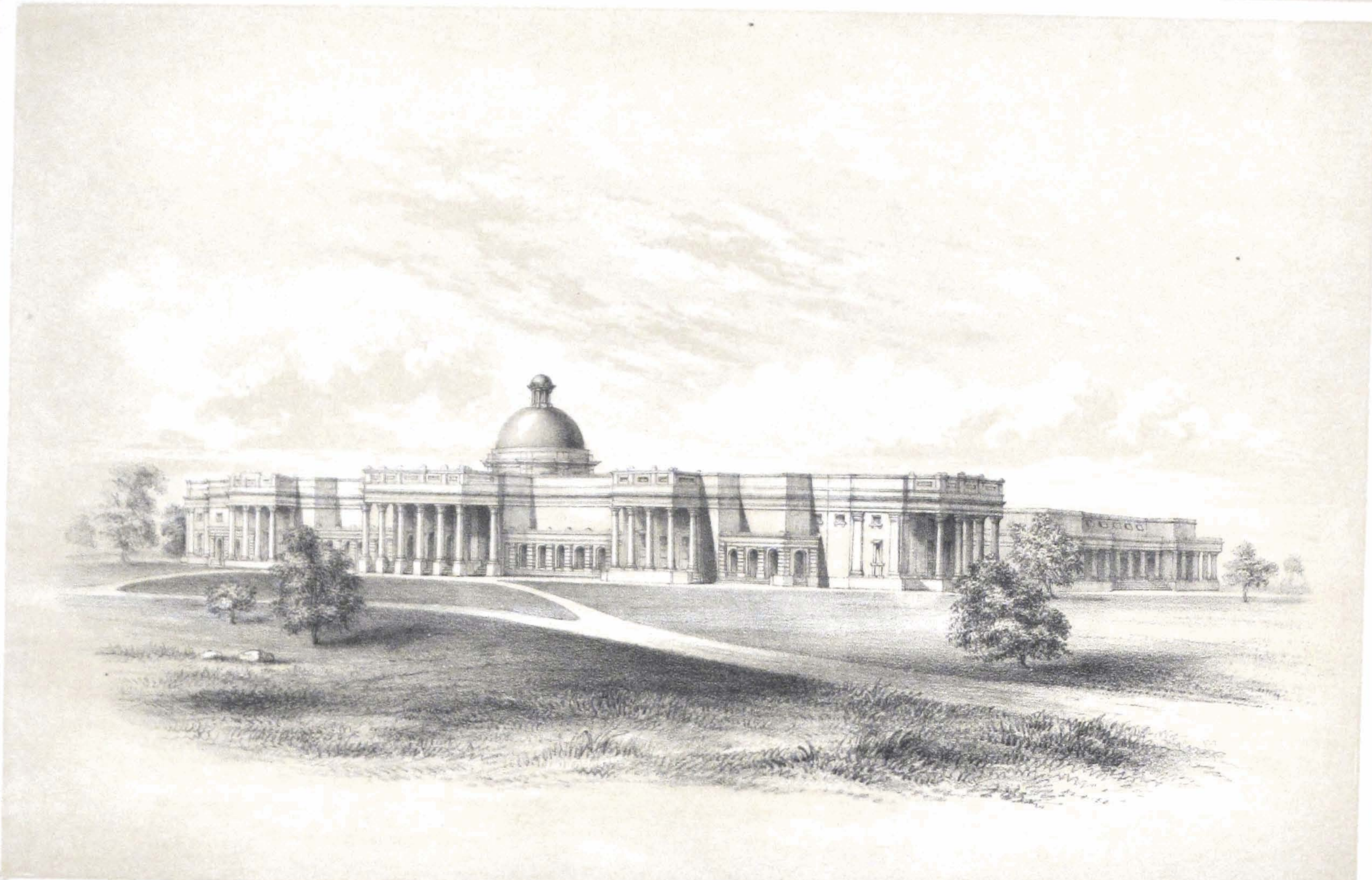

THOMASON COLLEGE, FOR CIVIL ENGINEERS.
ROORKEE.
Designed & Built by Lt. George Price,
1st Fusileers

London: Smith, Elder & Co. 65, Cornhill.

REPORT

ON THE

GANGES CANAL WORKS:

FROM THEIR COMMENCEMENT

UNTIL THE OPENING OF THE CANAL IN 1854.

BY

COLONEL SIR PROBY T. CAUTLEY, K.C.B., F.R.S.,

LATE OF THE BENGAL ARTILLERY, HONORARY MEMBER OF THE ASIATIC SOCIETY OF BENGAL,
AND LATE DIRECTOR OF THE GANGES CANAL WORKS.

VOL. III.

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LITTLE GREEN ARBOUR COURT, OLD BAILEY, E.C.

LIST OF APPENDICES.

THE GANGES CANAL.

APPENDIX A.

NORTHERN, OR FIRST DIVISION.

BRICK-MAKING.

THIS division, whilst the works were in progress of construction, included the first twenty-four miles of the canal, and comprehended the whole of the works necessary for the passage of the canal through the khadir of the Ganges on to the high land of the Doab. From the magnitude of many of these works, and the impossibility that a sufficient number of bricks for them could be manufactured by the methods ordinarily in use in India, an account of our operations in this respect will be peculiarly interesting, and be the means of placing on record data, which will, perhaps, be valuable to the conductors of future undertakings of an extensive nature.

The following abstract gives in one view the several works constructed, and the grand total cubic content of masonry for which material had to be provided; the figures in this abstract are derived partly from the bills submitted by the executive engineers, and partly from the estimates where bills have not been submitted:—

	Cubic Content in Feet.
Regulating works, ghats, revetments, &c., at the head of the Canal	520,101
Bridges at Kunkhul, Jowallapoor, Peeran Kulleeur, and Guneshpoor	567,540
Falls at Bahadoorabad, Nos. 2 and 3, and Assoffnuggur, No. 5	1,275,153
Locks at " " " for navigation ...	285,061
Superpassages at the Ranipoor and Puttri Torrents, including the Nos. 1 and 4 Falls, Locks, &c., connected with them	3,250,237
Dhunowri works for the passage of the Rutmoo Torrent, including the cross and regulating bridges	1,421,668
Solani Aqueduct Works, including the terminal bridges at Mahewur and Roorkee ...	10,992,778
Mills at Hurdwar, Kunkhul, and Bahadoorabad	301,443
Outlet at Kunkhul; inlets at the Lounda Leni Walla, Kunkhul, Jowallapoor, Selimpoor, and Badshahpoor	173,934
Workshops and model rooms	953,625
Buildings for the accommodation of establishments, offices, &c.	125,000
Grand Total Masonry	19,866,540

From a further abstract, it is found that of this mass of masonry, the following quantity is composed of brick:—

Pukka brick, solid masonry; pukka brick, in casing Kunkur Beton, and bonds to boulder and slag masonry	17,148,714
Peela brick masonry	542,375

And if we add to these the pukka and peela brick masonry contained in the Civil Engineers' College buildings, the tuhseel kutcheri, the station church, bazaars, road bridges, and the private dwellings of the subordinates attached to the division; for the whole of which bricks were supplied from the Government manufactories; we obtain an approximation to the total quantity of masonry for which the brick manufactories had to furnish bricks.

	Peela Brick Masonry.	Pukka Brick Masonry.
	Cubic Feet.	Cubic Feet.
In Ganges Canal Works	542,375	17,148,714
In Civil Engineers' College Buildings, Church, Bazaars, &c. ...	629,200	419,441
In Private Dwellings	390,000	75,000
Totals	1,561,575	17,643,155

And this is, moreover, independent of an immense quantity of broken brick which was used in ballasting the lines of railway, forming roads, &c. &c. the content of which cannot be estimated.

From the condensed abstract at the end of this paper, it will be seen that the actual number of bricks manufactured for the construction of the masonry above exhibited has been—

Pukka bricks of all sizes	18,07,79,542
Peela do. do.	3,07,44,988
Grand total number of bricks ...	21,15,24,530

Work in brick-making was commenced in this division in January, 1842, under the management of Mr. Thomas Wright, an uncovenanted assistant in the canal department. Our object at that period was to establish as many kilns as possible at every available village in the vicinity of the line to be taken up for the canal, and these kilns were to be of the ordinary pattern of "Puzawa" (*vide* plan, sheet No. 1), in constant use with the natives of India. For the working season of 1841–42, Mr. Wright reported that he had obtained contractors for the manufacture of bricks to the extent of 54 lakhs; and had commenced on a small scale a few kilns, independently of contractors, the principal portion of the fuel used in which, was wood obtained from the neighbouring jungles. On the 1st March, 1843, the executive control of the division was assumed by Lieut. R. Strachey, of the Bengal Engineers; and at an early period he reported, that for the season of 1842–43, fifty-three kilns were in progress of burning under contractors. For the season of 1843–44, contracts were made for 133½ lakhs; and for the season of 1844–45, the contracts in existence amounted to 145 lakhs. For the season of 1841–42, Mr. Wright's contract-rates were 350 rupees for pukka bricks, 12 × 6 × 2; and 200 rupees for peela bricks of the same dimensions. Lieut. Strachey, considering that a thickness of 2 inches was too little for the length of the brick, made all his contracts for 2½ inch at 435 rupees per lakh for pukka, and 250 rupees for peela bricks, only such peela bricks being paid for at this rate as were taken for use on the works.

During the last-mentioned working season (1844–45), Lieut. Strachey perceived that the total out-turn of pukka bricks had been quite incommensurate with the advances of money that had been made, and he determined not to enter into further contracts until the accounts of the existing contractors had been cleared off; this, however, as will be seen hereafter, was never accomplished. At the latter end of 1845, Lieut. Strachey was called away on field service with the army of the Sutlej; and on his return, the state of his health obliged him to proceed to the hills on medical certificate; his place being filled by Lieut. Henry Yule, of the Bengal Engineers.

The final results of Mr. Wright's and Lieut. Strachey's operations, from January, 1842, to June, 1846, in brick-making, were as follow:—

	RS.	A.	P.
Advances made to contractors	79,666	13	1
Expended on department kilns	1,869	13	6
Carting to works (portion of manufactured bricks only) ...	5,343	6	9
Stacking	761	6	8
Establishment and sundries	2,937	12	11
Total amount of Expenditure	90,579	4	11

The return in bricks for the above expenditure was:—

Description.	2 Inch.	2½ Inch.
Pukka bricks carted to works	22,76,250	8,29,921
„ at kilns	8,00,000	64,00,000
Total pukka bricks	30,76,250	72,29,921
Peela bricks used in works, or sold (both dimensions)		13,78,235
„ at kilns „		37,50,000
Total peela bricks		51,28,235

Grand total of all sorts, 154,34,406, and the actual cost of the bricks was, therefore—

	RS.	
Pukka bricks, 12 × 6 × 2, at the kilns	550	per lakh.
„ „ „ works	710	„
„ 12 × 6 × 2½ „ kilns	775	„
„ „ „ works	1,000	„
Peela bricks, average	236	„

which, for pukka bricks, is considerably in excess of the rates at which contracts had been entered into. The department kilns upon which Co.'s rupees 1869-13-6 had been expended, were entire failures, and this being known to Lieut. Strachey as soon as he joined, he discontinued the experiment. Setting this amount aside, and confining ourselves to the contractor's accounts, we find that—

	RS.	A.	P.	RS.	A.	P.
The advances to contractors were				79,666	13	1
Value of bricks at the contract rates:—						
30,76,250 pukka, 12 × 6 × 2, at 350 rs. per lakh ...	10,766	14	0			
11,92,295 peela, „ „ 200 „ „ ...	2,384	9	5			
72,29,921 pukka, 12 × 6 × 2½ „ 435 „ „ ...	31,450	2	6			
39,35,940 peela, „ „ 250 „ „ ...	9,839	13	7			
Real value of bricks				54,441	7	6
Loss by contractors				25,225	5	7

With one exception, the contractors against whom balances existed, were men of straw; every effort was made to get them to fulfil their engagements, or to refund, but all failed: and it was determined by Major Baker, the director at that time, that legal proceedings instituted against them, could lead to no other result than the addition of a large amount for law expenses to the heavy losses which had already been sustained.

The failures on the part of most of the contractors were undoubtedly due to the following causes:—

1st. The impracticability of obtaining from the villages situated within the small circle to which our operations were necessarily confined, a sufficient quantity of the requisite fuel, with which to burn the large number of bricks moulded.

2nd. To neglect on the part of the contractors, and their habit of stinting the kilns in fuel unless constantly watched.

3rd. To the want of intelligent European supervision: for a long time Lieut. Strachey had no overseers, and when he did get them they were unacquainted with the work.

1846 *and* 1846-47.—From June, 1846, to the end of the working season of 1846-47, the brick-making operations were carried on under the superintendence of Lieut. Yule. The little success that attended Lieut. Strachey's arrangements for contract bricks rendered it imperatively necessary that we should depend for our chief supply of this material on our own kilns, burned with wood fuel. The measures adopted for this purpose, and the progress made during this period, are thus described by Major Baker, in his final report on the Ganges Canal Works, dated 11th January, 1848:—

" A small commencement of the arrangements for this purpose was made in 1846, after the close of the Sutlej campaign, but it was then too late in the season to obtain any satisfactory results. In the cold weather of 1846-47, a number of new kilns were built, both at Roorkee and Muhewur, and considerable quantities of firewood were cut in the forests and carted to the works. During the early part of the season many circumstances combined to render the result of these operations very unsatisfactory. Great pains had been taken to ascertain the method of burning bricks with wood, as practised at Umballa and elsewhere; but our people did not at first get into the way of loading the kilns properly; and this, combined with a long duration of unfavourable weather, and the greenness of the firewood, rendered the operations of the cold weather almost entirely unprofitable. At the commencement of the hot season, however, a change for the better became apparent: two new descriptions of kiln were tried with better success, and before the setting in of the rains we had turned out about 38 lakhs of serviceable bricks from the English kilns."

The first description of English kiln tried at Roorkee was that used with considerable success by Major Napier at Umballa: it failed, however, with us, and this may be attributed to three causes—

1st. Using dhâk wood instead of bubool, or other hard woods.

2nd. Using koord instead of the light chupper grass, employed at Umballa to equalize the surface of the layers of wood.

3rd. Ignorance of the proper management of the fire by means of the flues and the surface covering of ashes.

The second method attempted was that described in the sixth part (vol. iii.) of Weale's *Quarterly Papers on Civil Engineering* as that practised in Holland. It entirely failed; the consumption of wood was greater than in the first experiment, and the result more unsatisfactory.

The third experiment was made with a flame kiln, such as is used in England with faggots; a few good bricks were obtained by this method, but not in a proportion that would warrant a second trial.

The fourth method was introduced by a pilgrim passing through Roorkee, who offered to take service as a brickmaker. His plan was somewhat similar to Major Napier's, and he understood its management; the produce of his kilns were comparatively good.

The fifth method was taught us by men obtained from Benares; it was less certain than the fourth method, and more dependent on the quality of the wood, but the bricks were less broken and of better quality.

A more detailed account of the manner of working the kilns above alluded to will be given when Mr. Finn's operations are under discussion.

Sixteen kilns of the above patterns, as also the small flame kiln, were built by Lieut. Yule, and he established three Hindustani kilns, under the supervision of Government servants. The first fifteen fillings of the English kilns turned out unmitigated failures, the whole of the bricks being *peela*. The whole number of kutcha bricks moulded was 67½ lakhs; of which there were—

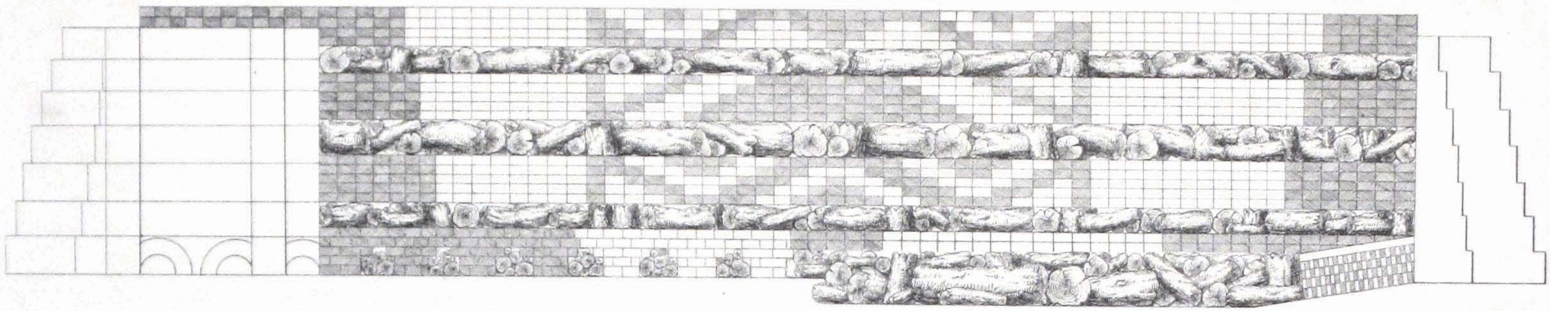
Loaded in English kilns	49·8	lakhs.
„ flame kilns	1·5	„
„ Hindustani kilns	4·5	„
Expended in building kilns	9·0	„
Waste by rain, &c.	2·7	„
Total lakhs	67·5	

And the total out-turn from them was—Pukka bricks, 38 lakhs; peela ditto, 11 lakhs; janior, about 50,000 cubic feet. The cost of these, including construction of kilns, clearance of ground, opening out of roads, and all the implements requisite in this sort of work, was Co.'s rupees 65,638-7-9¾, which gives the following rates for the manufactured material:—

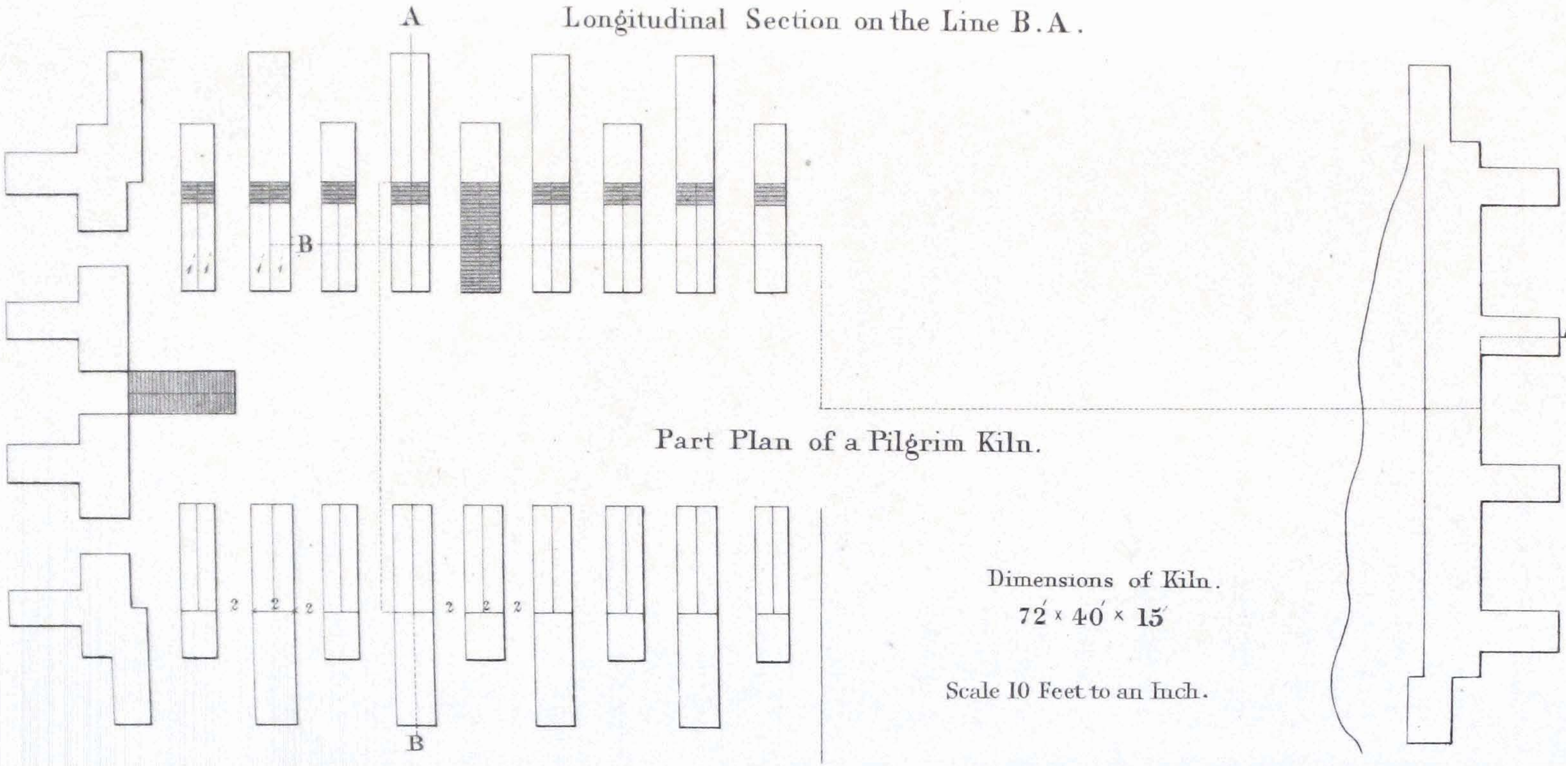
		RS.	
Pukka bricks, 12 × 6 × 2½, at works	... ...	1544	per lakh.
Peela „ „ „	... ...	450	„
„ „ „ at kilns	... ...	250	„

The cost of turning out moulded and dried bricks was approximately 7,559 Co.'s rupees, and consequently the cost of kutcha bricks was 112 Co.'s rupees per lakh. Besides the 49·8 lakhs shown above to have been placed in the English kilns, there were 13·6 lakhs of peela bricks reburned in these kilns, making a total of 63·4 lakhs, from which were derived only 31 lakhs of pukka bricks, or less than one-half of the whole

Part Elevation and Longitudinal Section of a Pilgrim Kiln.



Longitudinal Section on the Line B.A.



Part Plan of a Pilgrim Kiln.

Dimensions of Kiln.
72′ × 40′ × 15′

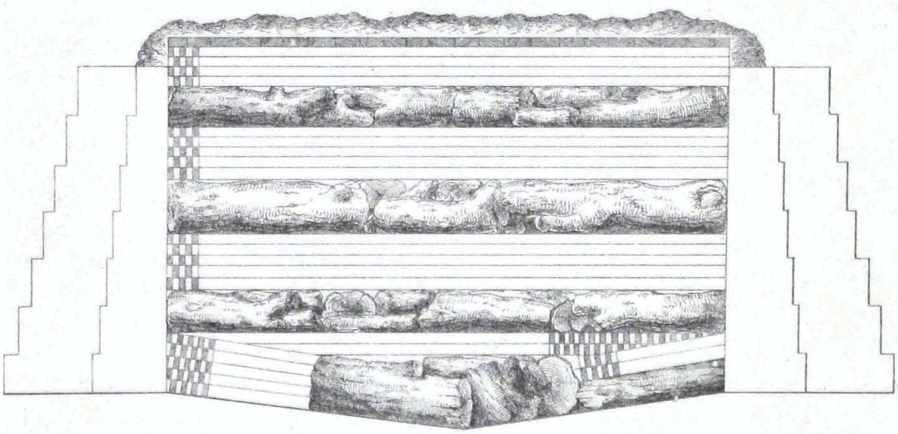
Scale 10 Feet to an Inch.

Sheet No. 2.

Sketch of a

PILGRIM KILN.

Transverse Section of a Pilgrim Kiln.



Section on the Line A.B.

Scale of 7½ Feet an Inch.

number. The results of the Hindustani kilns were good, being 3½ lakhs of pukka bricks out of the 4½ lakhs piled into kiln; and had it been possible to burn them entirely with litter and oopla, instead of the more expensive article of wood, which had to be put in to make up the deficiency, they would have been cheap bricks.

The operations during the season of 1846-47, carried on under Lieut. Yule, should be looked upon as the commencement of a series of experiments, the cost of which, though great in itself, was comparatively small with regard to the future expenditure; and in closing the summary of progress up to this period, it is but the just due of the officers who had been engaged on the works that I should repeat the concluding remarks contained in Major Baker's report, when making over to me the directorship of the canal in January, 1848, viz.:—"The executive officers have had to struggle with many difficulties, the conquest of which, though it has smoothed the path of their successors, has doubtless enhanced the cost of their own work; and it is important to bear this in mind, and to be cautious in drawing unfavourable comparisons between the cost of past and future work, and in attributing to the superior care and management of future executives an improvement in economy which may be chiefly due to the results of their predecessors' labours. The power requisite to maintain the regular and equable motion of a vast machine, is no measure of the force required to set it going."

1847-48.—The commencement of the working season of 1847-48 formed an entirely new era in the works on the Ganges Canal. The Government had by this time been moved to sanction their vigorous prosecution, and all the former restrictions as to the amount to be expended annually were taken off. The works alone in this division were considered amply sufficient for the supervision of the executive engineer; and a separate officer was appointed for the manufacture and supply of material. Mr. Finn entered upon the latter duties in October, 1847.

