 20 feet apart, connected with waling pieces above, and driven into the bed to correspond with the slopes of its sides, and to strengthen the intervals to a depth of 12 feet (or the difference between high and low spring tides) with a strong dry rubble pavement: this will be a very durable style of work, and will, I have no doubt, be found efficient.

The Dam and Escape-weir at Lukilatfoola.
Bridges. 59. In addition to the four small locks already described, and shown to be necessary to allow for the fall of the country, a dam and escape-weir at Lukilatfoola, and six road-bridges are required. Specifications of these, as well as of the necessary buildings, will be found at the head of their respective estimates. (Vide Estimate.)

Reference to Estimate.

Cost of Project.

60. From the general abstract of the accompanying estimate it will be seen that the estimated cost of the canal from Jerruck to Kurrachee is Rs. 44,86,597, whilst that of the cut forming the communication with the harbour amounts to Rs. 3,64,175.

The total expenditure for the complete project is, therefore, Rupees fortyeight lakhs, fifty thousand, seven hundred and seventy-three.

Consideration of probable Returns.

61. The next subject to be considered is the amount of traffic that may be expected on the canal, from which to deduce the means of ensuring some return on the outlay; and here it will be necessary to examine carefully the advantages which the project offers to the public, in order that the success of the scheme may not be hazarded by a too high taxation.

The number of Boats and amount of Traffic that may be expected on the Canal.

62. To enable a judgment to be formed as to the number of vessels likely to pass through the canal in the course of the year, a very satisfactory return of the river traffic for the year 1852-53 (vide Appendix B) is available. An abstract from this, given below, shows the number of boats which passed the following places on the river, during the course of the last year:—

Size of Vossels.	Seh	wan.	Tatta !	Bunder.	Ko	tree.	Ghorabarree, Kettie, Unnie, and Wagoda.		
	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	
Above 1000 maunds	20	5	155	64	248	157	102	45	
From 800 to 1000 maunds	31	6	144	43	286	201	175	70	
,, 600 to 800 ,,	82	39	58.1	169	787	504	586	229	
" 400 to 600 "	200	92	1,020	277	1,477	743	1,132	453	
,, 200 to 400 ,,	559	278	970	328	1,512	848	965	455	
Under 200 maunds	876	370	388	1,720	1,746	2,662	1,166	727	
Totals	1,768	790	3,258	2,601	6,065	5,115	4,126	1,979	
1 Otais	2,	558	5,8	359	11,1	ľ80	6,105		

63. From this statement, an approximation to the number of vessels which made the passage through to the ports at the different mouths of the river, and which may therefore be supposed to pass through the canal, may be readily deduced.

The Return at Kotreenot reliable.

64. The largest number of vessels passing down the river is shown at Kotree; but from this return being nearly double that registered at Tatta, it is clear, either that "a very large number of vessels from up-river discharged

their cargoes at Hydrabad;" "that there are places between Kotree and Tatta capable of consuming as much as half the traffic supply;" or "that au extensive local traffic is taken into account in the returns." The first of these suppositions is not borne out by the comparatively small return at Sehwau; Jerruck, the only town of any importance between Hydrabad and Tatta, cannot be made to account for the consumption implied in the second: the third supposition must, consequently; in a great measure hold good; so that the return for Kotree cannot be taken to represent the canal traffic.

65. The traffic registered at Tatta Bunder, on the other hand, or 5,859 vessels, laden and unladen, may be fairly taken as an approximation to that on a canal, because the number of vessels passing that point, and the total of those registered at the delta branches at the river, i. e. at the bunders of Ghorabarree, Kettie, Unnie, and Wagoda, nearly agree, proving that there is very little addition to the river traffic below Tatta. The slight increase in the total of the register of the latter places may fairly be allowed for the local movements of small craft, which may be assumed to be considerable, from the great proportion of vessels under 200 maunds shown in their returns.

Reason for adopting the Tatta Re-

66. Though not generally an advocate for the imposition of a tax, on a line of road for example, when the improvement of the communication is sure to repay the outlay by indirect advantages to the State, still I think a tax can be fairly shown to be admissible in this case, where a very large expenditure is involved, the advantages, in point of time and distance, are so much greater than can usually he looked for, and an establishment, moreover, for the efficient working of the scheme, must of necessity be kept up.

Tolls to be levied.

67. This tax may be drawn from two sources—1st, from fees to be payable at each lock; and 2nd, from wharfage and carriage fees to be levied at the basin, or other points where the cargo may be discharged.

Tolls how levied.

68. In order to form a judgment of the amount of the first tax recommended, the advantages offered to the public by the scheme must be considered.

The amount of lst Toll.

- 69. By referring to the accompanying Return (Appendix A) prepared by Captain Ethersey, it will be seen that the trip from Sukkur to Ghizree Bunder and back by the river occupies on an average 70 days; while that from Sukkur to Hydrabad is usually performed in 42 days. The difference of these periods gives from Kotree to Ghizree Bunder 28 days; and allowing the proportion of time from Kotree to Jerruck at 4 days, 24 days may be taken as the average time of passage from Jerruck to Ghizree Bunder.
- 70. On the other hand, the length of the canal being 92 miles, and supposing the crew of a boat (concluding that it will be some time before the economy of horse-power will be appreciated) to track 8 hours per diem, at the rate of 2 miles an hour, their progress during the day would be 16 miles, and 12 days would consequently be ample allowance for the transit of the canal to and fro.
- 71. This gives a clear gain in time of 12 days each trip. Leaving this substantial advantage, as well as the decrease of wear and tear and risk (which latter, I understand from Mr. Amos, the Government Steam Agent, is estimated at 7 per cent.) entirely to the boatmen, as an inducement to exertion and enterprise, it appears to me that a tax may be fairly levied on each boat, equal to the saving effected in the subsistence of the crew during the time gained.

72. Applying this to the medium-sized boat of Captain Ethersey's return, of 700 maunds, and having a crew of ten men, 120 days' provisions for one man is the saving which results: taking each day at one anna, one-third the rate of wages allowed by Captain Ethersey, and Rs. 7½ represents the tax to be levied on each boat, which would be distributed, in proportion to the distance, at the different locks.

The Revenue derivable. The annual income derivable from this source, calculated for the number of boats which it is concluded will pass through the canal, or 5,859, is Rs. 43,942; and this will no doubt rapidly increase.

The 2nd Toll; continued Craue-age.

- 73. The second tax recommended, which will fall exclusively on the merchants or shippers, is that to be levied on the use of the wharf and cranes at the basin, and may be approximately determined by the following considerations:—
- 74. The former calculations suppose Ghizree Bunder to be the point of discharge of cargo. If not discharged there, all freight destined for Kurrachee is sometimes transferred into sea boats, and sometimes brought at once by the river craft through one of the mouths of the Indus into the harbour.

Rate of 2nd Toll.

75. In the first case an extra expenditure for land carriage, at the rate of Rs. 1 per 12 maunds is incurred, and the freight from Ghorabarree or Khettie to Kurrachee may be estimated at Rs. 2-8-0 per 100 maunds; so that were Rs. 2 charged for the use of the cranes and wharfage room at the basin, on every 100 maunds of cargo transhipped, the public would still profit by the new arrangement, and 1,546,600 maunds, the maundage of the laden boats in the Tatta return (Appendix B) would give a further income of Rs. 30,932.

Revenue of 2nd Toll.

76. The amount of direct revenue derivable from the project being thus determined, the following Statement will show its merits as a commercial speculation:—

	Re.	<b>4.</b>	p.
Total amount of estimate	48,52,773	0	0
Probable cost of two small steamers, of the dimensions			
and power proposed	1,60,000	0	0
Ditto two flats or barges	10,000	0	0
Total capital required	50,22,773	0	0
Interest at 3 per cent. on above	1,50,683	0	0
Cost of Maintenance.			
Yearly establishment	6,252	0	0
Yearly repairs, at Rs. 250 per mile, for 96 miles	24,000	0	0
Cost of working two small steamers one trip each			
way per diem, or 92½ miles, about Rs. 50 per			
diem for each vessel	36,500	0	0
Wear and tear of vessels, at 4 per cent. on prime cost.	6,800	0	0
Total cost of maintenance	73,552	0	0
Probable Returns.			
By receipt from lock tolls, 5,859 boats, at Rs. 7½ each.	43,942	8	0
By wharfage and craneage fees on 1,546,600 maunds,			
at Rs. 2 per 100 maunds	30,932	0	0
Yearly expenses of two steamers to be dispensed with			
from the Indus, vide Captain Ethersey's letter			
(Appendix A to Railroad Report)	<b>75,000</b>	0	0
Carried forward Rs.	1,49,874	8	Ú
• <sup>-</sup>			

Brought forward Rs.	1,49,874	8	Q.
Yearly cost of post, vide Postmaster's letter No. 482,		•	
(Appendix to Railroad,) three-fourths of Rs. 24,000			
(to Jerruck). The steamers can readily be worked			
at the rate of 10 to 12 miles an hour	18,00Q	Ó	0
422 tons of private merchandize conveyed by the			
Indus Flotilla (vide Appendix to Railroad,) at 1 anna			
per ton per mile on 92.5 miles	2,439	11	Ó
[Government stores and troops by river are			
included in the Rs. 75,000 allowed for the			
Indus Flotilla expenses.]			
2681 tons of traffic overland, according to the			
returns given in Appendix F and G to Railroad, at	3.5 400		^
I anna per ton per mile	15,499	8	6
TotalRs.	1,85,813	11	6
Deduct Cost of Maintenance	73,552	0	0
Direct return (more than 2 per cent. on the outlay)	1,12,261	0	0

77. The canal would, therefore, yield in direct returns about 2 per cent. on the gross outlay, making no allowance for the certain increase of traffic, or for the receipts by passengers and parcels, which latter items would probably prove a source of considerable revenue.

Direct Return yielded by the Ca-

78. In addition to the direct returns, however, the contingent advantages, alluded to above, which the unlimited supply of Indus water is calculated to secure, have yet to be examined, in considering the project as a remunerative speculation.

Indirect Return.

The supply of water required may be classed under three heads: 1st, the supply to the harbour and shipping; 2nd, the supply to the town

The Water sup-

of Kurrachee; and 3rd, the supply to the cantonment. The advisability of adopting and carrying out some scheme for

securing to the inhabitants of the town, as well as to the harbour of

Its desirability.

Kurrachee, an abundant supply of good and wholesome water, has been so well considered, and so clearly and strongly advocated by the Board of Conservancy, that I cannot better exemplify the urgency of the want, than by an extract of a memorandum by one of its oldest and most active members, the present Collector of Customs. He says: "Hitherto, the water within moderate reach has been at all times indifferent, and occasionally scarce. The Scindees have not complained, for they have never known it otherwise: to all, however, who have made Kurrachee their residence since British occupation, the saltness of the water has been a source of inconvenience, and they have been obliged to draw their supplies from a distance, the expense attending which I have ascertained to range from Rs. 2 to Rs 4 for each house monthly. The harbour, and the residents at Kemaree and Baba, get their supplies at the bunder, at the cost of 2 annas the puckal, and the article is of the worst kind, being dirty brackish water.

Advocated by the Board of Conservancy.

As the Sub-Committee of the Board entered at length into the supply required by the harbour and town of Kurrachee, during the end of 1851, when an estimate for an aqueduct to lead from wells sunk in the valley of the Learee was prepared, I shall adopt their calculations on these points, allowing the increase of the shipping visiting the harbour, and of

To this part of the population, now considerable, and fast increasing, the

aqueduct will be of the utmost service."

The calculation of the Board as to the Amount of Supply required adoptthe population of the town during the period which has intervened, to compensate for any over-estimation which may at that time have occurred.

- 82. The supply of water in the canal cannot fail to be abundant, and a good head is at once available immediately above lock No. 3, where the surface of the water stands 18 feet 5 inches above the high-water mark of the sea: a height quite sufficient to command the town, harbour, and cantonments, as well as the basement floors of all the new barrack buildings, with the exception, perhaps, of the hospitals.
- 83. On a rough estimate, the expense attendant upon the distribution of the water is as follows:—

	$R_{\theta}$ .	a.	p.
10,500 running feet of 4-inch main pipe from head			
to junction of town pipe, at Rs. 12 per foot, includ-			
ing laying, and all expenses	15,750	0	0
16,817 running feet of 3-inch pipe from lock No. 3			
to harbour at Kemaree, along the cut embankment.			
10,560 running feet of 3-inch pipe from junction,			
through Sudder Bazar by Golundauze lines, to town			
reservoir.			
5,500 running feet of 3-inch pipe from junction of			
town pipe and main pipe, through Commissariat			
Store and Native Infantry lines.			
32,877 running feet of 3-inch iron piping, including			
laying, &c., at Rs. 14 per foot	41,096	8	0
5,280 running feet of service pipe, at Rs. 1 per foot,			
for supply of Government House, &c	5,280	0	0
Reservoirs, &c	5,000	8	0

Total amount .... Rs. 67,127 0 0

The returns, on the other hand, making use of the calculations approved of by the Board, would be as below:—

#### Returns from the Supply of the Town and Harbour.

	Rs.	a.	p.
An average of 14,400 gallons supplied daily to the harbour and shipping, at 1 anna for 25 gallons (or half the price at which bad brackish water is now	10.140	0	0
procurable)	13,140	U	Ū
house tax, if considered preferable	14,280	9	0
the Board from Rs. 9,000 to Rs. 15,000, say  Supply to Camp.	12,000	0	0
The annual saving effected by supplying the Camp at all points, instead of, as now, having to convey water, especially to the new barracks, a considerable distance (vide "Abstract Statement of Cost of supplying Water to Corps and Establishments,"			
Appendix C)	10,500	0	0
Total amount of Revenue from water supplyRs.	49,920	9	0

- 84. Deducting from this amount interest at the rate of 5 per cent. on the sum expended, or Rs. 3,357, we have a clear yearly return on account of the water supply of Rs. 46,563, which, added to the profits of the canal proper, gives Rs. 1,58,824, or more than 3 per cent. upon the entire outlay.
- 85. It must, however, be borne in mind, in considering the merits of the project, that several sources of advantage to the State and revenue have not been taken into account in the above calculations. These may be enumerated, as follows:—
  - 1st.—The movement of troops by land, which, with carriage, and wear and tear of kit, cannot but prove a heavy item of expenditure.
  - 2nd.—The local charges of the Commisariat Department, in merely moving Government stores in the immediate neighbourhood. The expense incurred on this item alone will be found by a return (marked D in the Appendix) to amount to Rs. 12,856 per annum, the greater part of which would be rendered unnecessary by the arrangements proposed at the basin, in the present project, and by the connection of the canal with the harbour.
  - 3rd.—The further revenue derivable from the increased supply of water to the Kulleeree canal.
  - 4th.—The application of the water at and in the neighbourhood of Kurrachee to the purposes of irrigation.
  - 5th.—The return derivable from the supply of water to the houses in cantonments, as well as to those in the camp bazar, the population of which was given in the last returns at 16,900 souls.
- 86. Taking into consideration these further contingent advantages, which have only been omitted in the examination of the project from the difficulty of determining the revenue to be allowed for each, it appears probable that 4 per cent. upon the entire outlay, or even more, might be expected from a canal, under skilful and judicious management.

For continuation see accompanying Railroad Report.

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

Kurrachee, November 1st, 1853.

## APPENDIX A.

Statement exhibiting the General Tonnage and Draught of the Native Craft employed in the River Traffic, together with a Scale showing the Government Mode and Rate of Hiring the same by the Trip, and the usual Time allowed for the up and down Voyage.

Size in Maunds.	Crew a	llowed.	Pay of Crew per Month.  Rs. 2 per 100 Maunds.  Amount of Tonnage, at Rs. 2 per 100 Maunds.  Draught when Empty.  Draught when Laden.  Laden.  Draught when Laden.  Laden.  Time allowed when Boats are taken up by the Trip, which includes the Return Voyage.		which includes the Return Voyces Remarks.							
Native Boats. 100 150 200 250 300 350 400 450	Tindal.  1 1 1 1 1 1 1	2 4 4 5 5 6	Rs. 16 26 26 31 31 36 36 41	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Rs. 2 2 4 5 6 7 8 9	0 18 0 29 0 30 0 36 0 37 0 43 0 44 0 50	0 0 0 0 0	P. F7 0 I 0 I 0 I 0 I 0 I 0 I 0 I 0 I 0 I 0 I	0 1 2 3 4 5 6	2 2 2 2 3 3	In. 0 2 4 6 8 10 0 2	From Sukkur to Larkhana 8 days  "" Sehwan 20 "  "" Hydrabad 42 "  "" Tatta 50 "  "" Beacan 60 "  "" Beacan 60 "  "" Ghizree Bunder. 70 "  "" When boats are towed by steamers, payment is made
500 550 600 650 700 750 800 850 900 950 1000 1100 1200 1300 1400		8 9 9 10 10 11 11 11 12 12	41 46 46 46 51 56 61 66 61 76	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 10 12 0 13 0 14 0 15 0 16 0 17 0 18 0 19 0 20 0 24 0 28	51 57 58 59 65 66 72 73 79 80 81 88 90 97	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	8 9 10 0 0 0 0 0 0 0	333344444444444444444444444444444444444	4 6 8 10 0 0 0 0 0 0 0 0 0 0 0	mittencote 25 mittencote .

(True copy)

W. CHAPMAN, Lieutenant,

Engineers.

(Signed) R. ETHERSEY, Captain, I. N., Commanding Indus Flotilla.

Kotree, 20th June 1853.

APPENDIX B.

Return showing the Number of Boats arriving at and departing from the undermentioned Bunders on the Indus, during the Years 1851-52 and 1852-53.

	with	ا ند	without				<u></u>			s	ize of B	oats.			<u>.</u>							<del></del>
Ports.	Steamer with Flat. Steamer without			Abov 100 Maun	00 to 1000		000	From 800 to 600 Maunds.		From 400 to 600 Maunds.		From 200 to 400 Maunds.		Less tl Mau	nan 200 inds.	Total Tonnage.		Laden.		Unladen.		
	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Laden.	Unladen.	Increase.	Decrease.	Increase.	Decrease,
RIVER PORTS.													<del></del>				Maunds.	Maunds.	Maunds.	Maunds.	Maunds.	Maunds.
Sukkur	18 10	1	27 33 47 31	4 19[1	41	19 11 93 39	45 88 241 200	41 39 232	190 280 532	183 136 376	705	357 887	401 405 723	274 503	810 833	214 1,489	6,23,900 8,16,800 13,61,900	4,69,800 4,25,500 13,67,600	1,92,900	****	••••	44,300
ka-Tanda, the port of Hydrabad 1851-52	37 80	9 2.	119 90	12 66	198 1	51 57	222 286	1	559 645 787	278 366 504	1,477	743	707 1,473 1,512		1,027	2,111	14,04,300 20,29,200 24,05,800	7,81,200 13,03,200 15,98,500	••••	****	2 <b>,95,3</b> 00	5,86,400
Tatta	13 23		58 69	28 13	116	60 64	108 144	51 43	435 581	190 1 <b>6</b> 9		277	912 970	419 328			11,39,700 15,46,600	7,14,900 6,37,100		****	••••	77,800
DELTA PORTS.				1																		
Gorabarree and Khet- \$ 1851-52 tie, on the Dochta. \$ 1852-53 Wagoodur, on the \$ 1851-52 Gharra Creek \$ 1852-53 Unnie, on the Kede- \$ 1851-52	7 10		11 43 41 44	i 7	85	50 36 12 9	110 144 14 31	67 43 16 27	349 508 42 78	163 163 36 66	1,019 <b>7</b> 9		872	390 34 65	1,156 7	584 19 143	1,86,600	6,52,600 5,45,300 86,400 1,62,200 4,200	3,49,600 62,800		75,800	1,07,300
waree Branch { 1852-53	_	<u> </u>	68 	-ŀ	•••	••		•••				•,•	••		1	4	100	400		20,200		3,800
1851-52				-ŀ	<b></b> ⊦	—-I					<del></del>		<b> </b> -		<b> </b> -	ì	<b></b> i	45,97,800	*******			****
1852-53					328	16	89:3	445	2,793	1,316	5,063	2,200	4,559	2,282	4,768	6,963	78,25,600	41,50,200	14,31,200	20,200	3,71,100	8,19,600

(True copy)

W. CHAPMAN, Lieutenant, Engineers.

(True copy)

(Signed) H. B. ELLIS,
Assistant Commissioner.

## APPENDIX C.

Abstract of Returns received from Officers Commanding Corps, and Heads of Departments at Kurrachee, showing the Expense at present incurred by Government in supplying Water for their use; as well as the estimated probable Saving to Government were Water fully supplied at all points by a Canal.

Corps and Departments.	Puckals.	Bheesties.	Carts.	Monthly Expense.	Proportion estimated as Saving.	Remarks.
Lieutenant Colonel Law, commanding H. M.'s 83rd Regiment.  Lieutenant Colonel Stopford, commanding H. M.'s 64th Regiment.  Captain Forster, commanding 1st Troop H. A.  Lieutenant Sellon, commanding Sappers and Miners  Major Morse, commanding 8th Regiment N. I.  Major Stewart, commanding 14th Regiment N. I.  Lieutenant Lucas, in charge No. 9 Light Field Battery.  Executive Engineer on various counts  General Hospital  Commissioner's Establishment  Collector's Establishment  Collector's Establishment  Church Establishment  Church Establishment  Ordnance Department, no return received	 4 3  1  2 8 3 	12 27 4   8 1 6 1	12 27   62 2	84. a. p. 120 0 0 270 0 0 96 0 0 27 0 0 9 0 0 592 0 0 18 0 0 578 0 0 59 0 0 5 0 0 10 0 0	135 0 0 48 0 0 13 8 0	Water to Regimental Lines supplied by Commissariat Department. Barracks supplied by Commissariat Carts.  Supplied by Commissariat.  Ditto ditto. Assisted by Commissariat.
				enditure		Representing a Capital at 5 per cent. of Rs. 2,10,000.

(True extract of Returns)

W. CHAPMAN, Lieutenant, Engineers.

Kurrachec, October 1853.

## APPENDIX D.

Abstract of Returns of Carts employed by the Commissariat Department, Kurrachee, in the conveyance of Public Stores, &c. to and from the undermentioned Places, during the Official Year 1852-53.

Year.	From Commissariat Stores to Year. Kurrachee Bunder and Kemaree.			Kemarce arrachee er to issariat res.	From C sariat S Ghizree	tores to	Bunder	Ghizree to Com- t Stores.	to Com	Wagoda missariat ores.	From Commissariat Stores to Wagoda.		
	No.	Loads, lbs.	No.	Loads, lbs.	No.	Loads, lbs.	No.	Londs, lbs.	No.	Loads, lbs.	No.	Loads,	
1852~53	11,960	600 to 800	2,823	600 to 800	1,042	600 to 800	682	600 to 800	9	600 to 800	9	600 to 800	

(True extract from Returns)
W. CHAPMAN, Lieutenant,

(Signed) C. BIRDWOOD, Major, Assistant Commissary General.

Engineers.

Kurrachee, Commissariat Office, 1st October 1853.

#### Abstract Estimate of Cost.

				<del></del> -			A CONTRACTOR OF THE CONTRACTOR
				Rs.	A.	P.	
			as 1 & 2, at 12 annas each	ŧ			I common include the landing
1,724	`>;	"	3 & 4, at Rs. 1 each	1,724	0	0	and unloading, which
18	"	"	5 & 6, at Rs. 2-8-0 each	45	0	0	still required at the wharf.
			Total Annual Cost to Government	12,856	4	0	

W. CHAPMAN, Lieutenant, Engineers.

Kurrachec, October 1853.

APPENDIX E.

Names and Dimensions of Rivers and Watercourses crossed by a line of Levels from Jerruck to Kurrachee.