There were several evils that existed in the arrangements made by Lieut. Yule with regard to the relative situations of the moulding grounds, tughars, and kilns; but as work had commenced actively under the executive engineer, and the call for bricks was very urgent, there was not time, in the first instance, to rectify them; Mr. Finn, therefore, began with the fields and kilns as left by Lieut. Yule, and made the improvements so much needed gradually: before the close of the season, Lieut. Yule's kilns were almost entirely superseded by new ones, built more substantially, and situated in closer proximity to the drying grounds. The operations were conducted with variable success, and always at a heavy expense. Nevertheless, the turn-out of pukka bricks was highly satisfactory, as compared with the results of former years, and a method of burning was hit upon which seemed to promise well for the ensuing season. Two Hindustani kilns were established on the Roorkee fields under the supervision of the Government establishment, and were very successfully worked; and several other kilns of this description were set in progress either by contract, or by hired labour supervised by Government servants, at villages within a reasonable distance from the works, where the appropriate fuel was obtainable.

The different systems pursued by Mr. Finn may be described thus; the description being a precis of that officer's reports.

FIRST, or PILGRIM MODE, *vide* "Plan and Sections" (Sheet, No. 2).

This mode takes its name from the pilgrim referred to in the account of Lieut. Yule's operations. The floor of this kiln is hollowed out to a depth of 1′ 6″ in the centre, with side slopes up to the level of the mouth of the flues; the flues are at 2 feet intervals, 2 feet in width, 2 feet in height, and are carried 5 feet inwards from every side of the kiln; at that distance they cease, and the whole interior is packed with wood to the top level of the flues; two courses of bricks are then laid on edge, and over that the wood and bricks in alternate layers. The results of the kilns filled on this system were uncertain; the average return was 54 per cent. of pukka on the kutcha bricks piled, but the greater number of the former were broken; the bottom layer, and the bricks in a space of 5 feet all round the walls of the kiln, were always peela, and janior was invariably found in the centre. Great damage was done to the walls of the kiln by the heavy pressure of the bricks against them in sinking as the wood was consumed. After trials, this system was abandoned, as there appeared little hope of success.

The quantity of firewood used per lakh of bricks was 3,300 maunds.

SECOND, OR BENARES MODE, *vide* "Plan and Section" (Sheet, No. 3).

The floor of the kiln is first levelled off, and the bricks are then packed in tiers of arched flues throughout the kiln; the flues are all 3 feet wide at bottom, the piers are 1 foot, or one brick only, in width, and four bricks high, from whence the arched is commenced and closed with the tenth tier, making the flues 5 feet high. When the lower tier of flues is completed, a second tier is built thereupon, crossing it transversely; on the second is built a third tier, which completes the kiln. The wood is carefully packed into each flue as it is constructed, and all interstices filled in with chips. The average result of kilns so filled was 55 per cent. of pukka on the kutcha bricks piled. The bricks of the lower tier flues, and many in the shoulders of the arches, turned out peela, whilst in the centre of the kiln large quantities of janior were found, owing, partly to the want of proper distribution of the wood, and partly to the breaking in of the flues, which drawing the fire to particular parts caused vitrefaction.

The quantity of firewood used per lakh of bricks was 3,200 maunds.

THIRD SYSTEM, *vide* "Plan and Section" (Sheet, No. 4).

This was an endeavour made to improve upon the Benares mode. The lower part of the kiln was packed with a tier of flues similar to the Benares method, and completed with alternate layers of wood and bricks, the lower layer being always less than the upper one in depth or thickness. In some of the kilns 2 feet of wood and a layer of five bricks in depth was placed immediately over the flues; in others, 2 feet of wood and four bricks were tried, and over this, to form the second layer, 2 feet of wood and five, six, and even seven bricks in depth were placed. The average result of this mode was 55 per cent. of pukka bricks. The lower portions and sides of the kiln were bad, turning out peela and much broken bricks; the lower centre produced janior, whilst the upper centre and the entire upper layer were very good. Damage was done to the walls of the kiln in the same way as to those of the "Pilgrim" kilns.

The quantity of wood used per lakh of bricks was 3,300 maunds.

FOURTH, OR "SIND FLAME KILN," *vide* "Plan," &c. (Sheet, No. 5).

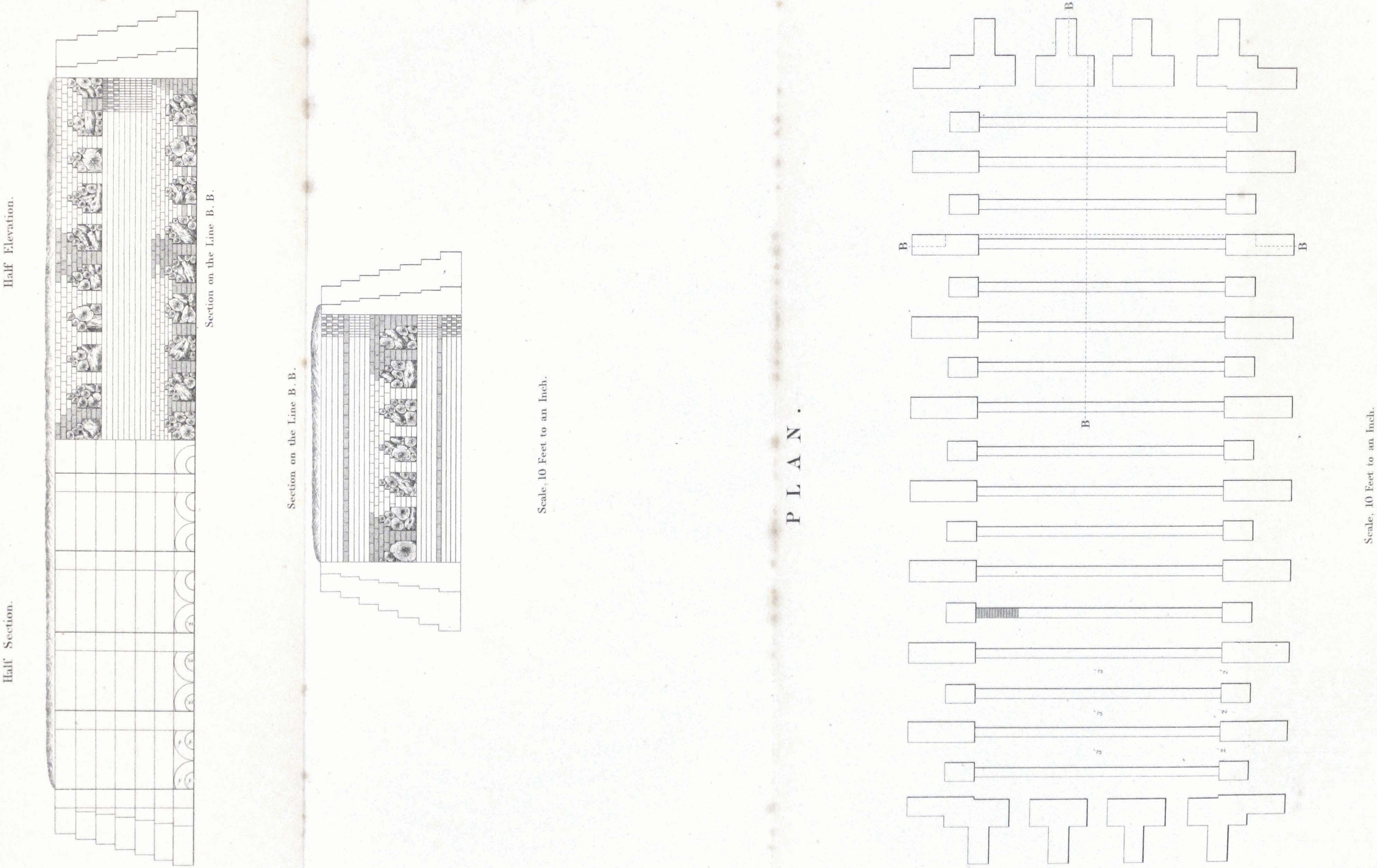
An experimental kiln on this plan was built, its interior dimensions being 20′ × 12′, and it was sunk 3 feet into the ground; the exterior walls were raised 3 feet high by 1′ 9″; the two side walls were perforated by three arched flues, each 3 feet wide, 2 feet high, and the centres of each arch were 5 feet apart; these flues were carried across through lines of longitudinal walls built in the interior of the kiln, each wall being 3 feet high, 1′ 6″ wide, and about 6 inches apart; it was completed by raising the exterior walls to a height of 8 feet, the additional 5 feet being only 1′ 6″ wide, which left a shoulder, 3 inches in breadth, on a level with the longitudinal walls for the bricks of the lower line to rest on. The kiln was filled by laying the bricks on edge on the top of the interior walls, the flues having been first packed with wood; the first four layers were placed openly, the bricks of the lowest one about 2 inches, and those of the fourth about 1 inch asunder; the remaining six layers required to complete the kiln were packed closely. The kiln contained 7,800 bricks, and was loaded three times, with the following results: 1st result, 56 per cent.; 2nd, 71 per cent.; 3rd, 38 per cent. (with large well bricks 3 inches thick). On each occasion it was fired vigorously for 60 hours; when the fire reached the second line of bricks from the top, the kiln was covered in by a layer of ashes 3 or 4 inches thick.

The quantity of wood used to each kiln was 350 maunds, or about 4,500 maunds to each lakh of kutcha bricks.

The advantages in these kilns were, that they were more readily packed than the larger kilns; and the

Sheet No. 3.

BENARES STYLE.



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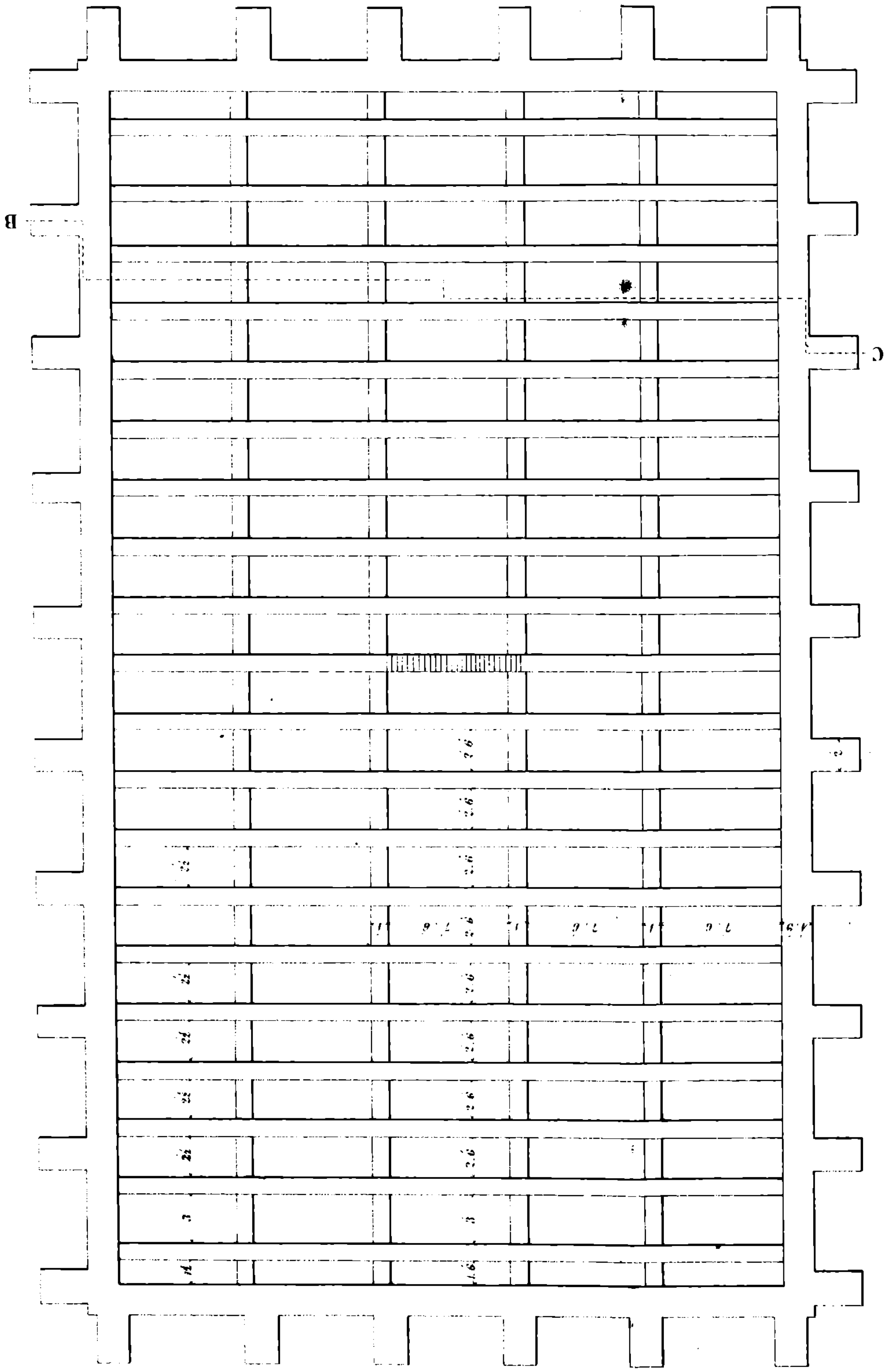
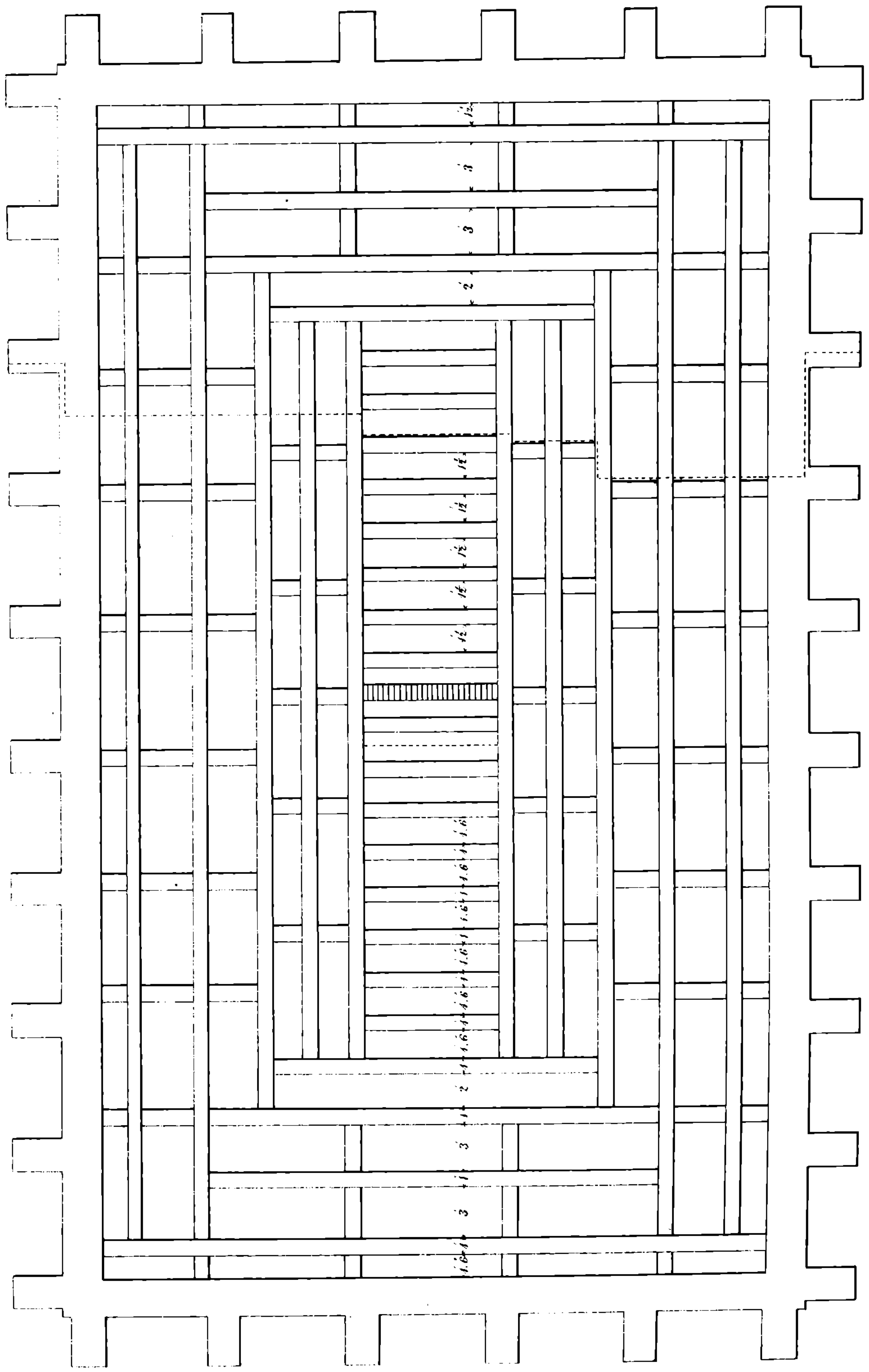
8TH JULY, 1853.

SKETCH OF THE
MODIFIED BENARES KILN.

Scale 10 Feet to an Inch.



PLAN OF 3rd ROW.



PLAN OF 2nd ROW.

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Sheet No. 5.

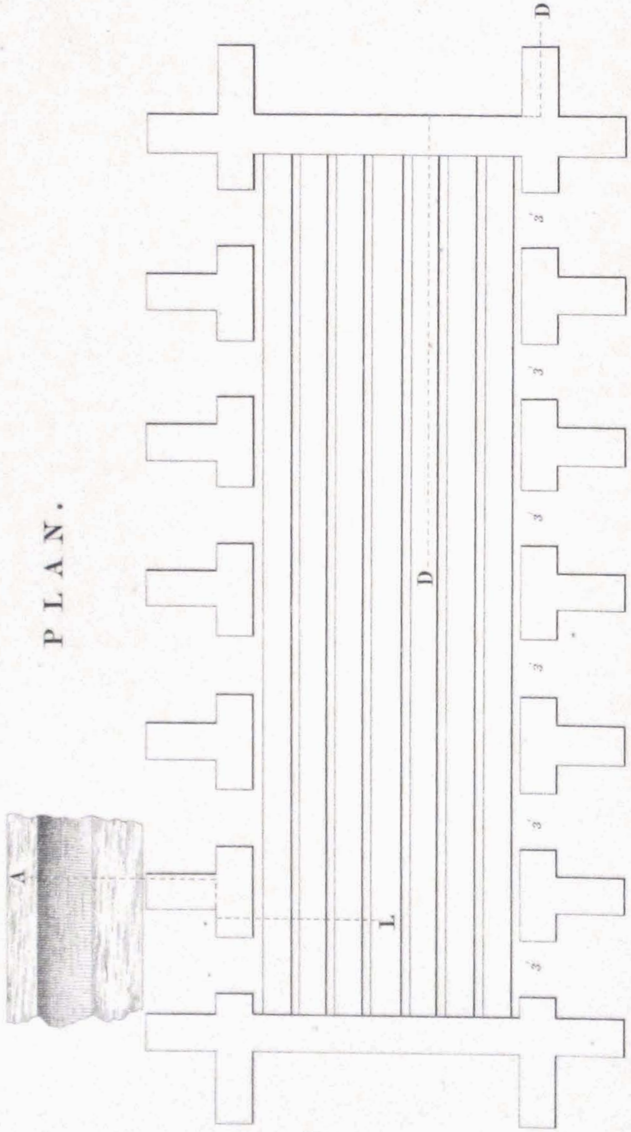
SKETCH

of a

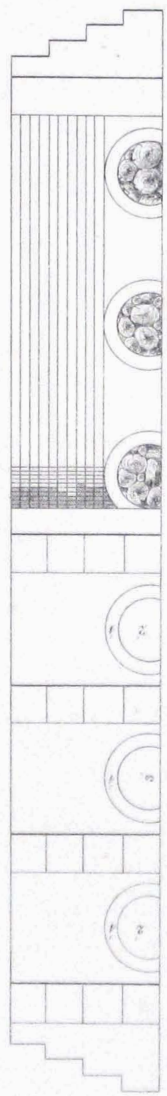
SIND FLAME KILN.

SIND KILN.

PLAN.



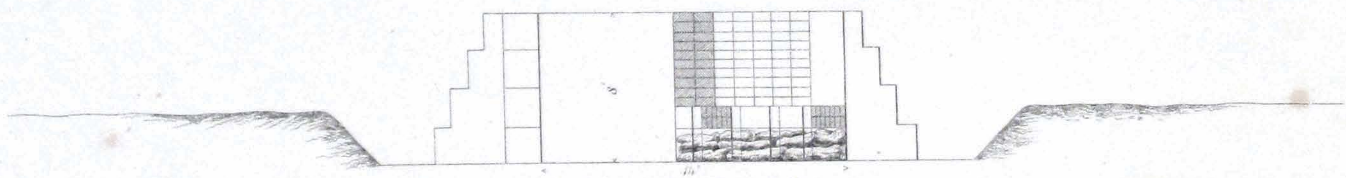
Longitudinal Section and Elevation.



Section on the Line D.D.

Scale, 10 Feet to an Inch.

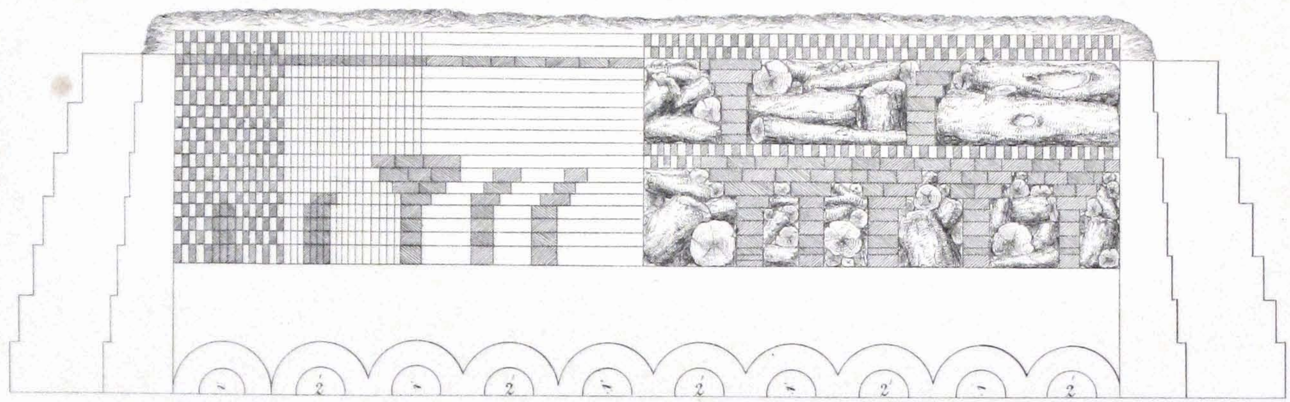
Transverse Section.



Section on the Line A.L.

Scale, 10 Feet to an Inch.

Transverse Section of 2nd and 3rd Rows.



2nd Row Section on the Line C.L.
3rd Row to C.B.

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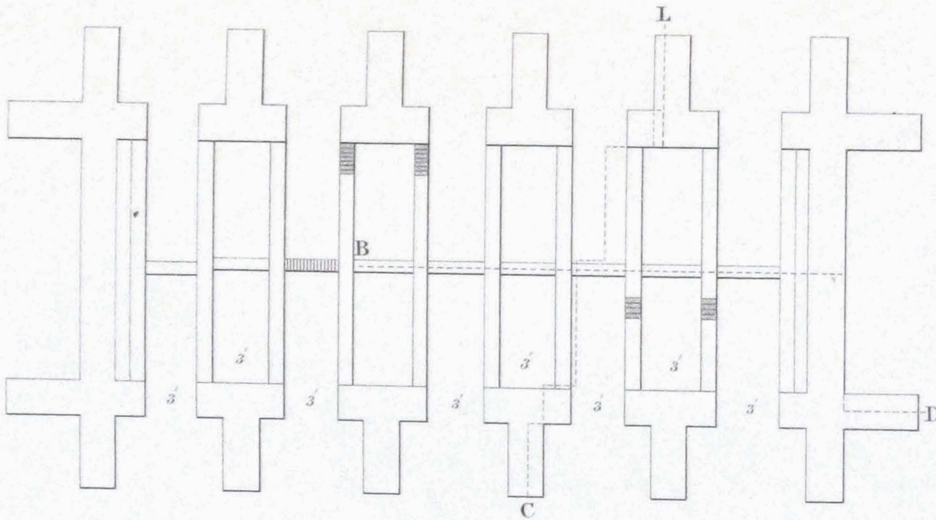
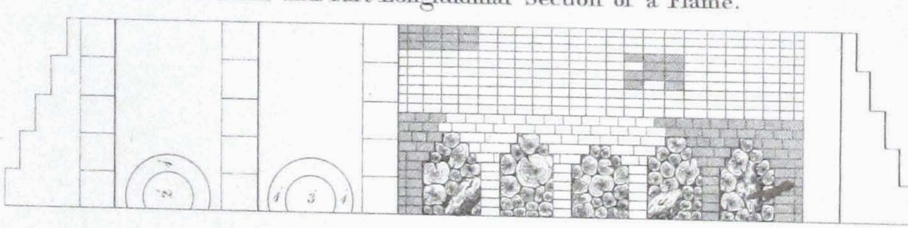
Sheet N° 6.