Derrach to Rarrachec.								
Nos.	Names.	Breadth.	Depth.	Stations.	Distances.			
		Feet.	Feet.		· <del>-</del> /			
1	Baglee Wah	6	5	2nd Pin of ⊙ 12	3rd mile.			
2	Chundun Wah	10	9	3rd ,, ,, 23	4th "			
	Larka Wah (old)	14	10	,, ,, ,, 9	<u> </u>			
	Watercourses		3	2nd " " 13	} 8th "			
5 6	Larka Wah (new)	5	8 10	" " " 14 " " 22				
7	Jain Wah	10	16	,, ,, ,, 22 ,, ,, ,, 24	} 10th "			
8	Gharce Wah	10	16	" " " 26	} i Ith			
	Hajre Wah	14	11	,, ,, ,, 28	"			
10	Alibahar Wah	16	12	» » 45	14th ,, 16th ,,			
	Gidder Wah	16 15	8 8	,, ,, ,, 60 64	1744			
	Shahat Wah	14	6	″ ″ ″ <del>7</del> 2	19th "			
14	Watercourse Irrigation	10	4	190 past 2nd Pin © 224	<b>"</b>			
15	,,	3	13	<b>262</b> ,, ,, ,, ,, 223	  ≻25th			
16	,,,	4	0 }	36 ,, ,, ,, ,, 223	, , , , , , , , , , , , , , , , , , ,			
17	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	4	1	2nd Pin of ② 222	K			
18 19	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	6 31	l   lij	428 past 2nd Pin ⊙ 219 262 ,, 1st ,, ,, 218	<u> </u>			
20	,,	9	43	336 , 2nd , , 217	00.1			
21	))	4	11	90 ", ", ", 216	>26th "			
22	,,,	4	1 1	210 ,, ,, ,, 214	]			
23	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	7	4	62 ,, ,, ,, 214	ال			
24 25	,,,	4 7	6	256 ,, ,, ,, 213 153 ,, ,, ,, 207	<b>i                                    </b>			
26 26	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	6	21	07 1 1 007	>27th ,,			
27	,,	9	3	8 ,, ,, ,, 207	Į <b>J</b>			
28	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	4	1	228 " 2nd " " 203	<u> </u>			
29	27	4	1	313 ,, ,, ,, ,, 202	l <b>1</b>			
30	<b>7</b> 9	15	3	75 , 1st , , 201	1004			
31 32	,,	4 7	2 2	120 ,, 2nd ,, ,, 201 337 ,, 1st ,, ,, 201	}28th "			
33		7	2	14 " " 201				
34	j; ••••••*******************************	5	$\tilde{2}$	234 ,, 2nd ,, 199	j			
35	22	7	2	343 ", ", ", 198	Ì			
36	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	9	4	42 ,, ,, ,, ,, 197	i			
37	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	10	6	120 ,, ,, ,, 197	}29th ,,			
38 39	,,	5 4	6 11	88 ,, ,, ,, ,, 196 157 ,, 1st ,, ,, 195	<b>  29th ,,</b>			
40	))	5	6	206 109				
41	,,	11	4	14 , 2nd , , 191	j			
42	,,	9	3	100 ,, ,, ,, 189	Ù			
43	,,,	6	1	66 ,, lst ,, ,, 189				
44 45	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	5	1	250 ,, ,, ,, 188 236 ,, 2nd ,, ,, 186	<b>                                     </b>			
<b>4</b> 6	77	6 7	3	116 186	}30th "			
47	79	10	3	84 ,, ,, ,, ,, 185	1			
48		5	2	6 , 1st , , 1×5	: <b>1</b>			
49	29	5	11	214 ,, ,, ,, ,, 184	J			
50	,,	8	]	197 , 2nd , , 183	}			
51 52	"	5 7	1	200 ,, ,, ,, ,, 182 205 ,, 1st ,, ,, 182	: 1			
52 53	93	7	2 2	43 189	1			
54	, , , , , , , , , , , , , , , , , , , ,	4	9	196 ,, 2nd ,, ,, 181	: 1			
55	)) · · · · · · · · · · · · · · · · · ·	5	1	310 , lst , , 181	>31st "			
56	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	5	13	217 ,, ,, ,, ,, 181				
57	39 4	10	2	200 ,, ,, ,, ,, 181	. ]			
<b>58</b> 59	, , , , , , , , , , , , , , , , , , , ,	6	3 2	84 ,, 2nd ,, ,, 180 305 ,, 1st ,, ,, 180	, [			
60	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	3	0 <sup>3</sup>	055 0 1 170	•			
	, , , , , , , , , , , , , , , , , , , ,	1	1 03	200 ,, 2nd ,, ,, 1/9	,			

Nos.	Names.	Breadth.	Depth.	Stations.	Distances.
		Feet.	Feet.	•	
61	Watercourse Irrigation	5	2	14 past 2nd Pin 💿 179	ገ
62	,,	38	4	111 , lst , , 177	31st mile.
63	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	9	3	22 ", ", ", 177	701St Illine.
64	,,	26	3	286 , 2nd , , 176	j
65	99	3	11	323 ", ", ", ", 174	Ĺ
66	,,,	7	3	277 ", ", ", ", 174	1
67	,,	4	1	299 ", ", ", ", 172	>32nd "
68	,,	14	2	147 ,, lst ,, ,, 172	
69	,,	15	3 <u>}</u>	222 ", 2nd ", ", 171	i
70	••	7	ì	50 " " 160	<b>`</b>
71	,,	4	6	200 124 7 160	1
72	,,,	12	3	006 " 150	>33rd "
73	29	5	23	205 7 7 155	Soura "
74	,,	7	3	51 7 7 7 154	
75	Channel of Kulleeree	9	6	9 " " " 1/3	35th "
76	Charmer of Wallegreet 11111111111111111111111111111111111	13	4	40 " " " 136	27+1
77	Watercourse Dund	7	2	69 70-4 7 115	30tP ,
78	A greccourse Daild	11	$\tilde{2}$	016 104 " 115	, sam
79	Channel from Kulleeree	15		007 0.3 " 100	1
80	Channel from Luffeeree		5		չ40tb "
	,,	15	6	11 ,, ,, ,, 109	1
81	,,	16	5	20 ,, ,, ,, 108	Į
82	,, , , , , , , , , , , , , , , , , , , ,	14	3	96 ,, 1st ,, ,, 107	}41st
83	Watercourse Dund	9	3	16 ", ", ", 106	Yarar "
84	,,	3	09	182 , 2nd , , 96	)
85	,,,	10	0≇	3rd Pin , 95	≽42n <b>d</b> "
86	Channel	50	2	285 past 1st Pin ⊙ 95	) <u>.</u> .
87	,,	69	2	56 , 2nd , , 90	43rd ,,
88	" "	60	2	130 ,, 1st ,, ,, 48	48th "
89	Runn Pitteanee River	550	6કુ	96 ,, 2nd ,, ,, 46	49th "
•	On Pin	780			
90	Channel Creek	12	3 (	110 past 2nd Pin ,, 29	51st "
91	,,	8	2	110 ,, 1st ,, ,, 21	52ud "
92	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	25	2	40 ,, ,, ,, ,, 14	)
93	,,	27	5	59 ,, ,, ,, 13	≯53rd "
94	Perpunnon Wah	8	2	15 " " " 10	li "
95	Nullah (saltwater)	200	74	3rd Pin of O 8	56th "
96	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	70	7	, , , , 23	59th "
97	, , , , , , , , , , , , , , , , , , ,	110	31	" " " 47	62nd "
98	Guggen River, n. Wuttagee		• •	" " " ·	64th
99	Nullah (salt)	80	5	້ " " າ	67th "
100	Jurrund Nullah	12	10	" " " 95	() "
101		1000	171		<b>ի69ւհ "</b>
102	Nullah	20	4	້ ກໍ່ ກໍ່	73rd
103	Lutt River	75	4	1.5	76th "
104	Raree River	100	4	" " Ro	70.4
105	Nullah	102	13	,, ,, ,, 02 ,, ,, ,, 84	voa **
106	a Aaa ) aaa baabaa aa aa aa aa aa aa aa aa aa a	200	2	2 - 2 - 2	971k "
107	Mullear (portion)	3.50	5		87th "
108	time also become also		9	2nd Pin of ⊙ 117	001.
100	" (main branch)	950	9	3rd ,, ,, 118	>88th "
109	, (portion)	450		Pin 119 opposite Bank.	J
1114	,, (portion)	450	8	50 past 3rd Pin 122	∺9th ,,

APPENDIX F.

Arrangement for the disposal of Watercourses, with a deduction of Mean Depths, and Area of Opening required.

Size of Watercourses.	To be taken under the Canal by Syphon Drain.	Mean Depth.	To be passed through the Canal by Inlet and Outlet.	Mean Depth.	To be passed under the Canal by Culvert.	Mean Depth.	Aqueducts over Rivers
From 4 to 6 feet broad. [No. 28]	1 4 6 15 16 17 18 19 21 22 5 5 10 1½ ½ 1 1 1 1½ 1½ 1½ 1½ 1 2 ½ 1 1 1 1½ 1½ 1½ 1½ 1½ 1½ 1½ 1½ 1½ 1½ 1	[51.5]; say 2 feet; area of opening 10 square feet.	24, 39, 40, 45, 48, 54, 58, 71, 6, 6, 6, 73, 84, 10]	[45]; 4] feet; area of opening 22] square feet.			
From 7 to 9 feet broad. [15]	1 1 1 3 3 3 1 1 1 1 5 20 23 25 27 83 25 30 42 50 8 43 4 3 3 3 3 9 4 8 1 1 1 6 3 66 70 77 32 3 3 3 7 9 4 8 1 1	[453]; 3 feet; area of opening 24 square feet.	3 2 2 3 3 6 6	[19½]; 3 feet; area of opening 24 square feet.	91 94 2 2	2; area 16.	o feet section.
From 10 to 12 feet broad.	9 14 41 78 9 4 4 9	[19]; 41 feet; area of opening 491 square feet.	$ \frac{7}{16}, \frac{8}{16}, \frac{37}{6}, \frac{47}{3}, \frac{57}{2}, \frac{72}{8}, \frac{85}{0.9}, \frac{90}{8}, \frac{100}{10} $ (opening 49.5) [8]	[49.75]; say 4.5 for water way.			rer 780 800 1,000 River. 1,750
(*)	3 9 19 13 30 68 69 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -7 -	[43½]; 6 feet; opening 72 square feet.	70, 70, 80, 83 [4] (Area of opening 52 square feet)	[18]			Runn Pitteanee River, Wuttagee River, Peepul River, 108, 109, Mullear River
16 feet broad	t e	Say 10	5		102	Area 80 feet.	, Runn P. Wuttage , Peepul 7, 108, 10
25 feet broad	84	•••••			93 93	91	No. 89, No. 98, No. 101, Nos. 107,
38 feet broad	63 -4		96 3	Area 100 square feet			KAKK
60 feet broad	***************************************		88	Do. 120 ditto.			

30

102 to 100 feet broad	,	***************************************	18	Do. 132 ditto	97 94	385	
69 to 70 feet broad		*************	87 9	Do. 138 ditto	90 7	490	
200 feet broad		***************************************	***************************************	************	95, 106 7½, 2	850	
75 feet broad		***************************************		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	103	300	
80 feet broad		***************************************		************	99 5	400	
100 feet broad			*************		10 <u>4</u> .	400	

N.B.—The upper figures give the number of the watercourses, and the lower show the mean depth to high-water line.

W. CHAPMAN, Lieutenant,

Engineers.

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# Abstract of Classification of Watercourses.

	By Syphon Drain.	hon Drain. Inlet and Outlet.				Aqueducts.		
No.	Breadth and Mean Depth.		No.	Breadth and Mean Depth.		No.	Breadth and Mean Depth.	
28	4 to 6 feet broad; 2 feet deep	10	10	4 to 6 feet broad; 41 feet deep	221			gq.
15	7 to 9 feet broad; 3 feet deep	24	6	7 to 9 feet broad; 3 feet deep	49 <del>]</del>	2	7 to 9 feet broad; 2 feet deep 16	broad.
4	10 to 12 feet broad; 41 feet deep	491	8	10 to 12 feet brond; 43 feet deep	49≩			i i i i
7	13 to 15 feet broad; 6 feet deep	72	4	13 to 15 feet broad; 41 feet deep	52			2000
2	16 feet broad; 10 feet deep	Say 100	1	16 feet broad; 5 feet deep	80			882,
						1	20 feet broad; 4 feet deep 80	
1	25 to 27 feet broad; 3 feet deep	78				2	25 to 27 feet broad; 34 feet deep 91	<b>a</b>
1	38 feet broad; 4 feet deep	144						
			1	50 feet broad	100		1	ee Ri
		:	1	60 feet broad	120	Ì		eanee River
			1	102 to 110 feet broad	306	1	110 feet broad; 3; feet deep 385	Pitt Bee
			1	69 feet broad	138	1	70 feet broad; 7 feet deep 490	Runn Pitteanee I Wuttagee River Peepul River
						2	200 feet broad; 41 feet deep 850	% ¥ g.
						1	75 feet broad; 4 feet deep 300	88,
	:					1	80 feet broad; 5 feet deep 400	NZZ O O O
						1	100 feet broad; 4 feet deep 400	ZZZZ
To	otals 58			33			12	4

W. CHAPMAN, Lieutenant,
Engineers.

# APPENDIX G.

Results of Experiments carried on during the Inundation of 1853, with a view to determining the Proportional Quantity, both as to Bulk and Weight, of Earthy Matter held in suspension by the Water of the Indus.

The mean results of three experiments made by W. S. Cole, Esq., Deputy Collector at Jerruck, and of four experiments by G. Elander, Esq., Deputy Collector, at several places on the river below Tatta, the water having been evaporated by boiling, according to specific directions given: the calculations, made by myself from the packets of sediment and measurements forwarded, are as below:—

Proportion of Earthy Matter held in suspension during the Inundation.

By Weight.
 By Bulk

 Mr. Cole
 
$$\frac{1}{296}$$
 $\frac{1}{312}$ 

 Mr. Elander
  $\frac{1}{288}$ 
 $\frac{1}{304}$ 

 Means
  $\frac{1}{292}$ 
 $\frac{1}{308}$ 

 From experiments by myself during the fair season
  $\frac{1}{645}$ 
 $\frac{1}{684}$ 

To apply the result of these experiments to the determination of the effect which the Indus water at inundation may have in silting up the canal:

The water stands in a reach, and is 6 feet in depth; therefore—

 $6 \times 12 = 72$  inches depth.

 $\frac{72}{292}$  = .247 inch nearly, or say 0.25, or  $\frac{1}{4}$  of an inch, is the maximum depth of earthy matter which could be deposited over the whole bottom of the canal.

But as the water in the different reaches will be periodically renewed by lockfulls passed with the boats using the canal, it is necessary to make an allowance for the increase of silt on this account.

Taking the first reach, from Jerruck to Lukka, as the one likely to be most affected-

Length 24.25 miles about

$$\frac{76+58}{2} = \text{mean breadth ; and}$$

 $67 \times 6$  depth = 402 = area section area.

Therefore—

 $402 \times 128040$  feet = 5147280 cubic feet, which represents the volume of water required for once renewing this reach.

Then supposing, for the sake of argument, the regulation lock to be worked 6 months with the large gates (24-6) = 18 feet in height, and 6 months with the small gates (15-6) = 9 feet high,

$$130 \times 22 \times 13.5 = 38610$$
 cubic feet

would be the quantity passed by each boat. Multiplying this by the number of boats

supposed to pass through the canal yearly, or 5859, the result is 226215990 cubic feet; or the whole volume in the reach would be four times renewed, nearly, in the course of one year, and the deposition of silt would be increased in the same proportion.

The deposit in the course of one year would consequently amount to no more than 1 inch.

As the above calculations make allowance, from the water in the experiments having been evaporated by boiling, for the maximum deposit that can, under any circumstances, take place, it does not appear necessary to allow more than 10 inches, or sufficient to provide for the quantity of silt likely to be deposited in the course of ten years.

W. CHAPMAN, Lieutenant, Engineers.

Kurrachee, November 1853.

### APPENDIX H.

Memorandum of the Distances and Levels of the Canal, with the Falls and Rises to the different Bench Marks.

Names of Places having Bench Marks.	Main Line.	Check Line.	Difference.	Di	istanc	e.	Interme- diate Levels.	Remarks.
	P.	F.	P.	M,	F.	Y.		
PBM Jerruck.								
PBM Meanee	4.70	4.79	0.09	6	0	134	4.70	J
BM Somera	<b>5.4</b> 2	5.53	0.11	7	6	114	10.12	
BM Duffrance	8.14	8.14	0.00	6	0	<b>26</b> 0	18.26	
PBM Lullung	0.71	1.37	0.66	3	0	425	18.97	Distance actual-
PBM Lukka	6.70	6.67	0.03	1	2	310	12.27	miles and 313
PBM Gharra	28.91	29.12	0.21	29	6	492	41.18	
BM Wuttagee	4.53	5.12	0.59	9	5	378	45.71	
PBM Pimpree	16.55	16.32	0.23	4	3	510	29.16	}
By BM Clifton to high-water mark, Bay	22.37	••••	1.24	24	2	534	<b>51.5</b> 3	The high-water marks of the Harbour and
By Travellers' Bungalow to highwater mark, Harbour	••••	23. 61	5		_			Back Bay dif- fer this much.
Total fall	51.53	D	istance	92	4	4Ĩ7		· · · · · · · · · · · · · · · · · · ·

The above, though sufficiently good for most practical ordinary purposes, are not good levels. There was no time last season for further corrections.

W. CHAPMAN, Lieutenant,

Engineers.

Kurrachee, November 1853.

## CANAL ESTIMATE.

#### CIVIL.

# TERRITORIAL DEPARTMENT, REVENUE.

Scinde Division.

Public Works.

Estimate, framed by Lieutenant Chapman, Engineers, on Special Duty, Scinde, of the probable Expense of constructing a navigable Canal from Jerruck, on the River Indus, to Kurrachee, including also the Works necessary for the perfecting and maintenance of the same, as a constant Line of Water Communication between the Indus and Kurrachee Harbour.

A MOUNT OF ESTIMATE, Rupees Forty-eight Lakhs, Fifty thousand, Seven hundred and Seventy-three.

#### GENERAL DESCRIPTION.

The canal to be navigable throughout the year, by all description of Native river craft, as well as by small steamers, adapted to postal and other purposes requiring expedition. Its dimensions, calculated with this object, to be 79 feet top breadth, and 58 feet at the bottom, having a depth of water of 6 feet. Its length, including the cut into Kurrachee Harbour, to be 95 miles and 1,824 feet. The canal to be connected with the river at Jerruck by a regulation lock, providing for the highest and lowest levels of the Indus, and to terminate at Kurrachee in a fresh-water basin, having its bottom 6 feet below the high-water line. The intermediate fall of the country (from the level of canal bed at head to level of bottom of basin at tail), or 31 feet 6 inches, being disposed of by locks as below:—

	raii in reet.
Lock No. 1, Lukka	. 8.0
Lock No. 2, Runn Pitteanee	. 5.0
Lock No. 3, near Kurrachee	. 9.0
Lock No. 4, into Basin	. 9.6
_	
Total fall	. 31.6

The locks, particularly the regulation lock at head, to be constructed in the most substantial manner, of hammer-dressed rubble stone and chunam masonry, all coigns and copings being of cut-stone; a dam with escape-weir to be provided near Lakilat-foola, to guard against the flooding of the country below, should any accident happen to the lock-gates at head.

The store-houses, offices for establishment, and chokies, to be built of rough rubble stone masonry.

The slopes in embankments to be  $1\frac{1}{2}$  to 1, and in cuttings on an average 1 to 1. All embankments to be strengthened with pise work, and a tow-path on either side of the canal, 12 feet broad, to be provided. (For General Section of Canal, both in Cuttings and Embankments, see Plate 10, and for details of Regulation Lock, see Plates 10 and 11, in accompanying Plans.)

#### CUTTINGS AND EMBANKMENTS.

The side slopes of the canal bed, both in cuttings and embankments, to have a slope of  $1\frac{1}{2}$  to 1, and the cuttings above the level of the tow-path to be, on an average, finished off at 1 to 1.

The outer slopes of all embankments to be  $1\frac{1}{2}$  to 1, and all embankments to be strengthened by pise work, as shown in Plate 10.

[ 36 ]

EARTH WORKS.

Miles.	Cuttings.		Embankmen	ts.	Totals of Cutting Embankment		Total of Pise W	ork.
	Cubic Feet.	Dels.	Cubic Feet.	Dcls.	Cubic Feet.	Dels.	Cubic Feet.	Dels.
1st	13,988,375.	68						
2nd	13,182,391.	06						
3rd	8,787,900.	18						
4th	8,972,266.	11						
5th	10,442,890.	97						
6th	15,297,563.	00						
7th	14,922,653.	90						
8th	10,576,143.	50						
9th	9,059,877.	60						
10th	8,984,655.	50					ı	
llth	9,020,612.	40			i			
12th	8,165,188.	18						
13th 14th	5,274,299.	93						
1 1	8,367,602. 7,659,146.	88   48						
10.1	<b>7,</b> 343,759.	64			7,343,759.	64		
7 A	7,088,946.	10	• • • • •	•	7,088,946.	10		
17th	6,528,860.	04	* * * * *	•	6,528,860.	04		
19th	4,150,166.	72	2,513.		4,152,679.	72	700.	00
20th	3,219,626.	28	4,071.		3,223,697.	34	1,134.	00
21st	3,155,592.	00	2,012		3,155,592.	00	2,101.	•
22nd	3,009,072.	00			3,009,072.	00		
23rd	2,851,240.	40	2,579.		2,853,819.	90	700.	00
24th	1,355,699.	88	618,689.		1,974,389.	61	153,208.	25
25th	5,539,469.	11	98,023.		5,637,493.	10	23,033.	00
26th	5,300,467.	00 .	••••		5,300,467.	40	•	
27th	4,622,671.	44		- <b>-</b>	4,622,671.	44		
28th	3,810,139.	40		•	3,810,139.	40		
29th	4,091,141.	06	• • • •		4,091,141.	06	•	
30th	3,337,130.	64	1,105.		3,338,236.	36	308.	00
31st	, ,	90	10,047.	. 24	3,599,930.	14	2,658.	00
32nd	4,030,377.	28			4,030,377.	28		• •
33rd	2,323,829.	20	190,120		2,513,949.	76	48,102.	00
34th	2,571,128.	05	168,614		2,739,742.		40,532.	00
35th	2,435,096.	72	150,489		2,585,585.		36,852.	00
36th		23	38,451.	. 28	2,867,170.		10,192.	00
37th 38th	3,326,175.	25	060 666		3,326,175.	25 90	64,141.	25
_	2,146,728.	20	268,666.		2,415,394. 1,811,938.	00	283,738.	75
39th	691,022. 1,447,031.	70 77	1,120,915. 638,876		2,085,908.	64	153,743.	25
41 .	1,729,365.	01	481,442		2,210,807.	73	112,341.	50
41st 42nd	1040110	95	750,714		1,993,827.	<b>5</b> 9	180,172.	
12-1	811,853.	21	1,040,246		1,852,099.		262,152.	
44th	0 764 720	29	201,758		2,966,490.	87	47,385.	
45th	4,915,058.	90	202,,00		4,915,058.			-
46th	6,395,430.	79			6,395,430.			
47th	0.000 450	50		•	8,209,452.			
48th	1 0005 405				6,005,485.			
49th	054010		1,139,224		1,993,442.		624,745.	00
50th	0.010.00=		218,588		3,438,553.	86	52,084.	
51st	1,000,010		554,879		2,144,892.	. 03	141,568.	. 00
Cd over	281,234,228.	63	7,700,019	. 40	288,934,248	. 03	2,239,490.	75

Miles.	Cuttings.	Embankment	s.	Totals of Cutting Embankmen		Total of Pise Work.		
	Cubic Feet. Dels.	Cubic Feet.	Dcls.	Cubic Feet.	Dels.	Cubic Feet.	Dels.	
Bt. over.	281,234,228. 63	7,700,019.	40	288,934,248.	03	2,239,490.	<b>75</b>	
52nd	488,371. 99	1,267,698.	55	1,756,070.	54	324,648.	<b>5</b> 0	
53rd	157,780. 27	1,634,498.	63	1,792,278.	90	401,040.		
54th	· -	923,236.	74	3,348,916.	22	322,888.		
55th		3,746,995.	51	3,746,995.	51	2,008,955.		
56th	• • • • •	3,394,691.	86	3,394,691.	86	1,838,887.		
57th	25,803. 00	4,372,840.	40	4,398,643.	40	1,923,411.		
58th	927,035. 58	1,207,313.	00	2,134,348.	58	290,730.		
59th	5,589. 00	4,222,024.	88	4,227,610.	88	1,703,882.	00	
<b>6</b> 0th	• • • • •	6,506,907.	<b>52</b>	6,506,907.	52	2,328,480.		
61st		5,845,092.	20	5,845,092.	20	2,328,480.		
62nd		6,513,987.	20	6,513,987.	20	2,328,480.		
63rd		6,410,612.	12	6,410,612.	12	2,328,480.		
64th		6,146,460.	27	6,146,460.	27	2,060,960.		
65th		4,504,115.	64	4,504,115.	64	1,823,848.		
66th		6,149,976.	89	6,149,976.	89	2,248,220.		
67th	274,549. 50	5,201,388.	<b>79</b>	5,475,938.	29	1,895,205.		
68th	11,928,768. 52			11,928,768.	53	, , , , ,		
69th	2,185,378. 16	895,215.	36	3,080,593.	52	677,907.	00	
70th		7,049,509.	64	7,049,509.	64	2,167,980.		
71st		7,499,550.	24	7,495,550.	23	2,328,480.		
72ud		7,185,798.	49	7,185,798.	49	2,328,480.		
73rd		8,713,475.	34	8,713,475.	34	2,328,480.		
74th		10,154,580.	76	10,154,580.	76	2,328,480.		
75th	• • • • •	83,855,506.	-65	8,385,506.	65	2,328,480.		
76th	1,644,839. 08	5,360,371.	12	7,005,210.	20	1,698,174.		
77th	*****	8,135,313.	91	8,135,313.	91	2,328,480.		
78th		8,598,767.	43	8,598,767.	43	2,328,480.		
79th		8,268,594.	6 l	8,268,594.	61	2,328,480.		
80th		9,595,677.	67	9,595,677.	67	2,328,480.		
81st	3,841,812. 04	7,226,479.	20	11,068,291.	24	1,800,138.		
82nd	25,797,659. 20			25,797,659.	20	' '		
83rd	34,560,528. 16			34,560,528.	16			
84th	18,021,993. 51			18,021,993.	51			
85th	1,440,045. 92	1,046,802.	46	2,486,848.	38	208,483.	50	
86th	110,107. 18	2,152,276.	74	2,462,383.	92	673,105,	24	
87th	• • • • •	5,390,414.	25	5,390,414.	25	2,312,242.	75	
88th	• • • • •	3,348,050.	50	3,348,050.	50	1,830,859.		
89th .		6,311,396.	88	6,311,396.	88	1,952,808.		
90th	6,669,471. 26	2,537,999.	55	9,207,470.	81	747,908.		
91st	7,984,143. 55			7,984,143.	55			
92nd	1,422,207. 20	1,457,210.	43	2,879,417.	63	381,526.	<b>7</b> 5	
93r <b>d</b>		1,780,206.	40	1,780,206.	40	533,821.	50	
	401,145,991. 24	19,68,37,054.	22	507 002 045		<del></del>	·	
	701,170,331, 24	146U,16,0U,51	42	597,983,045.	46	64,337,361.	50	

# Abstract.

Items.	Rs.	A.	P.	
401,145,991.24 cubic feet of cutting, at 5 annas for 100 cubic f as a mean.	٠.	12,53,581	3	6
196,837,054.22 cubic feet embankment, at 5 annas, also to all of, in some cases, soil being brought a short distance 64,337,361.30 pise work in enbankments, at 12 annas per 1		6,15,115	12	8
cubic feet.		4,82,530	8	4
Add 5 per cent. for tools and contingencies		23,51,227 1,17,561	8	6
Total		24,68,788	14	6

## REGULATION LOCK AT CANAL-HEAD.

This work to consist of two lock-chambers, each 130 feet long by 22 feet broad, the whole to be built on strong inverted arches, and the pavements at both ends to be further secured by rubble stone fillings, and rows of stout teak-wood piling. Each lock-chamber to be provided with a double set of gates, the one set, 15 feet in height, to be worked during the fair season; and the other, 25 feet 3 inches high, to be kept in good repair, and available for any sudden rise of the river, and to be used during the inundation only. The lock works to be kept retired within the bank of the river, and connected with it by wing walls 176 and 315 feet long respectively, a channel and basin being dredged to the depth required. (For details of Lock vide Plates 10 and 11.)

#### MEASUREMENTS.

Excavation by Dredging.	Cubic Feet. D	)cls.
Deepening river bed at mouth of lock	156,400.	,0
Excavation in Hard Soil.		
For lock mouth, including wing walls	986,875.	5
For body of lock	513,751.	0
Connection of canal and lock, including retaining walls	231,660.	0
Ramps and slopes	72,124.	0
Total excavation in hard soil	1,804,410.	5
Stone and Chunam Masonry.		
Pavement of mouth, including circular recess foundations	11,970.	0
Pavement of lock not arched	-	0
,		<u> </u>
Total pavements	34,755.	0
Inverted arch pavements	34,438.	0
Side and Wing Wall of Lock.		
Pilaster of front wing walls	27,120.	0
Side walls		0
Circular end		9
Steps		9
Front wing wall, including foundations	93,584.	6
Straight wing walls	•	0
Circular recess front wing walls		5
Total stone and chunam	257,641.	9
Centre pier, not deducting staircases, arch work, &c. all work included.	65,184.	0
Cut-stone Work.	Running F	eet.
Coping of circular wing walls	491.	
Coping of straight portion wing walls	230.	
Coping of pilastersSquare Feet	896.	25

[ 39 ]	
Stone Filling.	Cubic Feet.
Mouth apron	1,890
Tail apron	2,380
Total stone filling	4,270
Teak-wood Piling.	No.
At mouth apron	270 324
•	
Total piles with shoes	594
Iron Piping for Sluices.	lbs.
Iron piping 2 feet in diameter, and of 1-inch metal, 464 running feet, at 250 lbs. per lineal foot, or	116,000
-	
Wood Work of Lock-gates and Sill. Carge lock-gates, each leaf 25 feet 3 inches by 12 feet 6 inches, frame-	ubic Feet. Dels.
work of teak-wood	174. 5
4-inch planking, each leaf	105. 41
No. of leaves in four gates	279. 91 8
Cubic feet teak-wood, large gates	2,239. 28
Small lock-gates, each leaf 15 feet by 12 feet 6 inches, frame-work	121. 0
Planking	62. 5
For four gates	183. <b>5</b>
Cubic feet teak-wood, small gates	1,468. 0
Total cubic feet teak-wood in gates	3,707. 28
Teak-wood for gate sill platform 40 logs 25 feet long and 1 foot square.	1,000. 0
Gate sills No. 16×14 feet×1×1	224. 0
Gate sill struts	80. 0
Total teak-wood for platforms and sills	1,304. 0
Iron Work of Gates and Sills.	lbs.
Wrought iron anchor hinges, weight of each hinge 64.86 lbs., 3 pairs for each large gate leaf, and 2 pairs for each small ditto, or 40 hinges. Iron clamps for sill struts, each 4'×3"×2" No. 96, weight per	2,594. 4
foot 19·6 lbs.	1,881. 6
Miscellaneous small iron work	750. 0
Total iron work for gates	5,226. 0
Iron Chain for Gates.	Running Feet.
Iron chain, at 32 lbs. to a fathom, length 32 x 50	1,600. 0
Winches, small	No. 32
•	

# Abstract Regulation Lock.

Items.	Rs.	۸.	P.
156,400 cubic feet excavation by dredging, at Rs. 1-8-0 per 100	_		
1,804,410.5 cubic feet excavation in hard soil, at 8 annas per	2,346	0	0
100 cubic feet	9,022	0	10
34,755 cubic feet stone and chunam masonry for pavements, at Rs. 15 per 100 cubic feet	5,213	4	0
34,438 cubic feet inverted arch work, at Rs. 20 per 100 cubic feet. 257,6419 cubic feet stone and chunam masonry in lock and wing	6,887	9	7
walls, at Rs. 15 per 100 cubic feet	38,646	4	7
65,184 cubic feet masonry in central pier, making no deductions on account of arch work, staircases, &c., at Rs. 18 per 100 cubic			
feet 491 running feet coping of corresponding wing walls, at Rs. 3	11,733	1	11
per foot	1,473	0	0
230 running feet coping of straight portion wing walls, at Rs. 3-8-0 per foot	805	0	0
896.25 square feet coping of square pilasters, at Rs. 1 per square foot	896	4	0
4,270 cubic feet rough stone filling fitted above, at Rs. 4-8-0 per 100 cubic feet	192	9	4
594 teak-wood piles, with shoes, including driving, $7' \times 9'' \times 9''$ ,			
at Rs. 8 each	4,752	0	0
per ton, add 25 per cent. for freight and carriage	4,531	4	0
Rs. 1-12-0 per foot, including carpentery	6,487		0
White lead and tallow, fixing gates, &c	500	0	0
struts, at Rs. 1-4-0 per foot	1,630	0	0
5,226 lbs. of iron for hinges, clamps, and miscellaneous, at 6 annas per lb., including smiths' work, &c.	1,959	12	0
1,600 running feet of iron chain, at 7s. 6d. per fathom in England, add 25 per cent. for freight and carriage	1,250	0	0
32 small winches, cost in England £6 10s. each, add 25 per cent. as above	2,600	0	0
cent. as above	· · · · · · · · · · · · · · · · · · ·		
Contingencies 5 per cent	1,00,799 5,039		3 11
Total amount for regulation look	1,05,839		2
1 dtal amount for regulation lock	1,00,000		

#### DAM AND ESCAPE-WEIR.

This work to consist of five strong piers of stone and chunam masonry, one 12 feet thick, in the centre of the canal bed, and one on either side of the tow-path, on each bank of the canal; the inner and outer being  $10\frac{1}{2}$  and 10 feet in thickness respectively. These piers to be connected below by inverted arches, and above, over the tow-path only, by arched masonry, and on both sides with the banks. The four openings thus formed to be provided with gates similar to those of the regulation lock, and these to be further protected by log-sleepers in advance (like those in use in the North-West Province canals), strengthened by struts; the whole work to form an obstacle across the canal cutting 1 foot higher than the high inundation water-line at head.

The escape, 100 feet broad, to be constructed in the left bank of the canal, communicating with a cut now existing, and to be formed of two wing walls 200 and 250 feet long respectively; the lower wall being connected with the dam, and most substantially

built. The whole of the escape, including the tow-path and slope of the canal bed, to be strongly paved, the angle formed by the tow-path and slope being further strengthened by a wall 9 feet deep by 3 feet thick, throughout the whole length of the pavement.

The lower end of the escape pavement to be secured by teak-wood piling, with an apron of rubble stone.

The escape opening to be partially filled in with an earthen bund over the pavement, to keep out the river water from the cut at ordinary inundations.

#### MEASUREMENTS.

				Excava	tion.			C	Cubic Feet.	Dels.
For escape			• •	• •		٠.	• •.		453,600.	. 0
Filling in ove	r pavem	ents wh	en finis	shed	• •				100,000.	. 0
Foundation of	•					٠.			2,016.	. 0
Foundation of						• •			3,528.	
	itto	• •		• •	••	•		• •	10,800.	
Under tow-pa			• •			• •			10,080.	
	Total e	xcavatio	n in e	arth	• •	• •	• •	• •	580,024.	0
	•	Mo	isonry,	Stone	and C	hunam.				
Centre pier	• •	• •,			• •	• •		• •.	14,136.	. 0
Side pier	• •								24,738.	0
Ditto	• •				• •	• •		• •	20,010.	0
Walls across t	ow-path					• •			2,592.	0
Wing walls, r	ight						•	• •	74,400.	0
Wing walls, le	eft			• •	• •	• •			36,000.	0
Connecting w	all on ri	ght ban	k of ca	nal		• •			1,140.	
Wall to streng		-				•.			<b>4,050.</b>	
Pavement of t		-	-						7,500.	
Pavement of c	-				• •	• •	• •		45,000.	
		• •								<u> </u>
	Total fe	et rubb	le maso	onry	• •	• •	• •	• •	229,566.	0
			A	rch W	ork.				<u> </u>	<del></del>
Under flooring	g large c	hamber	s .			• •			8,484.	Q
Under and ab	ove tow-	path							3,744.	0
	Total as	· .ahad m								
	Total ar	chea in	•		••	• •	• •	• •	12,228.	<u> </u>
<b>15</b>	·00' 14			Lock-go						
For gates, four	28 x 14	, and tv	70 21 x	(13.5 f	eet	• •	• •	• •	1.697.	46
For log-sleeper	rs and s	truts.	• •	• •	• •	• •		• •	1.350.	00
For sill platfor	ms	• •	• •			••			380.	00
For sills	• •	• •					• •		<b>56.</b>	00
For sill struts		• •							20.	00
	Cubic fe	et teak-	wood						456.	00
				scellane					No.	
Piles, teak-woo	od, 8 feet	longx					- 4	- 4	100	
White lead and	d tallow	. &c.							lot.	
Winches, smal		,	• •	• •	• •	••		• •	3	
Iron chain, 32			• •	• •	• •	• •	• •	• •	250 Fo	net
			• •	• •	• •	• •	• •	• •	ZUU T	.e.

L

Hinges, wrought iron, anchor, weight of each 64.86 lbs, 3 pairs fo large gate, and 2 pairs for each small ditto	pairs	1,037 323	
Total iron work	• •	1,361	. (
Abstract of Dam and Escape-weir.			
Items.	Rs.	<b>A.</b>	P.
580,024 cubic feet excavation in earth, at 4 annas per 100 cubic			
feet	1,450	0.	11
Rs. 18 per 100 cubic feet	41,32	1 14	0
12,228 cubic feet arch masoury, at Rs. 20 per 100 cubic feet 1,697.46 cubic feet teak-wood for gates, including carpenters, &c.,	2,44	5 9	7
at Rs. 1-12-0 per cubic foot	2,97	0 8	10
Rs. 1-12-0, including carpenters' work 456 cubic feet teak-wood for platforms and sills, at Rs. 1-4-0 per	2,36	2 8	0
cubic foot	57	0 0	0
driving	- 80	0 0	'0
White lead, tallow, &c. for hanging gates	12	5 0	0
3 small winches (as before) £6 10s. each, add 25 per cent	•	3 12	0
250 feet of chain, iron, at 7s. 6d. per fathom, add 25 per cent 1,361 lbs. iron work for hinges, &c., at 6 annas per lb., including	19		
smiths' work	51	0 6	0
	52,99	5 0	4
Add 5 per cent. contingencies	2,64	9 12	0
Amount of dam and escape-weir Rs.	55,64	4 10	4

## AQUEDUCTS.

These works (vide "Abstract of Classification of Watercourses," Appendix to Estimate F) are required for the following rivers:—

### Length of section.

No. 89, Runn Pitteanee River	780 feet.	<b>1</b>
· · · · · · · · · · · · · · ·	800 "	With a breadth of waterway of
No. 101, Peepul River	1,000 ,,	30 feet, and allowing path of 8
Nos. 107, 108, 109, Mullear Riv	er,	feet on either side.
three branches	1.750	.)

[N.B.—To avoid the labour and time required for making out detailed plans and estimates for these works, a rough estimate only is submitted.]

The Solani Aqueduct, on the Ganges Canal, affords the best example of the style of construction required, the block-sinking used in its foundations, being especially applito the Mullear and Pimpree Rivers.

The cost of the Solani Aqueduct, as estimated, was about Rs. 2,90,000. The length, taken at 650 feet, gives Rs. 446 for each foot of section. Making the necessary allowances for the difference of the areas of the waterways, (the Solani having an area of 760 feet, and that of those now under consideration being 322 feet,) and taking into account, also, the height of the different constructions, as well as the comparatively high price of labour in Scinde, the following rates for each of the aqueducts may be allowed:—

## Abstract of Aqueducts

_		A bstr	act of 1	Aquedu	cts.					
		Names.					R	s.	۸.	P.
No. 89, Runn P	itteanee River,	780 fe	et in se	ection,	at Rs.	250 per				
foot				••			1,95	-	0	0
No. 98, Wuttage							2,00,		0	0
No. 101, Peepul							2,75	,000	0	(
Nos. 107, 108, 10	og, Mullear Ki	ver, 1,7	ou teet,	ai ns.	Soo pe	r 100t				
Add 5 per cent.	contingencies					,	11,95 59	,000 , <b>7</b> 50	0	0
• _		••				, D.			0	-0
1(	otal amount for	r aqued	ucus	• •	· · ·	Rs.	12,04	,700		_
		S	mall L	ocks.		-		,		
	spose of the fal		•						_	
he Indus at the				of the	canal ba	asin at I	Kurrache	e, 31	feet	t (
nches, four lock	s are required,	as follo	ows:—				Fa	ll in Fe	et.	
Lock No.	1, near Lukka	a				• •		8. (	0	
Lock No.	2, Runn Pitte	eanee						5.	0	
Lock No.	3, near Kurra	chee .		• •				9. (	0	
Lock No.	4, iuto Basin							9.	6	
							•		<del>-</del>	
	Total : nave two cham		•••••	••	•••	• •			6	
ings, to be buil					•	•				
chunam masonry		<u> </u>				•••				
	No. 1		<i>a Lock</i> Easure	•	Feet Fa	u.				
			Excava							
	(Pr	_			ection.)					
	-				m, Arch		Cul	oic Feet	. D	els
Flooring of ch	ambers				٠.			24,90	7.	5
Block arch wo	rk to gates				• •			1,21	5.	0
To	otal arched ma	sonry			.,		••	26,12		 5
Ruj	bble Stone and	Chuna	m Mas	onru s	with Cu	t-stone				
Pavements, fla						•-010/20		1,71	6.	(
Ditto, m	outh							17,68		(
-	per end		• •					3,67		(
Abutments			• •					9,88		(
Counterforts	••	• •	• •			• •		1,44		(
	ehind gates		••					7,88		0
	traight, includi			s				3,06		0
Curved ditto								4,03		0
Head wall.					• •		• •	1,05		0
Do. buttress		••	• •	• •	• •		•••	99		0
Centre pier, 1s		• •			• •	• •	••	13,82		0
•	emainder		·	••	• • •	••	• •	1,84		0
_	otal masonry							67,09		<u> </u>
1	our masoning	• •	• •	••	• •	• •	••	U1,08	· J.	

		L	,						
		Lock	-gales.				Sq	uare F	
Four $12 \times 15$ , and four $12$ :	×7	• •	• •	• •	• •	• •	• •	1,056	3
		Misce	ellaneous						
Four winches, with appare	atus fo	or openi	ing sluic	es, wh	ite lead	i, &c.		lot.	
Proportion to be added or cks:—	deduc	ted for	1 foot	more o	r less	fall, in o	therwis	e sim	ilar
Cas .—		MEASU	REMENT	s.					
		M	asonry.				C	abic F	eet.
Abutments	• •		•	• •			• •	824	1
Counterforts	• •	• •						120	
Ditto behind gates	• •		• •	• •	• •		• -	464	
Wing walls, straight	• •	• •	• •	• •		• •	• •	360	
Ditto, curved	• •	• •	• •	• •	• •	• •	• •	336	
Centre pier	• •	• •	• •	• •	• •	• •	• •	1,159	Z 
,	Tota	l masor	ry				• •	3,250	6
Gates	• •	• •			••	Square	Feet	48	3
Miscellaneous								lot	
	4 %	dans ad a d	C11	Tasks					
		iruci oj	Small.	Livens.					<del></del>
	, It	tems.					Re	). A.	P
26,122.5 cubic feet arched 67,099 cubic feet stone a cubic feet 1,056 square feet lock-ga iron work, &c.	ud ch ites, a	unam  at Rs. 2	masonry  2½ per so	, at F quare	ls. 16 foot, ii	per 100 	10,73 2,64	5 13 0 0	£
4 windlasses, with apparat	us for	openin	g sluices	, &c.	•	• ••	50	0 0	(
							19,10	0 5	_ ;
Add contingencies, at 5 pe	r cent			• •			95	5 0	•
No. 1, amou	nt for	a lock	of 8 feet	fall	•	. Rs.	20,05	5 5	1
Proportion for 1 foot fall,	mana	on less i			·,				
Troportion for Troot lan,	шиге		stract.						
	Ite	ms.	<del></del>				Re	. A.	
<u> </u>				g. <b></b>	<del></del>				
3,256 cubic feet stone a	nd ch	unam	masonry	, at I	Rs. 15	per 100	o		
cubic feet					•	• •	. 48		
48 square feet lock-gates,	at Ks.		square	to <b>ot</b> .	•	•	9		(
Proportion of miscellaneou	19 .	• •	• ••	•	<b>9</b> (	• •	`  <u> </u>		
<i>a</i>							62		
Contingencies, at 5 per ce	nt	• •		•	• •	• •	. 3	1 6	
Proportion to be added or	deduc	ted for	1 foot	•	• .	Rs	. 65	9 13	1
No. 3.—Fo	or a L	ock of	9 Feet I	Fall.				<del></del>	
Total amount No	o. 3 .				•	Rs	20,71	5 2	9
•	-	•		•		= /-	1		

## No. 2.—For a Lock of 5 Feet Fall.

Total amounts of lo	•		79, <del>8</del> 91	8 2
Total amount for lo	ck No. 4	., Rs. ———	21,045	1 4
Add proportion for ½ foot		329 14 7		
Total for 9 feet fall	••	Rs. 20,715 2 9		
No. 4.—	For a Lock of	f 9½ Feet Fall.		
Total amount for le	ock No. 2	Rs	18,075	14 5
Deduct proportion for 3 feet		1,979 7 3		
Total for 8 feet fall		Rs. 20,055 5 8		

#### WATERCOURSES.

#### General Remarks.

The watercourses are disposed of according to the height of their beds with reference to that of the canal, and are arranged under the following heads, having been first classified by the areas of their waterways (vide Classification of Watercourses, Appendix F to Estimate):—

- No. 1, to be taken under the canal by syphon drain, as practised in Italy.
- No. 2, to be passed through the canal by inlet and outlet.
- No. 3, to be passed under the canal by culvert.

All to be built of rubble stone and chunam masonry (with arches of brick, if available), with cut-stone coigns.

[N.B.—In the following estimates a syphon drain is calculated for 10 square feet of waterway, and as many of these openings are adapted to each watercourse, under this head, as are required by its area of waterway.

An inlet with its outlet is calculated for 25 square feet waterway, and a culvert for 50 square feet waterway; such a number of openings being allowed to each water-course under these heads as they respectively require.]

#### SYPHON DRAIN.

#### MEASUREMENTS.

				Exce	vation	•	•			Cubic Feet.
Below cans On slope	al bed			••	••	••	••		• •	6,174 3,888
	Total	excava	tion in	earth	• •	• •	• •	• •		10,062
		.,	Stone a	nd Chun	am A	rch Wo	rk.			
Of drain	• •					• •	••	••	••	3,762
			Stone	and Chu	nam 1	Iasonry	į.		•	
Pavement	bed of	nullah			•	• •	••			285
Hend and	wing w	all	•		a e'	• •		• •		435
Buttresses	at angl	es	• •	• •					• •	96
	Total	mason	гу		•	••	• •			816

## Abstract.

						tract.							
				·Ite	ms.		·			- · · · · · -	Rs.	A.	,
3,76	52 cubic feet 52 cubic feet 16 cubic feet	t arched	i masor	ıry, at	Rs. 20	0 per 100	) cul	bic f	eet	ic feet.	752	11 6 6	
Ad	ld 5 per cen	ıt. conti	ngencie	es .			•		• •		912	8	
	-		•		IO fee	t waterw	ay			Rs.	958	2	
bst	ract of No.					rains of Vatercour					shown	to	
Vo.		of Water	-	<u> </u>		Rs.	A.	P.	Per		Rs.	▲.	
28	Single	<del></del>	·	<del></del>		958	2	4	each		6,828	 1	
5	Double	• •	• •	• •		1,916	4	8			8,744		
4	Five		• •	••		4,790	11	8	33 °	L	9,162		
7	Seven	• •				6,707	0	4	,, ,,	4	6,949	2	
2	Ten	• •	• •		• •	9,581	7	4	23	r	9,162		
1	Eight	• •	• •	• •	••	7,665	2	8	"		7,665	2	
1	Fourteen	• •	• •	• •	• •	13,414	0	8	39	1.	3,414	0	
	·		nount	INLE	ET AN	D OUTLE	:T	•	., R	s. 1,6	1,926	10	-
	· <u></u>	<u>.                                    </u>				D OUTLE	T.	•	., к	s. 1,6	1,920	10	•
·	·			M	[easui			•	к				
In	ner wing w			M Dig	[easui	REMENTS.			K	Cu	ibic Fe		
	ner wing wa	alls		M Digg	[easui	REMENTS.				Cu	ibic Fe	et. ]	+
Ou		alls .		M Dig	leasur	REMENTS.		•		Cu	ibic Fe	et. 1 0. 68.	1
Ou At	iter ditto	alls		M Dig	leasur	REMENTS.		•		Cu	ibic Fe . 81	eet. 1 0. 68.	1
Ou At Pa	nter ditto outments evements	alls		Migg	leasur	REMENTS.				Cu	bic Fe . 81 . 46 . 1,01	eet. 1 0. 68.	•
Ou At Pa	nter ditto outments evements	alls		M Digg	Teasul	REMENTS.				Cu	ibic Fe . 81 . 46 . 1,01 . 58 . 46	eet. 1 0. 68. 15. 35.	5
Ou Al Pa	iter ditto outments ivements Ditto bay	alls		M Digg	JEASUI	rements. Foundation				Cu	bic Fe . 81 . 46 . 1,01 . 58	eet. 1 0. 68. 15. 35.	5
Ou Al Pa	nter ditto outments vements Ditto bay entre'wall etween piers	alls	ear .	M Digg	JEASUI	rements. Foundation	on.	•		Cu	ibic Fe . 81 . 46 . 1,01 . 58 . 46	0. 68. 55. 35. 60.	5
Ou Al Pa	nter ditto outments vements Ditto bay entre'wall etween piers	alls	ear	Digg	JEASUI ging I	REMENTS.  Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45	0. 68. 55. 35. 60.	5
Ou Al Pa Ce Be	nter ditto outments vements Ditto bay entre'wall etween piers	alls	ear	Digg	JEASUI ging I	rements.  Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45	0. 68. 55. 60. 66.	5
Ou Al Pa Ce Be	outments  Ditto bayentre' wall etween piers	alls	ear	Digg	Jeasul ging I	REMENTS.  Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45 . 6 . 38	0. 68. 55. 60. 66.	5
Ou All Pa	outments  Ditto bayentre' wall etween piers	alls  y and re  (for m	asonry founda	Digg	Jeasul ging I	REMENTS. Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45 . 6 . 38	60. 68. 67. 60. 61.	5 (2)
Ou All Pa	outments  vements  Ditto bay entre' wall  etween piers  T	alls  y and re  (for m  otal for	ear	Digg	Jeasul ging I	REMENTS. Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45 . 6 . 38	o. 68. 15. 67. 60. 66. 1	50
Ou All Pa	ter ditto outments vements Ditto bay entre' wall etween piers T s above	alls  y and re  (for m  otal for	ear	Digg	Jeasulging 1	REMENTS. Foundation	on.	•		Cu	bic Fe . 81 . 46 . 1,01 . 58 . 45 . 6 . 38	o. 68. 15. 67. 60. 66. 1	56

	Additional Work for each Extra Bay.	Cubic Fe		
		3,37	,	
IVI	asonry and chunam	1,61	<del></del> .	
Cı	ut-stones as above	• •	. N	
	• Abstract.			
<del></del>	Items.	Rs.	. A.	. :
3,7	781.75 cubic feet digging foundation in earth, at 4 annas per 100			-
3,3	cubic feet	9	7	
	cubic feet	509		
10	cut-stones for groves and sills	72 36		
1re	on work, &c	25		
	square feet boarding, and joists for roadway, at Rs. 1 per square foot	60	0	
		·		
Ac	ld contingencies 5 per cent	711 35		
	Total for outlet, 25 square feet	747	5	
Ad	ld for inlet, the same	747	5	
	Total for outlet and inlet single opening Rs.	1,494	11	
	Abstract for each Additional Bay.			
	Items.	· Rs.	Α.	
3,8	378.5 cubic feet digging foundation, at 4 annas per 100 cubic feet	8	7	
1,6	516.75 cubic feet stone and chunam masonry, at Rs. 15 per 100			
	cubic feet	242	8	
	cut-stones, planking, &c. as above	193 22	0 3	
	ļ <u>-</u>	<del></del>		-
Δ.A	Total for outlet	466 466	2 2	
Au	Total amount for outlet and inlet, additional opening	400		
	of 25 square feet Rs.	932	4	
	eact of No. and Cost of Outlets and Inlets of various Waterways, a	e chom	n to	
bstr	required in Classification of Watercourses (Appendix F).	0. 3NOW	<i>,</i> , ,,	
		Rs.	. A.	
о.	required in Classification of Watercourses (Appendix F).  No. of Waterways required.  Rs. A. P. Per	Rs.	Δ.	
o.   0	required in Classification of Watercourses (Appendix F).  No. of Waterways required.  Rs. A. P. Per  Single	Rs.	15	, i
o. 0 0 8	required in Classification of Watercourses (Appendix F).           No. of Waterways required.         Rs. A. P.         Per           Single          1,494 11 2 Each.         Each.           Double          2,427 0 0 , 3,359 4 10 , 3         4	Rs.	Δ.	1
0 8 1	required in Classification of Watercourses (Appendix F).           No. of Waterways required.         Rs. A. P.         Per           Single         1,494 11 2 Each.         Each.         1           Double         2,427 0 0 , 4         4         7           Three         3,359 4 10 , 4,291 9 8 , 7         7	Rs. 14,946 13,686 3,359 4,291	15 0 4 9	1
0 8 1 1	required in Classification of Watercourses (Appendix F).           No. of Waterways required.         Rs. A. P.         Per           Single          1,494 11 2 Each.         Each.           Double          2,427 0 0 , 4            Three          3,359 4 10 ,            Four          4,291 9 8 ,            Five          5,223 14 6 ,	Rs. 14,946 13,686 3,359 4,291 5,223	15 0 4 9 14	]
0 8 1 1 1	required in Classification of Watercourses (Appendix F).         No. of Waterways required.       Rs. A. P.       Per         Single       1,494 11 2 Each.       Each.         Double.       2,427 0 0 ,       4         Three.       3,359 4 10 ,       7         Four.       4,291 9 8 ,       7         Five.       5,223 14 6 ,       7         Six       6,156 3 4 ,       7         Twelve       11,750 0 4 ,       7	Rs. 14,946 13,686 3,359 4,291 5,223 6,156	15 0 4 9 14 3	1
0 8 1 1	required in Classification of Watercourses (Appendix F).         No. of Waterways required.       Rs. A. P.       Per         Single        1,494 11 2 Each.       Each.         Double        2,427 0 0 , 4         Three        3,359 4 10 , 7         Four        4,291 9 8 , 7         Five        5,223 14 6 , 7         Six        6,156 3 4 , 7	Rs. 14,946 13,686 3,359 4,291 5,223	15 0 4 9 14	1