SKETCH
of a
ROORKEE FLAME KILN.

Plan of a Flame Kiln.

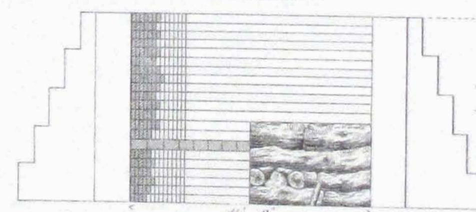


Part Elevation and Part Longitudinal Section of a Flame.



Section on the Line B.D.

Transverse Section of a Flame Kiln.



Section on the Line C.L.

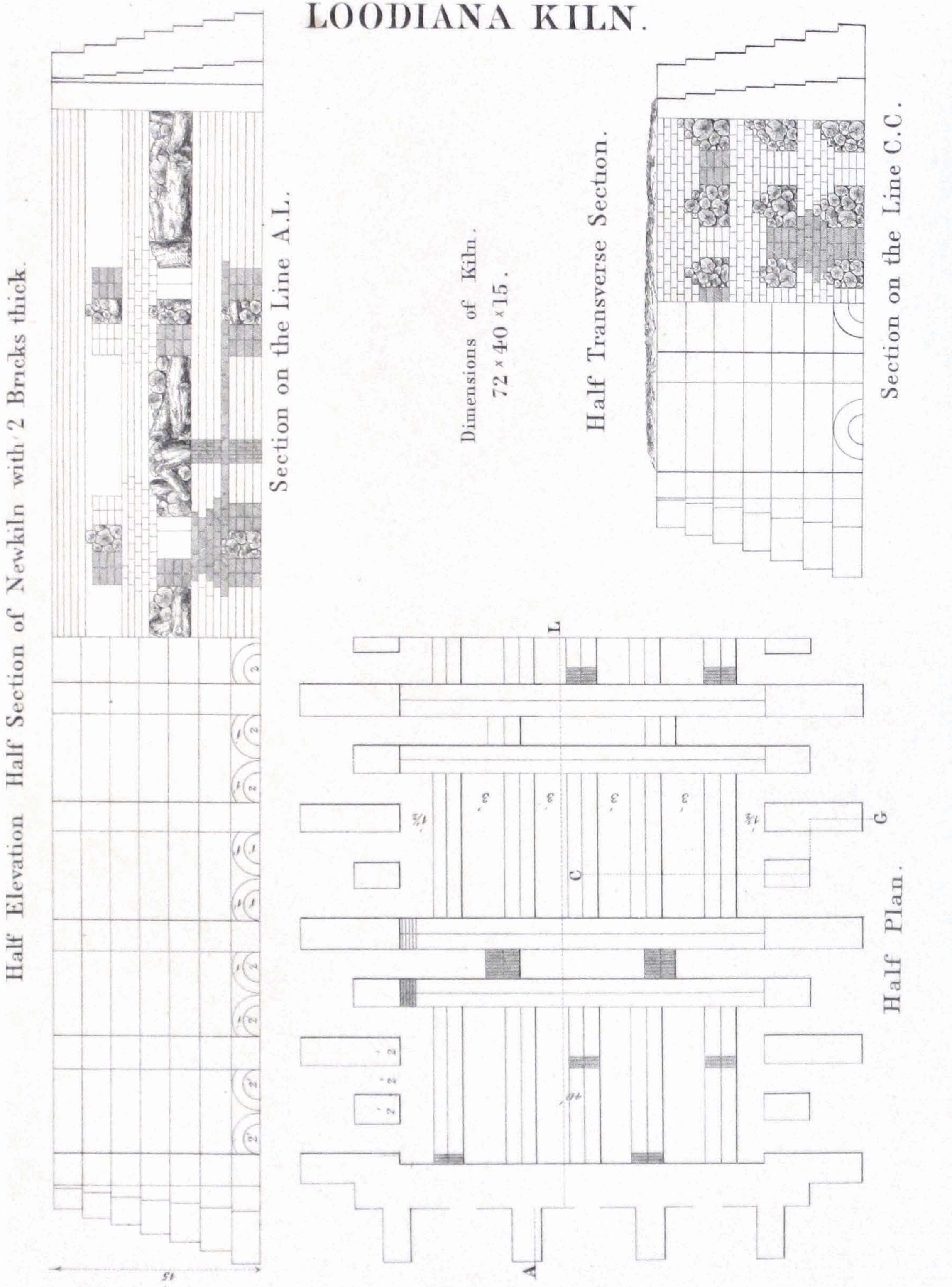
Scale, 10 Feet to an Inch.

Sheet No. 7.

To face Page 7.
Vol. 3.

Sketch of a

LOODIANA KILN.



Scale 10 Feet to an Inch.

large proportion of whole bricks obtained from them. The disadvantages were, the great expenditure of wood, and the injuries sustained by the arches of the interior longitudinal walls by every firing.

Encouraged by the favourable results of the above described small kilns, Mr. Finn tried others on a larger scale, and with the view to economizing the expenditure of wood; and following out the plan of a Sind kiln, with which he had been provided, the centres of the arches or flues were extended from 5 to 8 feet apart, and the interior width of the kiln was made 14 instead of 12 feet. The same process of filling and firing as had been practised in the small kilns were adopted in these, but the results were unfavourable; the out-turn being nothing but second class and peela bricks; this plan was, therefore, abandoned. The dimensions of the largest Sind kiln were 150 x 14 x 8.

FIFTH, or "ROORKEE FLAME KILN," *vide* Plan, &c. (Sheet, No. 6).

It being supposed that the last described kiln failed on account of the flues being being so far apart, and the advantages of burning by flame being evident, Mr. Finn determined to try a modification of the Sind pattern. For this purpose he removed the interior longitudinal walls from the large kiln above-mentioned, and increased the height of the interior walls by 2 feet, making the kiln 150 x 14 x 10. Its floor was levelled off and a tier of arched flues 3 feet wide and 5½ feet high was formed from side to side; on the top of these flues eight rows of bricks on edge were piled, the four under layers being rather open, the upper layers close. Every other flue only had an arch, small holes being left in the piers for the fire to communicate; each of the open flues were divided by a cross wall 1 foot thick, to prevent the wind blowing the fire through the bottom of the kiln.

The average result from six kilns, burned during the season, was 70 per cent., and the expenditure of wood was about 4,400 maunds to each lakh of kutcha bricks.

SIXTH, or "LOODIANA SYSTEM," *vide* Plan, &c. (Sheet, No. 7).

Introduced by a native, who professed to have gained great experience in brick-burning under a European soldier at Loodiana. His system differed from that of the Benares one, in having two bricks in the piers of the flues instead of one, and in having one flue open and three closed, instead of firing from the whole. The two kilns filled by this man were great failures, and his system was at once abandoned.

SEVENTH, or "ROORKEE NEW SYSTEM," *vide* Plans, &c. (Sheet, No. 8).

The kilns previously described having been filled time after time without any marked improvement in the out-turn of pukka bricks, it became necessary to find out a mode by which better and more regular results would be ensured. The Benares system was, therefore, modified in the following manner :—

Instead of one uniform width and height of flue, the "Roorkee new system" kilns had them of various sizes, according as experience had taught that they were required. Thus, in the lower part of the kiln, where peela bricks prevailed in the Benares, the new system had flues 3 feet wide and 5 feet 6″ high, the arch commencing on the sixth instead of on the fourth brick, which gave space for a considerable quantity more fuel. In the centre of the second tier where janior formed, the flues were reduced to 1½ foot in width, and on each side of these were placed two 2 feet flues, the tier being completed with 2½ and 3 feet flues towards the sides and ends of the kiln, where in the Benares system peela bricks were found; the arches of the second tier of flues commenced on the fifth brick throughout, and were ten bricks or 5 feet in height. In the third tier, one-and-half flues were made at each end of the kiln, 3 feet, and all the rest were 2½ feet wide; the arches commencing on the same brick, and being of the same height as in the second tier. The flues of each tier were divided by cross walls into cells of about 10 feet in length, and this was found to be a great improvement, by increasing the number of bricks in the kiln, and, consequently, decreasing the quantity of fuel; and by regulating, in some measure, the current of wind and air through the kiln.

The superiority of kilns, filled in the manner just described, was soon apparent. A comparison between eight English kilns filled on previous plans, and eight of the same size filled in the new way, gave, for the former, an average return from each kiln of 35,737 whole pukka bricks, or 55·4 per cent.; whilst the latter gave 61,140 whole pukka bricks, and an average per-centage of 66·3, showing an increase of 11 per cent. of pukka bricks, with the very great advantage of nearly twice the number of whole ones. This method was, therefore, continued throughout the remainder of the season, and the best kiln yielded a per-centage of 84·6 of pukka bricks on the kutcha ones piled into kiln. The quantity of wood used in these kilns was about 3,000 maunds per lakh of kutcha bricks.

In all the English kilns filled by Mr. Finn two layers of broken bricks were laid flat on the top, and over these, kiln ash was deposited in ridges at first, and spread out when the fire made its appearance at the top of the kiln, the layer of ashes being from 9 to 12 inches in depth. In firing, the flues were replenished with wood for from thirty-six to forty-eight hours after lighting, or until the fire had laid good hold of the kiln. Various methods of firing were tried, some with every other flue closed; some with one open and two closed; and others with one open and three closed flues. The system of one open and two closed appeared to act the best, as the fire passed more equally through the kiln than in the others. Two flues were attended and fired by one beldar, and the kilns were watched day and night for a week after firing, and all the chasms and sinkings filled up with janior.

The wood with which these kilns were fired was dhâk, peepul, burghut, saul, &c., but the most part was dhâk derived from the kheree forests; it was cut by servant beldars, and carted in by contractors at a rate of 9 rupees per 100 maunds. 800 carts were constantly employed on this work alone during the season under review.

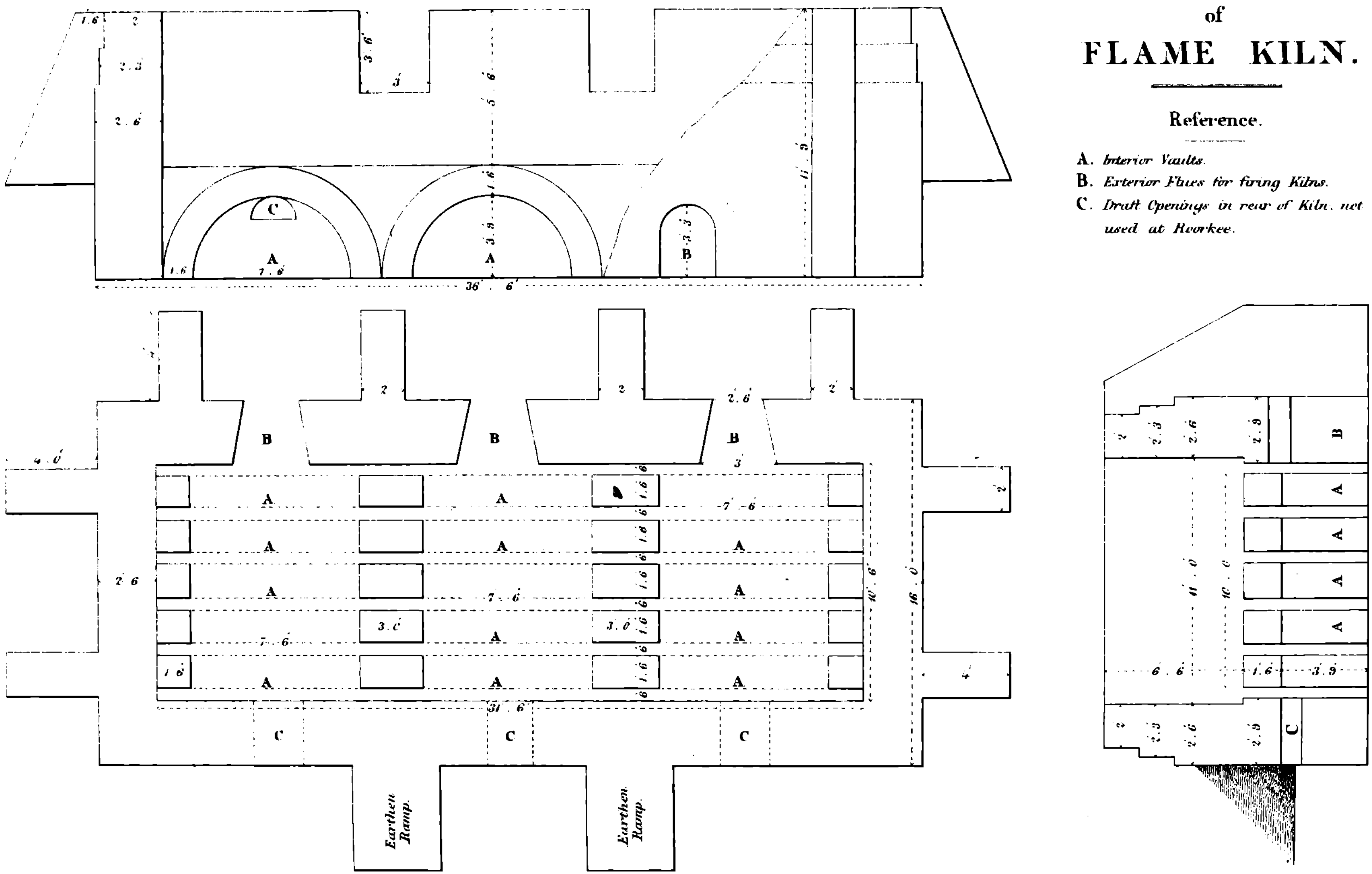
The two Government Hindustani kilns yielded a return of 83·4 per cent., which was an excellent result; but the bricks were dear, for this system of burning, owing to the scarcity of the description of fuel (khak and koora) required, some of which had to be carted in from villages distant about six miles, and the carriage of fuel alone for the first kiln cost the sum of 643 rupees. Oopla, which on the Jumna canals was obtained at 2 rupees, cost at Roorkee rs. 6-8-0 per 100 maunds.

The Hindustani kilns established in neighbouring villages were also successful, having contributed to the grand total out-turn for the season 26,50,260 pukka bricks.

In the early part of this season the kutcha bricks were moulded upon the bare ground, and were of very bad shape, leading not only to failures in burning by the incompact way in which they piled into kiln, which admitting passages for air, flame and heat, caused the fire to be rapidly expended without doing its proper duty; but also to extra expense in the masonry built from them, by the amount of chipping and dressing which they required before being laid in the work. To remedy this, pukka terraces, or masonry platforms with even surfaces, were introduced on all the brickfields upon which the bricks were moulded, and in a short time our bricks were equal to the best table-moulded bricks that could be turned out. Up to the 31st July, however, the cost of the kutcha bricks was very high, having been 144 Co.'s rupees per lakh. The detail of this expenditure is introduced here, in order that comparison may be made with similar detail for future years, when the improvements made in the relative situations of the tughars and moulding terraces had reduced the price of kutcha bricks to a fair average rate.

	RS.	A.	P.
1 brick moulder, at 7 rupees per month	7	0	0
3 beldars, excavating and carrying earth to the tughars, a distance of about 300 feet, at 4 rupees per month	12	0	0
1 beldar, breaking clods and rough tempering the mould	4	0	0
3 beldars, mixing and carrying the clay to the moulder, at 4 rupees per month ...	12	0	0
1-6th of a bildar for ashes and water, at 4 rupees per month	0	10	8
1-4th of a bullock drawing water, say	1	12	0
Establishment	0	8	0
Sundries.—Expense of bamboo handbarrows, handies, and koonduhs, wear and tear of well churrusses and well ropes, repairing brick moulds, stacking the bricks, and occasionally covering them with grass chuppers to protect them from the rain ...	1	0	0
Total Co.'s rupees	38	14	8

PLAN of FLAME KILN.



Reference.

A. *Interior Vaults.*
B. *Exterior Flues for firing Kilns.*
C. *Draft Openings in rear of Kiln, not used at Roorkee.*

Each moulder and his attendants, as per above account, cost per month 38*rs.* 14*a.* 8*p.*, and each on an average turned out 1,000 bricks per diem, or per month 31,000

Deduct for four Sundays in a month 4,000

Balance, the number of bricks made by one moulder 27,000

Then if 27,000 kutcha bricks, 12″ × 6″ × 2½″, cost 38*rs.* 14*a.* 8*p.*, 1 lakh will cost 143*rs.* 15*a.* 9*p.*

It must be understood that in showing the results of each season's operations, a period extending from about the middle of October to the end of the month of June following is embraced. In the statements which are given below all the work done on the Government fields during the season is represented; the bricks from the outlying Hindustani kilns are never available until after the season in which they were piled into kiln has passed, hence, therefore, the 26,50,260 pukka bricks stated in a former paragraph to have been derived from Hindustani kilns are not included in the returns, but are brought to account in the abstracts for the ensuing season.

The results of the season of 1847-48 may be described thus:—

Piled into kilns	1,64,99,652
Used in building kilns, &c.	8,35,000
Lost by rain wastage, &c.	25,73,623
Stock remaining at close of season	8,70,912
Total kutcha bricks moulded	2,07,79,187

The return from the kilns so piled, was:—

Pukka bricks of all sizes ...	1,08,91,961, or 66	per cent. on the kutcha bricks filled into kilns.
Peela „ „ ...	54,56,933, or 33	„ „ „
Jhama ... (cubic feet)	1,19,615, or 1	„ „ „

The total cost of the season's operations was 1,68,072 *rs.* 12 *a.* 5 *p.*, and, after deducting from this the value of the few bricks made for the special purposes of pillars, architraves, &c.; and excluding altogether 32,55,285 peela bricks which, as not being at the time required for the works, were held to be of no value, the following rates were exhibited for the bricks in ordinary use:—

	RS.	A.	P.	
Pukka bricks, 12″ × 6″ × 2½″, at the kilns	1,154	5	9	per lakh.
Peela „ „ „	250	0	0	„
Jhama	2	0	0	per 100 cubic feet.

1848–49.—The results of the season of 1847–48 had so fully proved the success of the "Roorkee Flame" and "Roorkee New System" kilns over all others that had been tried, that the brick burning of 1848–49 was for some time confined to these two modes, and Mr. Finn's operations were carried on steadily; the out-turn of pukka bricks increased in number, and each quarter's accounts exhibited a reduction in their cost. In February, 1849, Captain Weller of the Engineers visited Roorkee and spoke highly of a flame kiln which he had used in Sind. As we had already learnt the value of flame kilns—in their easy management, and freedom from broken bricks, his plan was at once tried. The first few trials were not very successful; but in a short time, with some modifications introduced by Mr. Finn, it proved so satisfactory and regular in its results, that it was introduced to the exclusion of all others, not only in the Roorkee and Muhewar fields, which were remodelled for the purpose, but in the new fields which were now being established at Dhunouri and Selimpoor. Plan and sections of this kiln are given in sheet No. 9, and the following memorandum on the method of filling and firing it, which was submitted by Mr. Finn on the 1st March, 1850, after a full year's experience had established its complete success, will be found of the greatest value:—

Memorandum on the Filling and Firing of Flame-Kilns.

"Interior dimensions of flame-kiln in general use at Roorkee, &c.:—Length, 31′ 6″; breadth, 11′ above flues; height, 6′ 6″ above flues. Excavate to a depth of 3 feet for the floors or bottom of the kiln, giving any foundation *below* that depth local circumstances may require; slope away the ground in front of firing flues, so as to give the firemen ready access to them.

"A kiln is loaded in one day, fired in two days, cooled in four days, emptied in one day: total, 8 days. A kiln of the above given dimensions contains about 15,500 kutcha bricks, each brick being $12'' \times 6'' \times 2\frac{1}{2}''$; 24 beldars load a kiln, 18 beldars unload a kiln; these men also select the bricks into classes—first, second, and peela.

"The quantity of *dry* wood expended at Roorkee in firing a kiln 48 hours is 575 maunds; and the number of beldars (firemen) employed to feed the flues, 24; thus, 2 men to each flue—6 to a kiln—the firemen work in spells of 21 hours, night and day; then for 48 hours' firing, 4 spells, and 6 men for each = 24 men.

"No ashes or covering of any sort to be placed on the top of the bricks in the kiln; and when the firing of the kiln is completed, the flues should not be closed up, but left open.

"Bricks and wood are placed separately in flame-kilns, the former are packed on top of the inner longitudinal walls 12 bricks or 6 feet high, and the latter is placed in the three vaults at the bottom of the kilns. The spaces, 6 inches wide, between the longitudinal walls, are flues for the admission of the heated air upwards. The lower tier of bricks in kiln are placed about 2 inches apart, the second, third, fourth, and fifth a little closer; and from the sixth to the twelfth tier inclusive, the brick are packed in closely. When the bricks are placed in the kiln, the vaults are filled with wood, and the firing commenced; this operation should be carried on vigorously for, at least, 24 hours, by which time, if the bricks are baked, the fire will be well up all over the top of the kiln.

"During the cold season, or when bricks are not thoroughly dry on being packed into kiln, it requires fully 48 hours to bake them.

"Firewood issued to the Roorkee kilns is charged for at the rate of 11 rupees per 100 maunds; this wood is of various sorts, but by far the greater part of it is dhâk, which is supposed to be about the very worst description that could be had for the purpose: babool, khyr, and tamarind are all good; and doubtless, of either sort, a much less quantity than we expend of dhâk would suffice to bake a kiln of bricks; but of these we have none here.

"Firing kilns on high windy days should, if possible, be avoided; for then the bricks require a longer time to bake, and the kilns seldom or never afford a good return; the bricks of the windward side invariably remain unbaked.

"The average return of pukka from kutcha bricks baked in 44 flame-kilns at Roorkee for one month was 81·7 per cent. Some of the kilns, however, yielded a return of 92·8 per cent."

At the commencement of this season (October, 1848) Hall's brick-making machines (for a description and plans of which, see Appendix) was set up at Roorkee. Mr. Finn, and the overseer Sergeant Durrant, in immediate charge of the Roorkee brick fields, first made themselves acquainted with the working of the machine, and then taught a party of bildars the use of it. For the first three months, owing probably to the awkwardness of the men employed, it was constantly getting out of order, and considerable interruption to progress was the consequence; but Mr. Finn persevered, and before the close of the season, had the satisfaction of seeing it work regularly, and of counting 11,670 bricks made by it in one day—an out-turn fully equal to the best that had been obtained in England or America. These bricks, from the process the clay undergoes in its passage through the pug-mill, are beautifully tempered, and when burned are found to be very close-grained; their only disadvantage being, that their size, $9\frac{1}{2}'' \times 4'' \times 3''$, differed from that in common use on the Ganges Canal works. They were invariably burned in Hindustani kilns under the supervision of the Government establishments.

Before this machine was in full work, the men employed on the Ganges Canal brick-fields, as moulders, were the most intractable and troublesome class of people that were on the works; their combined and frequent efforts to evade the doing of a fair day's work, or to extort higher rates of pay, caused much anxiety; every attempt to coerce a moulder, or even if fault was found with the quality or quantity of work performed by one or more of them, led to a strike of the whole body. When, however, they saw that we could turn out from the machine 11,000 bricks per day, independently of themselves, they became the most docile of our people, and after a while, they were glad to receive 6 rupees per month for a full day's work.

At first, it was attempted to work the machine by horses, but they were found not to answer so well as bullocks, and four of these latter animals were, therefore, employed daily in cutting and mixing the clay in the pug-mill: two worked from sunrise till noon, and the other two from two P.M. till dusk.

At the close of the season, the complement of men attached to the machine for working was as follows:—

Excavating the clay and carrying it to the pug-mill cistern, an average distance of 130 ft.	11	beldars.
Supplying the cistern with water, and clearing up the drying ground	2	"
Filling the pug-mill from the contents of the cistern	3	"
Cleaning and handing the moulds preparatory to passing them into the machine ...	1	"
Serving the machine with empty brick-moulds	1	"
On the wheel for pressing the mixed clay into the moulds	1	"
Carried forward	19	

	Brought forward	19 beldars.
On the lever, for forcing out the moulds	... ...	1 „
On the mister, or strike, cleaning top of the bricks and raising the moulds to the heads of the carriers	... ...	1 „
Carrying the loaded moulds from the machine to the drying ground	... ...	6 „
Relieving the carriers of the moulds, and placing the bricks in regular lines on the drying ground	... ...	1 „
Total	... ...	28 beldars.

The following abstract of workpeople employed, number and cost of the bricks made by this machine, from its setting up to the termination of the season, may well find a place in this report, as it shows how progressively Mr. Finn increased the turn-out of bricks, and decreased their cost.