## CULVERTS.

## MEASUREMENTS.

Digging Foundation.   Cabie Feet. Delta			M	Basuren	ents.						
Pavements			Digg	ing Fou	ındatio	n.		(	Cabic Fæ	t. D	cls.
Total digging foundation, earth   11,292.   0	Abutment wal	ls		• •		• •		• •	8,83	32.	0
Stone and Chunam Masonry   Source   S	Pavements	••		• •		• •	. • •	• •	2,46	<b>30.</b>	0
Abutments		Total diggin	ng foun	dation,	earth	• •	• •	• •	11,29	92.	0
Counterforts		St	one and	Chuna	m Mas	onry.					
Poundation wing walls   1,368   0	Abutments					• •			8,37	79.	0
Ditto ditto   750. 0   1,890. 0   1,890. 0   240. 0   2	Counterforts		• •				• •	• •	1,06	34.	0
Pavement   1,890. 0	Foundation wir	ng walls	• •	• •	• •		• •	• •	1,36	<b>68.</b>	0
Ditto   Read wall above and below ground   240   0		litto	• •	• •	• •	• •	• •	• •			0
Total masonry   14,546.   0   Arched Masonry   4,095.   0   For Additional Waterway of the same size.	· -	• • • •	• •	• •	• •	• •	• •	• •	•		
Total masonry   14,546. 0					• •	• •		• •			
### For Additional Waterway of the same size.    Digging Foundation.	Head wall abov	re and below g	ground	• •			• •	• •	24	10.	0
Pier foundation   Pavement   1,710   0		Total mason	ry	• •	••		• •	• •	14,54	16.	0
Digging Foundation.   Pier foundation.   2,268. 0   1,710. 0	Arched Mason	<i>y</i>	• •		• •		• •		4,09	95.	0
Total digging foundation		For Add	itional	Waterw	ay of t	he same	size.		<del> </del>		
Total digging foundation 3.978. 0    Masonry		. C Pier	foundat	ion.					2.26	38.	0
Total digging foundation	Digging Found	ation Pave	ment	••	••	••	• •		-		-
Masonry       Pavement Head wall       2,631. 0 240. 0         Total masonry       6,499. 8         Arched Masonry, as above       4,095. 0         Abstract.         Items.       Rs. A. P.         11,292 cubic feet digging foundation, at 4 annas per 100 cubic feet       28 3 8 819 0 0         4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet       2,181 14 5         2,181 14 5       3,429 2 1         Add contingencies 5 per cent.       151 7 3         Amount for culvert single waterway       Rs. 3,180 9 4         Abstract for Additional Waterway.         Items.       Rs. A. P.         3,978 cubic feet digging foundation, at 4 annas per 100 cubic feet       9 15 1 6,4998 cubic feet masonry, at Rs. 15 per 100 cubic feet       974 15 6 4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet       819 0 0         Add contingencies 5 per cent.       1,803 14 7 90 3 1		•			• •		• •	• •	3,97	78.	0
Masonry       Pavement Head wall       2,631. 0 240. 0         Total masonry       6,499. 8         Arched Masonry, as above       4,095. 0         Abstract.         Items.       Rs. A. P.         11,292 cubic feet digging foundation, at 4 annas per 100 cubic feet       28 3 8 819 0 0         4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet       2,181 14 5         14,546 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet       2,181 14 5         Add contingencies 5 per cent.       3,429 2 1 151 7 3         Amount for culvert single waterway       Rs. 3,180 9 4         Abstract for Additional Waterway.         Items.       Rs. A. P.         3,978 cubic feet digging foundation, at 4 annas per 100 cubic feet       9 15 1 6,499 8 cubic feet masonry, at Rs. 15 per 100 cubic feet       974 15 6 4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet       819 0 0         Add contingencies 5 per cent.       1,803 14 7 90 3 1		(Pier					•		3.69	 98	8
Head wall	Masonry		men <b>t</b>		• • •	••	• • •	• • •	•		
Arched Masonry, as above	•	(Head			• •		• •	• •	24	10.	.0
Abstract.   Rs.   A.   P.		Total mason	ry	• •					6,49	99.	8
Rs.   A.   P.	Arched Mason	ry, as above	• •	• •	• •	••	• • •		4,09	5.	0
11,292 cubic feet digging foundation, at 4 annas per 100 cubic feet 28 3 8 81,905 cubic feet arched masonry, at Rs. 20 per 100 cubic feet 214,546 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet 2,181 14 5 2,181 14 5 3,029 2 1 151 7 3 Amount for culvert single waterway Rs. 3,180 9 4 Abstract for Additional Waterway.    Rs.   A.   P.		•		Abstra	ct.				•		
4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet 819 0 0 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet 2,181 14 5 3,029 2 1 151 7 3 Amount for culvert single waterway Rs. 3,180 9 4 Abstract for Additional Waterway.    Rs.   A.   P.		······································	Items.	•					Rs.	۸.	P.
14,546 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet	11,292 cubic fe	et digging for	ındatio	n, at 4 a	annas p	er 100	cubic fe	et			
Add contingencies 5 per cent.   2,181 14 5   3,029 2 1   151 7 3								100	819	V	Û
Add contingencies 5 per cent		et stone and	Chuna	ш, іразс	лиγ, а		to per	100	2,181	14	5
Add contingencies 5 per cent		•						-	2 000	_	_
Abstract for Additional Waterway.  Items.  Rs. A. P.  3,978 cubic feet digging foundation, at 4 annas per 100 cubic feet 9 15 1 6,499 8 cubic feet masonry, at Rs. 15 per 100 cubic feet 974 15 6 4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet 819 0 0  1,803 14 7 Add contingencies 5 per cent 90 3 1	Add contingend	cies 5 per cent	•	••		• •	• •				
3,978 cubic feet digging foundation, at 4 annas per 100 cubic feet 9 15 1 6,499 8 cubic feet masonry, at Rs. 15 per 100 cubic feet 974 15 6 4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet 819 0 0 1,803 14 7 Add contingencies 5 per cent 90 3 1	Amount	for culvert sin	ngle wa	terway	• •	••		Rs.	3,180	9	4
3,978 cubic feet digging foundation, at 4 annas per 100 cubic feet		A bstro	act for	Additio	onal W	aterway	/·				
6,499 8 cubic feet masonry, at Rs. 15 per 100 cubic feet 974 15 6 4,095 cubic feet arched masonry, at Rs. 20 per 100 cubic feet 819 0 0 1,803 14 7 Add contingencies 5 per cent 90 3 1			Items.	<del>. ,</del>			. ,		Rs.	Α.	P.
Add contingencies 5 per cent 90 3 1	6,499.8 cubic fe	et masonry, a	t Rs. 13	5_per 10	00 cubic	c feet		et	974	15	
	Add contingen	cies 5 per cen	t.	••			 		-		
		Amount for a	addition	nal wate	rway a	nd culv	ert	Rs.	1,894	l	8

Abstract of No. and Cost of Culverts of various Waterways, as shown to be required in Classification of Watercourses.

No.		No. o	f Waterw	ays requi	red.		Rs.	<b>A.</b>	P.	Per	Rs.	Α.	P.
2	Single		• •				3,180	9	4	Each	6,361	2	8
3	Double				.,		5,074	11	0	,,	15,224	1	0
1	Seven				• •		14,545	3	4	"	14,545	3	4
3	Tea	. ,	• .•		• •		20,227	.8	4	"	60,682	9	0
1	Twelve		• •		• •		24,015	11	8	,,	24,015	11	8
2	Twenty	• •	••	• •	• •	••	39,168	9	0	59	78,337	2	O
12	culverts,	amou	ınt		• •	••		•	 •	Rs.	1,99,165	13	8

# ROAD BRIDGES.

## General Description.

Road bridges will be required at present at the following places:—Kurrachee, Pimpree, Gharra, Halla, Chettee, Jerruck.

Any additional communications, by means of foot bridges or rafts, that may hereafter be found necessary, will be provided out of the contingencies of the work.

The bridges to be built of rubble stone and chunam masonry, and to consist of two arches, each 36 feet 5 inches span, with a rise at the crowns of 11 feet above the level of the tow-path. The tow-path on either side to be carried under the archway, and to be  $10\frac{1}{2}$  feet in width.

The roadway to be 25 feet broad, and the approaches to have a slope of 1 in 20.

#### MEASUREMENTS.

			MIEA	SUREM	ENTS.					
			Digging	g Four	idation.	ı		(	Cubic Feet.	Dels.
Abutments	• •		••						4,320.	00
Wing walls	• •								2,640.	00
Ditto	• •	••					• •		2,394.	00
Tow-path wall	• •		• •			• •			1,188.	00
Pier		• •	• •	- •		• •	• •	• •	1,584.	00
	Total	excava	tion in e	arth					12,126.	00
		Ma	sonry, S	tone a	nd Chu	nam.				
Abutments			• •						9,360.	00
Wing walls						• •			8,778.	00
Ditto									5,685.	<b>75</b>
Tow-path wall			• •				• •		3,300.	00
Wall above abu	tments								2,131.	50
Pier			• •						1,344.	00
Spandril walls							• •		864.	00
Parapet ditto							• •		1,102.	50
Loading	1 1.	• •		• •		• •	• •		3,168.	00
	Total:	mason	гу		• •	• •			35,733.	<b>7</b> 5
			Cut-	stone V	Vork.				Running	Feet.
Coping		• •			• •				294.	00
String course			• •				• •	• •	294.	00
	Total	cut-sto	ne work		• •	.,			588.	00

Arched Masonry	••	• •		••	* *	••	Cubi 5,	c Fee 292	-
$oldsymbol{E}$	arth I	Embank	ments,	&с.					-
Embankments, slope 1 in 20 Filling in roadway above arch	••		••	• •	• •	• •	666, 25,	,045 ,938	
Deduct earthwork available from	om fou	ndatior	and lo	pading		• •	691, 15,	983 294	
Total embanl	kments	and fil	ling ea	ırth			676,	689	-
		A bstra	ct.						<b>-</b>
	Items.						Rs.	۸.	Р.
12,126 cubic feet digging fo cubic feet 35,733.75 cubic feet stone ar							30	5	0
cubic feet		• •	• •	• •	••		5,360	1	0
centering 588 running feet cut-stone wo 676,689 cubic feet earthwork	ork, at	 Rs. Ip	er foot	••	••		1,323 588	0	0
100 cubic feet	··				, al 0 a		2,114	10	5
Add contingencies 5 per cent			••		••		9,416 470	0 12	5 10
Amount for one bridge		•		• •		Rs.	9,886	13	3
Amount for six bridges						R.	59,320	15	6

#### COMMUNICATION WITH THE HARBOUR.

# BASIN, DOCK, AND CUT.

## General Description.

The canal basin to be 1,500 feet long by 500 feet broad, with a depth of water of 6 feet. The dock to be separated from the basin by a wharf pier 40 feet broad, and to have a length of 1,500, with a breadth of 300 feet.

Both dock and basin, omitting in the former the mouth of the cut, to be lined with walls of rubble stone and chunam masonry. The centre wharf walls to have a rear paddling of blue clay. The roadway of the wharf pier to be strongly paved, a roadway of communication 30 feet broad to extend all round both basin and dock; this to be connected with the town by the road shown in the plan (Plate 9).

The wharf pier to be provided with 20 cranes, each of two tons power, strongly set in masonry in the centre of the roadway.

The cut to the harbour to be 13,667 feet in length, to have a breadth at top of 100, and at bottom of 75 feet. The cut to be strengthened by teak-wood piles 20 feet apart, driven to correspond with the slope of its sides, and extending 4 feet below its bed. The piles to be connected by waling pieces above, and the intervals between them to be fitted with strong rubble stone pavement to a depth of 10 feet, or a little more than the ordinary difference of rise and fall of tide.

## MEASUREMENTS.

Basin, including foundation of wall				Ex	cavation	ı.			Cubic	Feet.	Dels.
Cut	Basin, including for	undation	a of w	rall	• •		• •	• •	4,596	,384.	0
Total excavation in mud and water   26,145,699   0	Dock, ditto	ditto	ditt	to					1,048	,815.	0
Stone and Chunam Masonry.   132,396. 0   Walls of basin	Cut				• •	• •		• •	20,500	,500.	0
Walls of basin       132,396. 0         Wall of pier on dock side       113,062. 5         Walls of dock       11,812. 5         Pavement of wharf pier       90,000. 0         Bed of crane fixings       3,000. 0         Cut Lining.         Piling.         Teak-wood piles driven in at 20 feet apart, corresponding with the slope of the sides of cut with waling       No.         Rubble Stone Pavement.       Square Feet.         In the intervals between the piles       311,616         Miscellaneous.       No.         Cranes of 2 tons each       20         Fixing above, &c.       lot.         Abstract.         Rs. A. P.         26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet       2,16,457 0 0         350,271 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet       52,640 10 5         1,367 teak-wood piles, 20 feet long, including waling pieces, and driving, at Rs. 25 each       34,175 0 0         311,616 square feet of pavement to sides of cut, at Rs. 10 per 100 square feet       31,161 9 7         20 cranes, at £50 each in England, add 25 per cent. carriage and fixing       31,46,834 4 0         Add 5 per cent. contingencies       17,341 11 4	To	otal exca	vatio	n in n	nud and	water	••	••	26,145	,699.	0
Walls of basin       132,396. 0         Wall of pier on dock side       113,062. 5         Walls of dock       11,812. 5         Pavement of wharf pier       90,000. 0         Bed of crane fixings       3,000. 0         Cut Lining.         Piling.         Teak-wood piles driven in at 20 feet apart, corresponding with the slope of the sides of cut with waling       No.         Rubble Stone Pavement.       Square Feet.         In the intervals between the piles       311,616         Miscellaneous.       No.         Cranes of 2 tons each       20         Fixing above, &c.       lot.         Abstract.         Rs. A. P.         26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet       2,16,457 0 0         350,271 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet       52,640 10 5         1,367 teak-wood piles, 20 feet long, including waling pieces, and driving, at Rs. 25 each       34,175 0 0         311,616 square feet of pavement to sides of cut, at Rs. 10 per 100 square feet       31,161 9 7         20 cranes, at £50 each in England, add 25 per cent. carriage and fixing       31,46,834 4 0         Add 5 per cent. contingencies       17,341 11 4			Stone	and (	Chunani	Mason	P9/_				,
Wall of pier on dock side	Walls of basin								132	.396.	0
Walls of dock	Wall of pier on doc							• •		•	
Pavement of wharf pier   90,000. 0   3,000. 0				•	•					-	
Total masonry   350,271. 0	Pavement of wharf	pier .				•				-	0
Cut Lining.   Piling.   No.   1,366.   7     Rubble Stone Pavement.   Square Feet.   In the intervals between the piles   Miscellaneous.   No.   1,366.   7     Rubble Stone Pavement.   Square Feet.   Square Feet.   No.   1,366.   7     Rubble Stone Pavement.   Square Feet.   No.   Square Feet.   No.   Cranes of 2 tons each   20   String above, &c.   lot.   Abstract.   Rs.   A.   P.     26,145,699 cubic feet of excavation in mud and water, at Rs.   per 100 cubic feet     2,16,457   0   0   350,271 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet         52,540   10   5   1,367 teak-wood piles, 20 feet long, including waling pieces, and driving, at Rs. 25 each     31,161   9   7   20 cranes, at £50 each in England, add 25 per cent. carriage and fixing     12,500   0   0   0   0   0   0   0   0   0		•								-	0
Piling.   No.   1,366.   7	Ü		onry		• •	• •					0
Piling.   No.   1,366.   7				C	_ T	~			<b></b>		
Teak-wood piles driven in at 20 feet apart, corresponding with the slope of the sides of cut with waling	•				_	à.					
Cranes of 2 tons each   Square Feet	Tech wood wiles do	: :	-4 00				)::	ah ah	. alama	N	i a
Miscellaneous.   No.				•	part, coi	rrespond	ing w		· ·		
Miscellaneous.   No.			$R_{u}$	bble S	Stone Po	nement.				Sanare	Feet
Miscellaneous.       No.         Cranes of 2 tons each	In the intervals het	ween th			,,,,,,	•••••••••••••••••••••••••••••••••••••••				-	
Cranes of 2 tons each   20   lot.	III BEC INSCIVATE DES	WCCH UII	c pire	3	• •	• •	••	••	••		
Abstract.   Items.   Rs. A. F.				Mise	cellaneor	us.				N	o.
Abstract.  Items.  Rs. A. P.  26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet	Cranes of 2 tons each	ch .			• •	• •		• •	• •	2	0
Items.       Rs. A. P.         26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet	Fixing above, &c		•	• •		• •		• •	• •	lo	t.
Items.       Rs. A. P.         26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet				A	bstract.						
26,145,699 cubic feet of excavation in mud and water, at Rs. 1 per 100 cubic feet											
per 100 cubic feet			Item	3.					R	5. A.	P.
350,271 cubic feet stone and chunam masonry, at Rs. 15 per 100 cubic feet			cavat	ion in	mud a	nd wate	r, at I	Rs. 1	0.10.4	- F A	
1,367 teak-wood piles, 20 feet long, including waling pieces, and driving, at Rs. 25 each			dah		* *	v at I	20 15	Der	2,10,4	197 U	U
driving, at Rs. 25 each	100 cubic feet .					• • •			52,5	40 10	5
100 square feet	2,007 toda 1700ti pr	103, 20 1	CCU 10	ng, m	ciading	W411115	proces,		34 1	75 0	0
20 cranes, at £50 each in England, add 25 per cent. carriage and fixing		each.		• •	• •	• •		• • •	07,1		
Add 5 per cent. contingencies	311,616 square feet	each . of pav	ement	•	des of c	ut, at	Rs. 10	рег	1		7
Add 5 per cent. contingencies	311,616 square feet . 100 square feet . 20 cranes, at £50	each . of pav	ement				• •		31,1	61 9	
	311,616 square feet . 100 square feet . 20 cranes, at £50	each . of pav	ement				• •		31,1	61 9	0
Total amount for basin, dock, and cut Rs. 3,64,175 15 4	311,616 square feet 100 square feet. 20 cranes, at £50 and fixing.	of pave each in	Eng				• •		31,1 12,5 3,46,8	61 9 00 0 34 4	0

## Buildings.

The following buildings, store-houses, and chowkies, will be required:---

At Kurrachee.—An Overseer and Collector's house at basin; a store-house for tools, &c., and workshop; a Lockman's shed.

At Jerruck.—An Overseer and Collector's house, a store-house, and Lockman's shed.

At each of the intermediate Locks.—A house for a Munshee as Collector, a store-house, and Lockman's shed.

Eight Chowkies on line for Muccadums.

## Abstract.

Locality.	Items.	Rs.	<b>A.</b>	P.
(	An Overseer's and Collector's house at basin	1,200	0	0
At Kurrachee. 🔾	A storehouse for tools, &c., and work-shop	1,600	.0	0
Mr Wallachee.	Fittings for above	1,000	0	0
(	Lockman's shed	100	0	0
(	An Overseer's and Collector's house at head	1,000	0	0
At Jerruck	Store-house and work-shop	2,500	0	0
	Fittings, &c	1,500	Ø	0
(	Lockman's shed	100	0	0
ntermediate (	Munshee Collectors' houses, at Rs. 200	600	0	0
Locks ?	Lockmen's sheds, at Rs. 80 each	240	0	0
(	Store-houses for tools, at Rs. 350 each	1,050	0	0
	Eight chowkies throughout the line, at Rs. 50 each.	400	0	0
		11,290	0	0
	5 per cent. contingencies	564	8	0
	Amount for buildings, &c Rs.	11,854	8	0

## GENERAL RECAPITULATION.

		Iter	ns.						Rs.	A.	P.
Cuttings	•			R	s. 12,53	3,581	3	6		· · ·	
Embankments	,					5,115	12	8			
Pise work					4,89	2,530	8	4			
Contingencies, &c					1,17	7,561	6	0			
Total earthw	ork								24,68,788	14	6
Regulation lock at h			•• •						1,05,839	15	2
Dam and escape-wei	r							]	55,644	12	4
Aqueducts									12,54,750	0	0
Small locks		,0 ,0			, .				79,891	8	2
Syphon drains .									1,61,926	10	4
Outlets and inlets	•			• •					89,414	0	4
Culverts, &c.					• •				1,99,165	13	8
Road bridges .	•								59,320	15	6
Buildings	•	• •	• •	•	• •	• •		• -	11,854	8	0
									44,86,597	2	0
The cut to harbour.	•	• •	• •			• •		$\cdot \cdot  $	3,64,175	15	0
Grand total	of est	imate			• •		1	Rs.	48,50,773	0	0

Company's Rupees Forty-eight lakhs, Fifty thousand, Seven hundred and Seventy-three.

H. B. TURNER, Major, Superintending Engineer. W. CHAPMAN, Lieutenant,
Engineers.

Kurrachee, November 1st, 1853.

# RAILROAD REPORT.

A cursory inspection of the map of Scinde, and a slight knowledge of the commercial routes of the province, are requisite to determine on the valley of the Indus as the direction that any contemplated railroad must of necessity take; and since the unequivocal success which attended the construction of the first line of railroad in England is universally attributed to a complete communication having been at once established between two important points, while the wisdom of the principle laid down has been so fully borne out, as well by the failures as successes of subsequent undertakings, as to have become almost an axiom in railway considerations, no further argument appears necessary to demonstrate the advisability of at once connecting the two most considerable places in the general line of communication desired.

2. In ascending the valley of the Indus, the first point of political and commercial importance presenting itself, on the right bank of the river, is Kutree; and as a railroad with its terminus here would fully satisfy the requirements of a direct communication with the Indus, which forms the subject of this Report, it appears advisable that Kotree, the port of Hyderabad, should be at once connected with Kurrachee, the harbour of Scinde.

The latter derives its consequence from being the head quarters of the Civil government and Military establishments of the province, in addition to being a rising sea-port, dependent only upon the improvement of its harbour for European commercial importance; while the former, in addition to its immediate proximity to the large station of Hyderabad, and being itself the depôt of the Indus Flotilla, presents also, in conjunction with Hyderabad, a centre, to which all the great lines of traffic from Upper and Lower Scinde, Southern Rajpootana, and Cutch, severally converge; whilst its position on the Indus adds to these the additional advantages of intercepting the down river traffic before the navigation becomes difficult and attended with risk.

- 3. As the only other important preliminary consideration necessary to be noticed, i. e. that of capability of extension along the valley of the Indus, is answered by the position of Kotree, little doubt appears to exist as to the advisability of selecting Kotree, (or, as will be hereafter explained, a spot near it,) and Kurrachee, as the termini of the first railway to be constructed in Scinde, provided it can be shown that no financial objections exist.
- 4. There are, however, two practical disadvantages to Kotree as a terminus to a railroad, which require full consideration—the one arising from the doubtful stability of the river bank above the town, (vi le Captain Ethersey's letter, Appendix A,) and the other existing in the outlay which would be required to bridge the Bharun, a large broad river, with an uncertain sandy bed, which, in freshes, brings down an immense volume of water.
  - 5. The first objection, I am inclined to believe, may readily be overcome

General Remarks.

The point to be connected with Kurrachee.

The importance of Kotree and Kurrachee.

Capability of ex-

Practical objections to Kotree as a Terminus by locating the railway terminus on some hard rising ground about 1½ mile to the SW. of Kotree, and then connecting it with the town and river, either by a branch line of rails, or by caual, as circumstances may show to be expedient.

The second objection, being a mere matter of expenditure, its weight may be at once determined by a comparison of the pecuniary advantages resulting from the adoption or rejection of the extension beyond Jerruck.

disposed of for the present.

6. As neither point, however, will materially affect the general consideration of the railway, on which only this Reportenters, the settlement of both may be advantageously postponed until the local knowledge acquired from detailed surveys, and the necessary calculations, shall have furnished data for arriving at satisfactory conclusions.

Line from Kurrachee to Kotree.

7. In the mean time, for the purpose of examining the project, I shall suppose that the line from Kurrachee to Kotree has been selected upon the general principles already submitted.

General Remarks.

- 8. My time having been fully occupied during last season with the canal project, I was unable to lay down a line for a railway, or to take any levels with a view to determining its gradients; still I have collected sufficient information to enable me to give a general opinion as to the cost of constructing a railroad from Kurrachee to Kotree, and to form a judgment as to whether the undertaking may be expected to be remunerative, or otherwise, with the present amount of traffic.
- 9. The considerations brought forward, though doubtless imperfect, from their not entering sufficiently into detail, will still afford ample data to enable a conclusion to be drawn by Government as to the respective advantages of a canal and railroad. Should the first project be approved, it could at once be carried out on the estimate now submitted; and should the second be preferred, the approaching season would probably suffice for the survey and estimate of the details of its construction.

Facility offered by the Country.

- 10. That the flat country of Lower Scinde is most favourable to the introduction of a railroad will be evident from an inspection of the sections of the canal, in which work, though the line was necessarily restricted to a series of dead levels, neither cuttings nor embankments are proportionably great.
- 11. The railroad, by reason of admission of inclines into its construction, will be enabled to take a more direct route than the canal through the hills to Kotree, and, with its branch to Kotree, will probably extend to 110 miles in length.

Estimate; re-

12. The following estimate is drawn out in accordance with the general principles laid down in the Most Noble the Governor General's Minute on Railroads. The guage has been fixed at 4'8½", as being that now by common consent most generally adopted; and the rail proposed is that of the ordinary a shape, with fished joints, and weighing 70 lbs. to the yard, as being of the simplest form in use, and sufficiently heavy for the expected traffic. For sleepers, I propose using the red heart of the babool wood from the Scinde forests. An extract of a letter from the Forest Ranger, in reply to my inquiries as to its durability and cost, will be found in Appendix B.

Rough Estimate of the probable Cost of constructing a Mile of Railway between Kurrachee and Kotree on the Indus.

The line to be formed with a single track, with bridges and embankments corresponding, but the foundations in extension bridges, or in difficult cases, to be at once built to suit a double line of rails.

[ 55 ]	•				
	**		70-		_
Earth Works, calculated at a mean depth of cutting in embankments of 4 feet formation, level roadway 18 feet broad, slopes 2 to 1; or 549,120 cubic feet, at 6	Rs.	a.	p. Rs.	a.	p.
annas per 100 cubic feet  Bridges and Culverts, not including Mullear or Bharun	2,059	0	0		
rivers, inclusive of foot bridges and level crossings Walling, Fencing, and Drainage of embankments and	<b>3,</b> 800	0	0		
cuttings	500	0	0		
Turn-tables, Switches, Crossings, &c	900	0	0		
Water Tanks, Cranes, Pumps, &c	1,200	0	0		
Signal Posts, &c	150	0	0		
Total Rs.	8,609	0	0		
PERMANENT WAY.					
Ballasting, 126,720 cubic feet, at Rs. 3 per 100 c. ft. Sleepers, 1,760, of Scinde babool wood, none but the	3,802	0	0		
red heart of the wood being used, at Rs. 2½ each (10 feet long ×8"×5")	3,960	0	0		
Spikes, 8,000, at 1 lb. each, or 3½ tons, about, at £12 per ton.	420	0	0		
Chairs, all intermediates of 25 lbs. each; 3,520, weight 40 tons, about, at £7 per ton	2,800	0	0		
per ton.	9,900	0	0		
Add one-tenth for sidings and station rails  Laying Rails, (including keys of compressed wood, valued at £8 per 1,000,) at Rs. 2 per lineal yard	990 3,520		0		
		<del></del>	<del></del>		
Total permanent way per mile Rs. As above	25,392 8,609	0	0		
Cost of construction per mile	34,001	0	0		
Cost of 110 miles, from Kurrachee to Kotree Rs. $Add$ —	37,40,110	0	0		
For Mullear river bridge	2,00,000	0	0		
For Bharun river bridge	3,00,000	0	0		
Total cost of construction from Kurrachee to Kotree.Rs			-42,40,110	0	0
ROLLING STOCK FOR 110 MILES.					
10 locomotive engines, with tenders, with duplicates of working and wearing parts, from 10 to 14 tons					
weight, at £2,000 each	2,00,000	0	0		
6 first class passenger carriages, at £300 each	18,000	0	0		
6 second class do. do., at £220 each	13,200	0	0		
20 third class do. do. at £150 each	30,000	0	0		
6 horse boxes, at Rs. 1,200 each	7,200	0	0		
150 goods waggons, at Rs. 1,000 each	1,50,000	0	0		
10 cattle cages, at Rs. 1,000 each	10,000		.0		
20 coal waggons, at Rs. 560 each	11,200	0			
4 luggage vans, at Rs. 1,200 each	4,800	0	0	_	
Total rolling stock			<b>- 4,44,400</b>	0	0
Freight and carriage, &c	••	•	. 80,000	0	0
Carried forward .		$\mathbf{R}$ s	47,64,510	0	0

Brought forward	•		Rs. 47,64,510		
Buildings and Stations.					
Total Lathes, tools, Furniture, &c. fittings for do.  Total buildings and stations		68,000	3,18,000	0	0
Grand Total	••	Rs.	50,82,510	0	0

#### RECAPITULATION,

Showing the probable Cost of each (as estimated) General Item in the Construction and Stocking of a Railroad from Kurrachee to Kotree on the Indus.

Items.	Cost for whole 110 Mil	leng	th,			
		1. dtt		Rs.	A.	P.
Earth works				2,26,490	0	0
Bridge over Mullear River				2,00,000	0	0
Ditto over Bharun River				3,00,000	0	(
Remaining bridges and culverts		• •		4,18,000	0	(
Walling, fencing, and drainage		• •		55,000	0	(
Turn-tables, switches, crossings, &c.	• •			99,000	0	(
Water tanks, cranes, pumps, &c.				1,32,000	0	(
Signal posts, &c				16,500	0	(
PERMANENT WAY.						
Ballasting		4,18,	220			
Sleepers		4,35,	600			
Spikes		46.	200	İ		
Chairs		3,08	000			
Rails		11,97		ļ		
Laying rails		3,87,				
Total				27,93,120	0	•
Rolling stock				4 4 4 4 0 0	0	(
Freight and carriage				000.00	0	(
Buildings and stations	••			2 19 000	0	(
				50,82,510	0	(
Contingencies and establishment at	10 pe	er cent	• •	500.051	0	(
Grand total of estimate			Rs.	56.64,761	0	(

Amount of Esti-

- 13. The total estimated amount of a railroad from Kurrachee to Kotree is therefore Rupees Fifty-six Lakhs, Sixty-four thousand, Seven hundred and Sixty-one.
- 14. Not including the two large rivers, i. e. the Mullear and Bharun, the probable cost per mile amounts to Rs. 46,952.3; but inclusive of these, the rate per mile is estimated at Rs. 51,497.8, which provides for working stock, buildings, and all necessaries for the commencement of the working of the line.

Traffic.

15. The amount of traffic which will probably be brought upon the railroad, and the returns which may be consequently expected, contrasted with the working expenditure, for the purpose of determining what interest way reasonably be looked for on the capital required, are now the points for consideration.

- 16. From the position of Kurrachee with respect to the Indus, the traffic naturally classifies itself under two divisions:

1st, the traffic by river. 2nd, the traffic by land.

Each of these, again, resolves itself into two heads:-1st, the traffic carried on by Native river craft.

2nd, that conveyed by the steamers of the Indus Flotilla.

And again :-

1st, the traffic by the main road through Tatta and Jerruck to Kotree. 2nd, that existing on several direct routes through the hills, varying in extent, as the supplies of water and forage are scarce or abundant.

Under these heads the goods traffic must first be considered'.

- 17. To enable a judgment to be formed of the amount under the first head, a return (Appendix C) of the exports and imports of the different ports of the Indus, furnished by the Collector of Customs, is available, from which it will be seen, that the river traffic by Native craft is estimated at 30,406 tons.
- 18. A slight check upon this amount is derivable from a register, kept by the authorities of the Iudus Flotilla, of the number of boats passing different stations of the river (vide Appendix to Canal B), from which an approximation to the maundage of goods passing Tatta, (which only, for reasons given in the Canal Report, can be safely taken,) is calculated at 15,46,600 maunds. Reducing this by one-third, as an allowance for vessels being imperfectly filled, it gives a tonnage of 55,236 tons, which is no doubt exaggerated, but so far valuable as to show that the first estimate, which must be taken as representing the river traffic, is probably on the safe side.
- 19. The quantities of goods and merchandize, both Government and private, conveyed by the Indus Flotilla, are shown in the accompanying returns, (Appendices D and E,) furnished by Captain Ethersey. The first item, Government stores, amounted from the 1st February 1848 to 30th April 1853, or during the course of 62 months, to 10,936 tons. The proportion of this for one year is 2,117 tons. Private merchandize, again, conveyed from the 1st May 1851 to the 30th April 1853, was 23,622 maunds. The half of this for one year amounts to 422 tons. The tonnage under this head may consequently be set down at 2,539 tons per annum.
- The overland routes, divided into, 1st, the traffic by the main road by Tatta and Jerruck; 2nd, by the various hill routes.
- 21. In considering this branch of the traffic, the returns furnished by the Police Authorities constitute the only official documents available: though imperfect for the purpose, still some approximation may be deduced from them, upon which an estimate of the probable amount of traffic may be based.
- 22. These returns (vide Appendix F) are taken at four places on the high road between Kurrachee and Hyderabad: two of these, i. e. those at Gharra and Tatta, the central stations, cannot clearly be taken as representing the through traffic, on account of the registers at Jemedur-ke-Landi and Jerruck, the outer stations, showing a great decrease in almost every item. The great difference observable may be accounted for, in the instance of Tutta, by its being a large city, and consequently subject to great local movement; and in the case of Gharra, by a much frequented cross-communication from the Sakra Purgunna passing through it, as well as from its neighbourhood being a favourite grazing-ground for camels, of which animals a large number is shown in its register.

River Traffic; Native Craft.

Indus Flotilia.

Overland Traffic.

To assume the returns of Jemedar-ke-Landi, would be to suppose that everything passing through that place continued on to Kotree, which would manifestly lead to error.

- 23. The mean between the returns of Jemedar-ke-Landi and Jerruck must, therefore, be taken to represent the *through* traffic between Kurrachee and Kotree, on this road.
- 24. As the returns do not distinguish between laden and unladen, the usual proportion of two-thirds to one-third will be taken for all descriptions of conveyance. The abstract statement attached to the Police Returns (Appendix F) shows the calculation, agreeably to the above considerations; and the amount, 1,571 tons, must be supposed to represent the overland traffic by this route.

But a correction is still required for the various routes mentioned under the second head of this division, for which no register of any description exists.

This is supplied by a return furnished me by the Captain of Police, from inquiries made of all the principal merchants of the town, and by written statements received from those of Camp, including, in all instances, the entire trade of their firms by the land route (vide Appendix G). From an abstract of these statements, also annexed, in which the necessary deductions are made in certain cases, it will be seen that 3,792 tons are deduced.

- 25. In order to apply this correction, it will be necessary to take the mean of the two estimates, or 2,681 tons, as the total amount of traffic to be calculated upon the land route from Kurrachee through to Kotree.
- 26. The entire present traffic in goods and merchandize which would be carried by a railroad would therefore be as follows:—

D	¶ Native Craft		30,406	tons.
by river	∫ Native Craft	. <i>.</i>	2,539	••
	routes			
			<del></del>	•
	Total	. <b>.</b>	35.626	tons.

Further Check on Total Traffic.

- 27. As a check upon this total, again, the Collector of Customs, in a return furnished by him of the exports and imports by the sea face (vide remarks on Appendix H), after making deductions,—lst, for the consumption at Kurrachee; 2nd, for the imports and exports across the western frontier; and 3rd, for the partial lading of vessels,—estimates the probable amount of exports and imports of the land face, both by the direct routes and by the river, at 57,050 tons.
- 28. Considering, then, the sources from which the totals of the above summary have been derived, and the authority which supports the last estimated amount, it appears to me that 40,000 tons may be very safely assumed as the smallest amount of goods which will probably be carried over its entire length each year by a railroad.

Ordnance and Commissariat Stores.

N. B.—All stores forwarded by the Commissariat and Ordnance Departments are transmitted through the agency of the Indus Flotilia (vide Appendices I and K), and are consequently included in the returns furnished by the Superintendent.

Passenger Traffic; General Remarks.

29. Before proceeding to the consideration of the amount of passenger traffic that may be expected upon a rollway, I would quote an extract from a letter from Captain Crawford, the Superintending Engineer Railway Department, Bombay, on this head, which, though of the greatest importance at home, has not always been allowed a place in railway calculations in India,

an omission arising from a general conviction that Natives would be slow to take advantage of a new means of locomotion supposed to be incompatible with their present habits, and, in fact, much beyond their appreciation.

Captain Crawford, in speaking of the experimental line at Bombay more than three months after its opening, when the novelty must to a certain degree have worn off, says: "It answers well, and conveys a regular traffic, even during the monsoon, of some 5,000 passengers a week, and considerably more than pays its own expenses. All classes use it—men, women and children; and the poorest avail themselves of it in travelling on business, which is a good sign for the further extension."

- 30. This testimony, supported by the combined reports of the different Presidency journals, appears a sufficient authority for believing that passenger traffic in India, provided the fares are low, will form a very important item in railway returns, and that taking into account the marvellous increase of movement which has always followed the introduction of railroads, it fully warrants the assumption that at least onethird of the number of passengers at present found on any line of road affected are likely to avail themselves of the new means of transport.
- 31. Suppose this to be admitted, the following passengers may be expected on the line :--

Passenger Traffic.

						Per Annum.
1st Class, say		• •	• •	• •		600
2nd Class, say			• •			1,200
3rd Class, the mean	of the P	olice Re	turn of	•		
Jemedar-ke-Landi and						
(vide Appendix F)				11,3	42	
Troops, the average of	five year	s (vide	Deputy			
Assistant Quarter M	aster Ge	neral's	Return	•		
Appendix to Estimate	: L) .			9,3	00	
Total	l 3rd Cla	es .				20,642
4th Class, servants and c	amp follo	wers for	above,	2 to ea	ch	18,600

32. The following comparative estimate of working expenses and returns will show the surplus available for a dividend on the capital required for the construction of the railroad.

Reference to Estimate; Working Expenses.

- The rate per ton per mile at which goods are calculated is judged to be reasonable, on a consideration of the present cost of carriage in Lower Scinde, from inquiries made in various quarters, a statement of the results of which will be found in Appendix M.
- 34. The scale of passenger fares is for the 1st class about that in use in England, but by the introduction of a 4th class, at 2 pie per mile, the railroad becomes available to the very poorest labourer, whose fare, supposing him to travel from Kurrachee to Hyderabad, would be Rs. 1-2-0, an expenditure which would be fully made up to him by his labour and saving of food during the time gained.
- Estimate of the probable Working Expenses and Returns of a Line of Railroad between Kurrachee and Kotree—Length 110 Miles; probable Traffic Goods 40,000 Tons.

EXPENDITURE.  By maintenance of way, at Rs. 600 per mile, for 1 10 miles.						Rs.	a.	р.
						66,000	0	Ō
Ditto	ditto of mase	oury we	orks and	d build	lings,	•		
at 1 pe	r cent. on cost	•			•	12,360	0	0
	Car	ried for	ward			78,360	0	0

Fares.

D 1.4	Rs.		p.
	78,360	0	0
Locomotive Expenses.			
One train each way daily, for the conveyance of pas-			
sengers, the post, and light goods; and one train for			
heavy goods each way every alternate day; or 120,450			
mileage, at 8 annas	60,225	0	0
General charges, police and establishment	60,000	0	O
Rs.	1,98,585	0	0
RECEIPTS.	<del></del>		
From 40,000 tons of traffic over 110 miles, at 1 anna			
per ton per mile	2,75,000	0	0
600 passengers, 1st Class, at 2 annas per mile	8,250	0	0
1,200 ditto, 2nd Class, at 1 anna per mile	8,250	0	0
11,342 ditto, 3rd Class, at 6 pie per mile	38,988	0	0
9,300 Troops, at 6 pie per mile	31,968	12	0
18,600 Camp Followers, 4th Class, at 2 pie per mile	21,312	8	0
The yearly expenses of two Indus steamers dispensed			
with (vide Captain Ethersey's letter, Appendix A)	75,000	0	0
The yearly cost of dawk contract (vide Post Master's			
letter, Appendix O)	24,000	0	0
Rs.	4,82,769	4	0
		•	

Amount available for Dividend.

36. The surplus of the income over the expenditure is, therefore, Rs. 2,84,184, which would provide for a dividend of upwards of 5 per cent. on the estimated capital required.

Probable increase of Traffic.

- 37. In the above calculations no credit is taken for the great increase of the trade of the port, which is stated by the Collector of Customs (vide his letter, Appendix H,) to have steadily augmented "for several years past at the rate of 20 per cent. per annum," and which bids fair to show a greater proportional increase for the future, from the desire evinced by the Comissariat authorities to take advantage of the Indus route in providing European necessaries to the Troops in the Upper Provinces and the Punjab.
- 38. As an experiment, 10,000 casks of ale and porter, during the present year alone, have been forwarded from England direct to Kurrachee, for transmission by the Indus. Should this not answer as an economical arrangement, from the serious drawbacks existing in the navigation of the tidal channels, and lower part of the river, a railroad, removing all these obstacles, could not fail to have the effect of turning the scale in favour of the route, and a considerable traffic would be opened out in the conveyance of Government stores alone, to the no small benefit of Government itself.

Further Saving.

39. In common with a canal, the railroad would effect much saving to Government in the wear and tear of camp equipage, and marching kit, as well as in avoiding damage from exposure and delay to perishable articles, such as the European stores above alluded to.

It would also, provided, as must necessarily be the case, it were connected with the harbour, either by a cut to its terminus, or by extending a line of rails to the shipping, assist in effecting a very great saving in the local expenses of the Commissariat Department.

Returns really under-estimated.

40. In assuming no greater a return than 5 per cent. as the least dividend a railroad may be fairly expected to yield, when, as will be evident

throughout the calculations, I might have availed myself of the elasticity of facts and probabilities, which both practice and the ripe experience of railroad statistics would fully justify, to augment considerably the profits, I have been guided by a desire merely to show that the project would in itself pay; but this desire need not prevent my expressing a conviction, that, provided the Company undertaking its construction can be prevailed upon to do away with the unnecessary and expensive addition of a Board of Directors in England, substituting Agents and Auditors only, and placing confidence in the superintendence of the local Government and Direction, a railroad from Kurrachee to Kotree will prove a most remunerative speculation.

It now remains only to place the two projects in contrast-lst, as regards expenditure and returns, so far as they have been considered; and 2nd, with reference to the advantages offered by each.

Comparison of Canal & Railroad.

1st.—The estimated cost of the two projects, with their probable return, are as below:-

Return on Capital. Cost. Canal..... Rs. 48,50,773 ..... 4 per cent. 56,64,761 ..... 5 per cent.

In this comparison the railroad apparently holds out the greatest promise.

2nd.—In the matter of indirect advantages, the supply of water which the Remarks on Canal. canal would ensure to Kurrachee and its neighbourhood cannot be overrated, and were it possible to guarantee the execution and unopposed continuance of one scheme only, this great benefit, considering the other facilities it affords, would in my opinion be a sufficient reason for deciding in its favour. But in the present age of progress, nothing in any way behind the onward spirit of the times can, I am afraid, be contemplated, and we have a case in point in the supercession of the Mahmoudie Canal, the warning held out by which must, I fear, be held fatal to a similar project here.

42. It appears unnecessary to dwell upon the advantages, political, commercial, and social, which have invariably followed the introduction of railroads in all parts of the world, and which I cannot but think are to be equally claimed for India, where British enterprise would still lead the way; nor need arguments be adduced to prove that India is in a position, from the immense capability which she possesses in her wide-spreading fertile plains for the growth of surplus produce, to take a prominent position among countries exporting raw materials and grain, provided only the means of transporting these staple sources of wealth to her numerous ports were adequately provided.

Remarks on Rail-

43. Scinde in itself is a crying proof of this prevailing want. Here, on account of the scarcity of a coined medium, a great portion of the Government revenue is annually paid in kind; and I have heard upon good authority, that it is not uncommon, in seasons more than usually abundant, to see masses of grain, which under other circumstances might possibly have been the means of mitigating in a distant part the horrors of famine, lying rotting on the ground. This necessity is further exemplified, in the case of the province, by the great disproportion which exists in the price of grain in the producing and consuming districts, as seen in the weekly tariffs, (vide Appendix and Remarks N,) evincing an absence of the necessary means for regulating market prices, and rendering apparent the existence of a monopoly in the supply of the necessaries of life, which cannot but act prejudicially in any place or state of society.

Great want of Means of Communication in Scinde.

Concluding Re-

44. A conviction of the general importance of Scinde as a commercial acquisition has so grown upon me during the course of the inqu ries on which I have been engaged, that I cannot close this R port, especially since the examination shows that no financial objection exists to either project, without respectfully urging, through you, upon Government, the advisability of at once securing to the province and Upper India the manifold benefits which the adoption of either scheme, preferably doubtless the latter, is unquestionably calculated to bestow; and I would conclude by trusting that the statistical information collated and embodied in the documents now submitted will in some measure excuse the length to which this Report has necessarily been extended.

I have the honour to be,
Sir,
Your most obedient Servant,
W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

Kurrachee, November 1st, 1853.

(True copy)

W. CHAPMAN, Lieutenant,

Engineers.

#### APPENDIX A.

No. 584 of 1853.

From Captain R. ETHERSEY, I. N.,

Commanding Indus Flotilla,

To LIEUTENANT CHAPMAN, Engineers,

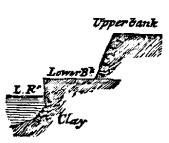
On Special Duty, Scinde.

Dated Kotree, 23rd June 1853.

Sir,

I have now the pleasure to forward the several returns called for in your letter dated the 9th ultimo, which has been a work of much time and labour.

- 2. A return of the number of laden and unladen boats of all descriptions which have passed this place for the last two years can be obtained from the Commissioner.
- 3. With regard to the merits of Kotree and Jerruck as points for the terminus of a railway, the latter has this one advantage, viz. it may be considered a permanent point, whereas Kotree cannot; nevertheless, for eleven years, the bank here has undergone little or no alteration: it has during that period remained steep, with deep water close to it. Immediately above this, however, the river has considerably altered the upper bank. The inundation of 1850 commenced, and subsequent ones have continued, to wash it away to a considerable extent: this it will not be a difficult matter to stop, for should



the bandalls, which have been re-erected this year, fail in their object, there is abundance of rubble stone available within a mile of the bank, than which nothing appears to answer better in protecting a bank (formed as it is above Kotree) from the effects of a strong stream; and so long as this can be done, there is no probability of the river forcing its passage in the rear, for the lower bank in this vicinity consists of a yellowish clay, on which the stream has little or no effect, so

that when the inundation subsides the river retires into its old channel.

- 4. But if, after all, the bank at Kotree be objected to as a terminus, from doubts of its permanency, the advantages of position are so great, as affording direct communication between Kurrachee and a large town, arsenal, and Military station like Hydrabad, that some spot should be selected in its vicinity for a terminus, connected with the river by a tram-way or other means.
- 5. For this purpose, the hard stony ground  $1\frac{1}{2}$  mile SW. from this offers an excellent site.
- 6. If a railroad be completed to Kotree, the working of the Flotilla could be confined above this, and the services of three steamers dispensed with, the working expenses of which amount to about Rs. 75,000 per annum.

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

(Signed) R. ETHERSEY, Captain I. N.,

Commanding Indus Flotilla.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

#### APPENDIX B.

No. 189 of 1853.

From the FOREST RANGER IN SCINDE,

On Circuit,

To LIEUTENANT CHAPMAN,

Engineer Department,

On Special Duty, Scinde.

Dated 16th May 1853.

SIR.

In reply to your letter No. 31, of the 9th instant, I have the honour to inform you, that I have not sufficient knowledge of babool timber to enable me to give satisfactory replies to your questions, with the exception of the last, regarding the cost at which timber for sleepers can be supplied.

- 2. In reply to question No. 1, I beg to state, that I applied for, and have received the Commissioner's sanction to exporting babool timber from Scinde as a trial, a proof that I consider it worthy of exportation; but the only way in which I would expect the value of the Scinde Forests to be increased, by the means of transport afforded by a railway, would be by the consumption of timber in Kurrachee.
- 3. During my stay in Kurrachee last rains, the Executive Engineer showed me a block of babool which had lain in the timber-yard for some years, and he stated, that if he could obtain such timber in Kurrachee, he would prefer it, for many purposes, to the best teak-wood.
- 4. The white-ants had attempted to eat the log of babool, and had made an impression on the white part or sap-wood, but had not been able even to mark the red wood, and no means had been adopted to preserve it against their attacks.
- 5. Although I cannot give any information as to the difference between it and the Deckan babool, I have no hesitation in stating, that the *red* part, or heart of the Scinde babool, is *not* liable to destruction by white-ants, when seasoned.
- 6. Before it is seasoned, babool is decidedly liable to destruction by white-ants, especially the white part, but the red heart generally resists their attacks well, even when exposed in the green state.
- 7. The red babool of Scinde, from the density of its fibre, and its lasting properties, is particularly suited, in my opinion, for railway sleepers.
- 8. After it is well seasoned, say for nearly two years, nothing is required to preserve the red babool from dry-rot, or the attacks of white-ants.
- 9. If used before it is perfectly seasoned, I would recommend the simple and cheap process of giving a coating of tar to the babool, to protect it against the influence of water, and that only the *red wood* should be used.
- 10. If your Department will be at the expense of felling and removing the timber, and will lay no claim to the cuttings or chips therefrom, removed in the dressing, but will allow them to be disposed of by the Forest Department, you may choose timber

from the forests, taking only the red wood for sleepers, by paying at the rate of Rs. 1 for each sleeper 8 feet in length  $\times 10'' \times 6''$ ; or, if you will cause the timber to be dressed by the saw, instead of the hatchet, and allow the Forest Department to have the disposal of the planks, you may have the sleepers at Rs. 15 per score.

- 11. According to the above terms, no discount or deduction will be allowed on your bills.
- 12. You will be better able than I to form an estimate of the expense of cutting and conveying the sleepers from the forests.
- 13. The larger and older the trees from which the timber be taken, the better properties will it possess, and the less wastage of sap-wood will there be.
- 14. I would recommend trees not less than 4 feet in girth, from which 2 sleepers could be sawn.
- 15. Timbers may be sawn at the rate of Rs. 2 per hundred square feet, and pieces  $8' \times 12'' \times 10''$  might be removed to the line of railway, leaving the cuttings in the forest.
- 16. I append a list of the forests from which timber may be had for your purpose, with their situation, &c.
- 17. Garkah forest, the lowest down, near Peer Puttah, is not easily accessible by land, except from Tatta, from which it is distant 9 or 10 miles; but it is on the bank of the Bigar, by which, in the monsoon, timber can be conveyed in boats to Whagoodhur Bunder, 14 miles from Kurrachee, and about 3 miles from Jemedar-ke-Landi.
- 18. The next forest, proceeding upwards, is Shah Loonkah Beylah, near which the road passes, 4 miles above Tatta.
- 19. Adjoining Shah Loonkah is Lullung forest, which joins with Heliyah forest, of which the lower part only contains babool timber.
  - 20. The upper part of Heliyah forest consists principally of jungle wood.
- 21. Above Heliyah there is a distance of 8 miles without timber, to Toondah forest, close to which the road runs for about half a mile.
  - 22. In Toondah forest are good old babool trees, suitable for cutting into sleepers.
- 23. From Toondah, there is a good hard road for about 6 miles, to Veeran forest, which is about 2 miles below Jerruck.
  - 24. In Veeran Beylah are old red babool trees.
- 25. The lower part of Karikah forest is about 14 miles above Jerruck, on the river bank, and is a narrow strip of fine old babool trees, extending towards Kotree, for about 5 miles. Its upper end is 3 miles below Kotree.
  - 26. The best timber is to be had from trees measuring from 4 to 4½ feet in girth.
- 27. Many of the trees above 5 feet in circumference are unsound; and, generally speaking, the Scinde babool does not grow healthily much above 5 feet in circumference; though some healthy trees may be found measuring as much as 12 or 13 feet in girth.

I have the honour to be, Sir,
Your most obedient Servant,
(Signed) R. W. BAYNE, Assistant Surgeon,
Forest Ranger in Scinde.

Bunnhur, Ranger's Office, 16th May 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

### List of Babool Forests on the Right Bank of the Indus, below Kotree.

Names.	Remarks.
Karikah	Commences 3 miles below Kotree, and extends along the river bank for 5 miles.
Veeran	On the river bank, 2 miles below Jerruck.
	6 miles below Veeran.
	8 miles below Toondah.
Lullung	Joins with Heliyah forest, and extends about 2 miles.
Shah Loonkah	Extends for about 3 miles above Chuttun-ka-Gainn, 4 miles above Tatta.
Garkah	Is 9 or 10 miles below Tatta, on the Bigar, and is not near the Kurrachee road.

(Signed) R. W. BAYNE, Assistant Surgeon,
Forest Ranger in Scinde.

Bunnhur, Ranger's Office, 16th May 1853.

(True copy)
W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

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APPENDIX C.

Statement of Imports and Exports, also the Tonnage employed in conveying Merchandize, and the Amount of Freight paid thereon, from May 1850 to April 1851.