Date.	Bildars, at 4 *rs.* per Month.	Bildars, at 3 *rs.* 8 *a.* per Month.	Chuprassies, at 5 *rs.* per Month.	Horses, at 5 *a.* per Diem.	Bullocks, at 5 *a.* per Diem.	Bricks made Daily.	Remarks.	Total Monthly Expenditure, and Rate of Bricks Manufactured.			
									RS.	A.	P.
1848.											
Octr. 23	7	...	1	2	...	2,090	Commenced making bricks.				
„ 24	9	...	1	2	...	2,695					
„ 25	15	...	1	2	...	2,400	Beam of pug-mill broke.	Labour	15	12	10
„ 26	2	...	1	...	...	...		Sundries	4	10	11
„ 27	...	...	1	...	...	...	Sunday.				
„ 28	5	...	1	...	...	...		Total	20	7	9
„ 29	5	...	1	...	...	...					
„ 30	15	...	1	2	...	3,010	Work recommenced.				
„ 31	21	...	1	2	...	2,600		Average cost per lakh ...	160	1	6
Total...	79	...	9	10	...	12,795					
Novr. 1	2	18	1	2	...	2,290					
„ 2	2	18	1	2	...	2,130	The cistern of the pug-mill broken.				
„ 4	...	7	1	...	...	...					
„ 5	...	7	1	...	...	...	Sunday.				
„ 18	...	12	1	...	...	...	Filling the cistern and preparing for work.	Labour	63	1	4
„ 19	...	12	1	...	...	...	Sunday.	Sundries	5	3	9
„ 20	...	18	1	2	...	4,000					
„ 21	3	18	1	2	...	5,790		Total	68	5	1
„ 22	5	16	1	2	4	6,450					
„ 23	5	17	1	2	4	6,850					
„ 24	5	23	1	2	4	6,240		Average cost per lakh ...	103	9	2
„ 25	5	25	1	2	4	6,570		Ditto, after deducting			
„ 26	5	25	1	...	...	...	Sunday.	wages for Sundays...	91	11	6
„ 27	5	22	1	2	4	6,550					
„ 28	6	22	1	2	4	6,880					
„ 29	6	22	1	2	4	7,000					
„ 30	3	25	1	2	4	5,210					
Total...	52	307	17	24	32	65,960					
Decr. 4	5	24	1	2	4	5,080		Labour	18	9	3
„ 9	5	22	1	2	4	4,090					
„ 10	5	22	1	...	...	...	Sunday.				
„ 12	5	24	1	2	2	6,000	Horses altogether discontinued.	Average per lakh	122	10	9
								Ditto, after deducting			
Total...	20	92	4	6	10	15,170		wages for Sundays...	101	3	10

Date.	Bildars, at 4 *rs.* per Month.	Bildars, at 3 *rs.* 8 *a.* per Month.	Chuprassies, at 5 *rs.* per Month.	Horses, at 5 *a.* per Diem.	Bullocks, at 5 *a.* per Diem.	Bricks made Daily.	Remarks.	Total Monthly Expenditure, and Rate of Bricks Manufactured.
1849.								
Jany. 9	10	...	...	...	...	...	Filling cistern.	
„ 10	3	...	...	...	...	...	Preparing for work.	
„ 11	28	...	1	...	4	6,120		
„ 12	28	...	1	...	4	7,370		
„ 13	28	...	1	...	4	7,500		RS. A. P.
„ 14	28	...	1	...	4	...	Sunday.	Labour 77 5 2
„ 15	15	...	1	...	2	3,050	Machine out of order.	Sundries 1 14 2
„ 18	28	...	1	...	2	7,000		
„ 19	25	...	1	...	4	7,100		Total 79 3 4
„ 20	26	...	1	...	4	7,000		
„ 21	26	...	1	...	...	...	Sunday.	
„ 22	26	...	1	...	4	7,000	Machine out of order.	Average cost per lakh ... 88 11 4
„ 26	29	...	1	...	4	7,100		Ditto, after deducting
„ 27	29	...	1	...	4	7,400		wages for Sundays... 74 4 9
„ 28	29	...	1	...	...	...	Sunday.	
„ 29	28	...	1	...	4	7,500		
„ 30	29	...	1	...	4	7,650		
„ 31	29	...	1	...	4	7,500		
Total...	444	...	16	...	48	89,290		

Date.	Bildars, at 4 *rs.* per Month.	Bullocks, at 5 *a.* per Diem.	Bricks made Daily.	Remarks.	Total Monthly Expenditure, and Rates of the Bricks Manufactured.
1849.					RS. A. P.
Feby. 1	29	4	7,700		Labour 37 10 3
„ 2	29	4	7,150		Sundries 2 6 3
„ 3	29	4	8,040		
„ 4	29	...	...	Sunday.	Total 40 0 6
„ 5	29	4	8,090		
„ 6	29	4	8,020		Average cost per lakh ... 88 8 9
„ 7	3	...	...	Clearing out pug-mill.	Ditto, after deducting
„ 8	26	4	6,210	Machine broken.	wages for Sundays... 79 1 3
Total...	203	24	45,210		
Mar. 20	12	...	...	Filling cistern with clay, and preparing.	
„ 21	25	4	6,200		
„ 22	26	4	8,100		
„ 23	26	4	8,050		Labour 53 10 7
„ 24	27	4	8,110		Sundries 2 3 8
„ 25	27	...	...	Sunday.	
„ 26	27	4	9,125		Total 55 14 3
„ 27	27	4	9,515		
„ 28	27	4	9,540		Average cost per lakh ... 64 5 2
„ 29	27	4	9,580		Ditto, after deducting
„ 30	28	4	9,000		wages for Sundays... 60 2 8
„ 31	28	4	9,670		
Total...	307	40	86,890		

Date.	Bildars, at 4 *rs.* per Month.	Bullocks, at 5 *a.* per Diem.	Bricks made Daily.	Remarks.	Total Monthly Expenditure, and Rates of the Bricks Manufactured.
1849.					
April 1	28	...	...	Sunday.	
" 2	28	4	10,260		
" 3	28	4	9,075		
" 4	28	4	10,050		
" 5	28	4	10,026		
" 6	28	4	9,960		
" 7	28	4	10,100		
" 8	28	...	...	Sunday.	
" 9	28	4	10,000		
" 10	28	...	...	Holidays on account of Hurdwar fair, beldars allowed 1 day's pay.	
" 11	...	...	...		
" 12	28	4	9,480		RS. A. P.
" 13	28	4	10,180		Labour 136 4 9
" 14	28	4	10,030		Sundries 9 12 6
" 15	28	...	...	Sunday.	
" 16	28	4	10,200		Total 146 1 3
" 17	28	4	9,600		
" 18	28	4	10,370		Average cost per lakh ... 66 14 0
" 19	2	...	...	Cleaning machine.	Ditto, after deducting
" 20	28	4	6,500		wages for Sundays... 58 0 5
" 21	28	4	10,360		
" 22	28	...	...	Sunday.	
" 23	28	4	10,650		
" 24	28	4	9,840		
" 25	28	4	10,620		
" 26	28	4	10,450		
" 27	28	4	10,140		
" 28	28	4	10,350		
" 29	28	...	...	Sunday.	
" 30	28	4	10,100		
Total...	786	88	218,341		
May 1	28	4	10,500		
" 2	28	4	10,240		
" 3	28	4	10,500		
" 4	28	4	10,300		
" 5	28	4	10,500		
" 6	28	...	...	Sunday.	
" 7	28	4	10,640		
" 8	28	4	10,750		Labour 149 12 0
" 9	28	4	10,520		Sundries 7 9 10
" 10	28	4	10,650		
" 11	28	4	10,560		Total 157 5 10
" 12	28	4	10,700		
" 13	28	...	...	Sunday.	Average cost per lakh ... 54 12 2
" 14	28	4	10,680		Ditto, after deducting
" 15	28	4	10,680		wages for Sundays... 49 8 8
" 16	28	4	10,450		
" 17	28	4	10,700		
" 18	28	4	10,250		
" 19	28	4	10,550		
" 20	28	...	...	Sunday.	
" 21	28	4	10,460		
" 22	28	4	10,500		
" 23	28	4	10,900		

Date.	Bildars, at 4 *rs.* per Month.	Bullocks, at 5 *a.* per Diem.	Bricks made Daily.	Remarks.	Total Monthly Expenditure, and Rates of the Bricks Manufactured.
1849.					
May 24	28	4	10,800		
„ 25	28	4	10,950		
„ 26	28	4	10,900		
„ 27	28	...	...	Sunday.	
„ 28	28	4	10,900		
„ 29	28	4	10,900		
„ 30	28	4	10,950		
„ 31	28	4	10,980		
Total...	868	108	287,410		
June 1	28	4	10,900		
„ 2	28	4	10,950		
„ 3	28	...	...	Sunday.	
„ 4	28	4	10,900		
„ 5	28	4	10,980		
„ 6	28	4	10,900		RS. A. P.
„ 7	28	4	10,980		Labour 83 3 9
„ 8	28	4	10,980		Sundries 0 6 0
„ 9	28	4	10,980		
„ 10	28	...	...	Sunday.	Total 83 9 9
„ 11	28	4	10,960		Average cost per lakh ... 53 15 1
„ 12	28	4	10,900		Ditto, after deducting
„ 13	28	4	11,670		wages for Sundays... 46 8 1
„ 14	28	4	11,000		
„ 15	28	4	11,300		
„ 16	28	4	11,450		
„ 17	28	...	...	Sunday.	
Total...	476	56	154,850		

N.B.—Half-pay for a tindal, at 8 rupees per month, charged throughout.

Total number of bricks made by this machine during the whole season 976,016
At an average cost of 68 *rs.* 9 *a.* 8 *p.* per lakh.

Bricks made by the machine during the month of May cost, on an average, 54 *rs.* 12 *a.* 2 *p.* per lakh, and the rate of the bricks moulded by hand on the pukka terraces at Roorkee during the same month was 91 *rs.* 0 *a.* 10 *p.* per lakh; the pay of the beldars for Sundays in both cases being included; size of the last-mentioned brick (unburnt) $12\frac{1}{2}'' \times 6\frac{1}{4}'' \times 2\frac{5}{8}''$. During June, 28 beldars at 4 rupees per month, and 4 bullocks at 5 annas each, made with the machine on an average 11,046 bricks per day; and during the same period to make 11,200 terrace-moulded bricks, it required

Moulders, at 6 rupees per month	14 men.
Beldars, at 4 „ „	39 „
Total	53 men.

Two of Ainslie's brick-making machines reached the works during this season, but too late to admit of their being fairly tried.

Hindustani kilns were as usual established at outlying villages, but their out-turn not being known at the close of the season, the results are not exhibited in the general returns which follow.

The average cost of the kutcha bricks made on the Government fields was 119 Co.'s rupees per lakh, and the following table represents the details of this rate:—

	RS.	A.	P.
1 brick moulder, at 6 rupees per month	6	0	0
3 bildars, excavating and carrying earth to tughars, breaking clods, and rough tempering the mould, at 4 rupees per month	12	0	0
2½ bildars, mixing and carrying the prepared earth to the moulders, at 4 rs. per month	10	0	0
1-6th of a bildar for ashes and water, at 4 rupees per month	0	10	8
¼th of a bullock drawing water ... ... say	1	12	0
Establishment	0	8	0
Sundries—detail as in former table	1	4	0
Total	32	2	8

As in the former table, the cost of 27,000 bricks is here represented. Then, if 27,000 cost 32 *rs.* 2 *a.* 8 *p.*, one lakh will cost 119 *rs.* nearly.

The number of kutcha bricks moulded on the Government fields, was, including those on hand at the close of the previous season:—

Filled into kilns	1,60,64,468
Used in making and repairing kilns	8,92,152
Loss by rain, wastage, &c.	26,13,914
Stock remaining at close of season	53,140
Total	1,96,23,674

The return from those filled into kilns was:—

Pukka bricks	... ...	1,10,07,328 or 68·5	per cent. on the kutcha bricks filled into kilns.
Peela "	... ...	36,08,720 or 22·5	" " "
Jhama "	(cubic feet)	1,35,876 or 9·0	" " "

The produce of the outlying Hindustani kilns was 36,92,829 pukka bricks, making the total results of the season as follow:—

Pukka bricks	1,47,00,157
Peela "	36,08,720
Jhama ... ... (cubic feet)	135,876

The total cost of the season's operations was 1,49,219 *rs.* 0 *a.* 11 *p.*, giving (under the same conditions as explained in last season's *resumé*) the following average rates for the bricks in ordinary use:—

	RS.	A.	P.	
Pukka bricks, 12″ × 6″ × 2½″, at kilns	736	2	6	per lakh.
Peela bricks " "	250	0	0	"
Jhama	3	6	6	per 100 cubic feet.

1849–50.—The brick-making season of 1849–50 commenced at Roorkee and Muhewur in October, 1849. The new fields established during this season at Selimpoor and Dhunouri were also in active progress, the former from November, 1849, the latter from February, 1850. The whole of these fields were provided with pukka terraces for moulding the kutcha bricks upon; and the only system employed for burning the bricks was that of the flame-kiln. In April, 1850, a brick-making machine on the same plan as Hall's patent, manufactured in the Roorkee workshops, was set up at Muhewur, and was worked with equal success as that which had been brought by me from England. By the end of the season, but too late for bricks to be made from it, another similar machine, also manufactured at Roorkee, was established at Dhunouri; and the several brick-fields were now in the order in which the whole of the future operations were carried on.

Ainslie's brick-making machine, although every effort was made to render it of use, proved an entire failure on our works, and was eventually abandoned.

Hall's brick-making machine continued to keep up its character; and the maximum out-turn in any one day during the season was 12,200.

The same course of work was gone through as described for 1848–49, and the results show a considerable improvement.

The average cost of the kutcha bricks made on the Government fields was 88 *rs.* 4 *a.* 3 *p.* per lakh: the detail of this rate is represented in the following table:—

	RS.	A.	P.
1 moulder, at 6 rs. per month ...	6	0	0
1 bildar, excavating and carrying earth to tughars, breaking clods, rough tempering, &c., at 4 rs. per month ...	4	0	0
2½ bildars, mixing and carrying the prepared earth to the moulders, at 4 rs. per month ...	10	0	0
1-6th of a bildar for ashes and water, at 4rs. per month ...	0	10	8
¼th of a bullock, for drawing water, say ...	1	12	0
Establishment ...	0	6	6
Sundries—detail as in former table ...	1	0	0
Cost of 27,000 bricks ...	23	13	2

Then, if 27,000 cost 23 *rs.* 13 *a.* 2 *p.*, 1 lakh will cost 88 *rs.* 4 *a.* 3 *p.*

The present season exhibits the kutcha brick-making in its most favourable aspect, the above rate being the lowest ever arrived at. Mr. Finn's arrangements were now matured; the quantity of work that could be done by each individual employed was known, and the performance of it strictly insisted on; and from this period forward no variation, except in the one item of "excavating and carrying earth to tughars, &c.," was permitted—this item was necessarily a fluctuating one, and it was entirely dependent on the distance the earth had to be carried. The excavations for this earth were carried on at Roorkee within a defined area, so that on the close of our operations, a large large tank or reservoir might be formed for the convenience of the town. In April, 1854, this reservoir was 1,480 feet long, 370 feet average broad, and 12 feet deep.

The number of kutcha bricks mounded on the Government fields was, including those on hand at the close of the previous season:—

Filled into kilns ...	1,86,48,800
Used in repairing kilns ...	23,34,520
Loss by rain, wastage, &c. ...	40,30,451
Total ...	2,50,13,771

The return from those filled into kilns was:—

Pukka bricks ...	1,47,83,540	or 79 per cent. on the kutcha bricks filled into kilns.
Peela „ ...	32,75,200	or 18 „ „ „
Jhama ... (cubic feet)	76,391	or 3 „ „ „

The produce of the Hindustani kilns was 41,50,000 pukka bricks, making the total results of the season as follow:—

Pukka bricks ...	1,89,33,540
Peela „ ...	32,75,200
Jhama ... (cubic feet)	76,391

Hall's brick machine made during this season 15,15,095 kutcha bricks; of which, 14,23,195 were piled into kilns, and 91,900 were destroyed by rain. The total cost of the season's operations was 1,61,601 *rs.* 8 *a.* 5 *p.* Giving (under the conditions before noted) the following average rates for the bricks in ordinary use:—

	RS.	A.	P.	
Pukka bricks, 12″ × 6″ × 2½″ ...	752	12	4	per lakh.
„ 9½″ × 4″ × 3″ ...	536	0	0	„
Peela „ 12″ × 6″ × 2½″ ...	250	0	0	„
Jhama ...	6	0	0	per 100 cubic feet.

About 1,500 carts were constantly employed during this season in carting firewood to the several fields.

1850–51.—The brick-fields having now been established on one fixed principle, and the same course of work being in operation throughout, it will be sufficient to exhibit the results, noting that this season was marked by extraordinary cold weather rains, which led to great loss in kutcha bricks, and to much interruption in progress. Nevertheless, the returns exhibit continued improvement, and the season's operations were highly satisfactory.

Hall's brick machine made 37,90,670 kutcha bricks, of which 32,26,670 were piled into kiln, and 5,64,000 were destroyed by rain. The maximum number of bricks made by this machine in any one day was, in the present season, 12,500.

Kutcha bricks moulded on the terraces of the Government fields cost 96 *rs.* 9 *a.* 9 *p.* per lakh.

The number of kutcha bricks moulded on the Government fields was :—

Filled into kilns	2,21,21,100
Used in repairing kilns, &c.	30,86,115
Destroyed by rain, &c.	57,44,830
Total	3,09,52,045

The return from those filled into kiln was :—

Pukka bricks	... ...	1,89,42,100 or 85·6	per cent. on the kutcha bricks filled into kilns.
Peela ,,	... ...	25,57,800 or 11·4	,, ,, ,,
Jhama ...	(cubic feet)	66,546 or 3	,, ,, ,,

The produce of the Hindustani kilns was 75,00,000 of pukka bricks, making the total results of the season as follow :—

Pukka bricks	2,64,42,100
Peela ,, ...	25,57,800
Jhama ... ... (cubic feet)	66,546

The total cost of the season's operations was 2,19,586 *rs.* 5 *a.* 9 *p.*, giving (under the conditions before explained) the following average rates for the bricks in ordinary use :—

			RS.	A.	P.	
Pukka bricks,	12″ × 6″ × 2½″	... ...	763	7	0	per lakh.
,, ,,	9½″ × 4″ × 3″	... ...	536	0	0	,,
Peela ,,	12″ × 6″ × 2½″	... ...	250	0	0	,,
Jhama	... ...	... ...	6	0	0	per 100 cubic feet.

The maximum number of carts employed in bringing firewood to the works was 1,500 per day.

1851-52.—Hall's brick-making machine turned out during this season 54,23,000 kutcha bricks, the whole of which were piled into the Hindustani kilns in which they were baked. Its maximum rate of working was equal to 13,500 kutcha bricks per diem.

Kutcha bricks moulded on the terraces of the Government fields cost on an average 93 *rs.* 13 *a.* 4 *p.* per lakh.

The number of kutcha bricks moulded on the Government fields :—

Filled into kilns	3,13,35,400
Used in repairing kilns, &c.	52,26,800
Loss by rain, wastage, &c.	44,17,300
Total	4,09,79,500

The return from those filled into kilns was :—

Pukka bricks ...	... ...	2,57,81,120 or 83	per cent. on the kutcha bricks filled into kilns.
Peela ,, ...	... ...	38,65,300 or 13	,, ,, ,,
Jhama	(cubic feet)	37,820 or 4	,, ,, ,,

The produce from the Hindustani kilns was 93,00,000 pukka bricks, making the total results of the season as follow :—

Pukka bricks	3,50,81,120
Peela ,, ...	38,65,300
Jhama	37,820

The total cost of the season's operations was 3,05,013 *rs.* 3 *a.* 1 *p.*, giving (under the usual conditions) the following average rates for the bricks in ordinary use:—

		RS.	A.	P.	
Pukka bricks, 12″ × 6″ × 2½″	... ...	804	15	8	per lakh.
" " 9½″ × 4″ × 3″	... ...	536	0	0	"
Peela "	... ...	250	0	0	"
Jhama	... ...	6	0	0	per 100 cubic feet.

The maximum number of carts employed per day during this season in bringing firewood to the works was 2,000.

1852-53.—Hall's brick-making machines turned out during this season 59,43,400 kutcha bricks, the whole of which were filled into Hindustani kilns. The maximum working of these machines was at the rate of 14,000 bricks per day each.

Kutcha bricks moulded on the terraces of the Government fields cost 90 *rs.* 7 *a.* 9 *p.* per lakh.

The number of kutcha bricks moulded on the Government fields was:—

Filled into kilns	3,18,91,060
Used in repairing kilns	52,44,248
Loss by rain, &c.	54,89,912
Total	4,26,25,220

The return from those filled into kilns was:—

Pukka bricks	2,62,43,880 or 82	per cent. on the kutcha bricks filled into kilns.
Peela "	36,73,700 or 12	" " "
Jhama	86,037 or 6	" " "

The produce of the Hindustani kilns was 90,00,000 pukka bricks, making the total for the season as follows:—

Pukka bricks	3,52,43,880
Peela "	36,73,700
Jhama	86,037

The total cost of the season's operations was 3,59,588 *rs.* 14 *a.* 9 *p.*, giving (under the usual conditions) the following average rates for the bricks in ordinary use:—

		RS.	A.	P.	
Pukka bricks, 12″ × 6″ × 2½″	... ...	940	14	6	per lakh.
" " 9½″ × 4″ × 3″	... ...	650	0	0	"
Peela " 12″ × 6″ × 2½″	... ...	250	0	0	"
Jhama	... ...	6	0	0	per 100 cubic feet.

The great increase observable here in the cost of the pukka bricks is entirely owing to the enhanced price that had to be given for the carriage of firewood, which had annually to be brought from a greater distance, as the forests nearest to our works became cleared.

1853-54.—As far as this paper is concerned, the season of 1853-54 terminates on the 31st of March, 1854; up to that date the Roorkee and Muhewar brick manufactories were most successfully worked to their utmost capabilities, owing to the increased demand that was made upon them to meet the energetic measures which had been taken by the executive engineer to prepare the aqueduct works for the reception of water early in April. The Dhunouri manufactory was also steadily worked; but that at Selimpoor was closed on the 31st January, on which date a sufficient number of bricks had been prepared to complete the works in the neighbourhood.

Hall's brickmaking machines had made 22,36,500 kutcha bricks, 21,68,500 of which had been piled into Hindustani kilns; the average maximum working of these machines continued at 14,000* per day from each machine.

Kutcha bricks moulded on the terrace platforms of the Government fields cost 89 *rs.* 13 *a.* per lakh.

The number of kutcha bricks moulded up to the 31st March, 1854, was:—

Filled into kilns	2,12,96,000
Used in repairing kilns, &c.	36,65,200
Loss by rain, wastage, &c.	3,29,880
In hand	14,52,200
Total	2,67,43,280

So far as they were known (some kilns necessarily remaining unloaded) the results of the bricks filled into kilns had been—

Pukka bricks		1,78,80,613	or 84	per cent. on the kutcha bricks piled into kilns.
Peela „		20,79,100	or 9	„ „ „
Jhama	(cubic feet)	72,922	or 7	„ „ „

The Hindustani kilns contributed a further supply of 75,00,000 pukka bricks, making the total number that had been sent to, or were available for, the works up to the termination of the period embraced by this section, as follows:—

Pukka bricks		2,53,80,613
Peela „		20,79,100
Jhama	(cubic feet)	72,922

The total cost of the operations during this period was 2,38,542 *rs.* 13 *a.* 1 *p.*, giving (under the usual conditions) the following average rates for the bricks in ordinary use:—

	RS.	A.	P.	
Pukka bricks, 12″ × 6″ × $2\frac{1}{2}$″	939	13	10	per lakh.
„ „ $9\frac{1}{2}$″ × 4″ × 3″	650	0	0	„
Peela „ 12″ × 6″ × $2\frac{1}{2}$″	250	0	0	„
Jhama	6	0	0	per 100 cubic feet.

The following condensed abstract of the foregoing results will exhibit the extent of the brickmaking operations in the northern division of the Ganges Canal from their commencement, in 1842, to the 31st March, 1854:—

	Pukka Bricks of all Sizes.	Peela Bricks of all Sizes.
From commencement to the end of June, 1846	1,03,06,171	51,28,235
„ June, 1846, to October, 1847	38,00,000	11,00,000
„ November, 1847, to October, 1848	1,08,91,961	54,56,933
„ „ 1848, to „ 1849	1,47,00,157	36,08,720
„ „ 1849, to „ 1850	1,89,33,540	32,75,200
„ „ 1850, to „ 1851	2,64,42,100	25,57,800
„ „ 1851, to „ 1852	3,50,81,120	38,65,300
„ „ 1852, to „ 1853	3,52,43,880	36,73,700
„ „ 1853, to 31st March, 1854	2,53,80,613	20,79,100
Totals	18,07,79,542	3,07,44,988
Grand Total	21,15,24,530	

and a popular idea of its vastness may be given by stating that if the above number of bricks were laid endwise they would form a line upwards of 40,000 miles in length.

* In the early part of June, 1854, just before brickmaking for the season closed, 15,000 bricks were made daily by the machine.

The memorandum appended to this paper was drawn up by Mr. Finn for another purpose than this report, but it very appropriately takes its place here, and exhibits results during the whole of the period which it embraces highly creditable to that officer's energetic management.