						Importa	from		Expor	ta to	ı	employe Merchandi	ort, No. of and in convice, and the ght paid the	eyin Amo	gunt	employe Merchandi	ort, No. of To d in convey ze, and the An ght paid thereo	ing lount	Numbe occupied in	r of Days Upward Trip.	Number occupied in D	r of Days ownward Trip.
												Number of Tons.	Amount of	Fre	ight.	Number of Tons.	Amount of Fr	eight	Pair Season.	Cold Sesson.	Fair Season.	Cold Season.
						Rs.	Δ.	P.	Rs.	Α.	P.		Rs.	A.	P.		Rs.	l. P.		•		
Tatta	• •	••	• •	••	••	7,500	0	0	8,585	0	0	280	227	8	0	368	185 (	0	2 days.	5 days.	13 days.	4 days.
Jerruck		• •	• •	••	••	7,125	12	0	551	8	0	333	231	4	0	98	29 1	0 9	3 "	7 "	2½ "	6 "
Kotree	• •	• •	• •	• •	••	1,965	0	0	22,159	10	6	112	101	8	0	84	63 8	3 0	4 "	10 "	3 "	9 "
Hyderabad	• •	• •	• •	••	• •	2,69,740	4	0	1,39,188	10	0	7,366	6,859	6	0	3,624	1,810 19	0	4 "	10 "	3 "	9 "
Muttara		••	• •	••	••	31,952	8	0	3,954	2	0	1,145	823	8	0	630	195	<b>6</b> 0	5 "	11 "	5 "	10 "
Gotannah			• •		• •	1,87,942	10	0	67,211	8	0	6,870	6,448	14	0	362	1,723	1 0	6 "	13 "	5 "	11 "
Mazendah		• •	• •			29,635	12	0	1,664		0	1,141	895	12	0	568	339 (	0 0	7 ,,	14 ,,	7 "	13 "
Sehwan		• •	••			11,135	13	0	883	12	0	486	726	7	0	104	56 19	2 0	8 "	16 "	9 "	14 ,,
Larkhana	••	••	••	• •	• •	32,381	12	0	112	0	0	1,181	2,338	0	0	16	24 8	3 0	14 "	40 ,,	11 "	38 "
Sukkur	••		••	• •		2,32,075		02	2,35,863		0	3,314	5,929	0	0	4,554	7,844	4 0	15 "	45 ,,	12 ,,	40 ,,
Shikarpore	••	••	••	••	••	5,169		0	••••			126	186	0	0		••••	•	16 "	48 "	15 "	45 "
						8,16,623	15	04	4,80,174	12	6	22,354	24,767	3	0	10,480	12,272	4 0	84 days.	219 days.	73% days.	199 days.

Khettie Custom House, 3rd June 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

(Signed) M. M. D'ABREO, Clerk in Charge.

Statement of Imports and Exports, also the Tonnage employed in conveying Merchandize, and the Amount of Freight paid thereon, from May 1851 to April 1852.

						Imports f	irom		Export	s to		employe Merchandi	port, No. of ad in conv zo, and the ght paid the	eyin Ame	g	employe Merchandia	ort, No. of 'ld in conve e, and the A tht paid ther	ying Toot	int	Number occupied in	of Days Upward Trip.		of Days cownward Trip.
												Number of Tons.	Amount of	Fre	ght.	Number of Tons.	Amount of	Freig	ght.	Fair Season.	Cold Season.	Fair Season.	Cold Season.
						Rs.	٨.	P.	Rs.	۸.	p.		Rs.	Δ.	P.		Rs.	۸.	r.				
Tatta		• •	4.5		• •	3,362	5	0	7,613	4	0	117	67	13	0	254	130	4	0	2 days.	5 days.	14 days.	4 days.
Jerruck	• •		• •	• •		2,156	8	0	187	13	0	68	39	0	0	66	35	12	0	3 "	7 "	21 ,,	6 ,,
Kotree			••	••	• .	<b>2,</b> 250	8	0	15,070	0	0	112	101	8	0	24	26	0	0	4 "	10 "	3 "	9 "
Hyderabad					• •	90,391	0	0	2,09,267	5	6	3,385	2,690	10	0	3,074	2,131	12	0	4 ,,	10 "	3 "	9 "
Muttara		• •	• •	• •		24,231	8	0	3,815	0	0	879	480	12	0	594	195	12	0	δ",	11 "	5 "	10 "
Gotannah		• •	• •		• •	1,76,866	8	0	37,775	8	0	6,664	5,404	13	0	3,132	1,618	12	0	6 "	13 "	5 "	11 ,
Mazendalı				••	• •	10,715	8	0	1,567	0	0	452	395	4	0	608	371	0	0	7 "	14 "	7 "	13 "
Behwan		• •	• •	••	• 1	16,796	0	0	7,847	0	0	736	1,237	8	0	352	270	8	0.	8 "	16 "	9 ,,	14 "
Larkhana		••	••	••	• •	4,664	0	0	1,457	0	0	73	242	8	0	34	38	8	0	14 "	40 "	11 "	28 ,,
Sukkur	••	• •	• •	• •	• •	5,40,268	8	0	4,07,871	13	8	6,398	12,484	0	0	3,360	5,768	11	0	15 "	45 ,,	12 "	40 ,,
Shikarpore	••	••		••	• •	3,211	0	0		••		24	56	6	0		••••	••		16 "	48 "	15 "	45 "
						8,74,913	Б	0	6,92,471	12	2	18,908	23,200	2	0	11,498	10,586	15	0	84 days.	219 days.	732 days.	199 days.

Khettie Custom House, 3rd June 1853.

(True copy)

(Signed) J. MACLEOD,

Deputy Collector.

(Signed) M. M. D'ABREO, Clerk in Charge. No. 122 of 1853.

To JOHN MACLEOD, Esq.,

Collector of Customs,

Kurrachee.

Sir,

In acknowledging the receipt of your endorsement No. 232, dated 24th ultimo, giving cover to copy of a letter from Lieutenant Chapman, of the Engineers, on special duty in Scinde, I do myself the honour to furnish such data as is available in the Department relating to the river traffic. This has been embodied in the annexed statements, drawn up for the two past official years, 1851-52 and 1852-53, and furnishes the information required by Lieutenant Chapman in the 2nd clause of the 3rd paragraph of his communication to your address.

2. The average of the amount of freight from stations of export and import has been given, in consequence of the practice existing of merchants freighting boats by the trip, and not by the mile: the rate of the freight varies according to the rise and fall of trade, and the fair and wet seasons of the year tend to make a great difference in this respect.

I have, &c.

(Signed) M. M. D'ABREO, Clerk in Charge.

Khettie Custom House, 3rd June 1853.

(True copy)
W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

APPENDIX D.

Statement showing the Return of the Number of Passengers and Tonnage of Goods conveyed by the Steamers of the Indus Flotilla, up and down River, from 1st May 1851 to 30th April 1853.

					Nu	m ber	of Pri	vate I	Passen	gers.	Car	riages,	&c.				
From what to what Station.	Tonnage of Weight, per	Maund 0	Tonnage of C Measurement Feet.	of Cubic	1st Class.	2nd Class.	3rd Class.	4th Class.	Children in Cabin.	Children on Deck.	Carriages.	Buggies.	Palkees.	Specie or Bullion.	Goats.	Dogs.	
From Kurrachee to Mooltan, from 1st May 1851 to 30th							`							Rs.			•
April 1852	2,271	68	1,409	11	4	7	4	27	••	••					* *		
April 1853	4,855	25	2,438	0	8	4	<b>2</b> 0	40		2		٠.		••••			
From Mooltan to Kurrachee, from 1st May 1851 to 30th April 1852  Ditto ditto ditto, from 1st May 1852 to 30th	673	7	812	3	7	9	3	13	6	••						1	
April 1853	2,096	57	26	2	29	20	19	<b>3</b> 3	14	1			••	•••	••	3	
From Kurrachee to Sukkur, from 1st May 1851 to 30th April 1852	3.013	70	300	1		3	1	3		1	<b>.</b>		1		<b></b>		
Ditto ditto ditto, from 1st May 1852 to 30th April 1853	2,725	37	707	2	5	4	7	23	4		lı	1	1	••••		1	
From Sukkur to Kurrachee, from 1st May 1851 to 30th April 1852	2,425	7	587	4	3		1	6								1	
Ditto ditto ditto, from 1st May 1852 to 30th April 1853.	4.018	40		• • •	6	5	12	33	2	1			1			1	
From Kurrachee to Kotree, from 1st May 1851 to 30th April 1852  Ditto ditto ditto, from 1st May 1852 to 30th	763	28	696	8	1			6		1	<b>.</b>		••		••		
April 1853	584	22	547	2	10	4	20	31	2	5		1	3	••••			
From Kotree to Kurrachee, from 1st May 1851 to 30th April 1852	122	45	180	2	6	16	2	<b>5</b> 3	3	2				2,250	<b> </b>	1	
Ditto ditto ditto, from 1st May 1852 to 30th April 1853	72	6	886	0	11	15	24	<b>8</b> 8	5	13				3,880	1	4	
Total	23,622	12		· <del></del>	90	87	113	356	36	26	$\vdash_1$	2	6	6,130	1	12	-

(True copy)
W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

(Signed) R. ETHERSEY, Captain, I. N., Commanding Indus Flotilla.

#### APPENDIX E.

Statement showing the Number of Government Troops, Stores, and Passengers, conveyed by the different Steamers and Flats of the Indus Flotilla, between Kurrachee and Mooltan, and vice versa, between the 1st February 1848 and 30th April 1853.

No. of Troops.	Government Stores: Quantity or No. of Packages.	Government Stores : Tonnage.	No. of Government Passengers.	Remarks.
28,022	133,319	Tons. cwt. qrs. 1bs.	20,831	The Stores comprise Military, Ordnance, Commissariat, and Flotilla Stores, which are usually numerous and bulky; grain for the Commissariat Departments in the province; boxes of treasure; iron stores for the Punjaub, which have been excessively heavy, and will in all probability
				increase yearly; Regimental kit and baggage of Troops; and ale and porter for the Punjaub, which will also increase in quantity.

Kotree, 23rd June 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

(Signed) R. ETHERSEY, Captain I. N., Commanding Indus Flotilla.

APPENDIX F.

Abstract of the Police Returns, showing the Total of the different Stations on the High Road between Kurrachee and Kotree.

Police S	Stations.			Carts.	Camels.	Horses.	Donkeys and Mules.	HornedCattle.	Sheep and Goats.	Porters with Loads.	European Foot Passengers	Native Foot Passengers.	Pälkees and Litters.	European Car- riages.	a#
Jemedar-ke-Landi Gharra Tatta Jerruck	••	••	•••	201 146 132 66	7,697  4,391	7,162 2,339	6,940	7,416  4,460	1,684  5,561	7,287	392	46,958 21,094	93	56  13	
Mean of Jemedar- ruck	ke-Land	li and	Jer-	133	6,044	4,750	5,391	5,938	3,622	4,002	236	34,026	50	34	
Deduct one-third	• •	••	• •	44	2,014	1,583	1,797	••••	***	••••	Passengers.	d above for Passengers.	••••	****	
				89	4,030	3,167	3,594	••••	••••	4,002	236	11,342	***	••••	

#### ABSTRACT.

(True abstract)
W. CHAPMAN, Lieutenant,
Engineers.

Return of the Traffic at the undermentioned Places, from June 1852 to May 1853, inclusive, compiled from the Monthly Returns furnished by the Police Authorities.

										10	iius z	1 46/40/ 6													
							J	EM ED A F	R-KB-LA	NDI.				]					GH	ARRA.					
	·			Carts.	Camels.	Horses.	Donkeys and Mules.	Horned Cattle.	Sheep and Goats.	Porters with Loads.	Foot Passengers, European.	Foot Passengers, Native.	Palkies or Litters.	European Car- riages.	Carts.	Cemels.	Horses.	Donkeys and Mules.	Horned Cattle.	Sheep and Goats.	Porters with Loads.	Foot Passengers, European,	Foot Passengers, Native.	European Car-	Palkies or Litters.
June July August Septembe October Novembe	r		••	13 13	722 950 500 682 812 792 1,235	398 339 559 685 882	395 43 <b>0</b> 639 595 478	344 263 614 720 812	42 63 143 112 80	1,421 853 413 315 682	l: 51	1,329 1,343 1,339 2,722 6,985	3 5 6	2	3	848 389 236	962 691 561 511 1,470 666 821	1,421 1,240 978 934 3,172 1,793 1,081	2,774 1,091 622 240	1,640 2,468 1,834 5,197 3,093		1 12 3	2,753 2,462 2,282 3,219 2,996	 3 1	1 6
Pebruary March April May	••	••	•••	20 42 25 27 30 201	458 119 457 430 540 7,697	1,019 389 157 379	994 512 540 412	1,124 585 415 327	112 625 217	712 372 289 256	38 87 49 27	2,562 4,912 5,678	15 12 2	12 5 3	13 39 33	3,715 3,593		1,434 2,337 2,618 3,114	1,350 3,019 4,547 5,121	790 1,300 303	2,061 2,689 3,712	39 14	3,648 4,714 4,970	3	5 5 1
Gharra Tatta Jerruck	••	••	•••	146	23,798 13,438	16,387 6,850	21,943 6,052	26,511 9,041	21,186 4,138	24,682 5,142	210 218	44,117	39 34	21 15	<u> </u>	20,130	10,007	21,540	20,011	21,100	24,002			39	
Total Grand		••	<u></u>	<del>-</del>	<del></del>	i	i——	<del></del>	30,885	ì——	i <del>i</del>	99,686 146,644	<u>-</u>		ŀ										
Mean of places	the s		foar	j			<u> </u>		8,142		_	<u></u>													

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			-			Т	ATTA.		<u>-</u>		•							Jer	RUCK.						
			Carts.	Camels.	Horses.	Donkeys and Mules.	Horned Cattle.	Sheep and Goats.	Porters with Loads.	Foot Passengers, European.	Foot Passengers, Native.	Palkies or Litters,	European Carriages.	Carts.	Camels.	Horses.	Donkeys or Mules.	Homed Cattle.	Sheep and Goats.	Parters with Loads.	Foot Passengers, European.	Foot Passengers, Native.	Palkies or Litters.	European Carriages.	
June July August September October November	••	•••	4    2 12	1,028 1,534 511 419 15 1,058 2,120	503 863 615 388 489 667 617	391 583 449 215 256 404 476	465 744 721 328 1,063 873 901	316 632 273 568 1,206 130 71	62 3 12 24 65 56 158	9  24 14	3,133 2,216 2,5.8 2,516 2,579	 1 4 2		2	473 316 191 345 504 649	137 123 166 174 163	187 214 262 174 236 192 484	179 959 578 717 173	952 690 1,037 758 720	45 51 24 43 68	1 4	1,273 1,824 1,562 1,629	1	::	_
January February March April May	•••		10 46 15 18 25	1,594 1,401 1,340 1,296 1,122	561 553 591 608 394 6,850	374 565 817 781 741 6,052	1,005 718 9×4 660 579	140 319 80 253 150 4,138	18 4 1,647 1,780 1,312 5,142	29 36 33 12	3,642 3,451 2,984	 3 2 	6 3	3 3 10	431 475 455	218 180 246	ļ	280 281 263 314	38 205 59 300	74 47 101 65	13 6 4		••	 7 	-
	÷		<u> </u>				Mea	n of Jer			e-Landi		2)	201 267 133		9,501	10,783	7,416 11,876 5,938	1,684 7,245	7,287 8,005	392 473	46,958 68,052 34,026	93	56 69	

(True Abstract of Monthly Returns in the Commissioner's Office)

W. CHAPMAN, Lieutenant,

Engineers.

APPENDIX G.

Abstract of Statement given by Camp Merchants in writing of the Overland Trade of their respective Firms.

Names of Camp Merchants.	Camels.	Carts.	Coolies.	Load, Camel.	Load, Cart.	Load, Coolie.	Total.	Remarks.
Treacher and Co	141	••••		lbs. 300	lbs.	lbs.	lbs. 42,300	•
Cursetjee Cowasjee	53	••••	••••		••••		50,880	
Jehangeer Nasserwanjee	None.	••••		<b></b>			••••	
Ruttonjee Framjee	107		****	261	****		27,927	Several other Merchants and
Jhanjeer Bhomajee	None.	••••	••••	• • • •	• • • •		••••	Bhoras were applied to for similar information, but no
Merwanjee and Co	75	****	••••	150	****	••••	11,250	replies were received.
Pestonjee Rajkota	30	25	4	320	960	40	33,760	
						Total	166,117	Or 74.2 tons.

(Signed) W. CHAPMAN, Lieutenant, Engineers.

Kurrachee, October 1853.

Abstract of Roll of Merchandize forwarded by the different Overland Routes by the Merchants, Residents, and Agents, in the Town of Kurrachee.

	Number	reported.	Proportion as going	to be taken through.	Camel Load		Total Tons.	
	Camela.	Tattoos.	Camels.	Tattoos.	600 lbs.	240 lbs.		Remarks.
Kurrachee Merchants	7,406	25	7,406	25				
Shikarpore ditto	1,696	••••	1,696	<b></b>	lbs.	,		Sett Navian Doss and others
Ditto ditto	596	• • • •	- 596		3,800	, lbs.	tons.	taking two-thirds over the whole distance.
Tatta ditto	1,600	<b>43</b> 0	1,067	430	s. each, =8,218,800 lbs.	each	3.7 tc	
Kojahs, Rs. 50,000, at Rs. 125 per camel	400	• • • •	400		lbs. ==	18s. = 109	3,669 48	Take half most probably, for short
Miscellaneous, Rs. 1,00,000	800	••••	400	****	At 600 lbs. × 600 lbs. =	t 240 lbs. each, 240 = 109,200 lbs.	Camels 3,669 Tattoos 48.7	distances.
imports by Land, estimated at Rs. 4,00,000, at					* × .	455 x	Tat	
Rs. 125 per camel	3,200	••••	2,133	••••	13,698	4		Suppose two-thirds to pass over the whole distance.
Total Tons			13,698	455		,	3,717.7	
	Camp	Merchants	as above	•• •• ••	Tons. 74.2			
•	•	Merchants		•• •• ••	3,717.7			
			To	tal	3,792.0			

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

Roll of the Merchants residing in Kurrachee, showing the Amount of Merchandize transported by them during the Year 1852 from Kurrachee up Country, Weight and Approximate Value of each Load, and the Number of Camels and Tattoos used for the carriage thereof.

a No.	N.	AMES OF MERCHANTS			CAMELS.			TATTOOS.	Total		Remar	
	Name of Owner.	Resident of	Name of Agent or Carrier.	No.	Value of 1	load.	No.	Value of Load.	Value of Lo	eds.	Remar	<u> </u>
	MERCHANTS OF KURRACHEE.				Rs.	<b>A.</b> P		Re. A. P.	Rs.	A. P.		
1	Sett Khemchund	Kurrachee	K hanahund	100 350	12,500 23,750	0 0		5,000 0 0	17,500 23,750	0 0		
3	Numga Bhattia	Gumbat	Kowni wattad Hoseah	400	50,000	0 0	. 1	••••	,	0 0		
4	Sowett welled (follo	Ditto	Museut mulled Osmama	200	<b>47,</b> 500	0 0		•••••	47,500	0 0		
5	Gool Patolee	Allyar-ke-Tanda	Godoo Bhattia	160	19,000	0 0			19,000	ŏŏ		
6	Gool Patolee	Gumbat	Gooloomull wullud Butchamull	625	78,125	ŏŏ			78,125	0 0	1	
7	Gungoomull wullud Hoonda	Gorrabarry	Ramieemull	128	16,100	0 0			16,100	ŏŏ	ł	
8	Mugganmull wallad Chutta	Ditto	Achoomuli wullud Amund	571	91,375	Ŏ O		• • • • •	91,375	0 0		
9	Nuwcomuli	Kurrachee	Mahboob wullud Khemchund	80	10,000	0 0			10,000	0 0		
10	Anoomuli wullud Endass	Maiundeh		141	16,625	0 0	1		16,625	0 0	Ì	
11	Narroomull wullud Butcha	Barry	Gungoomull	272	34,0●0	0 0		,.	34,000	0 0		
12	Tarramull wüllud Tawoomull Oomurnamull wullud Assanund	Sehwan	******	208	26,000	0 0		•••••	26,€00	0 0	Į.	
13	Oomurnamuli wullud Assanund	Allyar-ke-Tanda	*****	64	8,000	0 0			8,000	0 0	ļ	
14	Ayudass	Majundeh	Dinomull wullud Tillokchund.	225	28,125	0 0			28,125	0 0	1	
15	Husraz wullud Gain	Ragoo Ghotha	*****	64	8,000	0 0		*****	8,000	0 0	İ	
10	Bhooromull wullud Daivun	Sehwan		245	30,625	0 0		*****	30,625	0 0		
17	Kawulmull wullud Rajoonund	Allyan-ke-landa	Hurput wullud Allumchund	60	7,500	0 0		*****	7,500	0 0		
18 19	Sungut Wurrie	Ditto	Sukoomuli wullud Lailchund	128	16,100	0 0		*****	16,100	0 0		
.9∩	Tellchund wullud Chundun Suntoo wullud Chellah	Dista	*****	160 322	19,000	0 0		4 * * * * *	,	0 0		
21	Gungoo wullud Toolsia	Allien to Tonde	Dunnensk mulled Sookhoo	172	40,250 21,500	0 0		* * * * * *	,	0 0	1	
22	Vapareemuli	Hyderahad	Physical walled Sockhoo	601	75,125	0 0		*****		0 0	1	
	Alla Bux	Tatta	Bhoome wulled Suchanned	625	78,125	0 0				0 0	ŀ	
24	Tarachund Mookhie	Hyderabad	Amout wallad Suchanand	400	50,000	0 0	1	•••••		0 0		
25	Dhoola wullud Gunoo	Ditto	Abanas de de de la constantida del constantida de la constantida de la constantida de la constantida de la constantida de la constantida del constantida de la constantida de la constantida de la constantida de la constantida de la constantida del constantida del constantida del constantida del constantida del constantida del constantida del constantida del constantida d	250	31,250	ŏŏ		*****	31,250	0 0	]	
26	Wunundmull	Ditto	Bhomull wullud Susanah	200	25,000	o o	4		25,000	0 0	Į.	
	Halfiz Wurrianee	Tatta	Roshun wullud Niboodha	250	31,250	0 0			31,250	0 0	i	
28	Goolam wullud Kadindinah	Ditto	*******	225	28,125	Ö. Ö				ŏŏ		
							_  ``				Total	camels
					9,22,950	0 0		5,000 0 0	9,27,950	0 0	7,406;	
					• •		ł		1 1		25.	

	NA	AMES OF MERCHANTS	•		CAMELS.				TATTOOS.		Total				
No.	Name of Owner.	Resident of	Name of Agent or Carrier.	No.	Value of	Load		No.	Value of	Load.	Value of I			Reman	rks.
	Merchants of Shikarpore.  Mungoomull Lallchund wullud Boollamull Madowdass Choowur wullud Nanoo Ramdass Heeranund wullud Meghraz Boollamull wullud Mohunmull Narraindass wullud Goollamull Rahakisson wullud Nundram	Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto	Purushram wullud Chumondass	150 150 100 150 150 250 150 325 271	Rs.  45,000 45,000 45,000 45,000 75,000 45,000 97,500 81,300	0 0 0 0 0	0 0 0 0 0 0 0	•••	Rs.	a # 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	Rs. 45,000 45,000 30,000 45,000 45,000 75,000 45,000 97,500 81,300	0 0 0 0 0 0	P. 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Total	camels
2 3 4 5 6 7 8 9	Merchants of Tatta.  Assoomuli	Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto Ditto	Loodhunmull Bhattia Gungoomull wullud Mungoomull Gowmull wullud Samee	25 25 100 100 250 250 250 150 100	3,125 3,125 12,500 12,500 31,250 31,250 31,250 18,750 12,500 12,500	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0	25 25 25 25 50 50 50 40 25 40	5,000 5,000 5,000 10,000 10,000 10,000 8,000 5,000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	8,125 8,126 17,500 17,500 41,250 41,250 41,250 26,750 17,500 20,500	0 0 0 0 0 0 0 0 0 0		Total	camels
			Grand Total		16,31,750	0	0		86,000	0 0	17,17,750	0	0	1,600 ; 430.	tattoos

(True copy)

W. CHAPMAN, Lieutenant,
Engineers.

List showing the names of the Jhutts employed by the Merchants for the conveyance of their Merchandize.

No.		N	ames.				Caste.	Residence.
1	Ghoolam Hoo	sain		• • •			)	)
2	Chutton		• •	• •	• •		/	
3	Joomah.		• •			•	Lusharie	
4	Goolam Allie			• •	•			
5	Mohobut			•		• • •	)	<u> </u>
6	Peeranah	••	• •	• •	• •	• •	7.	≻Sehwan.
7	Kandeyra	••		• •			Bubur	<b>! !</b>
8	Loung	• •	• •	• •	• •	• •	Behranee	1 .
9	Mahomed	• •	• •	• •	• •		Bullad	
10	Hazie	••		• • •			Gudda	
11	Moobaruck	- 4	• •	• •	• •		Lusharie	
12	Meer Khan		• •	• •	• •	• • •	Kosha	Hyderabad.
13	Ranah			• •	• •		<b>)</b>	*
14	Sunzur		• •			•	Behranee	Hillavah.
15	Khubud	• •					<b>\</b>	
16	Bhuria		• •		• •		Gudda	Kotree.
17	Adil	••						Allyar-ke-Tanda
18	Dittah	• •	• •	• •			Bubur	Sehwan.
19	Mewah Jhutt			• •	• •			Majundeh.
20	Mahomed All		tt	• •				h "
21	Robill Chand		• •	• •	••		Chandia	
22	Puklua Meer		• •	• •	• •	• • •		Seh wan.
23	Bungul Meer		• •	• •	• •			
24	Dosee		• •				Sohah	ij

(True copy)

W. CHAPMAN, Lieutenant, Engineers.

# Estimate of the Average Load carried by Camels and Tattoos, and Approximate Value of each Load.

A camel load varies from 7 to 8 maunds; the merchants pay for 8 maunds. It is optional with the Jhutts to use one or more animals for this load.

The value of a camel load of goods belonging to a Kurrachee merchant is averaged as low as Rs. 125, which is attributable to many of the loads consisting of grocery, coconnuts, and dates, the maximum value of the loads being Rs. 130, minimum Rs. 12: the most valuable loads consist of sugar-candy.

The Shikarpore merchants' loads are much more valuable, consisting chiefly of silks and fine cloth, the maximum value of such being Rs. 800, minimum Rs. 500, average value Rs. 300.

The load of a tattoo is three maunds, valued at Rs. 200 per load, and is thus highly priced, as it consists of valuable silks and fine cloth.

From information obtained from various individuals, it is calculated that last year the Kurrachee merchants forwarded Rs. 9,27,950 worth of merchandize.

The Shikarpore merchants, or their Agents residing in Kurrachee, Rs. 3,30,000 worth, the Tatta merchants Rs. 2,86,000.

The amount of the Kojahs' has not been ascertained, as also of one of Shikarpore, Sett Narraindoss, but the amount of merchandize transported up country by these parties is supposed to be about one lakh.

It is estimated that one lake of goods is transported away by various people who do not reside permanently in Kurrachee, but come in to hire out their camels at the opening of the season. The above account gives a total of Rs. 17,43,950 worth of goods transported from Kurrachee bunder. I feel pretty sure that this falls far short of the actual amount that was transported; but from a great dislike on the part of the merchants to disclose the amount of their business, from a foolish dread that the inquiry is only a forerunner of some kind of limitation, it was impossible to gain very accurate information on this subject.

I have adopted measures for procuring a correct account of goods transported up country during the present year.

The names of the camel-men who actually took away each load could not be ascertained, but a list is furnished of the men who are usually employed as Jhutts by these merchants.

Since writing the above, I have obtained the account of the Shikarpore Sett Narraindoss, which amounts to Rs. 97,500, and that of another Shikarpore merchant, named Radda Kishun, amounting to Rs. 81,300, and estimating the amount of the Kojahs at half a lakh, we have a grand total of eighteen lakhs, ninety-two thousand, seven hundred and fifty (18,92,750). Imports by land are estimated at four lakhs, and consist chiefly of oil seeds, mustard seed, wheat, bajerce, and coloured cloth from Upper Scinde.

(Signed) E. P. ARTHUR,
Officiating Captain of Police.

Kurrachee, 10th October 1853.

(True copies)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

#### APPENDIX H.

No. 406 of 1853.

To LIEUTENANT CHAPMAN, Engineers,

On Special Duty, Scinde, Kurrachee.

SIR,

In acknowledging the receipt of your letter of the 12th May last, I would beg leave to submit to you, that my knowledge of the country between Kurrachee and the line of the Indus is very limited. I would mention, however, casually, for your consideration, that Jerruck is a fixed position, which is not the case with Kotree, and that the former on that account would appear to be better adapted as a terminus to a railway. In addition to the above, I might mention that in the direct line to Kotree is the Bharun river, at times a wide, rapid, and dangerous stream, which might materially interfere with, as well as add to, the expense of the projected work.

- 2. There can be no doubt as to the benefits which must accrue to the province should a line of railway be carried out between Kurrachee and any point on the river. At present the traffic is conducted partly by camels between Sehwan, Kotree, and Kurrachee, and in part by the river doondas, which navigate the tidal channels at all seasons of the year: both are most tedious, and far from inexpensive, owing to the waste of time, more especially in the case of doondas, as also to the serious losses which occasionally occur, owing to the foundering of these unwieldy craft. In rainy weather, laden camels are unable to travel, so that the road line may be considered closed should a wet season occur.
- 3. As my duty extends to the registry of the external trade only, I am able to say nothing positive with regard to the internal traffic by land. One point, however, I am satisfied of—that is, that the whole of the trade which now finds its way by the direct line to Sehwan, to Kotree, and to Tatta, and by doondas and other cargo boats by the tidal channels, will all enter the railroad.
- 4. The external trade of Scinde has steadily increased at the rate of 20 per cent. per annum for several years past: this may form an index, though but a faint one, to the future progress of the province. We have already commenced a direct traffic with England, and once we are able to export produce to the mother country, Kurrachee will command the trade of Mekran, of Eastern Arabia, and of the Persian Gulf.
- 5. I may also add that the Indus, though nominally open to commerce since Lord Ellenborough's proclamation after the conquest of the country in 1843, yet was virtually sealed up to the beginning of last year, when river dues were finally abolished: we may therefore expect that the raw produce of the Punjaub and the North-West Provinces will now find its way continuously and uninterruptedly by the line of the Indus, in exchange for the manufactures of Europe—a trade which has already received considerable impetus from the establishment of the regular monthly steamer between Mooltan and Kurrachee. And here I must not forget to mention the important fact that the Indus is now the highway for Troops and Military stores to the Punjaub and Upper India. During the present year 5,000 casks of ale and porter alone passed through Kurrachee, and as much more is

hourly expected. All this is conveyed in carts from Kemaree to Ghizree, a distance of 6 miles, where it is shipped in country boats, many of which will spend the greater part of a month in the salt-water creeks before they get to the Indus. The cost of all these operations has yet to be ascertained, but were the projected railway in existence, there cannot remain a doubt, that not only a considerable saving would be made in carriage, but that the article itself would have ever g chance of reaching the Indus in good order and condition,—a point which, under present arrangements, must be considered doubtful.

6. I have, in conclusion, to regret that I am unable to furnish you with more precise information on the various subjects touched on by you. The tables which accompany this are—

1st,—The last Trade Report of External Commerce.

2nd,—An Abstract of Shipping for 1852-53, with remarks thereon.

3rd,—Statement of the River Traffic for 1851-52 and 1852-53, as registered at Khettie.

I have the honour to be, Sir,
Your most obedient Servant,
(Signed) J. MACLEOD,
Deputy Collector of Customs.

Kurrachee Custom House, 19th October 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,

On Special Duty, Scinde.

			•					Bo	MBAY.					Coz	NCAN.					Cu	тсн.			Goa Dea	AND IAUN.
	Ат К	URRACI	HBB.			Mer	chandize.	Sto	ernment res and roops.	E	mpty.	Merc	handize.	Stor	ernment es and coops.	Ец	pty.	Merc	handize.	Sto	ernment res and roops.	En	pty.	Merch	andize.
							essels.	v	essels.	v	essels.	V	essels.	Ve	easels.	Ves	sels.	Ve	ssels.	v	essels.	Ves	sels.	Ves	sels.
August 1852	••			-		No.	Tons. 425	No.	Tons.	No.	Tons.	No.	Tons.	No.	Топа.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
ieptember	••			••	* *	13	1,228	2	83	• •	••		••	•	100	• •	••	2	80		••	••	• •	••	::
October	••	••	••	••	• •	36	2,316	3		1	••		••	3	130	••	••	12	475	•	117	5	• '	••	••
lovember		••	• •	• •	• •	<b>3</b> 9	<b>2,5</b> 10				••	١٣	••	, 1	27	••	••	16	519	1	••	1	12	••	• •
ecember	••	••	••	• •	• •		•	9			••	2			••	••	••	22	661			••	••	5	
anuary 1853	••	• •	• •	••	••	39	2,232	22	'		••	2	76	•••	••	••	••	16	456	1		. 4	<b>9</b> 2	.3	107
·	••	••	••	••	• •	39	2,892			,	1,354		• •	•••	••	••	••	23	692	13	597	2	77	••	• •
ebruary	••		••	••	••	38	2,463		229	1	33	4		•	•,•	•••	••	25	731	••	••	1	1,7	2	39
Iarch	••	• •	••	••	••	51	3,138		••	••	••	8	289	••	••	]	33	28	844	••	••	2	179	• • •	••
pril	• •	**	••	<b>4.</b> n	••	35	<b>2,15</b> 0	••	••	••	••	2	74	••	••	••		21	696	••	••	3	90		••
lay	••	••	••	• •	••	44	2,170	••	• •	••	••	3	85	••	••	••	••	7	335	••	••	]	<b>5</b> 0	••	••
une	• •	••	••	••	• •	4	174	••	••	••	••	3	30	••	••	••	••		••	••	••	••	••	••	••
uly	••	••	••	**	• •	••	••••	••	••	••	••		• •	••	••	••		••	••	••	••	••		••	••
Khettie.	••	••	••	<b>, .</b>	• •	340 120	21,693 4,242	38	2,002		1,387	22 28	737 1,038	4	157		33	172 217	5,489 5,040	30	1,283	19	655	10	
						460	25,935	38	2,002		1,387	50	1,775	4	157		33	900	10,529	30	1,283	19	655	12	411

## Shipping Arrivals, 1852-53 (continued).

							Guzz	BRAT.		Mai	LABAR.		Arabia Ersian				Mekr	AN.				Scini	)E,		
	Ат І	CURRAC	сняв.			Merc	handize.	Gover Store Tro	s and	Merc	handize.	Merc	handize.	En	ıpty.	Merc	handize.	Em	pty.	Merch	andize.	Stor	rnment es and ops.	Em	pty.
						Ve	scels.	Ves	zels.	Ve	asels.	v	essels.	Ve	nels.	Ve	essels.	Ves	sels.	Ve	saels.	Vea	rels.	Ve	sels.
						No.	Tons.	No.	Tone.	No.	Tone.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tone.	No.	Tons.	No.	Tons.
August 1852	••	• •	••	• •	• •	••	••	• •	••	••	••	3	58	••	••	••.	••	••	••	<b>3</b> 3	<b>3</b> 63	••	••	••	••
September	••	••	••	••	• •	••	••	••	••	••	••	15	556	••	••	3	. <i>5</i> 5	1	15	128	1,574	••	••	••	••
October	••	••	••	• •	••	2	88	••	••	••	••	13	585	••	••	2	<b>3</b> 2	1	15	143	1,788	••		••	••
November .	••	••	••	••	••	11	433	••		4	<b>16</b> 3	13	460	••		4	107	••		111	1,403	• •		]	10
December	••	••	• •	••	••	7	233	••	••	3	144	9	378		<b>.</b> .	3	47	1	<b>6</b> 2	121	<b>1,38</b> 3	2	19	3	82
January 1853	••	••	• •	• •	• •	3	119	2	224	7	496	δ	219	1	38	7	172	••	••	111	1,283	••			
February	••		••	••	• •	8	447	••	• •	16	785	4	242	••		10	<b>22</b> 0		••	127	1,474	• •			
March	• •	••	••	••	• •	6	237	1	62	12	<b>7</b> 17	δ	197	••		9	<b>13</b> 3	4	9}	165	2,042	••			
April	; ••	• •	••	••	• •	5	198	••	••	1	<b>5</b> 4		••	••		3	<b>6</b> 6	••		125	1,615	••	••	2	19
May	••	••	••	••	٠.	10	510	••	••	6	347	1	56	4.		••	••	••		132	1,587	••		1	10
lune	••		••	••	• •			••	••		• •	2	82	••		••	••	••	••	56	518	••	••	••	••
Tuly	••	••	••	••	• •			••	••		• •		••	••		••	••	••	••	27	258	••	••	••	
•••						<u>52</u>	2,265	3	<b>28</b> 6	48	2,706	70	2,835	1	38	41	832	7	190	1,279	15,288	2	19	7	121
Khettie	• •	••	••	• •	• •	4	112	••	•••	5	218	22			<u></u>	•••	••				••			<u>··</u>	
						56	2.377		286	<b>5</b> 3	2,924	92	3,166	1	38	41	832	7	190	1,279	1.52×8	2	19	7	121

## Shipping Departures, 1852-53.

								1	Вомва	Y.				Cond	AN.				Ct	TCH.			Goz	A AND I	Эвма	UN.
	,]	From I	<b>C</b> URRAC	енев.			Mer	chandize.	Govern Store Tro		Em	ipty.	Merch	andize.	Em	pty.	Merç	bandize.	Stor	rnment es and oops.	Eı	mpty.	Mercl	handize.	Em	p <b>ty.</b>
							γ	esselq.	Ves	sels.	Ve	ssels.	Ve	sels.	Vea	sels.	Ve	ssels.	Ve	essels.	Ve	essels.	Ve	ssels.	Ves	els.
							No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Топа.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
August 185	2	••	• •	••	- 4	• •	2	450	, <b>* *</b>	••	••	••	••	••	•••	••	]	12		••	••	•	••	••	••	••
September	••	••	••	••	• •	••	29	2,010	••	••	)	70	••	••	••	••	6	176	••	••	1	19	••	••	••	••
October	••	••	••	••	• •	• •	36	2,513	••	••	1	54	••		••	••	1	34	••	••	5	170	••	••	2	56
November	••	••	••	• •	••	• •	40	8,105	9	482	1	115	••			••	5	118	••	••	9	<b>24</b> 2	2	37	2	62
December	••	••	••	• •	••	••	47	2,631	••	••	2	139			3	42	13	332	10	415	4	116	1	30	2	94
January 185	53	••	••	••	••	• •	40	2,377	••	••	••				••	<b> </b>	16	516	24	1,128	5	116	••	••		••
February	••	••		••	••	• •	33	2,262	••	••	••			<b></b>	••	   ••	8	163	8	494	7	248	٠.	••	••	••
March		,• •	••	••		• •	38	2,678	••		2	73			2	58	13	416	1	52	10	<b>3</b> 15		••	2	85
April	••	••	••			• •	34	2,627	••		2	99			••		10	299	••		6	369		••	3	91
Мау	• •	••	••	••			33	2,084	••	••							10	1			9	466			6	225
June				••	••				• •		1			Ì			4	<b>27</b> 9			3,	203		••	<b>9</b> , 4,	
July									·			1	••	•••	*.*											
	••	••	••	• •	••	• 1		••			<u></u>				<u></u> _		<u> </u>									
Khettie	••	••	••	••	••		332 299	22, <b>7</b> 37 10, <b>7</b> 09	9	482	10 	839	••			100	87 186	<b>2,825 3,905</b>	<b>4</b> 3	2,089	59 ••	2,264	3 8	67 266	17	613
							631	33,446	9	482	10	839	<u> </u>		3	100	273	6,730	43	2,089	<del></del> 59	2.264	11	333	17	613

							Guze	RAT.			MALA	BAR.			Arabia: Ersian				Meke	lan,				Sci	NDE.			
1	From	Kurr	ACHEE.			Merc	handize.	Em	ıpty.	Merc	handize.	Em	ıpty.	Merc	bandize.	Em	p <b>ty.</b>	Merc	handize.	Em	p <del>ty</del> .	Merc	handize.	Stor	rnment es and oops.	E	mpty.	
						Ve	asels.	Ve	ssels.	Ve	ssels.	Ves	sels.	Ve	ssels.	Ves	sels.	. Ve	essels.	Ves	sels.	Ve	asels.	V	cazels.	v	essels.	
A 1056						No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Топа.	No.	Tons.	No.	Tone.	No.	Tons.	No.	Tone.	
August 1859		••	••	••	• •	••	••	••	••	• •	• •	••	••		••	••	••	]	17	••	••	29	446	••	••	36	443	
September	••	••	••	• •	• •	1	23	••		••	• •	• •	••	4	172	••	••	3	53	6	218	38	458	••	••	97	1,241	
October	••	••	••	••	••	2	26	••	••		••	1	84	6	311	1	30	6	207	3	85	70	862	••	••	99	1,750	
November	••	••	••	••	••	2	65	1	27	1	41	••		6	222	2	89	6	123	4	119	60	778	••	••	49	780	
December	••	••	• •	••		2	<b>7</b> 3	••		19	866	2	91	3	107			4	82	5	115	64	807	10	147	71	989	
January 185	53	••		••		4	135	3	124		••	••		4	189			6	174	2	26	30	396	1	45	108	1,632	1
February	••	• •	••	••	••	1	39	••			••			2	<b>7</b> 5	1	39	13	332	4	47	27	423			102		
March		••	••	• •	••	6	233	6	306					4	145			4	154	1	15			l '	••	174		
April	••	• •		••	• •	1	30	4	<b>19</b> 9					5				4								99	,	
May	••	,	••	• •	• •	2	65	••				• •		2				4	122	1	37	39	462		••		,	
June	••			••												••	•••			1		28			••	88	1,086	
July					••	••	• •	••	••	••	••	••	••		••	••	••	''	••	••	• •		645		••	44	423	
. u.y 11	••	••	••	••	••		•••	• •		···	••	<u></u>		<u>  -                                   </u>		<u></u>		<u></u>			•••	21	300	;		18	165	
Khettie	••		••	••	••	21 7	689 293	14	656	20	907		175	36 9		4	158	51 	1,421	28	704	513	7,236	11	192	985	14,975	
						28	982	14	656	20	907	3	175	45	1,611	4	158	51	1,421	28	704						14,975	

Abstract of Shipping for 1852-53.

								Anni	VALS.							DEP.	ARTURE	8.		
Ports.					Merch	andize.	Sto	ernment es and cops.	Eı	mpty.	T	otal.	Merc	nandize.	Stor	rnment es and cops.	Eı	npty.	T	otal.
					Ve	seels.	V	essels.	Ve	essels.	Ve	saels.	Ve	saels.	Ve	ssels.	Ve	saels.	Ve	sels.
					No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.	No.	Tons.
Bombay	••	••	••	••	460	25,935	38	2,002	2	1,387	500	29,324	631	33,446	9	482	10	839	650	34,767
Concan	••	••	••	••	50	1,775	4	157	1	33	55	1,965	••	••	••	••	• 3	100	3	100
Cutch	••	••	• •	••	389	10,529	30	1,283	19	655	438	12,467	273	6,730	<b>4</b> 3	2,089	<b>5</b> 9	2,264	375	11,083
Goa and Demaun	••	••	••	• •	12	411	• •	••	••	••	12	411	11	<b>33</b> 3	• •	••	17	613	28	946
Guzerat	••	••	••	• •	56	2,377	3	286			<b>5</b> 9	<b>2,</b> 663	28	982	••	••	14	656	42	1,638
Malabar	••	• •		••	53	2,924	• •	**		••	<i>5</i> 3	2,924	20	907	• •	• •	3	175	23	1,082
Arabian and Persian Gulfs	••	••	••	••	92	3,166		••	1	38	93	3,204	45	1,611	••	••	4	158	49	1,769
Mekran	••	••	••	**	41	832	••	••	7	190	48	1,022	51	1,421	••		28	704	79	2,125
Total	••	••	••	••	1,153	<b>47,94</b> 9	75	3,728	30	2,303	1,258	53,980	1,059	45,430	52	2,571	138	5509	1,249	53,510
Scinde	• •	••	••	••	1,279	15,288	2	19	7	121	1,288	15,428	513	7,236	11	192	985	14,975	1,509	22,403
Grand Total		••		••	2,432	63,237	77	3,747	37	2,424	2,546	69,408	1,572	52,666	63	2,763	1,123	20,484	2,758	75,913

(True copy)

W. CHAPMAN, Lieutenaut, Engineers,
On Special Duty, Scinde.

(Signed) J. MACLEOD,
Deputy Collector of Customs.

From these statements it will be observed, that the amount of tonnage entered inwards in 1852-53 amounted to say 48,000 tons, exclusive of the provincial coasting trade; and that the outgoing tonnage was 45,000 tons.

It would not, however, be correct to assume these figures as the amount or weight of our internal traffic, or rather as the weight of the traffic passing between Kurrachee and the upper country by the line of the proposed railway. To estimate this traffic, we must exclude from the above figures, 1st, the consumption at Kurrachee, Khettie, and the neighbouring places; 2nd, the imports and exports across our western frontier; and 3rd, an allowance should be made for the partial lading of vessels. The balance may then be taken as the probable amount of traffic which passed upwards and downwards.

		ARRIVALS.		]	DEPARTURES	
Ports.	Tonnage of Merchandize as registered.	Deduct Allowance as above.	Probable Amount pass- ed upwards by Land & River.	Tounage of Merchandize as registered.	Deduct Al- lowance as above, Re-ex- ports.	Probable Amount brought down by Land and River.
Bombay	25,935	6,935	19,000	<b>3</b> 3,446	8,446	25,000
Concan	1,775	1,775				
Cutch	10,529	7,529	3,000	6,730	2,730	4,000
Goa and Demaun	411	411		333	183	150
Guzerat	2,377	2,177	200	982	682	300
Malabar	2,024	1,424	1,500	. 907	907	<u> </u>
Arabian and Persian Gulfs	3,166	1,166	2,000	1,611	811	800
Mekran	832	432	400	1,421	721	700
Tons	47,049	21,849	26,100	45,430	14,480	30,950

As the internal traffic of the province has not been registered, the above is the only data that can be offered for a railway statistic. This department has not the means of estimating the village to village traffic, nor the number of passengers passing upwards and downwards, both of which form important items in railway business.

The commerce of the port has been progressing during the past few years at the rate of 20 per cent. per annum, and there is every reason to expect a continuance of the progressive ratio. The residents in the Punjaub have shown a desire to procure their supplies by the Indus, in preference to the line of the Ganges, and in a few years their desire will in all probability be gratified to the fullest extent. An extensive Affghan trader, who has had dealings with Calcutta for years, having tried the Bombay market during the two past seasons, has given the latter the preference. Others will follow his example. These prospects of the Scinde trade lead me to believe that by the time a railway shall be laid down, and be prepared for action, our commerce will have doubled its present value, and the passenger traffic be ten times as much as it is at present.

To obtain data of a more accurate character than that now given, it will be necessary to adopt the Bombay plan for obtaining it, viz. to set Moonshees to watch the traffic by the principal roads in the direction of the proposed railway. The traffic on the river should also be noted, as well as the number of wayfarers passing by both the land and river routes. Everything, in fact, passing those roads should be noted; as the facts so collected may be made available for a railway statistic in some way or another.

The movement of Troops, and the transmission of Government stores, will, most likely, be effected by the railway; and the probable amount of employment by Government should also be ascertained from the departments concerned.

(Signed) J. MACLEOD,
Deputy Collector of Customs.

Kurrachee Custom House, 19th October 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers, On Special Duty, Scinde.

Tabular View of the Returns of the Custom House, Kurrachee, Scinde, for the Official Years 1847-48, 1850-51, and 1851-52, with a Contrasted Statement of the Increase and Decrease in Exports for 1850-51 and 1851-52.