MEMORANDUM *of* OPERATIONS *in the* MATERIAL DEPARTMENT, NORTHERN DIVISION GANGES CANAL, *drawn up by* MR. JAMES FINN, *Executive Officer of Materials.*

The purport of the figured sheet which accompanies this paper is to exhibit in a succinct yet comprehensive manner a summary of my principal doings as Executive Officer of Materials at Roorkee; and I shall here endeavour further to elucidate such points as appear to me to call for remark. I shall, however, confine myself in this memorandum, as I have done in the figured statement, to the staple articles of building materials supplied to the Executive Engineer, viz., bricks, lime, and soorkee, deeming it undesirable to hazard being tedious by entering on such comparatively insignificant items as cattle, timber, and miscellaneous materials.

2. The number of pukka bricks expended on the works of the northern division since the material department has been in my hands, together with those now in store, is as follows:—

Season of 1847–48	95,70,092
" 1848–49	1,60,98,194
" 1849–50	2,16,71,221
" 1850–51	2,55,93,135
" 1851–52	3,38,77,271
" 1852–53	3,39,39,064
From 1st August, 1853, to 31st March, 1854	2,99,52,861
Total	17,07,01,838

besides 2,00,68,040 peela bricks, and 6,65,816 cubic feet of jhama. Of the above, 16,10,94,899 pukka bricks were of the standard size, 12″ × 6″ × 2½″, and were manufactured at an average rate of 995 *rs.* 3 *a.* per lakh, including all expenses of carriage and stacking. The demands on me for this material, it will be seen, were far beyond what was originally anticipated, yet I am happy to say that on no occasion were the works stopped from the supply running out. I would invite attention to the column showing the cost of manufacture of the standard bricks. The first season's work may be regarded as experimental; after which, notwithstanding the enormous sums expended, as per margin,* on dead stock, nearly all of which has been charged off, it will be seen that up to November, 1849, there was a steady and gradual reduction in rate, which at this period reached the minimum of 780 rupees, or with carriage, &c., 900 rupees per lakh; and in wood kilns and under ordinary circumstances, I do not believe they would ever be cheaper at Roorkee. In May, 1852, there is again a rise in price, as might naturally be expected, owing to the greater distance which firewood had to be brought. At the commencement of operations this distance was 7 miles, latterly it has been 22 miles. The supply of fuel for my kilns has been my chief anxiety; it has cost me from 10 to 15 rupees per 100 maunds; and I have brought in and consumed the enormous quantity of 91,55,734 maunds, clearing away in so doing from 80 to 100 square miles of jungle.

3. I may here add that the whole of the bricks made during the first season were baked in large kilns on the old "English" pattern. Towards the close of the following season, a few experimental Sind flame-kilns were tried, and with such favourable results, that ever since they have been in full use, and the "English" ones entirely discontinued.

* Kilns, 27,400 rupees; terraces, 24,654 rupees; wells, 3,026 rupees: total, 55,080 rupees.

4. The quantity of lime furnished to our works is 19,38,000 maunds, viz. :—

	Maunds.	Seers.
Season of 1847–48	1,71,024	20
" 1848–49	3,12,253	0
" 1849–50	2,14,215	12½
" 1850–51	2,69,149	30
" 1851–52	3,14,011	37½
" 1852–53	3,02,896	27½
Part of season of 1853–54	3,54,448	32½
Total maunds	19,38,000	0

Issued at an average rate of 26 *rs.* 3 *a.* per 100 maunds. The established rate of this material, when I assumed charge, was 30 rupees per 100 maunds, and I was given to understand that even a higher price had been paid for it. As our work progressed and competition was engendered, I thought an opportunity offered for getting this article at a reduced rate, and to a certain extent I succeeded in the second season of our operations. In the following year, however, I proceeded too far; I paid no more than 23 *rs.* 12 *a.* per 100 maunds; the consequence was, that the supply fell off; contractors would not come forward, and I was reduced to the necessity of advancing the rate by 1 *rs.* 8 *a.* per 100 maunds. It will be seen from the statement accompanying, that ever since November, 1850, the price of lime has remained fixed at 25 *rs.* 4 *a.* per 100 maunds, and I believe this to be a fair rate both for contractors and Government.

5. The issues of soorkee annually, including stock now in hand, have been :—

	Maunds.	Seers.
Season of 1847–48	54,367	10
" 1848–49	1,92,937	30
" 1849–50	4,18,867	30
" 1850–51	4,42,751	30
" 1851–52	6,19,047	25
" 1852–53	6,72,268	25
Part of season of 1853–54	11,30,896	15
Total maunds	35,31,137	5

at an average of 12 *rs* 9 *a.* per 100 maunds. The rate, when I joined, was 14 *rs.* 12 *a.*; it has since naturally fluctuated with the cost of bricks; hence we find it reduced to 12 *rs.* 8 *a.*, and then to 12 *rs.* per 100 maunds, and latterly it has risen to 13 *rs.* 8 *a.*

6. I have been very fortunate in my extensive dealings with contractors for Puzawah made bricks, lime, and carriage of firewood. Of brick contractors I had from 40 to 50 in constant employ, about the same number of lime contractors, and sometimes as many as 400 contractors with 2,000 carts bringing firewood from the forest. Every rupee earned by my numerous contractors was paid to them in my presence, and although I have been obliged to make large advances to get them to work, and to retain them afterwards, I have not, to this date, lost one pie by the contractors for bricks and firewood; but I did lose about 150 rupees by the lime contractors, two of whom died before their contracts were completed, and they were in such poor circumstances that they left nothing but their starving families behind them.

7. In conclusion, I would advert to the large sum of money which has passed through my hands for the supply of materials for the northern division, and endeavour to show, that it has been, at least, not unprofitably expended. The sum-total of money laid out on materials, exclusive of establishment pay and current expenses is, as per accompanying statement, 23,48,398 *rs.* 4 *a.* 4 *p.*, which, being spread over 78 months, gives an average monthly outlay of 30,107 *rs.* 10 *a.* 8 *p.* The *increased* charges for supervision over this outlay—I mean my own salary, that of my *office* establishment and current expenses; for the same staff of overseers would necessarily have been maintained if the executive and material departments had not been separated—have been, as nearly as possible, 500 rupees per mensem, or 1⅔ per cent. Now, to look at the direct saving to Government effected by reduction of rates: the average cost of bricks during my first season's work, viz., 1,244 *rs.* 12 *a.* per lakh, may be assumed as the rate of manufacture when I took charge.

My bricks on the whole have come to 995 *rs.* 3 *a.*, equivalent to a saving of 249 *rs.* 9 *a.* per lakh, or on 16,10,94,899 bricks, 12″ × 6″ × 2½″, 4,02,032 *rs.* 7 *a.* 4 *p.* Similarly with lime: the reduction has been 30 *rs.* — 26 *rs.* 3 *a.* = 3 *rs.* 13 *a.* per 100 maunds, or on the total supply 72,893 *rs.* 14 *a.* And in respect to soorkee, the reduction is equal to 2 *rs.* 3 *a.* per 100 maunds; or on 35,31,137 maunds it is 77,243 *rs.* 10 *a.* Collecting these sums, we get:—

	RS.	A.	P.	RS.	A.	P.
Saving on bricks	4,02,032	7	4			
" lime	72,893	14	0			
" Soorkee	77,243	10	0			
				5,52,169	15	4
Deduct expense of supervision for 6½ years, at 6,000 rupees per annum				39,000	0	0
Nett saving to Government				5,13,169	15	4

being 17·93 per cent.

8. I shall say nothing of the difficulty of obtaining materials in large quantities at any price, of providing carriage for the immense stocks of firewood required for my kilns, of transporting lakhs of cubic feet of lime annually; in short, of making arrangements for materials generally, on so very extended a scale as was indispensable in the northern division; but allow the simple figures given above to speak for themselves, confidently trusting that the results which have been shown in this memorandum will prove satisfactory.

(Signed) JAMES FINN,
Executive Officer, Northern Division Ganges Canal.

STATEMENT *or* ABSTRACT *of* CASH *received to* ACCOUNT *of* MATERIALS, *and of* ISSUES *of* MATERIALS *to* WORKS, *with* RATES *of each.*

PERIOD.	Cash advances to Exec. Officer of Materials.	ISSUES TO WORKS.							Firewood brought on Works.	Pukka Bricks 12″ × 6″ × 2½″ per Lakh.	Stone Lime per 100 Maunds.	Soorkee per 100 Maunds.
		Pukka Bricks 12″ × 6″ × 2½″	Pukka Bricks (machine) 9¼″ × 4″ × 3″.	Pukka Bricks of Sizes.	Peela Bricks.	Jhama.	Stone Lime.	Soorkee.				
1848.	RS. A. P.	Number.	Number.	Number.	Number.	Cub. Ft.	Maunds. Seers	Maunds Seers	Maunds.	RS. A. P.	RS. A. P.	RS. A. P.
To April 30 ...	1,95,398 4 4	60,43,090	...	2,66,960	24,46,645	11,840	83,315 25	7,066 20	...	1,214 13 1*	29 9 7	14 10 9
„ July 31 ...	1,05,000 0 0	32,39,554	...	20,488	2,17,398	36,858	87,708 35	47,300 30	6,57,546	1,300 8 8*	30 0 0	14 12 0
„ Oct. 31 ...	52,000 0 0	41,84,866	...	15,080	10,39,360	94,344	19,475 15	23,543 25	...	1,149 8 0*	30 0 0	14 12 0
1849.												
„ Jan. 31 ...	1,11,200 0 0	53,57,615	...	5,08,012	8,86,918	22,789	1,02,717 12½	30,604 35	...	1,066 13 10*	30 0 0	14 12 0
„ April 30 ...	1,34,500 0 0	33,47,299	...	...	4,67,384	42,081	98,974 27½	84,828 0	...	850 0 0	30 0 0	12 8 0
„ July 31 ...	79,400 0 0	26,66,822	14,000	4,500	4,14,523	65,202	91,085 25	53,961 10	13,47,498	800 0 0	28 0 0	12 8 0
„ Oct. 31 ...	14,700 0 0	37,01,300	18,800	12,140	4,23,274	50	18 30	25,926 10	...	800 0 0	28 0 0	12 8 0
1850.												
„ Jan. 31 ...	63,200 0 0	52,20,651	1,02,708	...	12,54,234	33,528	22,802 22½	1,05,471 23	...	780 0 0	23 12 0	12 0 0
„ April 30 ...	1,07,000 0 0	72,58,166	2,64,200	...	8,63,209	45,771	65,222 15	1,79,429 10	...	780 0 0	23 12 0	12 0 0
„ July 31 ...	80,000 0 0	47,68,556	3,24,700	...	4,48,092	22,191	1,26,371 25	1,08,040 25	14,98,200	780 0 0	23 12 0	12 0 0
„ Oct. 31 ...	44,500 0 0	36,94,683	1,80,052	...	2,46,160	50	364 15	50,361 20	...	780 0 0	23 12 0	12 0 0
1851.												
„ Jan. 31 ...	75,000 0 0	67,91,037	2,30,800	150	6,80,734	700	43,365 25	57,324 30	...	780 0 0	25 4 0	12 0 0
„ April 30 ...	1,08,000 0 0	65,48,520	2,03,250	...	7,70,349	29,864	1,14,875 0	1,56,163 35	...	780 0 0	25 4 0	12 0 0
„ July 31 ...	75,000 0 0	75,74,328	3,70,315	...	6,91,590	35,932	1,10,544 30	1,78,901 25	12,41,755	780 0 0	25 4 0	12 0 0
„ Oct. 31 ...	37,000 0 0	51,22,708	7,22,260	500	3,06,850	...	1,532 20	68,305 5	...	780 0 0	25 4 0	12 0 0
1852.												
„ Jan. 31 ...	1,11,000 0 0	96,22,391	2,34,300	200	10,65,216	22,546	91,712 0	2,78,555 15	...	780 0 0	25 4 0	12 0 0
„ April 30 ...	1,65,000 0 0	1,06,41,669	6,42,713	...	14,69,066	...	1,03,634 30	1,26,910 35	...	780 0 0	25 4 0	12 0 0
„ July 31 ...	1,07,000 0 0	63,94,170	4,88,900	7,460	10,67,070	15,274	1,17,132 27½	1,45,276 10	22,81,507	880 0 0	25 4 0	12 0 0
„ Oct. 31 ...	35,500 0 0	57,38,834	8,93,435	30,900	12,07,532	7,674	856 10	41,261 20	...	880 0 0	25 4 0	12 0 0
1853.												
„ Jan. 31 ...	75,000 0 0	59,26,946	5,28,760	1,74,459	11,66,102	10,742	54,217 10	2,00,578 0	...	880 0 0	25 4 0	12 0 0
„ April 30 ...	1,30,000 0 0	1,11,53,925	4,64,350	60,668	8,44,760	49,134	1,19,353 5	2,38,637 0	...	950 0 0	25 4 0	12 0 0
„ July 31 ...	1,05,000 0 0	85,62,097	3,05,800	98,890	5,97,360	18,487	1,28,470 2½	1,91,792 5	12,29,228	950 0 0	25 4 0	12 0 0
„ Oct. 31 ...	83,000 0 0	58,18,315	5,93,250	1,18,011	1,95,120	40,039	18,141 27½	1,43,644 15	...	950 0 0	25 4 0	13 8 0
1854.												
„ Jan. 31 ...	1,55,000 0 0	1,30,38,573	8,75,280	2,09,598	10,84,590	3,875	2,33,531 27½	3,73,792 5	...	950 0 0	25 4 0	13 8 0
„ Mar. 31 ...	1,00,000 0 0	56,78,784	3,11,150	3,09,900	2,14,504	56,845	1,02,775 17½	4,38,459 35	9,00,000	950 0 0	25 4 0	13 8 0
Total	23,48,398 4 4	15,80,94,899	77,69,023	18,37,916	2,00,68,040	6,65,816	19,38,200 0	33,56,137 5	91,55,734	—	—	—
In store about	...	30,00,000	...	...	...	...	...	1,75,000 0	...	—	—	—
Grand Total	23,48,398 4 4	16,10,94,899	77,69,023	18,37,916	2,00,68,040	6,65,816	19,38,200 0	35,31,137 5	91,55,734	—	—	—

* These four rates include carriage and stacking. In February, 1849, I was relieved of the provision of carriage for bricks, but Captain Goodwin has ascertained from averages struck on large quantities, that 120 *rs.* 14 *a.* 5 *p.* cover all expenses of carriage, &c. If, therefore, 120 *rs.* be added to the succeeding rates, the total cost of bricks to the works will be obtained.

(Signed) JAMES FINN, *Executive Officer, Northern Division Ganges Canal.*

APPENDIX B.

REPORT *of a* COMMITTEE *assembled by General Orders Commander-in-Chief, dated* 16*th September*, 1845, *under Instructions from the Right Honourable the* GOVERNOR-GENERAL *of* INDIA *in* COUNCIL.

EXTRACT FROM GENERAL ORDERS.

"Under instructions from the Right Honourable the Governor-General of India in Council, the undermentioned officers are directed to form themselves into a Committee, to assemble at such places and on such dates as may be fixed by the President, for the purpose of reporting on the causes of the unhealthiness which has existed at Kurnaul and other portions of the country along the line of the Delhi Canal: the Committee will also report whether an injurious effect on the health of the people of the Dooab is or is not likely to be produced by the contemplated Ganges Canal:—President: Major W. E. BAKER, Engineers; Members: Surgeon T. E. DEMPSTER, Horse Artillery; Lieut. H. YULE, Engineers."

REPORT.

Roorkee, 3rd March, 1847.

THE conduct of the investigation intrusted to our Committee, and detailed in the annexed General Order, involved the necessity of personally examining the districts irrigated by the existing canals, and such other localities as seemed best suited for a fair comparison with them. For this purpose, the Committee met at Kurnaul on the 30th November, 1845, and proceeding southward had made considerable progress in the examination of the irrigated districts west of the Jumna, when they were summoned to military duty with the army of the Sutlej. On the 1st of November, 1846, the inquiry was resumed, and has continued without further interruption.

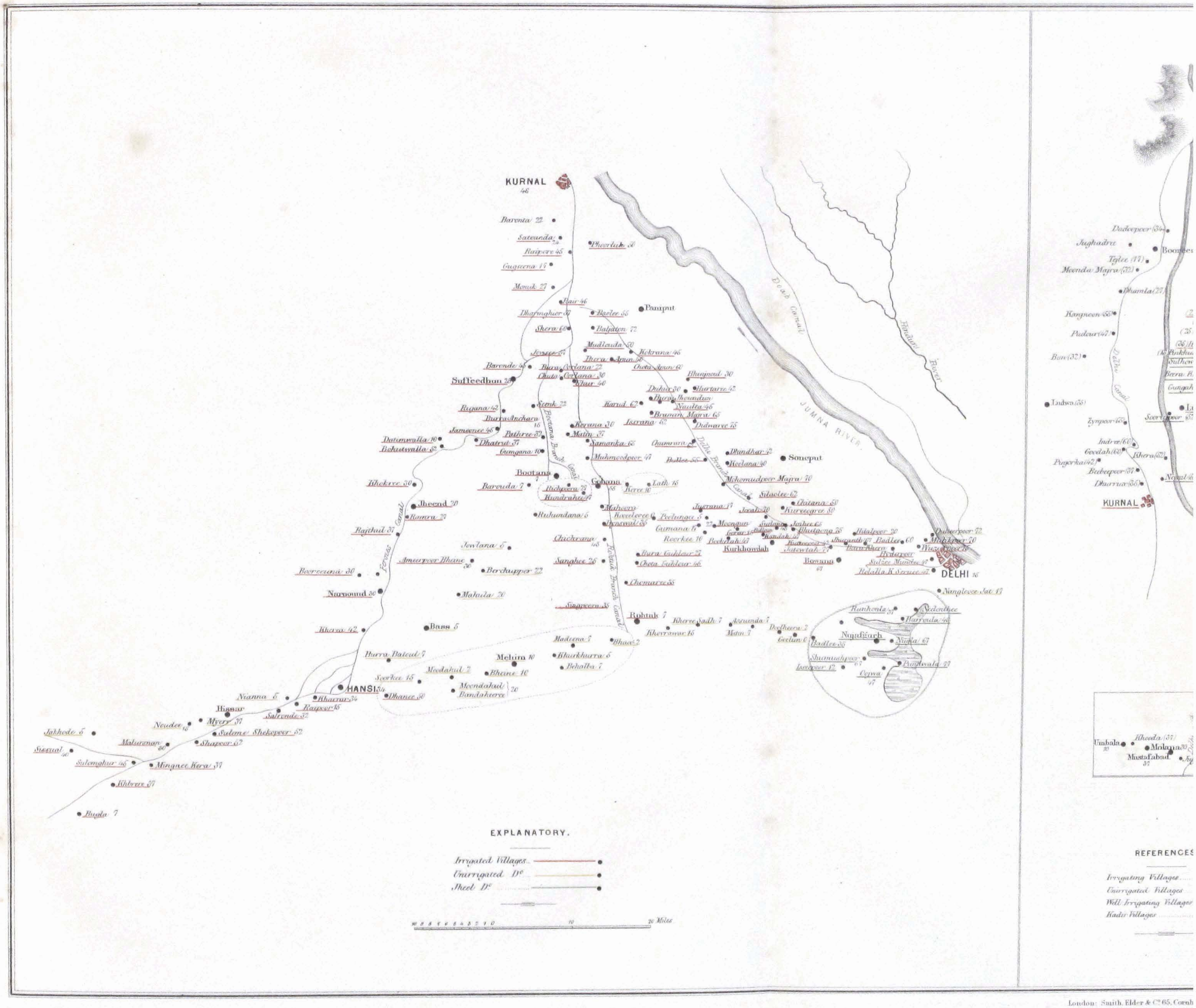
2nd. The route followed by our Committee may be traced on the accompanying sketch map. It was prescribed in some measure by the official engagements of Major Baker, whose inspection of the canals, &c. was necessarily performed in conjunction with his duties as a member of the Committee. It will be seen, that we have examined the irrigated and unirrigated districts on both banks of the Jumna, that we have visited the Nujufghur jheels, and have followed the proposed course of the Ganges Canal for 83 miles, viz., from Hurdwar to the latitude of Meerut. In the course of this inquiry, we have travelled about 1,400 miles. We have visited more than 300 inhabited localities, and have personally examined upwards of 12,000 individuals of all ages.

3rd. It was suggested by our medical member, and will be generally admitted, that a fair comparison of the sanitary condition of different districts must be founded on observations taken within a very brief period of each other, and under circumstances as nearly as possible similar. The observations taken in 1845 were, therefore, useless for our present purpose, and the necessity of completing our inquiry within a period limited to about three months, compelled us to restrict our observations to the bodily condition of the people and to those more obvious circumstances which all modern authority concurs in pronouncing to be those most concerned in the production of disease.

4th. In the commencement of our investigation, we had hoped to derive much assistance from the results of inquiries conducted by our own native agents, and at our instance by the establishments of the revenue and canal departments. We have now before us an immense mass of reports obtained from such sources, but they are in general so vague and unsatisfactory, and are so little corroborated by our own personal observations, that we were unwilling to incur the labour involved in arranging and digesting them, with so little prospect of ultimately obtaining trustworthy results.

5th. Our principal object was to ascertain what relation subsisted between certain physical conditions

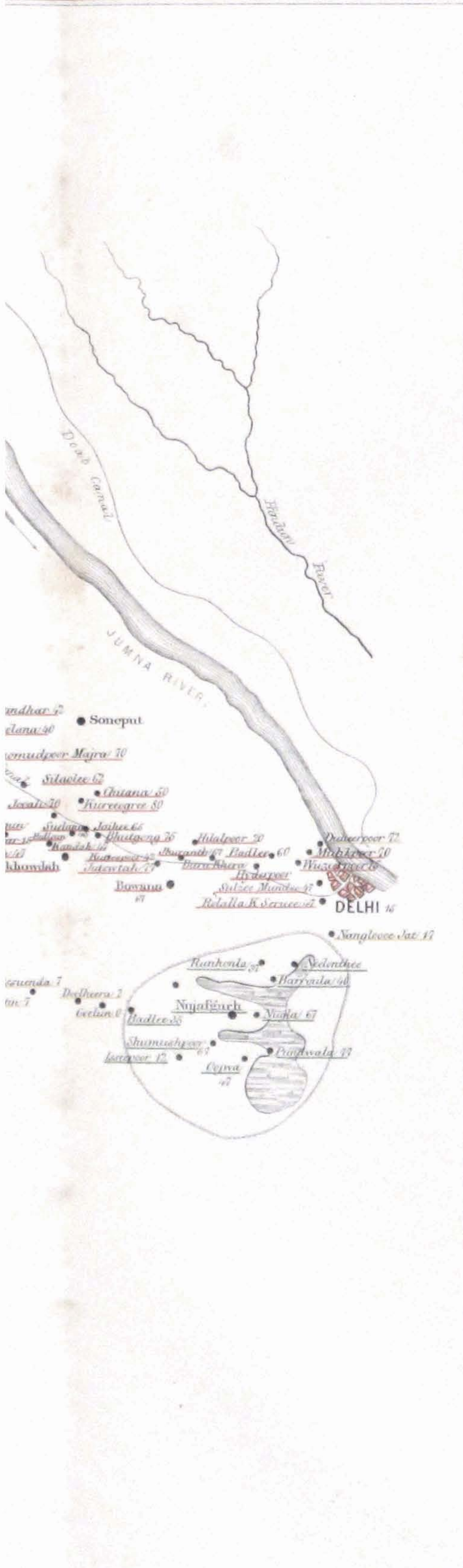
SKETCH MAPS TO ACCOMPA

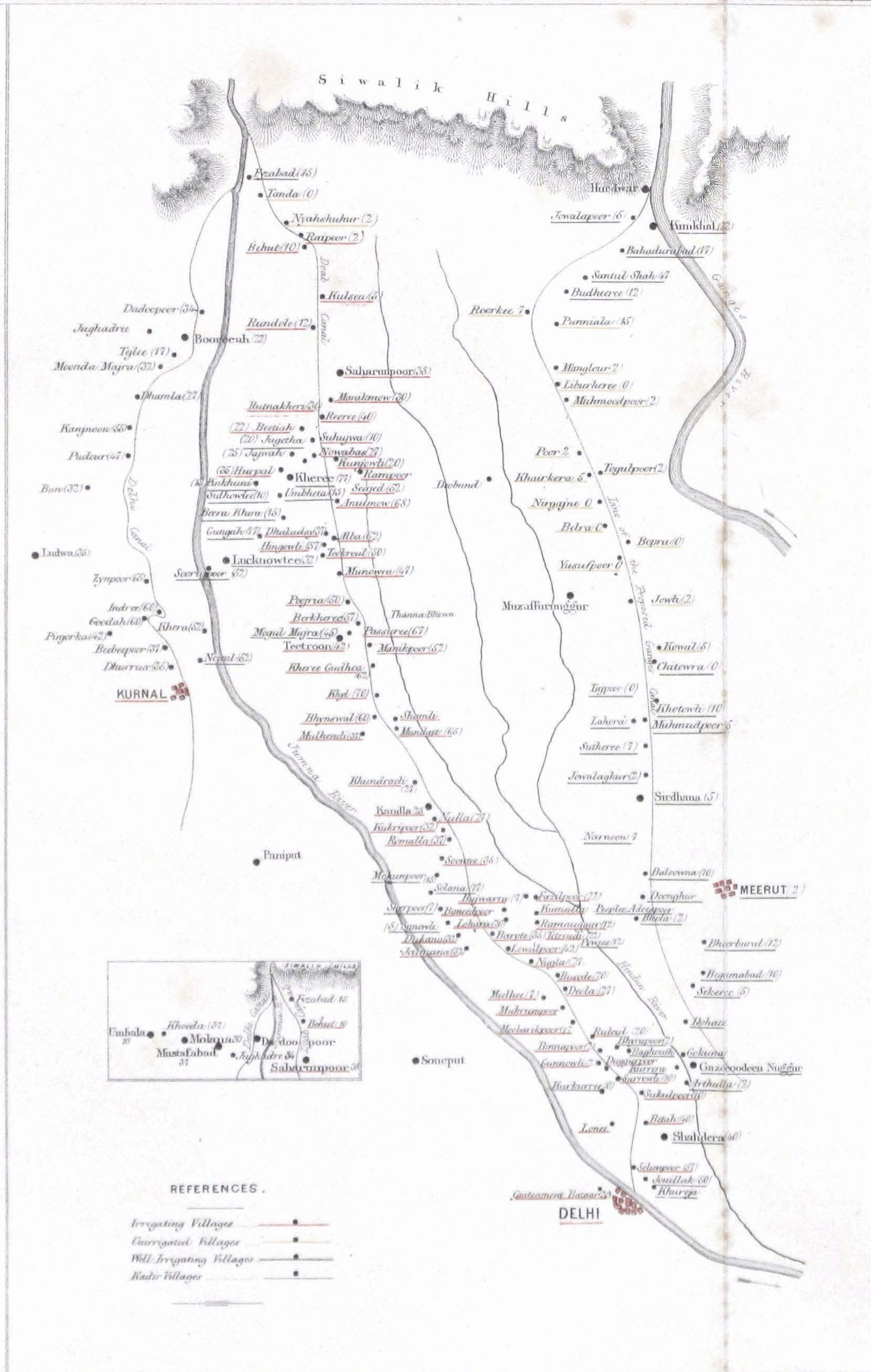


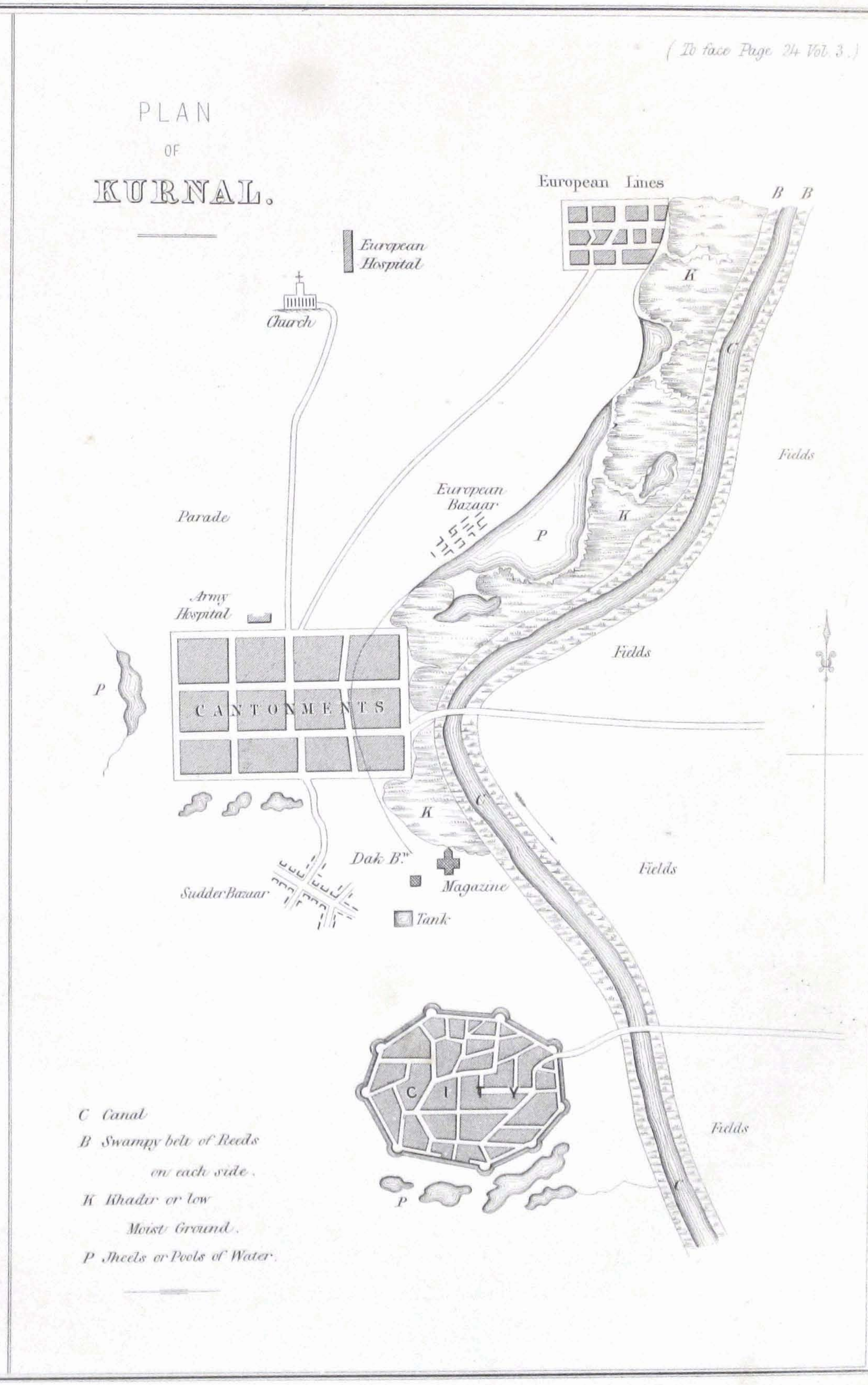
London: Smith, Elder & Co 65, Cornh

ETCH MAPS TO ACCOMPANY MEDICAL REPORT.

(To face Page 24 Vol. 3.)







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of the different districts, and the liability of their inhabitants to miasmatic fevers. The former could be noted with some degree of certainty; but in the absence of official medical statistics, and with frequent reason to doubt the accuracy of oral testimony, although collected by ourselves, we could not obtain even an approximation to a fair comparison of the past and present sanitary condition of the inhabitants of different localities. In this difficulty, it was suggested by our medical member, that the condition of the spleen in any number of individuals would be a fair test of the probable frequency and degree in which they had suffered from malarious influences. Having satisfied ourselves of the propriety of this test, and finding it easy of application, we determined to adopt it, and have based on the results so obtained the most important of the conclusions at which we have arrived. In the Appendices B and C, will be found a memoir by Mr. Dempster, stating the medical grounds for the adoption of this test, and describing the method followed in applying it.

6th. The present season, in which our observations were taken, has been a generally healthy one, and was preceded by a season scarcely less favourable. It is also separated by eight or nine years of good harvests from a season of drought, a circumstance decidedly in favour of unirrigating villages which have had abundant time to recover from any sickness that might have been entailed upon them by the unmitigated hardships of famine.

7th. Amongst the instructions furnished for our guidance from the Adjutant-General's office, we find a series of questions, on each of which his Honour the Lieutenant-Governor, North-Western Provinces, has called for our recorded opinion. These questions embrace nearly all the important points of our investigation, the results of which cannot perhaps be shown in a more intelligible form than that of consecutive answers to his Honour's interrogatories, as follows:—

8*th.*—First. *How far is the unhealthiness which has prevailed of late years at Kurnaul, Delhi, Hansi, Hissar, and Rohtuck, and in the villages irrigated from the canal, attributable to the existence of the canal, and to irrigation from it?*

Reply I.—We have obtained satisfactory proof that an extensive epidemic influence, in whatever it may have consisted, or however produced, undoubtedly pervaded a large portion of the North-Western Provinces of late years, and especially during and after the rainy season of 1843. To this we would partly attribute the sickness which occurred in the canal irrigated districts, where, however, it is also certain, that the disease was generally, though not universally, more prevalent and severe than in other situations.

9*th.*—Second. *Did similar unhealthiness prevail at the same time in other parts of the country not irrigated from the canal and beyond the reach of its influence? If so, to what cause is that unhealthiness attributable? Was the type of disease in the two cases the same?*

Reply II. — Nearly all places within the North-Western Provinces also suffered from fever at the same time, and in a degree greater than usual.* We have, moreover, every reason to believe, that in certain situations neither irrigated from the canal nor within reach of its influence (as at Kythul, in the vicinity of the Nujufghur jheels, and in the khadir of the Jumna, &c.), fevers prevailed to an extent and with an intensity, as great as in the worst of the canal villages. The season of the year at which the disease appeared, its symptoms, progress, and consequences, would mark it to have been everywhere of the same type, viz., the endemic (remittent and intermittent) of the rainy season, but everywhere, and especially in naturally malarious localities, greatly aggravated by the constitution or peculiarity of the season.

10*th.*—Third. *If you consider the canals to have been the cause of unhealthiness along their course, have you any grounds for thinking such to be the unavoidable result of canal irrigation, or is it attributable to other causes, such as intercepted drainage, flooding from canal, peculiarity of the soil irrigated, &c.?*

Reply III.—By far the greater part of the evils we have observed have not been the necessary and unavoidable results of canal irrigation. In all situations where mischief was prominently marked, the natural drainage of the country had been checked or interfered with, stiff and retentive soils saturated with water, and natural disadvantages of site enhanced by excess of moisture.

* See Appendix D.

11*th.*—FOURTH. *Can you suggest any means whereby the agricultural benefit of canal irrigation may be continued to the country at large while military cantonments or large towns may be saved from the risk of unhealthiness?*

Reply IV.—The effects of canal irrigation appear to be remarkably local, almost strictly so; three miles would probably be a safe distance; but if irrigation were prohibited within a circle of five miles radius round a large military station, its salubrity would not in our opinion be affected.

12*th.*—FIFTH. *Can you suggest any change in the lodging or mode of life of the agricultural population within reach of canal irrigation which would render them less liable than at present to any unhealthy influence occasioned by the canals?*

Reply V.—We feel doubtful whether any suggestion proceeding from authority, as to mode of life, exposure, food, clothing and construction of houses, would be adopted and voluntarily practised by the agricultural population. The best and most efficient prophylactics of this class, naturally come with competence and ease, but much might be done to improve the salubrity of village sites, viz., to stop irrigation within 200 yards round all canal villages, and to plant a double row of trees round the unirrigated space; to deepen all good village tanks, and to keep them full of water all the year round; to drain all shallow pools in or about villages, or to convert them into proper reservoirs of water; and, wherever it may be possible, to improve the drainage of village sites. It would be no hardship on a new canal to make such works an invariable condition of obtaining water for irrigation. Cleanliness is of much, though not of such vital importance as the measures above recommended; but we fear no rules on this subject could be generally enforced.

13*th.*—SIXTH. *Looking to the circumstances of the Eastern Jumna or Saharunpoor Canal, do you find that the effect of the canal irrigation on the health of the inhabitants has been the same there as on the West Jumna or Delhi Canal? If not, how do you account for this difference in effect?*

Reply VI.—The Eastern Jumna Canal furnishes examples of some of the best and worst results of canal irrigation. In the north and south divisions, where the soil is light, the drainage perfect, and irrigation carried on chiefly by "Rajbuhas," we perceive all the blessings and scarcely any of the evils of a canal. But in the centre division, where the drainage of the country has been greatly obstructed, and the soil is generally more stiff and clayey, the effect on the health of the inhabitants has been the same in kind, and nearly in degree, as in the objectionable portions of the Delhi canals.

14*th.*—SEVENTH. *Do you suppose that the contemplated Ganges Canal will or will not exercise an injurious effect on the health of the people of the Doab, over the whole of which it is intended to extend its influence? If you are of opinion that it will, can you propose any remedy or palliatives which will not involve the entire abandonment of the undertaking?*

Reply VII.—In the course of our inquiries on the existing canals, we have found salubrity to depend in a great measure on the nature of the soil and the efficiency of the surface drainage. In the districts which it is proposed to irrigate, the obvious geographical features of the country enable us to pronounce with some confidence, that an efficient drainage, if not everywhere existing, is at least generally attainable. On the proposed line of the canal from Roorkee to Meerut, we observed the soil to be light and friable; but without an extended examination, we cannot pronounce what proportion of the remaining districts of the Doab is characterized by similar soil. It can scarcely be hoped, however, that in the whole length of the proposed canal and its branches, some localities will not be met with, naturally and irremediably unfavourable to irrigation, and in which disease analogous to that found on the existing canals may not be expected to develop itself. On the other hand, if attention to drainage be made an absolute condition of participation in the benefits of the canal, an improvement rather than a deterioration of the general salubrity, may, in many instances, follow the introduction of canal irrigation. On the whole, we consider ourselves warranted in anticipating, on the Ganges Canal, a far less amount of contingent evil than has been experienced on those of the Jumna, which were originally constructed without reference to many important points which have been especially kept in view in projecting the present work. And more especially in drawing inferences from results on the Delhi Canal, great allowances should be made for the natural disadvantages of the country through which it flows—when compared with the Doab generally. It is a remarkable feature of the "bangur" land bordering the right bank of the Jumna, that its drainage flows from, instead of towards, that river. The slope of the country, which is to the south-west, amounts to 1 foot or 1 foot 6 inches per mile, and is not sufficient to prevent even a slight obstruction from interfering with the flow of water. In subordination to the general slope, there are minor undulations, the excess of slope in one part being compensated by the absolute want of it in another. In such cases, the drainage of the higher lands collects in the lower, and from the latter there is no efficient escape. This is exemplified on a large scale in the Nujufghur jheels, and to a less degree in many other localities. The Doab, on the other hand, is intersected by deep depressions, sometimes with the character of valleys, sometimes of ravines. These, except in a few instances, receive and rapidly carry off the surplus water of the country.

15th. With reference to the latter part of this question, we have prepared a memorandum of measures connected with the execution of the Ganges Canal, which we would strongly urge upon the attention of Government. With the details of these measures, which are of a technical nature, we have not encumbered this report, but they will be found in Appendix F.

16th. In addition to the above replies, it is proper to state our opinion of the effects produced by canals on the population of the irrigated districts, as regards their enjoyment of life and physical efficiency as agricultural labourers. During the cold season of 1846-47 (a healthy year), no obvious bad effects were perceptible in the adult population. The men generally looked healthy, happy, and thriving. The autumn crops were all gathered in, and the spring crops sown. The villagers on the Western Jumna canals are better clothed and housed, and have more appearance of wealth and comfort than those off the canal. In a few of the worst localities the aspect of the children was decidedly sickly; they were puny and pot-bellied. It must further be borne in mind, that our observations were made at a favourable season, and that we not only refrained from calling for the sick, but systematically discouraged their being brought forward.

17th. In our examination of districts unconnected with the canals, we have included some in which well irrigation is habitually practised, and in which we have found the population in a slight degree more subject to malarious diseases than in the totally unirrigated districts. We would, however, hesitate in attributing this difference to the mere circumstance of irrigation. It may perhaps be as justly ascribed to the abundance of springs and limited depth of wells, which are essential conditions of extensive well irrigation.

18th. In endeavouring to account for the observed difference of salubrity between well and canal irrigation, we beg to point out some material differences in the circumstances under which they are severally practised. Well irrigation is chiefly resorted to during the healthy season of the year; the water obtained with labour is used with economy, and the natural moisture of the soil is not increased by the water being transferred from a lower stratum to the surface. Canal irrigation, on the other hand, is practised throughout the year, being applied even during the rainy season to the cultivation of rice. The water being more easily obtained, is more likely to be used in excess, and such portion of it as may be absorbed by the soil increases by so much its natural humidity. It may be added that foreign alluvial matter is more likely to be held in suspension in canal water than in that obtained from wells.

19th. The pecuniary advantages of canal irrigation, both to Government and to the farmer, are, we believe, fully recognized, and are so well understood by the cultivators themselves that they would willingly take their chance of the contingent evils of irrigation, in order to secure its benefits. Of this we saw abundant proof in the course of our investigation. It would, however, have been an important test of the national value of canal irrigation could we have accurately ascertained its effects on the density of the population, and whether the augmented capacity of the soil for supporting life compensated for the increased activity of influences inimical to its duration. In the hope of determining this question we obtained from the revenue authorities certain returns, of which an abstract will be found in Appendix G., and which show a marked difference in favour of irrigated lands. It is, however, to be regretted that the census forming the basis of these returns was taken several years ago, and may therefore not be strictly applicable to the existing condition of the country.

20th. In the foregoing paragraphs we have confined ourselves to general conclusions, fearing lest, by entering on the consideration of local details, we should extend our report to an inconvenient length. But our attention having been particularly called to the station of Kurnaul, we beg to offer a few remarks showing briefly the causes to which we attribute the late sickness at that station, and the extent to which they may be removed or palliated.

21st. The insalubrity of Kurnaul has been ascribed to various causes: To the prevalence of an epidemic influence of late years over the North-Western Provinces—to its proximity to the Jumna khadir on the east, and to the unhealthy flats of Kythul on the west—to the stiff and retentive nature of its soil—to the swamps bordering on the canal—to the extent of rice cultivation—and to the naturally imperfect drainage, being still further obstructed by the canal embankments. Each of these causes, and especially the first named, have, in our opinion, contributed to the unhealthiness of Kurnaul. Some of them are obviously irremediable, but we are satisfied of the practicability of reclaiming the canal swamps, of improving the surface drainage by carrying off the superfluous water under the canal by two tunnels to the Jumna, and of prohibiting irrigation within two miles of the cantonment pillars. We have no doubt that the adoption of such measures would be attended with beneficial results; but believing that the level of the springs has been permanently altered, and the under strata of the soil saturated with moisture, we cannot confidently prognosticate that they would ensure the complete restoration of salubrity.

22nd. In the foregoing paragraphs, we have confined ourselves to general conclusions, purposely omitting the chain of induction by which they have been formed on the observed facts, as recorded in the figured abstracts in the Appendix E. A full discussion of the complicated considerations which have influenced our opinions would have extended this report to an undue length, and might probably have hindered rather than facilitated the formation of a correct judgment on the important question at issue. The facts, however, are recorded for reference, and will be found, on careful examination, to support our opinions.

23rd. In conclusion, we beg to record our obligations to the Honourable the Lieutenant-Governor, North-Western Provinces, for the assistance he has afforded us, both privately and officially, in the prosecution of our inquiries. On his requisition we have received from the Madras Government a report on a remarkable epidemic that pervaded the southern districts of that Presidency in 1809, 1810, and 1811, an abstract of which will be found in Appendix H., and at his suggestion we have obtained the appended reports from Drs. Kier and Collyer, showing that tank irrigation, as practised in certain districts of Rajpootana, is consistent with a high degree of salubrity. These documents possess much interest with reference to the subject of our inquiry, and have had their due influence on our general conclusions.

(Signed) W. E. BAKER, *Major, Engineers,*
President.

(Signed) T. E. DEMPSTER, *Surgeon, 1st Brigade Horse Artillery,*
Member of Committee.

I fully concur in the substance of this report; but as a change in my ordinary duties, since I was appointed a member of this committee, has prevented my taking any active share in its proceedings, my signature here is merely formal.

(Signed) H. YULE, *Lieutenant, Engineers,*
Member of Committee.

Appendix A.

I would willingly have confined myself strictly to the facts before our Committee, did I not consider it necessary, in order that these very facts should have due weight and consideration, first, fully to meet an argument often advanced by intelligent persons interested in canal irrigation, and believed by them so unanswerable, as alone to prove the doctrine of malaria a mere fiction of medical writers, and to render all further inquiry unnecessary, viz., that some marshes can be pointed out which do not cause fevers to any extraordinary extent; and some perfectly dry localities, where fevers of a very malignant nature abound.

That certain local peculiarities are *generally* connected, as cause and effect, with certain diseases of the human body, is no hypothesis of any set of medical speculators, but a belief which has forced itself on the conviction of mankind in various ages and countries. What those conditions are which are essential to the production of endemic disease, and what are accidentally associated with them, how the poison is evolved, and what are its sensible properties and chemical composition, have indeed furnished ample grounds for medical speculation and controversy; but the general proposition itself is as fair and legitimate an induction from observed facts as any within the whole range of science.

Exceptions do not confirm a rule, but neither do they overturn a fair induction. They only show that our knowledge is incomplete, and the whole law of the case not fully understood. If, in the exact sciences, residual phenomena are constantly occurring; something happening which was unlooked for; something expected which does not take place; how much more may they be anticipated in such a science as medicine, where the sources of error are at once so numerous and perplexing?

Mankind, not physicians alone, have agreed that typhus fever is a highly contagious disease. Suppose (what would not be difficult) that I collect a dozen authentic cases of persons who have freely exposed themselves to this contagion, and who, notwithstanding, entirely escaped the disease; am I therefore to shut my eyes to the thousands of instances in which the complaint was communicated under like circumstances, and to reject the whole doctrine of contagion as untenable? Surely this would be generally condemned as a dangerous and inexcusable error! The human race have, at least, as deep a concern in the laws of malaria as in those of contagion.

It is a remarkable and most important fact, that the diseases believed to arise from malaria are, beyond all comparison, more prevalent during and immediately after the periodical rains in India than at any other season of the year; and that this is precisely the time when the conditions everywhere alleged to be necessary to the production of that poison, are also, beyond all comparison, most abundant. At some places there may be more, and at others less; in some years more, and in others less; but the truth of the general remark may be verified, in this country, at all places, and in all years.

When we remember the feeble affinities which hold together the constituents of vegetable matter, the numerous and totally dissimilar combinations into which they may enter, and the seemingly trifling accidental circumstances which may determine the nature of the new compound, it is not unreasonable to believe that a *something* capable of causing human disease may be evolved during the decomposition of such substances, under the action of heat, moisture, and electricity; or to conceive, that unappreciable, or at least unnoticed modifications of these conditions, or of the chemical state of neighbouring bodies, may alter the nature of the expected product, and obstruct the formation of the poison when most confidently looked for. For instance, we may make all the usual arrangements for vinous fermentation; an unexpected and unobserved change takes place in the temperature or electric condition of the atmosphere, and *vinegar*, not wine, is the result. Is malaria alone to be a constant and unvarying product of such complex operations, even though all the ordinary conditions are apparently present?

Again, if we admit that a certain class of fevers arise from malaria, does it necessarily follow that all endemic fevers must originate in the same cause, or that all malaria is necessarily one and the same? Or who has demonstrated that malaria, like carbonic acid gas (an aëriform fluid, to which in some points it bears a striking analogy), may not be evolved under several and very different apparent conditions?

All our previous knowledge and experience would lead us to suspect some mischief from irrigating canals in such a climate as that of India, especially, if not expressly constructed so as to preserve the drainage of the country, and effectually to control the immoderate use of the water; and all I contend for is, that the question be tried and decided by the facts strictly bearing on the case before us, and not by a few exceptions, however striking or inexplicable, found in other distant situations or countries.

(Signed) T. E. Dempster, *Surgeon, 1st Brigade, Horse Artillery,*
Member of Committee.

Appendix B.

The first indispensable step in the present inquiry was to obtain some certain mode of determining the relative salubrity of different districts irrigated by the canals, irrigated by wells, or altogether unirrigated. In most European countries at the present day this would have been easy enough, by the mere comparison of the known medical statistics of the several localities under examination; but in India the difficulties were at first sight almost insurmountable. Here we had no record of diseases, births, deaths, and population to which we could refer. A native's account of the healthiness of his own town or village, even for one season, is the loosest and most vague of statements, and if employed to collect positive data, his written report is not a whit more to be depended on. The aspect of the people is always a matter liable to error and difference of opinion; and the important subject of longevity cannot even be approached, for no native knows his own age correctly, least of all those advanced in years. The records of military hospitals were good and valuable data as far as they went; but they applied only to a few widely distant points, and referred to a class of subjects, differing in all important particulars from the native inhabitants of the towns or the agricultural population of the country.

In this difficulty, it occurred to me that the inhabitants of malarious countries, but especially the native inhabitants of unhealthy districts in India, often carry in their own persons a record of past suffering, which can at all times be easily read, and which no one can either falsify or suppress. This is enlargement of the spleen, a disease to which the native of India is peculiarly liable, and which, if not the invariable consequence of miasmatic fever, is so constantly associated with it, that the one may (on the large scale) be safely taken as the measure of the other, or at least of that malaria from which both unquestionably spring. But as this is a test which has never before (to my knowledge) been used for the same purpose, and as many of our conclusions are based on the results with which it has furnished us, I trust I shall be permitted to enter somewhat fully into the subject.