Name					]	1847	7-48.	1850	<b>-51.</b>	1851	<b>–52.</b>		
Rupees.   Rupees. Rupees.   Rupees.   Rupees.   Rupees.   Rupees.   Rupees	1	VAMBS OF	ARTICLE	3.		Imports.	Exports.	Importe.	Exports.	Imports.	Exports.		Decrease in 1851-52.
Alum				· .		Value.	Value.	¥alue.	Value.	Value.	Value.		
Almonds						Rupees.	Rupees.	Rapees.	Rupess.	Rupees.	Rupees.	Rupees.	Rupees.
Almonds Apparel, Hosiery, and Millinery  35,083 38,085 38,			• • • •	••••		1,533		6,515	••••	8,563	• • •	2.048	4
	lmonds			****		3,919	18					,	463
Sulfor and Coins   2,150   7,73,719   12,870   4,919   14,097   8,910   5,118     Seeds	pparel, Hosiery, and I	Millinery				<b>3</b> 5,083						17.157	***
Beads		-			1	2,150	7,73,719	12.870		14.097	8.810		
Seer	Beads				1	412		1.464	619	1,648			
Setellant	`												
China and Earthenware       4,947       575       17,027       1,015       21,285       502       3,745         Occhineal       14,236       35       23,361       23,361       44,490       21,129         Joccoanuts       6,959       1,013       15,500       973       8,501         Ditto dry       26       75,290       264       87,775       189       12,410         Joffee       6,409       5,001       5,066       65         Cotton, raw       1,33,483       4,760       52,217       3,286       94,883       3,909       43,290         Jutes       1,22,955       12,937       1,06,603       6,726       94,535       3,314          Jugs and Medicines       13,795       23,934       33,214       28,906       41,061       23,470       2,411         Sishmaws       2,184       7,268       30,569       22,879       3,307       96,161       46,020         Hassware       2,184       7,268       30,569       22,879       3,307       96,161       46,020         Hums       1,945       1,777       2,270       1,033       2,459       510          Jumies       268	3 ( 1 )									17,630			
14,236   35   23,361     44,490     21,129								17,027			502		
Cocoanuts								23 361	·	44 400		21 120	••••
Ditto dry								6 050		15 500			••••
Coffee         6,409          5,001          5,066          65           Cotton, raw         1,13,463         4,760         52,217         3,286         94,883         3,909         43,290           Drugs and Medicines         1,22,955         12,937         1,06,603         6,726         94,535         3,314            Drugs and Medicines         23,934         33,214         28,906         41,061         23,470         2,411           Sishmaws         20,835         219         9,924         145         11,926         1,928           Shee         2,184         7,268         30,569         22,879         3,307         96,161         46,020           Stans         11,914         11,617         26,667         7,110         29,138         10,349         5,710           Stuns         3,04,367         46,510         84,830         5,97,257         2,02,591         6,97,766         2,18,260           Stuns         1,945         1,777         2,270         1,033         2,459         510           Stuns         2,05,800         2,856         2,643         2,195         773           Stuns         2,05,800					i i	• 1							••••
Cotton, raw         1,13,463         4,760         52,217         3,286         94,883         3,909         43,290           Dates         1,22,955         12,937         1,06,603         6,726         94,535         3,314            Drugs and Medicines         13,795         23,934         33,214         28,906         41,061         23,470         2,411           Sishmaws         20,835         219         9,924         145         11,926         1,928           Shee         2,184         7,268         30,569         22,879         3,307         96,161         46,020           Shasware         11,914         11,617         26,667         7,110         29,138         10,349         5,710           Grain of sorts         3,04,367         46,510         84,830         5,97,257         2,02,591         6,97,756         2,18,260           Sunnies         1,945         1,777         2,270         1,033         2,459         510           Gurases         2,05,800          82,000          1,01,600         19,600           Hardware and Cutlery         12,616         1,219         89,109         1,880         75,382         1,648        <	offee								1				***
1,22,955   12,937   1,06,603   6,726   94,535   3,314										0,000			••••
Orugs and Medicines       13,795       23,934       33,214       28,906       41,061       23,470       2,411         Sishmaws       20,835       219       9,924       145       11,926       1,928         Shee       2,184       7,268       30,569       22,879       3,307       96,161       46,020         Shassware       11,914       11,617       26,667       7,110       29,138       10,349       5,710         Frain of sorts       3,04,367       46,510       84,830       5,97,257       2,02,591       6,97,756       2,18,260         Stums       1,945       1,777       2,270       1,033       2,459       510         Horses, and live Animals       268       1,610       1,209       2,856       2,643       2,195       773         Iardware and Cutlery       12,616       1,219       89,109       1,880       75,382       1,648          wory       4,149       28,252        1,56,550        2,15,958       59,408         Marine Stores       946        1,65,111       1,073       1,64,916       392       9,124	\				••••			52,217	3,280		3,909	43,290	15.40
Sishmaws       20,835       219       9,924       145       11,926       1,928         Shee       2,184       7,268       30,569       22,879       3,307       96,161       46,020         Stain of sorts       11,914       11,617       26,667       7,110       29,138       10,349       5,710         Stain of sorts       3,04,367       46,510       84,830       5,97,257       2,02,591       6,97,766       2,18,260         Stunnies       1,945       1,777       2,270       1,033       2,459       510         Horses, and live Animals       268       1,610       1,209       2,856       2,643       2,195       773         Hardware and Cutlery       12,616       1,219       89,109       1,880       75,382       1,648          ndigo       4,149       28,252        1,56,550        2,15,958       59,408         vory       11,233       174       11,745       211       17,864       1,310       7,218         Marine Stores       32,915       675       1,55,111       1,073       1,64,916       392       9,124				•••	• • • •	1,22,955	12,937	1,06,603					15,480
Schee       2,184       7,268       30,569       22,879       3,307       96,161       46,020         Glassware       11,914       11,617       26,667       7,110       29,138       10,349       5,710         Grain of sorts       3,04,367       46,510       84,830       5,97,257       2,02,591       6,97,756       2,18,260         Gums       1,945       1,777       2,270       1,033       2,459       510         Gunnies       268       1,610       1,209       2,856       2,643       2,195       773         Horses, and live Animals       2,05,800       1,219       89,109       1,880       75,382       1,648          Indigo       4,149       28,252       1,56,550        2,15,958       59,408         Vory       11,233       174       11,745       211       17,864       1,310       7,218         Marine Stores       32,915       675       1,55,111       1,073       1,64,916       392       9,124		••••	• • • •		••••	13,795	23,934	33,214					••••
Glassware        11,914       11,617       26,667       7,110       29,138       10,349       5,710         Grain of sorts        3,04,367       46,510       84,830       5,97,257       2,02,591       6,97,756       2,18,260         Gums        1,945       1,777       2,270       1,033       2,459       510         Gunnies        268       1,610       1,209       2,856       2,643       2,195       773         Horses, and live Animals        2,05,800        82,000        1,01,600       19,600         Hardware and Cutlery        4,149       28,252        1,56,550        2,15,958       59,408         vory         11,233       174       11,745       211       17,864       1,310       7,218         Marine Stores        32,915       675       1,55,111       1,073       1,64,916       392       9,124		• • • •	• • • •	••••	••••		20,835		9,924			1,928	••••
Frain of sorts 3,04,367 46,510 84,830 5,97,257 2,02,591 6,97,756 2,18,260 5ums 1,945 1,777 2,270 1,033 2,459 510 510 510 510 510 510 510 510 510 510		****	* * * 4		••••					3,307			• • • •
Fums 1,945 1,777 2,270 1,033 2,459 510 1,610 1,209 2,856 2,643 2,195 773 2,05,800 82,000 1,01,600 19,600 19,600 1,219 89,109 1,880 75,382 1,648 1,016  1,219 89,252 1,56,550 2,15,958 59,408 1,233 174 11,745 211 17,864 1,310 7,218 Marine Stores 946 946 946 946 946 1,55,111 1,073 1,64,916 392 9,124		****	••••		••••		11,617			29,138			
Funnies 268 1,610 1,209 2,856 2,643 2,195 773  Horses, and live Animals 2,05,800 2,05,800 82,000 1,01,600 19,600  Hardware and Cutlery 12,616 1,219 89,109 1,880 75,382 1,648 1,648 1,56,550 2,15,958 59,408  Vory 11,233 174 11,745 211 17,864 1,310 7,218  Marine Stores 946 946  Metals 32,915 675 1,55,111 1,073 1,64,916 392 9,124				•••	• • • • •		46,510	84,830	<b>5,97,</b> 25 <b>7</b>	2,02,591		2,18,260	****
Funnies 268 1,610 1,209 2,856 2,643 2,195 773 2,05,800 1,01,600 19,600 1,219 89,109 1,880 75,382 1,648 1,219 89,109 1,56,550 2,15,958 59,408 2,000 4,149 28,252 1,56,550 2,15,958 59,408 2,100 1,210 1			,.		• • • • •			2,270					334
Horses, and live Animals       2,05,800       1,219       82,000       1,01,600       19,600         Hardware and Cutlery       12,616       1,219       89,109       1,880       75,382       1,648         Horing Stores       11,233       174       11,745       211       17,864       1,310       7,218         Metals       32,915       675       1,55,111       1,073       1,64,916       392       9,124			• • • •	• • • •		268		1,209	2,856	2,643	2,195		••••
Indigo     12,616     1,219     89,109     1,880     75,382     1,648       Indigo     1,149     28,252     1,56,550     2,15,958     59,408       Indigo     11,233     174     11,745     211     17,864     1,310     7,218       Indigo     32,915     675     1,55,111     1,073     1,64,916     392     9,124		8	,.				2,05,800	• • • • •				19,600	• • • •
ndigo      4,149     28,252      1,56,550      2,15,958     59,408       vory      11,233     174     11,745     211     17,864     1,310     7,218       Marine Stores      32,915     675     1,55,111     1,073     1,64,916     392     9,124					••••	12,616		89,109		75,382			13,959
Vory     11,233     174     11,745     211     17,864     1,310     7,218       Marine Stores     946       Metals     32,915     675     1,55,111     1,073     1,64,916     392     9,124	ndigo			* * * *				·		·		59,408	••••
Narine Stores	vory		• • • •				174		211	17.864	1.310	7.218	
Metals 32,915 675 1,55,111 1,073 1,64,916 392 9,124	Narine Stores			••••		946		,			-	•	
					į.								••••
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					1847	-48.	1850	-51.	185	1-52.			
· N	ames of A	RTICLE	s.	1	Imports.	Exports.	Imports.	Exports.	Imports.	Exports	Increase in 1851-52.	Decrease in 1851-52.	
					Value.	Value.	Value.	Value.	Value.	Value.		,	
			-		Rupees.	Rupees.	Rupees.	Rupees.	Rupees.	Rupecs.	Rupees.	Rupoes.	
			Brought o	verRs	8,51,177	11,47,470	9,83,506	9,62,026	12,03,195	12,15,771	5,07,665	34,031	
Oilman's Stores Piece Goods, Cotton and Plate and Plated Ware Precious Stones and Perfumery Sharkfins Shawls Silk, raw Spice Spirits Stationery Sugar Sugar Candy Tea. Tobacco Timber Twist and Yarn, Cotton Wines of sorts. Wool Woollens, British and	earls of sorts Country				3,881 9,22,064 3,588 545 3,295 67,107 61,656 52,375 18,050 4,39,204 11,696 32,739 31,980 12,421 47,900 40,695	12,881 50 264 9,039 1,293 537 427 9,715 133 1,469  5,430  1,81,598 1,102	49,759 15,60,297 5,649 9,623 8,956 298 2,814 1,50,500 1,12,801 1,06,144 47,634 4,35,163 19,377 27,108 34,600 24,478 1,40,820 1,12,090 2,675 29,460	4,076 17,161  455 133 15,613 10,311 1,225 585 606 455 334  128 111 4,684 216 3,803 5,19,318 3,673	56,363 18,70,958 6,284 16,703 11,624 50 1,080 1,17,063 1,88,029 1,10,530 51,756 3,69,256 26,239 51,200 61,582 40,980 1,89,481 1,18,964 950 48,172	223 39,213 195 650 17,607 5,058 6,196 183 157 2,543 424  150 877 248 453 7,57,162 2,094	2,751 3,32,713 830 7,275 2,635 1,746  74,826 3,937 6,210  6,862 24,114 17,748 12,066 48,898 3,071 2,36,119 17,133	6,987 29,466 65,817	
All Articles not enumer	ated above	••••	****	Total	2,56,005 28,78,720	1,75,453 15,47,308	3,94,764	4,19,805	3,61,743	3,93,024	10.06.500	59,802	I
M				11/4[114	20,70,720	10,47,000	42,58,316		48,92,202 crease	24,41,228	13,06,599 1,96,103	1,96,103_	

Net Increase for 1861-52....Rs. 11,10,496

#### APPENDIX I.

No. 577 of 1853.

To the SUPERINTENDING ENGINEER IN SCINDE.

SIR.

With reference to your letter No. 1066, dated 5th May last, I have the honour to forward a Return of Ordnance Stores,\* with their gross weight, which have been forwarded from this Arsenal to the different Stations in Scinde during the last two years. I am unable to state the cost of the conveyance of these Stores, as they were forwarded by the Commissariat Department.

I have the honour to be, &c.

(Signed) R. C. WORMALD, Captain, Commissary of Ordnance, S. D. A.

Kurrachee, 26th September 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

\* This Return is not printed, as the gross weight of Stores in this Department is included in column 3 of the Statement forming Appendix E.

#### APPENDIX K.

No. 2019 of 1853.

To the SUPERINTENDING ENGINEER, Scinde Division,

Kurrachee.

SIR,

In compliance with the request contained in your letter No. 1067, of the 5th ultimo, I have the honour to forward a Return of all Stores\* despatched by this Department to Central Upper Scinde and the Punjaub, from 1st May 1851.

This Department has been at no expense in the transmission of these Stores, as they were conveyed hence and from the mouth of the river by the Indus Flotilla, with the exception of a few boxes of medicine, sent by Government dooly-bearers.

I have the honour to be, &c.

(Signed) C. BIRDWOOD, Major,
Acting Assistant Commissary General, Scinde Division.

Camp Kurrachee, Commissariat Office, 21st June 1853.

(True copy)
W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

<sup>\*</sup> This Return is not printed, as the gross weight of Stores in this Department is included in column 3 of the Statement forming Appendix E.

#### APPENDIX L.

Statement showing the Number of Troops conveyed by the different Steamers and Flats of the Indus Flotilla between Kurrachee and Mooltan, and vice versa, between the 1st February 1848 and 30th April 1853; also the Number that marched from Kurrachee to Sukkur, and vice versa.

									Number.	Remarks.
Troops	••	• •	• •	••	• •		• •	••	28,022	These comprise Invalids, &c. from Upper Provinces, Treasure Guards, Escort Parties, Reliefs, and Recruits for the Punjaub.
Ditto	••	• •	••	••	• •				18,480	These comprise the Troops proceeded on Field Service, and Reliefs.
•				Year	s 5	. •	••	••	46,502	
						_			9,300	Men per annum.

(Signed) JAMES L. EVANS, Lieutenant, Deputy Assistant Quarter Master General.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

### APPENDIX M.

# Memo. of different Inquiries with a view to judging of the Cost per Ton per Mile of Land Carriage.

	Examples.  [ N.B.—The Maund is of 28 lbs., and 80 Maunds to the Ton.]	Rate per Ton per Mile,
	By inquiry in Kurrachee Town.	•
	From Kurrachee to Kotree, 96 miles by hill route.	Annas.
,		
1	Cloth, silk, and valuable goods, by camel, hire Rs. 4-4-0 to Rs. 4-8-0 (mean Rs. 4-6-0), load 7 maunds of 80 ths. each	2.91
2	Grain of sorts, and groceries, by camel, hire Rs. 2-8-0 to Rs. 2-12-0 (mean Rs. 2-10-0),	
3	load 7 maunds During the rains as above, hire Rs. 4-8-0 to Rs. 5 (mean Rs. 4-12-0)	1.75
4	By Bazar Master's nerrick, hire Rs. 4-8-0, load 6 maunds	3.16 3.50
5	By inquiry in Camp, hire Rs. 2-8-0 to Rs. 3 (mean Rs. 2-12-0), load 6 maunds	
6	(journey 6 days) According to Collector of Kurrachee, Rs. 10 per ton	1.42 1.66
	From Kurrachee to Sukkur, distance 290 miles.	
-		
7 8	On camel, hire Rs. 6 to Rs. 8, (mean Rs. 7), load 7 maunds of 80 lbs  According to Collector of Kurrachee, Rs. 24 per ton	1.54 1.32
	From Kurrachee to Sehwan, 146 miles.	1.00
n	L CAN CATAL DO 10	1 21
9	1 -	1.31
	From Kurrachee to Tatta, 61 miles.	
10 11	By Bazar Master's nerrick, camel hire Rs. 2-8-0, load 6 maunds  Ditto ditto ditto tattoo hire Rs. 1-8-0, load 2 maunds	3.06 5.51
••		0.01
12	From Wagoda to Kurrachee by land, distance 14 miles.  By camel, 7 maund loads, 12 as, to Rs. 1 (mean 14 as.)	4.00
13	By cart, 12 to 15 maunds, Rs. 1 to Rs. 1-8-0 (mean Rs. 1-4-0)	4.00 2.96
14	By camel, for karwa of 22 maunds, Rs. 1-4-0 to Rs. 1-12-0 (mean Rs. 1-8-0)	2.18
	Memo. for River Traffic Cost.	
	Examples.	Rate per Tor per Mil
	From Wagoda to Kotree, distance 82 miles; distance to Kotree from Kurrachee 96 miles.	Annas
1	Grain, groceries, &c., down trip, Rs. 7 to Rs. 8 (mean Rs. 7-8-0)	0.41
2 3	Load 100 maunds, add Rs. 2-6-0 to Wagoda for 100 maunds Load 100 maunds, up trip, Rs. 9 to Rs. 10, add landing and carriage to Kurrachee.	0.46
U	[N. B.—Come down with a fair wind in 6 or 7 days, and go up, if well manned, in	
	25 to 30 days. Otherwise they may take 15 days on the down, and 45 days on	
4	the return voyage.] From Wagoda to Kotree for a karwa of 22 maunds weight, Rs. 2-4-0 to Rs. 2-8-0	
	(mean Rs. 2-6-0)	0.58
	From Kurrachee to Wagoda, 14 miles by land.	
5	Boat load 100 maunds, Rs. 2-4-0 to Rs. 2-8-0 (mean Rs. 2-6-0)	0.76
6	Boat load 22 maunds, (1 karwa,) 12 as. to Rs. 1 (mean 14 as.)	1.27
	From Suhhur to Wagoda, 276 miles; deduct Wagoda to Kurrachee.	
7 8	Boat load 100 maunds for grain, Rs. 11-12-0	0.19
9	Ditto ditto for silk, cloth, and valuables, Rs. 25 to Rs. 35, 100 maunds Charges of Indus Flotilla for Steam Agent Rs. 8-12-0 per ton per 100	0.48
	miles up-river passage As. 1.40	
10	Ditto ditto at Rs. 5-11-4 per ton per 100 miles down-river passage 0.91	
	2) 2.31	
	Up and down stream (mean)	1.15

APPENDIX N.

Prices Current in the Districts during the Week ending 20th June 1853. (Scindian, July 2nd, 1853.)

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(True copy, corrected from the original Returns.)

W. CHAPMAN, Lieutenaut, Engineers,
On Special Duty, Scinde.

#### APPENDIX O.

No. 482 of 1853.

To LIEUTENANT W. CHAPMAN, Engineers,
On Special Duty, Scinde.

SIR,

I have the honour to acknowledge the receipt of your letter, dated 9th instant, and in reply to inform you, that the estimated amount per mensem for conveying the Mails between Kurrachee and Hyderabad, and vice versa, is Rs. 2,000: this includes extra speed money, or remuneration for travelling within the time contracted for, viz. 7 miles per hour.

- 2. I would assume this to be the average monthly outlay for the next five years, which would amount to Rs. 1,20,000.
  - 3. The above amount is solely a disbursement for the conveyance of the Mail.

I have the honour to be, Sir,
Your most obedient Servant,
(Signed) E. L. COFFEY,
Post Master in Scinde.

Post Master's Office, Kurrachee, 16th May 1853.

(True copy)

W. CHAPMAN, Lieutenant, Engineers,
On Special Duty, Scinde.

#### No. 456 of 1853,

REVENUE DEPARTMENT.

From the COMMISSIONER IN SCINDE,

To the RIGHT HONORABLE LORD VISCOUNT FALKLAND,
Governor and President in Council, Bombay.

Dated 16th November 1853.

My Lord,

With reference to paragraph 18 of my letter No. 459, of this day's date, I have the To the Superintending Engineer, No. 2836, of the 1st instant.

Reply from ditto. No. 2645, of 14th ditto, with enclosure.

Council, the copy of correspondence as per margin, on the subject of the railway project between Kurrachee and the Indus, and of granting an establishment to Lieutenant Chapman to enable him to lay down and survey the line in question during the coming season.

2. I would very strongly recommend a compliance with the suggestion of Major Turner. It will save one, if not two years, in commencing the work; and when it is considered that Lieutenant Chapman's Report, just received, shows, that on the most liberal estimate of outlay, and the most moderate calculation of profits, a return of at least five per cent. may be secured from the present traffic over the line of railway, and that a Company is now forming in England to take up the line and provide the capital, I feel assured that Government would wish to have the detailed surveys before them as soon as possible,

I have the honour to be, &c.

(Signed) H. B. E. FRERE, Commissioner in Scinde,

Kurrachee, Commissioner's Office, 16th November 1853.

No. 2836 of 1853,

GENERAL DEPARTMENT.

From the COMMISSIONER IN SCINDE,

To the SUPERINTENDING ENGINEER IN SCINDE,

Kurrachee.

Dated 1st October 1853.

SIR.

As Lieutenant Chapman has, I understand, nearly completed his Report on the subject of a canal to the Indus, and as the season for out-door operations is now at hand, I have the honour to request that you will instruct him, pending the receipt of Government

sanction, to commence such an examination of the country between this and Kotree as may enable him to select the best line for a railway, which I feel little doubt will prove preferable to any other mode of communication with the Indus, and to frame such estimates of the cost of a line, of the kind described in the lately published despatch of the Government of India to the Honorable Court of Directors on the general subject of railways, as would enable Government to decide as to the propriety of encouraging a private Company to undertake its construction.

- 2. This need not interfere with Lieutenant Chapman's visiting the Lukkee Pass, and planning and estimating a road over it; as, with the help of a steamer, which I have no doubt Captain Ethersey will be able to place at his disposal, the work will not probably occupy him many days.
- 3. In the execution of the survey between this and Kotree, it is very desirable that Lieutenant Chapman should put himself in communication with Lieutenant Steuart and Mr. Rassenrade, who is to undertake the survey of the frontier under Lieutenant Steuart's orders, as Captain Strange has urged in a letter, of which a copy will be sent to you, the extension of that survey, so as to provide a topographical survey of the country between the frontier and the Indus series of the great trigonometrical survey. The survey requisite for Lieutenant Chapman's operations will add largely to the surveyed portion of the country, and it would be a pity either to go over the same ground twice, or to omit to connect the one work with the other on either side of it.

I have, &c.

(Signed) H. B. E. FRERE,

Commissioner in Scinde.

Kurrachee, Commissioner's Office, 1st October 1853.

No. 2645 or 1853.

Public Works.

GENERAL DEFARTMENT.

To the COMMISSIONER IN SCINDE.

Sir,

I have the honour to transmit for your consideration a letter from Lieutenant Chapman, No. 58, of the 12th instant, on the subject of your letter No. 2836, of the 1st ultimo.

- 2. There can, I think, be no question, that if it be determined to construct a railway from Kurrachee to Kotree, it would greatly save both time and expense were Lieutenant Chapman furnished with the establishment he asks, and thus enabled, during the coming working season, not only to select the best line for the railway, but also to obtain the data for making an accurate estimate of its cost. Without the assistance asked, Lieutenant Chapman could do little more than examine the country, and, possibly, select the most eligible line, but with it he might, I think, have the line determined, and be prepared to let contracts for commencing the earth-works at all events at the beginning of the working season 1854-55.
- 3. The pay of the Assistants asked for would probably amount to Rs. 500\* per mensem each.

I have, &c.

(Signed) H. B. TURNER, Major,

Superintending Engineer in Scinde.

Kurrachee, 14th November 1853.

<sup>\*</sup> Inclusive of Military pay, if in the Service.

No. 58 of 1853.

To MAJOR TURNER,

Superintending Engineer in Scinde.

Sir.

I have the honour to acknowledge the receipt of your letter, No. 2433, of the 15th ultimo, with accompaniments, directing me to proceed to the Lukkee Pass, with a view to laying out and surveying a line of road in that locality.

This work I shall be prepared to undertake as soon as I shall have got my instruments and marching establishment in order.

2. I am further instructed, on the completion of the Lukkee road estimate, to proceed with the investigation of the railway project, and to lay down and survey a line of railroad from Kurrachee to the Indus.

To perform this latter work efficiently, and at the same time creditably to Government, and to myself, it seems hardly necessary to remind you that my present establishment of one Serjeant, having had little or no experience in such duties, is perfectly inadequate.

I can look to you only for the provision of such Assistants as will allow of the work being carried out in a satisfactory manner.

I beg to annex below a memo. of the assistance which is, in my opinion, necessary for the completion of a railroad survey during the approaching season:—

Two Assistants, either Officers from the Corps, or persons having received a practical education as Surveyors and Calculators.

Two Draftsmen, as Sub-Assistants, at Rs. 140 per mensem each.

One English Writer at Rs. 60 per mensum; and such further establishment, beyond that already sanctioned, as may hereafter be found to be necessary, in the shape of Kullasees, Peons, &c.

I have, &c.

(Signed) W. CHAPMAN, Lieutenant,

Engineers.

Kurrachee, 12th November 1853.

(True copy)

(Signed) H. B. TURNER, Major, Superintending Engineer, Scinde.

(True copies)

(Signed) B. H. ELLIS,

Assistant Commissioner.

No. 211 of 1853.

FINANCIAL DEPARTMENT (RAILWAY BRANCH).

To H. E. GOLDSMID, ESQUIRE,

Secretary to Government.

Sir,

In compliance with your endorsements on letters Nos. 456 and 459, dated 16th November, from the Commissioner in Scinde, with accompaniments, on the subject of

establishing a communication between the Indus and Kurrachee by a navigable canal, and an alternative project for effecting the same object by a railroad, I have the honour to offier the following remarks:—

- 2. I feel great diffidence in offering an opinion,—even a favourable one,—upon the merits of a plan drawn out and submitted, as it now is, in such minute and careful detail by Lieutenant Chapman, and after it has received the approval of an Officer of Major Turner's experience; and more especially in the present instance, where, setting other considerations aside, the opinions of an Officer regarding designs of this nature, formed on the spot, must ever be preferable to those derived from plans and reports by parties at a distance. I shall, therefore, merely say, that in my opinion, if the plans now submitted are adopted and carried out, the canal would fulfil all that is expected from it, and that in an economical point of view its probable advantages and returns have been exceedingly underrated by Lieutenant Chapman.
- 3. But the question now submitted for consideration is, whether, admitting the feasibility of the plan for establishing a communication between Jerruck on the Indus and Kurrachee by a navigable canal, the alternative measure of a line of railway from Kurrachee to Kotree is not, taking all points into consideration, to be preferred; and I must concur with the Commissioner in Scinde, Major Turner, and Lieutenant Chapman, in this latter view.
- 4. It is not necessary for me to enter into details on this question, which would merely be to recapitulate the reasons already brought forward in the accompanying Reports. No doubt it is an important advantage in the canal plan, viz. that whilst it provides communication, it would afford, at the same time, an unlimited supply of good water to Kurrachee, and also for purposes of irrigation at various points throughout its course; but, with this exception, all the advantages of speed, certainty, profit, &c. appear to be on the side of the railroad. As Mr. Frere observes, the very success of the canal would soon tend to call into action the rivalry of a railroad, which would at once endanger all the profits of the former, unless Government, which it appears to me they could hardly do, should undertake to promise a monopoly to the canal, by prohibiting the formation of a rail.
- There is also much more risk in the canal plan than in that of a railway. As far as human judgment can go, the spot chosen for the head of the canal in the limestone rock at Jerruck is perfectly safe; but, iu a costly work of this description, the treacherous nature of the river Indus must ever be borne in mind; and though there are no grounds at present for apprehending such a catastrophe, there is still no absolute certainty, that at some future period the river might not take a more easterly direction, and quit the foot of the Jerruck hills. Unlikely as this contingency is, still, if it did occur, it would render the whole costly work of the canal, in all probability, absolutely useless; whilst, in the case of a railroad, any alteration of the course of the river near the terminus could, at the worst, entail only the necessity of comparatively petty alterations. I would also, with every deference to Major Turner's and Lieutenant Chapman's opinions, submit, from what I remember of the nature of the country generally between Garrah and Kurrachee, that there are there some treacherous portions of country, across which the canal would have to be carried, and although the difficulty might by no means be insurmountable, I should fear, that from the nature of the soil below, and the material of which the banks would necessarily be composed, it would be a matter of no small engineering difficulty to keep the work secure and water-tight,
- 6. The consideration of the original project for a canal is now so intimately mixed up with the alternative one of a railroad, that it appears that the whole subject must remain undecided until that of the railroad is brought forward in such detail as will allow of a comparison of their respective merits. The present is the season for carrying on field operations in Scinde, and as this is rapidly passing by, and the loss of it must

entail a year's delay at least, I would beg most respectfully to submit for the consideration of Government, that Lieutenant Chapman should be furnished with the necessary means for completing at once the requisite surveys. Unless two Officers from the Corps could be at once sent up to join him, it would be necessary to sanction his procuring, if possible, in Scinde, the assistance he requires, viz. two Assistants, at a salary not exceeding Rs. 500 each, and two Draftsmen, at Rs. 140 each. The establishment of Kullassees, &c. might be drawn in a contingent bill.

- 7. In conclusion, I would beg to offer a few remarks on points connected with the proposed railway. In paragraph 12 of Mr. Chapman's report, he says "the gauge has been fixed at 4' 8½", as being that now, by common consent, most generally adopted." Without entering into any discussion as to the relative merits of various widths of gauge, I may mention that that chosen for the lines now in progress at the three Presidencies is a medium one of 5' 6"; and although there is no absolute necessity for keeping to the same in any line west of the Indus, as the public could not at any future period be inconvenienced by such break of gauge, still, if only for uniformity's sake, it might be advisable in all Indian railways to adhere to one gauge, should no good reasons exist for adopting another in any particular instance. In laying out the plans, therefore, for the proposed line from Kurrachee to Kotree, I would recommend, unless there are reasons to the contrary, that the gauge of 5' 6" be adopted.
- 8. As regards sleepers, a large proportion of the line, where it may be surface line, or in cutting, would, I presume, from the facilities of procuring the material, be laid with stone blocks: these, certainly, do not make so easy and smooth a road as a line laid with wooden sleepers, but the economy would probably be great. Sleepers for the embankments, then, would only have to be provided for. And with reference to what Major Turner mentions respecting the ravages of white-ants, there seems reason to suppose, from our present experience on the Bombay and Tanna line, that the vibration of the passing trains is sufficient to deter that insect from attacking the wood, but longer experience is necessary to be quite certain on this point.
- 9. The last subject I would allude to is the supply of water. In laying out a line, too great care cannot be taken to ascertain the nature of the supply, not only as to quantity, but also as to quality. It is impossible to say to what extent the working expenses may be affected by this latter point; and on such a line as that from Kurrachee to Kotree, there might be instances in which it might even be worth while to make a considerable detour, so as to ensure a proper supply of good water at certain stations on the line.

I have the honour, &c.

(Signed) J. H. G. CRAWFORD, Captain, Superintending Engineer, Railway Department.

Bombay, 2nd December 1853.