There is no fact more generally known or unhesitatingly admitted by medical men, than that disease of the spleen is one of the most frequent consequences of malarious fevers. To enumerate all the authorities on this point, would be to quote most of the respectable writers on these subjects; but that Government may appreciate the value of the test I chiefly depend on for the purpose of determining the comparative intensity of malaria in different localities, it will be proper to cite a few passages from two recent and well-known works, by authors, respectively, of European and Indian experience :—

"In moist countries, whether warm or temperate, they (diseases of the spleen) are endemic, as in Italy, Holland, South America, and some parts of India; *in fact, wherever malaria exists.*"

"The most frequent causes of enlarged spleen are ague and remittent fever."—*Cyclopædia of Practical Medicine.*

"The most part of the cases of vascular enlargement of the spleen in this country (Bengal) follow intermittent and remittent fevers, and tumid spleen may be stated as the most invariable consequence of acute and debilitating disease among children of weak constitutions in Bengal.

"The assemblage of constitutional symptoms described in the foregoing pages constitutes *the endemic cachexia of those tropical countries that are subject to paludal exhalations;* the enlargement of the spleen is the most frequent attendant on that cachexia; and its increase or subsidence generally corresponds with the unfavourable or favourable changes which are taking place in the constitution.

"Disease of the spleen is much more frequent in those years in which the most obstinate, fatal, and protracted remittents prevail. . . . The history of the fevers of St. Domingo and of Minorca by Jackson and Cleghorn shows how frequently disease of the spleen is connected with the autumnal fevers of these countries. But great heat is not essential to the production of that disease. It is the autumnal endemic of Holland, of the low parts of Hungary, of the marshes of Lombardy; and it is by no means rare in the fens and marshes of England. In fact, enlargement of the spleen *is frequent wherever intermittent and remittent fevers prevail.*"—*Twining's Diseases of Bengal.*

Such passages might be multiplied to a great extent; but the above will, I hope, suffice to establish the value of this kind of evidence, as a probable measure of the existence and intensity of malaria in any particular situation.

I may here remark that *Ague cake*, the name by which enlarged spleen is commonly known to the country people in the fenny districts of England, is a happy translation of *Tup tillee*,* the words used by the up-country Indian peasants to express the same disease.

Although the intimate connection between malarious fevers, and organic disease of the spleen is established beyond a doubt, it never was supposed that these diseases bear an *exact* proportion to each other, or that the number of enlarged spleens in any particular situation, should correspond precisely with the number of attacks of fever suffered by its inhabitants. Many fevers occur (epecially if the attacks have been slight and not often repeated) without being followed by enlargement of the spleen; and many tumid or slightly inflamed spleens become natural in size and structure, soon after the fever has passed off. On the other hand, the spleen may become enlarged from other causes, and in persons who have had no distinctly developed paroxysm of fever, although living in a malarious locality. Such cases, however, are, according to my experience, comparatively very rare.

When I first began to apply this test, I was not aware of its full value. I did not then know the extraordinary susceptibility of the natives, especially the native children of these provinces, to disease of the spleen; nor could I, before trial, have anticipated the facility with which it points out the relative salubrity of different situations, and at once detects unhealthy localities, which could not otherwise be discovered without the experience and observation of several seasons.

It must not, however, be supposed that this disease exists *everywhere* to a considerable extent, among the inhabitants of the North-Western Provinces. Places in close proximity, but in otherwise different local circumstances, exhibit the most wonderful differences in this respect; and in some extensive tracts of country, the complaint is scarcely to be met with. On the other hand, it is important to guard against exaggerated notions of the physical condition of the inhabitants of certain situations where so large a proportion are afflicted with this description of organic disease.

Enlargement of the spleen is the least formidable of all organic diseases of the viscera; and is chiefly important as a symbol of another complaint, which generally has preceded, and may come after it. The lesser varieties (marked

* Literally, fever spleen.

in the figure O. and S.), and which also form the great mass of the cases registered, may consist with every outward *appearance* of health and vigour. In most places where the disease is common, some strikingly healthy-looking men and children were found with decided enlargement of the spleen. But the larger varieties (M. L. VL.), of which but a comparatively small number are recorded, were usually accompanied with a sickly (cachectic) aspect.

Other diseases besides fever arise from malaria, and other consequences than spleen follow severe and protracted attacks of fever; but most of these can be effectually concealed, and none can be detected with such ease and certainty as enlargement of the spleen. Indeed, without this test, our whole inquiry must have ended in vague and unsatisfactory conjecture, and without a single fact collected among the agricultural population on which we could depend.

I have no wish to exaggerate the true and legitimate value of the spleen test, nor do I venture to assert that it wil indicate the presence of the remote causes of *all fevers*, or even of all pure endemic diseases of this class. There may be different kinds of malaria, giving rise to fevers of different types, and having different complications and consequences; or common continued and typhoid fevers may become mixed up with, and modified by, fevers of local origin. All these are worthy subjects of future inquiry. But from what I have lately witnessed, I am fully persuaded, that it will be found a true and faithful comparative measure of *marsh malaria* in its extended sense; and with *that* alone, have canals and canal irrigation any proper connection.

It was not, however, until after we had examined the cantonment of Meerut, that my own faith in the practical utility of the spleen test was fully established. Hitherto, spleen disease had borne some distinct relation to the nearness of water to the surface, and in a few instances where water was *very close*, we had found the almost incredible number of about 70 per cent. of the inhabitants with enlarged spleens. Was the disease then caused by moisture alone, and not always connected with marsh fevers? Meerut seemed well calculated to verify or disprove the received opinion; for in it we had a *known* healthy locality, with water only about 12 feet from the surface.

Four separate observations were made in different parts of that large station, and out of 160 native residents examined, only three cases of spleen were found; none above average size.

The city of Delhi appears, at first sight, an instance in which the test failed; but on careful examination, I think it will only be found to furnish a striking confirmation of its general accuracy. The medical topography of the city, civil station, and military cantonment of Delhi, is an extremely complicated subject, and involves a great variety of important considerations, but I need only briefly notice in this place the following particulars:

Within the walls, and especially in the most dense and crowded quarters of the city, there were comparatively few indications of pure malarious disease. This accords with what has often been remarked in other countries, viz., That the high walls, and narrow crowded smoky streets of large cities, are frequently a safeguard against marsh miasma, although other causes of disease may abound in such situations.

In the cantonment bazar, and suburbs outside the walls, a considerable amount of spleen disease was found. But when we proceeded to examine the villages situated on the verge of the low moist "khadir" land, immediately in front of the old sapper lines (a position now abandoned in consequence of its extreme insalubrity) the test at once pointed out malaria in its *highest intensity*.

(Signed) T. E. DEMPSTER, *Surgeon*, 1*st Brigade Horse Artillery*,
Member of Committee.

APPENDIX C.

Particular Account of the Manner of Conducting the Medical Examinations.

IT is for many reasons of great importance, that I should particularly describe the manner in which the spleen examinations have been conducted.

At each place twenty children and twenty male adults were selected, our chief care being, to take a *fair sample*, not of the sick, but of the "going about" population of the town or village under inspection. The avowedly diseased were discouraged from coming forward, and when brought were rejected, unless there were not others sufficient to make up the required number. We took subjects from all castes, and, whenever it was practicable, examined a certain number of the agricultural labourers found in the adjoining fields, before entering the village, where our numbers were completed from other classes. Each adult was asked his class, if he had had fever this year, last year, or the year before last. The children were only questioned as to caste. Major Baker generally pointed out the subjects. I conducted the medical examination, and Major Baker entered the result in his note-book.

As the great object was to make use of an unequivocal, but easily applied test, no case was ever registered as "spleen," *unless I had so distinctly felt the enlarged organ that it could not be confounded with any other disease.* When the abdomen was natural and the muscles soft and yielding, a satisfactory examination was generally obtained in the erect position; but if the belly was rigid, and the region of the spleen tumid, but not clearly defined, the subject was put flat on his back, with the knees bent and raised. If an enlarged spleen was not discovered after a *moderately careful* examination so conducted, the person was registered as *free from the disease.* Sometimes, though rarely, really doubtful cases were met with, which could not at once be pronounced upon; these were put aside, and others examined in their stead.

It will be obvious to medical men, that if all our subjects had been examined in a variety of postures, and in various states of the stomach and bowels, several cases of spleen would have been detected, which necessarily escaped my notice. But then this test would no longer have been an *easily applied* one, besides occupying a far longer time than we could afford to bestow on each village. The disease is not only so common, but in general so easily detected after a little practice, that we could afford to sink all cases not easily found, and as *precisely the same mode of examination was followed everywhere, it everywhere furnished a fair scale of comparison.*

One-half of the subjects selected for examination, was in all practicable cases composed of children under the age of puberty, first, because I believed young persons to be more liable to enlargement of the spleen than adults, and, secondly, because the disease, when present, is in them more easily and certainly detected. For both these reasons, I considered children to be the more delicate test of malaria. The results amply confirm this opinion.

As the size to which the spleen attains is a very important feature of the disease, and most probably indicative of the intensity of the remote cause, I adopted a simple plan of noting five different degrees of size, which will be at once understood by reference to the annexed figure.

O. Signifies a distinctly-marked case of spleen.
M. One decidedly larger than O, and the mean between the five varieties.
L. A large spleen extending to, or near to the navel.
VL. A very large one passing across the medial line.
S. A small but perfectly marked case of the disease.

The soft enlargements were seldom registered, even when they presented themselves. I was generally obliged to put them aside among the "doubtful cases;" for although very confident as to the real nature of the disease, a mistake was possible. But when I felt a solid tumour in the left side, distinctly ascertained its shape, consistence, and the direction of its edge, and hence knew that such could only be an enlarged spleen, in so registering it, we recorded a *fact*, not a mere medical *opinion*, resting of course on the credibility of the witness.

The very large spleens sometimes met with in bad localities, were rarely admitted into our returns, because the subjects usually presented themselves as "volunteers," and according to the rule adopted, were rejected.

(Signed) T. E. Dempster, *Surgeon, 1st Brigade Horse Artillery,*
Member of Committee.

Appendix D.

Abstract showing the comparative salubrity of seven different Military Stations in the North-Western Provinces, from 1825 to 1844.

Years.	Native Troops.												European Troops.											
	Loodiana.		Kurnaul.		Hansi.		Delhi.		Meerut.		Muttra.		Agra.		Loodiana.		Kurnaul.		Meerut.		Muttra.		Agra.	
	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.	Percentage of Admissions.	Percentage of Deaths.
1825	..	..	..	..	..	..	.	..	25	0·33	28	0·30	42	4·40	..	..	..	..	107	2·25	14	..	335	2·90
1826	13	0·33	23	0·20	25	0·33	61	0·83	38	1·66	..	..	..	..	..	..	76	14·25	112	2·66	..	..	..	..
1827	21	0·60	30	0·33	32	0·50	55	1·00	49	1·00	33	0·60	31	1·00	..	..	148	3·75	206	3·20	175	4·75	235	4·80
1828	24	0·16	29	0·33	45	0·33	45	0·50	24	0·20	23	0·30	15	0·25	..	..	140	3·25	175	3·50	115	1·10	228	2·70
1829	65	0·80	48	0·66	137	1·75	123	1·66	52	0·50	..	..	..	..	..	..	198	3·50	152	3·20	..	..	..	..
1830	42	0·33	45	0·40	84	0·75	113	1·20	52	0·25	..	..	..	..	..	..	140	2·50	145	2·50	..	..	..	..
1831	37	0·40	44	0·40	39	0·50	77	0·80	41	0·33	52	0·80	40	0·50	..	..	130	2·75	118	3·00	161	2·90	144	3·00
1832	37	0·60	69	0·75	24	0·10	41	0·33	41	0·37	36	0·40	46	0·66	..	..	136	3·40	94	3·50	75	..	102	1·55
1833	17	0·50	46	0·25	48	1·66	62	0·66	31	0·40	32	0·90	56	0·87	..	..	68	2·83	78	1·83	82	6·00	112	2·12
1834	46	0·20	39	0·20	142	1·50	41	0·75	27	0·33	46	0·90	59	0·66	..	..	60	3·00	88	2·25	86	11·00	109	1·66
1835	58	0·33	84	1·75	57	0·25	72	1·00	55	0·44	66	0·70	78	1·57	..	..	64	1·50	78	2·66	88	..	124	1·11
1836	39	0·50	55	0·66	44	0·08	61	0·50	56	0·80	46	0·70	36	0·83	..	..	130	1·66	97	4·00	142	4·70	126	1·50
1837	46	0·60	67	1·00	181	1·83	63	0·66	44	0·50	23	0·40	69	1·25	..	..	157	2·30	75	1·42	82	0·90	116	4·00
1838	55	1·25	93	1·10	162	1·16	71	1·00	52	0·55	66	3·10	173	5·75	..	..	201	7·25	121	4·33	176	11·50	225	7·50
1839	47	0·50	54	0·66	160	0·50	72	0·60	49	0·60	44	0·40	92	1·25	100	2·40	171	5·00	138	2·71	129	8·75	159	5·33
1840	47	0·50	43	0·66	185	0·33	57	0·42	36	0·37	84	0·40	125	1·50	94	3·50	152	3·40	113	2·25	99	1·00	151	3·00
1841	67	1·00	84	1·25	264	1·60	157	1·11	69	1·00	27	0·30	79	1·60	109	1·80	272	7·75	172	3·50	146	1·10	118	1·70
1842	82	1·00	115	1·12	119	0·80	293	1·66	149	1·11	41	..	144	1·10	149	4·33	309	9·25	346	3·60	69	1·00	110	1·60
1843	91	2·75	..	..	111	1·12	377	3·00	116	1·00	101	3·00	87	1·66	185	3·66	..	..	293	4·00	124	6·75	141	5·60
1844	141	2·14	..	..	93	1·00	342	3·50	115	1·12	62	0·60	99	1·60	189	3·20	..	..	307	3·60	124	1·90	125	3·30

The above table is compiled chiefly from returns furnished by the Medical Board. Those for Kurnaul having been returned for correction,* the few entries made under the head of that station have been extracted from a printed table by Dr. John Murray. The returns for Meerut and Delhi for the years 1842, 1843, and 1844, are stated to be inaccurate.

(Signed) W. E. Baker, *Major, Engineers,—President.*
(Signed) T. E. Dempster, *Surgeon,—Member.*

* Subsequently received; and the deficiencies supplied, except for the year 1843, which is still incomplete.

Abstract of Medical Examinations of Twenty-six Irrigating Villages situated within Half-a-mile of the Hansi Branch of the Western Jumna Canals.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c., &c.		Menials.		Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below the Surface of Ground.	Annual average Amount of Canal Irrigation. Tor.	Daul.	Total.	Average Annual Amount of irrigated Rice.	Detail of Size of enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	Beegas.	Beegas.	Beegas.	Beegas.	VL.	L.	M.	O.	S.	Total.
Hansi	36	24	..	..	8	..	8	4	6	4	18	6	3	3	43	17	43	33	20	34	55	5,270	250	5,520	700	1	4	3	21	12	41
Hissar	17	23	4	..	8	2	9	..	5	1	6	4	1	..	33	7	22	22	12	37	81	580	1,000	1,580	..	..	3	5	17	5	30
Khurrur	16	4	1	..	15	2	..	..	..	..	..	..	2	..	18	2	45	20	5	15	84	940	160	1,100	120	..	..	..	4	2	6
Raipoor	10	10	..	..	13	7	..	..	..	..	..	..	..	..	13	7	55	10	35	42	96	350	200	550	75	..	..	2	11	4	17
Satrouda	11	9	3	..	11	3	..	..	..	..	..	..	2	1	16	4	45	50	30	32	95	25	125	150	..	..	..	1	8	4	13
Sulems Thekopoor	8	12	..	..	4	4	5	4	..	..	1	1	1	..	11	9	45	65	20	52	..	25	125	150	..	..	1	4	15	1	21
Shahpoor	4	16	..	..	12	2	..	..	..	1	1	2	2	..	15	5	60	65	15	52	..	325	50	375	..	..	..	3	14	4	21
Maturshaum	11	9	5	1	10	2	..	..	..	..	2	..	..	..	17	3	65	35	10	30	..	345	80	425	5	..	..	1	6	5	12
Mingnee Khera	8	12	..	..	4	1	6	2	5	..	1	..	1	..	17	3	55	40	30	37	..	325	75	400	10	..	..	1	7	7	15
Sulemgurh	10	10	2	1	4	3	2	1	1	..	..	1	3	2	12	8	70	60	15	45	30	725	75	800	25	..	1	4	11	2	18
Kabrere	9	11	..	..	8	1	4	..	..	2	..	..	4	1	16	4	55	50	15	37	..	650	50	700	50	..	1	..	5	9	15
Siswal	8	12	1	..	8	2	..	..	2	1	2	1	3	..	16	4	55	50	10	40	72	1,130	170	1,300	..	..	..	2	10	4	16
Kheree	11	9	2	1	8	5	..	..	1	..	1	2	..	..	12	8	50	55	30	42	60	775	25	800	150	..	2	3	7	5	17
Majra	5	15	2	2	2	7	1	..	..	1	1	1	2	1	8	12	75	60	25	67	..	1,595	25	1,620	295	..	..	4	14	9	27
Narnound	12	8	..	..	12	2	..	..	4	..	..	..	..	2	16	4	75	50	30	30	107	3,350	50	3,400	700	..	3	5	3	1	12
Rajthul	12	8	..	..	11	6	1	1	..	..	1	..	..	..	13	7	45	40	20	37	..	200	350	550	20	..	1	5	7	2	15
Ramra	13	7	12	2	..	..	..	..	..	2	2	..	2	..	16	4	35	20	10	27	145	200	350	550	20	..	..	..	6	5	11
Jheend	28	12	7	3	6	4	2	..	8	..	5	4	1	..	29	11	30	25	20	29	..	1,400	500	1,900	450	..	..	4	9	10	23
Kokhre	12	8	2	..	10	4	..	..	..	..	2	..	2	..	16	4	45	15	15	30	..	400	150	550	160	..	..	1	6	5	12
Bohutwala	8	12	1	1	9	5	..	..	1	..	..	1	..	2	11	9	75	75	70	52	..	825	125	950	240	..	2	4	14	1	21
Dhatrut	8	12	2	..	5	2	5	..	4	..	1	1	..	..	17	3	35	25	10	37	145	1,775	125	1,900	500	..	..	..	9	6	15
Jamunee	9	11	4	1	6	3	..	..	..	1	3	2	..	..	13	7	70	60	20	45	145	775	175	950	260	..	..	4	9	5	18
Rujana	11	9	6	3	5	4	..	..	1	..	..	..	..	1	12	8	50	30	30	42	..	1,075	175	1,250	370	..	1	3	9	4	17
Suffeedhun	15	5	2	1	..	..	9	2	4	..	..	1	..	1	15	5	30	35	50	25	139	425	175	600	125	..	..	..	7	3	10
Baroude	5	8	..	..	..	..	9	5	2	..	1	..	1	2	13	7	30	45	25	45	..	330	20	350	60	..	..	3	10	2	15
Josshee	3	17	1	2	11	3	..	..	..	1	1	..	1	..	14	6	45	40	10	57	36	725	175	900	150	1	..	4	13	5	23
	300	293	57	18	190	74	61	19	44	14	49	27	31	16	432	168	50	41	22	39	92	—	—	—	—	—	—	—	—	—	—

Abstract of Medical Examinations of Five Irrigating Villages situate half a mile or more from the Hansi branch of the Western Jumna Canals.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.		Percentage of Adults having suffered from fever in			Percentage of enlarged Spleens.	Depth of Water below the Surface of Ground.	Annual Average Amount of Canal Irrigation. Tor.	Daul.	Total.	Average Annual Amount of Irrigated Rice.	Detail of Sizes of enlarged Spleens. VL.	L.	M.	O.	S.	Total.
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	Beegas.	Beegas.	Beegas.	Beegas.						
Nianna...............	18	2	2	..	11	..	1	..	1	..	1	..	4	..	20	..	15	15	10	5	106	275	100	375	20	..	..	..	..	2	2
Akburpoor Nowlee.	17	3	..	..	13	2	..	..	1	1	1	..	2	..	17	3	75	40	20	15	..	90	10	100	..	..	..	..	3	3	6
Booreana	12	8	..	..	15	2	..	..	..	..	..	1	1	1	16	4	40	45	25	30	117	not known	not known	not known	..	..	..	..	6	6	12
Ameerpoor Bheinee	9	11	3	..	14	1	..	..	..	..	..	..	2	..	19	1	80	20	20	30	124	1,480	20	1,500	225	..	..	1	7	4	12
Dalimwala	16	4	1	..	15	..	..	..	2	..	1	..	1	..	20	..	30	35	5	10	127	510	100	610	110	..	..	..	3	1	4
	72	28	6	..	68	5	1	..	4	1	3	1	10	1	92	8	40	31	16	18	118	—	—	—	—	—	—	—	—	—	—

Abstract of Medical Examinations of Seven Irrigating Villages, distant half a mile or more from the Bootana branch of the Western Jumna Canals.

Villages.	Children N.	Children E.	Brahmins N.	Brahmins E.	Hindoo Cult. N.	Hindoo Cult. E.	Mussulman Cult. N.	Mussulman Cult. E.	Bunnias N.	Bunnias E.	Artisans N.	Artisans E.	Menials N.	Menials E.	Totals N.	Totals E.	1844.	1845.	1846.	Percentage of enlarged Spleens.	Depth of Water	Tor.	Daul.	Total.	Irrigated Rice.	VL.	L.	M.	O.	S.	Total.
Chota Oorlana......	11	9	..	..	..	..	14	2	..	..	2	..	1	1	17	3	45	40	25	30	..	475	25	500	100	..	..	..	8	4	12
Burra Oorlana......	11	9	2	..	1	..	14	..	1	..	..	..	2	..	20	..	45	55	40	22	106	1,300	150	1,450	200	..	..	2	2	5	9
Seenk	17	3	..	..	13	4	..	..	1	..	..	..	..	2	14	6	50	30	20	22	109	1,800	150	1,950	260	..	..	..	6	3	9
Burra Anchura	15	5	7	..	7	..	..	..	2	..	2	1	1	..	19	1	50	25	20	15	138	745	5	750	20	..	..	..	5	1	6
Gungana	17	3	5	..	8	1	..	..	1	..	3	..	2	..	19	1	20	15	20	10	99	2,025	50	2,075	80	..	..	..	4	..	4
Bootana	19	1	2	..	12	2	..	..	2	..	..	..	2	..	18	2	60	60	30	7	82	3,430	50	3,480	500	..	..	..	3	..	3
Barouda	19	1	..	..	11	..	1	..	1	1	5	1	..	..	18	2	20	30	..	7	78	4,500	50	4,550	20	..	..	..	1	2	3
	109	31	16	..	52	7	29	2	8	1	12	2	8	3	125	15	41	36	22	16	102	—	—	—	—	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Twenty-two Villages situated near the Nujufgurh Jheels or in the Khadir lands of Rivers.

Situation.—Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.		Percentage of Adults having suffered from fever in			Percentage of enlarged Spleens.	Depth of Water below Surface of Ground.	Detail of Sizes of enlarged spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	V.L.	L.	M.	O.	S.	Total.
Nujufgurh Jheels :—																											
Runhowla	9	11	2	1	10	2	..	..	..	..	..	1	4	..	16	4	70	45	30	37	17	..	..	3	7	5	15
Baprowla	11	9	1	2	8	4	..	..	1	..	3	..	..	1	13	7	55	70	40	40	15	..	..	..	8	8	16
Nujufgurh	17	3	2	2	..	..	4	..	4	2	4	2	..	..	14	6	25	45	70	22	19	..	..	..	8	1	9
Nugla	2	18	..	2	8	5	..	..	..	..	2	2	1	..	11	9	65	75	60	67	10	..	..	..	19	8	27
Pandwala	4	16	2	7	3	6	..	..	..	..	..	2	..	..	5	15	45	60	85	77	5	..	4	7	16	4	31
Oojwa	8	12	..	1	9	2	1	2	1	..	1	..	1	2	13	7	25	60	70	47	14	..	1	3	12	3	19
Shumushpoor	4	16	..	..	11	7	..	..	..	..	..	..	2	..	13	7	35	90	65	57	7	..	1	2	16	4	23
Isheepoor	19	1	2	..	9	4	..	..	3	..	1	..	1	..	16	4	15	25	50	12	27	..	..	..	4	1	5
Badlee	11	9	2	..	7	..	..	..	2	1	3	3	1	1	15	5	45	65	40	35	20	..	..	1	6	7	14
Jumna West Khadir:—																											
Duherpoor	3	17	..	3	7	5	..	..	..	2	..	..	1	2	8	12	50	25	25	*72	7	..	3	3	16	7	29
Indurput	13	7	4	..	7	1	2	..	1	..	2	..	1	2	17	3	55	40	50	25	10	..	..	..	3	7	10
Newul	8	12	..	1	..	..	7	8	..	..	2	..	2	..	11	9	50	45	20	52	14	..	..	3	15	3	21
Mogul Majra	7	13	1	1	6	1	3	2	..	1	1	..	4	..	15	5	40	60	20	45	10	..	1	3	10	4	18
Jumna East Khadir :—																											
Luknowtee	10	10	1	..	1	..	2	..	2	1	6	..	5	2	17	3	55	45	15	32	18	..	..	..	9	4	13
Soorajpoor	7	13	..	1	2	1	9	3	..	..	1	3	..	..	12	8	35	40	25	52	10	..	..	2	12	7	21
Shahdera	11	9	1	1	3	1	3	1	3	1	3	2	..	1	13	7	65	60	40	40	15	..	2	3	8	3	16
Joondla	4	16	6	1	9	3	..	..	..	..	..	..	1	..	16	4	40	40	25	50	8	..	..	..	7	13	20
Valley of the Hindun :—																											
Arthulla	20	..	1	..	3	..	7	1	1	..	6	..	1	..	19	1	15	25	30	2	12	..	..	..	..	1	1
Kurrara	14	6	..	..	17	..	..	..	..	..	2	..	1	..	20	..	20	20	10	15	14	..	..	..	1	5	6
Ghazeeoodeennuggur	14	6	4	..	..	..	5	1	6	..	..	1	3	..	18	2	70	45	45	20	38	..	..	..	2	6	8
Gokuna	14	6	..	..	10	2	..	..	..	..	2	..	2	..	14	2	69	81	69	22	13	..	..	..	5	3	8
Ghorao	13	7	5	..	1	..	4	..	1	..	4	1	4	..	19	1	35	25	30	20	17	..	..	1	4	3	8
Total	223	217	34	23	131	44	47	18	25	8	43	17	35	11	315	121	44	49	42	38	15	—	—	—	—	—	—

Abstract of Medical Examinations of Twenty-two Villages, situated within half a mile of the Delhi branch of the Canals west of Jumna.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Adults. Hindoo Cultivators.		Adults. Mussulman Cultivators.		Adults. Bunnias.		Adults. Artisans, &c.		Adults. Menials.		Adults. Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below the Surface of Ground.	Average Annual Amount of Canal Irrigation.	Average Annual Amount of Irrigated Rice.	Proportion of Tor Irrigation.	Proportion of Daul Irrigation.	Detail of Sizes of Enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	Beegas.	Beegas.	Beegas.	Beegas.	VL.	L.	M.	O.	S.	Total.
Kurnaul	30	50	6	..	12	4	5	4	11	10	19	5	4	..	57	23	51	29	14	46	16	4,000	1,800	3,600	400	1	4	12	45	11	73
Phoorluk	7	13	6	..	5	..	..	1	..	5	1	..	1	1	13	7	55	55	45	50	14	1,350	175	925	425	..	1	6	10	3	20
Raipoor	6	14	3	1	6	2	1	..	2	..	4	1	..	..	16	4	40	40	35	45	12	350	125	200	150	..	..	4	11	3	18
Dhurmgurh	5	15	..	4	10	2	..	..	..	..	2	2	..	..	12	8	70	45	25	57	..	2,200	500	1,750	450	..	..	4	16	3	23
Shera	5	15	1	1	9	7	..	..	1	..	..	..	..	1	11	9	45	50	15	60	7	3,000	750	2,600	400	..	1	5	15	3	24
Mudlowda	8	12	2	..	7	7	..	..	1	..	1	..	1	1	12	8	35	45	15	50	14	3,130	420	2,630	500	..	..	1	13	6	20
Kokrana	11	9	..	..	5	5	..	..	1	..	2	2	3	2	11	9	60	65	65	45	12	350	50	100	250	..	..	3	10	5	18
Didwaree	1	19	1	..	5	6	2	2	1	1	..	1	..	1	9	11	60	75	55	75	7	900	300	750	150	..	3	9	12	6	30
Chumrara...............	4	16	2	1	7	4	..	1	..	1	..	1	2	1	11	9	15	15	45	62	7	1,450	350	1,200	250	..	2	6	14	3	25
Bullee	8	12	1	2	3	2	1	..	1	2	2	..	2	4	10	10	45	25	40	55	7	1,710	300	1,410	300	..	1	5	12	4	22
Mahomedpoor Majra..	2	18	1	2	6	4	..	..	2	1	..	2	1	1	10	10	75	55	45	70	9	650	5	150	500	..	..	6	14	8	28
Sitaolee..................	5	15	..	1	6	6	..	..	2	1	2	2	..	..	10	10	65	45	40	62	7	1,100	50	600	500	2	3	7	10	3	25
Jooah	3	17	3	1	5	3	..	..	..	3	1	4	..	..	9	11	65	40	25	70	5½	3,000	400	2,600	400	..	5	8	9	5	27
Jajhee	5	15	4	..	4	6	..	1	..	..	..	3	1	1	9	11	40	45	55	65	2½	600	150	350	250	1	3	7	13	1	25
Bhutgong................	5	15	1	4	3	8	..	1	..	1	..	1	1	..	5	15	35	60	50	75	4	5,500	2,500	4,500	1,000	1	2	5	20	2	30
Jhurouth	2	18	2	1	7	5	..	..	1	..	..	3	1	..	11	9	65	65	50	67	5	550	20	475	75	..	..	5	15	7	27
Jutowla	3	17	1	5	3	6	..	..	1	1	1	1	..	1	6	14	75	25	80	77	5	1,050	125	1,000	50	..	3	5	18	5	31
Bowanna	3	17	1	1	5	6	1	..	2	2	..	..	1	1	10	10	55	40	45	67	6½	3,000	800	2,980	20	1	1	4	14	7	27
Hydurpoor	4	16	1	2	4	5	..	..	2	1	1	1	2	1	10	10	60	55	50	65	10	1,000	225	1,000	..	..	3	2	16	5	26
Subzee Mundee	10	10	..	..	5	1	..	..	2	2	7	3	..	..	14	6	25	50	40	40	17	1,200	10	1,150	50	..	1	1	12	2	16
Rohilla Khan Serai ...	8	12	2	1	2	1	3	2	1	..	5	2	..	1	13	7	35	45	50	47	20	1,000	175	995	5	..	1	2	10	6	19
Delhi *	60	20	3	..	5	..	..	..	28	3	33	3	2	3	71	9	52	32	29	18	40	..	..	..	..	..	..	3	17	9	29
Total.........	195	365	41	27	124	90	13	12	59	34	81	37	22	20	340	220	51	45	41	58	11	—	—	—	—	–	–	–	–	–	—
* Delhi City	47	13	1	..	5	..	..	..	22	..	25	3	2	2	55	5	50	27	23	15	41	..	..	..	..	..	..	..	12	6	18
Do. Cantonments.	13	7	2	..	..	..	..	..	6	3	8	..	..	1	16	4	60	50	45	27	39	..	..	..	..	..	..	3	5	3	11

ABSTRACT of Medical Examinations of Twenty-eight Irrigating Villages distant half a mile or more from the Delhi branch of the Canals West of Jumna.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials.		Totals.	
	N.	E.	N.	E.	N.	E.	N.	E.	N	E.	N	E.	N.	E.	N.	E.
Sitoundi	25	15	9	2	10	..	6	..	5	1	3	1	3	..	36	4
Gugseena	33	7	6	..	20	1	..	..	5	..	3	..	4	1	38	2
Rair	14	26	1	1	..	1	19	5	2	..	4	4	3	..	29	11
Moonuk	27	13	7	..	2	1	11	1	4	3	3	1	4	3	31	9
Baul Jaton	2	18	2	5	4	3	..	..	1	1	1	2	1	..	9	11
Baolee	7	13	1	2	..	..	9	7	..	..	..	..	1	..	11	9
Burra Assun	9	11	2	2	6	..	..	..	4	2	..	..	3	1	15	5
Chota Assun	4	16	1	4	10	2	..	..	..	2	1	..	..	..	12	8
Noulta	9	11	5	..	6	4	..	..	1	3	1	..	..	..	13	7
Duhur	14	6	1	..	7	3	..	..	1	1	2	2	3	..	14	6
Hurtaree	8	12	2	..	..	..	8	2	2	..	1	2	2	1	15	5
Brahmin Majra	2	18	10	5	..	..	..	..	1	..	1	2	..	1	12	8
Burra Joundhun	4	16	3	5	5	5	..	..	..	..	1	1	..	..	9	11
Karud	3	17	2	1	7	2	..	..	..	..	3	3	..	2	12	8
Issrana	8	12	1	..	5	4	..	..	2	1	2	3	1	1	11	9
Bhinjowl	11	9	6	1	6	1	1	..	1	1	..	..	3	..	17	3
Dhindar	9	11	3	1	..	..	7	2	1	1	1	1	2	1	14	6
Hoolana	11	9	1	2	9	3	..	..	1	1	1	1	1	..	13	7
Kurreooree	..	20	2	..	6	7	..	..	..	1	..	3	..	1	8	12
Chitana	5	15	1	2	10	2	..	..	1	..	1	..	2	1	15	5
Bidhlaun	5	15	1	1	5	3	..	..	1	3	2	1	2	1	11	9
Suelana	6	14	2	1	10	..	..	..	2	1	1	1		1	16	4
Sissana	12	8	4	..	7	1	..	..	2	2	3	..	1	1	16	4
Kanduh	9	11	2	2	7	2	..	..	..	3	3	1	..	..	12	8
Kutloopoor	8	12	4	..	10	4	..	1	..	..	1	..	..	..	15	5
Burra Khera	4	16	1	..	9	8	..	..	..	..	2	..	..	..	12	8
Badlee	7	13	4	2	4	1	..	2	1	2	..	3	..	1	9	11
Wuzeeorpoor	3	17	1	1	6	6	..	..	..	1	..	3	..	2	7	13
Total	259	381	85	40	171	64	61	20	38	30	41	35	36	19	432	208

Villages.	Percentage of Adults having suffered from Fever, in 1844.	1845.	1846.	Percentage of enlarged Spleens.	Average Annual Amount of Canal Irrigation. Tor.	Daul.	Total.	Average Annual Amount of Irrigated Rice.	Wells.	Detail of Sizes of Enlarged Spleens. VL.	L.	M.	O.	S.	Total.
					Beegas.	Beegas.	Beegas.	Beegas.	Feet.						
Sitoundi	52	42	20	24	400	1,000	1,400	150	25	..	..	1	9	9	19
Gugseena	35	17	10	11	1,680	1,520	3,200	200	17	..	..	..	4	5	9
Rair	47	30	5	46	2,400	500	2,900	900	19	1	2	7	22	5	37
Moonuk	52	20	17	27	2,100	400	2,500	950	28	..	..	2	11	9	22
Baul Jaton	50	55	40	72	1,200	1,000	2,200	600	..	..	2	7	14	6	29
Baolee	75	60	40	55	2,000	300	2,300	1,100	10	..	3	9	7	3	22
Burra Assun	35	25	45	40	950	150	1,100	200	7	..	1	3	5	7	16
Chota Assun	70	65	45	60	550	50	600	80	8	..	1	4	11	8	24
Noulta	65	55	45	45	2,900	1,200	4,100	100	9	1	2	3	7	5	18
Duhur	30	40	40	30	850	100	950	150	33	..	..	..	8	4	12
Hurtaree	55	55	50	42	500	50	550	40	18	..	1	..	9	7	17
Brahmin Majra	45	65	55	65	950	50	1,000	10	16	1	..	4	20	1	26
Burra Joundhun	55	40	45	67	1,000	100	1,100	50	20	..	..	6	12	9	27
Karud	55	65	30	62	1,115	10	1,125	5	30	..	..	3	13	9	25
Issrana	50	40	55	52	2,030	20	2,050	75	..	1	..	2	13	5	21
Bhinjowl	50	75	40	30	720	5	725	40	14	..	..	2	9	1	12
Dhindar	55	40	60	42	375	100	475	20	17	..	..	1	13	3	17
Hoolana	65	50	45	40	700	800	1,500	150	15	..	..	2	5	9	16
Kurreooree	80	70	45	80	650	50	700	50	5	1	..	11	18	2	32
Chitana	30	30	55	50	680	20	700	5	12	..	..	1	12	7	20
Bidhlaun	50	40	5	60	1,980	20	2,000	..	15	1	1	2	17	3	24
Suelana	40	50	10	45	2,000	..	2,000	..	33	..	..	1	13	4	18
Sissana	45	40	30	30	2,750	50	2,800	150	40	..	..	2	7	3	12
Kanduh	40	40	40	47	2,595	5	2,600	20	18	..	1	5	12	1	19
Kutloopoor	45	55	65	42	200	50	50	..	19	1	1	1	11	3	17
Burra Khera	80	85	75	60	2,800	..	2,800	400	9	..	1	4	14	5	24
Badlee	30	65	65	60	1,200	..	1,200	200	8	..	3	2	14	5	24
Wuzeeorpoor	60	70	45	75	1,140	10	1,150	175	..	..	2	3	19	6	30
Total	51	49	40	49	..	..	..	..	18	–	–	–	–	–	—

ABSTRACT of Medical Examinations of Nine Irrigating Villages, situate within half a mile of the Rohtuk branch of the Canals West of the Jumna.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials.		Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below Surface of Ground.	Annual Average Amount of Canal Irrigation. Tor.	Daul.	Total.	Average Annual Amount of Irrigated Rice.	Detail of Sizes of Enlarged Spleens. VL.	L.	M.	O.	S.	Total.
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	Beegas.	Beegas.	Beegas.	Beegas.						
Singpoora	11	9	3	1	8	3	..	..	1	..	1	..	2	1	15	5	50	70	45	35	52	150	..	150	..	..	..	1	7	6	14
Chichrana	9	11	1	..	9	5	..	..	1	1	2	1	..	..	13	7	60	40	20	45	18	1,750	50	1,800	50	1	..	1	8	8	18
Bhynswal	10	10	3	..	9	..	..	..	..	1	3	2	1	1	16	4	20	15	35	35	..	1,400	100	1,500	150	..	1	4	3	6	14
Mahura	9	11	1	..	9	4	..	..	1	1	2	..	1	1	14	6	45	40	20	42	50	1,050	150	1,200	125	..	..	3	8	6	17
Gohanna	6	14	..	..	..	..	1	2	6	2	5	4	..	..	12	8	40	30	20	55	55	1,550	50	1,600	300	..	1	4	11	6	22
Muhmoodpoor	7	13	..	..	11	6	..	..	1	..	..	..	2	..	14	6	75	40	25	47	6	3,740	10	3,750	425	..	..	4	8	7	19
Sumanka	5	15	3	2	4	7	..	..	1	..	..	..	1	2	9	11	40	35	25	65	8	1,185	15	1,200	125	1	2	5	11	7	26
Korana	12	8	5	..	9	1	..	..	..	2	2	1	..	..	16	4	45	25	25	30	16	4,420	200	4,620	700	..	..	1	9	2	12
Uhur	9	11	4	2	7	1	..	..	..	1	2	..	2	1	15	5	45	50	30	40	24	2,050	300	2,350	250	..	..	2	9	5	16
	78	102	20	5	66	27	1	2	11	8	17	8	9	6	124	56	47	38	27	44	28	—	—	—	—	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Six Irrigating Villages distant half a mile or more from the Rohtuk branch of the Western Jumna Canals.

Villages.	Children N.	E.	Brahmins N.	E.	Hindoo N.	E.	Mussulman N.	E.	Bunnias N.	E.	Artisans N.	E.	Menials N.	E.	Totals N.	E.	1844.	1845.	1846.	Spleens %	Depth	Tor.	Daul.	Total.	Rice	VL.	L.	M.	O.	S.	Total.
Rohtuk	17	3	2	..	4	..	1	..	8	..	4	..	1	..	20	..	5	20	40	7	72	750	..	750	..	..	..	..	..	3	3
Chumaree	10	10	..	1	9	3	..	..	3	..	2	..	2	..	16	4	45	65	45	35	50	650	100	750	..	..	..	..	6	8	14
Sanghee	11	9	2	..	14	..	..	..	2	1	1	..	..	..	19	1	65	45	15	25	28	3,000	50	3,050	150	..	..	2	5	3	10
Burra Guhlowr	13	7	2	1	12	2	..	..	1	..	..	..	1	1	16	4	35	30	25	27	46	745	5	750	20	..	..	..	4	7	11
Chota Guhlowr	11	9	9	7	..	..	..	..	..	..	..	..	2	2	11	9	30	25	5	45	46	500	..	500	10	..	..	1	11	6	18
Matun	9	11	1	..	10	3	..	..	3	..	1	..	1	1	16	4	25	20	30	37	47	1,210	20	1,230	150	..	..	5	9	1	15
	71	49	16	9	49	8	1	..	17	1	8	..	7	4	98	22	34	34	27	29	48	—	—	—	—	—	—	—	—	—	—

Abstract of Medical Examinations of Twenty-four Unirrigated Villages in the Delhi Territory.

Collectorate.—Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Adults. Hindoo Cultivators.		Adults. Mussulman Cultivators.		Adults. Bunnias.		Adults. Artisans, &c.		Adults. Menials, &c.		Adults. Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below the Surface of Ground.	Detail of Sizes of enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.
Rohtuk :—																											
Barouta	16	4	4	3	7	1	..	..	..	..	2	1	2	..	15	5	40	40	30	22	21	..	..	1	5	3	9
Gorur	14	6	2	..	5	..	..	..	3	..	8	..	2	..	20	0	20	30	15	15	60	..	..	..	4	2	6
Booketuh	16	4	1	..	12	3	..	..	2	..	..	1	1	..	16	4	50	30	55	20	56	..	..	1	4	3	8
Poolungee	18	2	8	..	6	..	..	..	1	..	1	..	4	..	20	..	45	40	40	5	82	..	..	..	1	1	2
Jusrana	16	4	3	..	12	1	..	..	..	1	1	1	1	..	17	3	40	30	40	17	80	..	..	..	4	3	7
Guewana	14	6	6	..	6	..	2	1	1	..	1	..	3	..	19	1	40	30	30	17	90	..	..	..	3	4	7
Kuelooee	20	..	1	..	7	..	..	..	3	..	5	..	4	..	20	..	25	15	5	..	97	..	..	..	..	..	..
Roorkhi	17	3	2	..	4	..	..	..	5	..	7	..	1	1	19	1	20	55	40	10	93	..	..	..	3	1	4
Moongan	15	5	3	..	9	2	1	..	2	..	..	1	1	1	16	4	30	20	60	22	80	..	..	..	7	2	9
Goyla	20	..	1	..	14	..	..	..	1	..	2	..	2	..	20	..	10	15	30	..	45	..	..	..	..	..	..
Doolhera	19	1	2	..	10	..	..	..	1	..	5	..	2	..	20	..	30	5	15	2	57	..	..	..	1	..	1
Matin	19	1	2	1	9	1	..	..	1	..	4	..	2	..	18	2	35	20	25	7	65	..	..	..	1	2	3
Assueenda	19	1	3	..	11	2	..	..	..	..	1	..	3	..	18	2	35	30	35	7	65	..	..	1	..	2	3
Khoorawar	17	3	3	1	8	2	..	..	2	..	2	..	2	..	17	3	60	50	35	15	77	..	..	..	2	4	6
Kheree Sadh	18	2	2	1	10	..	..	..	1	..	4	..	2	..	19	1	25	20	20	7	85	..	..	..	1	2	3
Ruhundana	18	2	2	..	7	..	4	..	..	..	6	..	1	..	20	..	40	25	5	5	122	..	..	..	..	2	2
Jowlana	18	2	5	..	7	..	..	..	3	..	3	..	2	..	20	..	60	35	40	5	123	..	..	..	..	2	2
Hissar :—																											
Burchuppur	14	6	3	1	9	1	..	..	1	..	2	1	2	..	17	3	30	50	40	22	132	..	..	..	6	3	9
Mohula	15	5	2	..	9	1	..	..	..	..	1	1	5	1	17	3	65	55	25	20	..	..	..	..	6	2	8
Bass	20	..	3	..	10	1	..	..	2	..	2	..	1	1	18	2	50	40	35	5	135	..	..	..	..	2	2
Bhatowl	18	2	8	1	7	..	..	..	..	..	2	..	2	..	19	1	70	60	30	7	118	..	..	..	1	2	3
Bugla	17	3	1	..	16	..	..	..	..	..	2	..	1	..	20	..	80	25	10	7	81	..	..	..	3	..	3
Jakhode	18	2	1	..	9	..	..	..	4	..	4	..	2	..	20	..	60	15	10	5	101	..	..	..	2	..	2
Myerr	14	6	1	..	12	3	..	..	1	..	1	..	1	1	16	4	70	30	15	25	102	..	..	1	6	3	10
	410	70	69	8	216	18	7	1	34	1	66	6	49	5	441	39	43	32	28	11	88	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Twenty-one Towns and Villages in the Protected Sikh States, of which Twelve are connected, and Nine unconnected with the Delhi Canal.

Situation.—Villages.	Children of all Classes.		Adults.																Percentage of Adults having suffered from fever in			Percentage of enlarged Spleens.	Depth of Water below Surface of Ground.	Detail of Sizes of enlarged spleens.						
			Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.													
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845	1846.		Feet.	VL.	L.	M.	O.	S.	Total.
Situated near the Delhi Canal :																											
Dadoopoor	10	9	..	..	7	2	..	..	2	1	5	1	1	..	15	4	45	55	40	34	12	..	1	2	6	4	13
Boorreea	13	7	4	..	2	..	1	1	6	1	3	..	2	..	18	2	30	50	20	22	..	..	1	..	6	2	9
Moonda Majra	14	6	3	1	5	3	..	..	1	2	3	1	1	..	13	7	60	65	20	32	..	..	..	..	10	3	13
Damla	10	10	1	..	9	1	3	..	4	..	1	..	1	..	19	1	35	70	30	27	..	..	..	..	4	7	11
Kanjnoon	6	14	1	..	8	5	..	..	1	1	2	2	..	..	12	8	60	60	40	55	..	..	2	3	13	4	22
Rudowr	8	12	3	..	..	..	..	..	7	5	3	..	..	2	13	7	35	70	25	47	24	..	1	1	12	5	19
Zynpoor	4	16	..	2	3	1	3	1	3	2	..	3	1	1	10	10	55	55	20	65	..	1	1	1	19	4	26
Indree	5	15	4	1	3	1	1	..	2	3	1	4	..	..	11	9	60	40	35	60	15	1	2	4	13	4	24
Gooda	5	15	3	2	2	1	2	3	1	..	3	3	..	..	11	9	30	30	20	60	23	..	1	3	14	6	24
Khera	8	12	2	2	3	3	2	..	1	2	1	2	2	..	11	9	65	45	25	52	8	..	..	1	10	10	21
Beebeepoor	8	12	1	1	12	2	..	..	..	..	3	..	1	..	17	3	40	40	30	37	11	..	..	1	9	5	15
Dhurrur	8	12	1	..	..	..	9	2	5	..	1	..	2	..	18	2	50	40	10	35	20	..	..	..	11	3	14
Total	99	140	23	9	54	19	21	7	33	17	26	16	11	3	168	71	47	52	26	44	—	—	—	—	—	—	—
Unconnected with the Delhi Canal :—																											
Loodiana	12	8	1	..	..	1	..	..	4	..	14	..	..	..	19	1	20	70	30	22							
Umballa	19	1	..	..	4	..	5	2	6	1	2	..	..	..	17	3	25	60	40	10							
Khooda	10	10	6	..	2	..	2	2	5	3	..	..	..	..	15	5	30	25	10	37							
Mullana	11	9	5	2	5	..	3	..	3	1	1	..	..	..	17	3	65	65	30	30							
Mustafabad	9	11	5	..	..	..	2	1	8	2	1	1	..	..	16	4	55	85	25	37							
Tejlee	14	6	4	1	9	..	..	..	1	..	3	..	2	..	19	1	30	60	35	17	..	..	..	..	4	3	7
Bun	11	9	1	1	5	1	..	..	2	1	6	1	2	..	16	4	65	55	35	32	..	..	..	2	8	3	13
Ladwa	12	8	1	1	1	1	1	..	4	2	3	1	4	1	14	6	40	70	35	35	..	..	2	1	7	4	14
Pinjokra	7	13	..	..	7	2	..	1	..	..	3	1	6	..	16	4	60	55	30	42	21	..	..	2	11	4	17
Totals	105	75	23	5	33	5	13	6	33	10	33	4	14	1	149	31	43	61	30	29	—	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Thirty-four Villages, &c., practising Well Irrigation in the Northern Dooab.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.		Percentage of Adults having suffered from fever in			Percentage of enlarged Spleens.	Depth of Water from the Surface of Ground.	Detail of Sizes of enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.
Gungoh	14	6	1	..	6	..	3	1	1	..	4	..	4	..	19	1	70	55	40	17	16	..	..	..	2	5	7
Beera Kheree	16	4	2	1	12	1	1	..	..	..	3	..	..	..	18	2	55	55	40	15	20	..	..	..	1	5	6
Umbehta	14	6	1	..	4	..	2	..	7	..	4	..	2	..	20	..	60	35	10	15	11	..	..	..	4	2	6
Kheree	15	5	2	..	..	..	3	..	5	1	5	1	3	..	18	2	25	45	55	17	15	..	..	..	5	2	7
Sidhowli	17	3	..	..	17	1	..	..	..	..	2	..	..	..	19	1	25	15	5	10	14	..	..	..	1	3	4
Pilkhuni	16	3	1	..	8	1	..	..	..	..	1	..	..	..	10	1	36	45	36	13	12	..	..	..	2	2	4
Jajwa	11	9	3	..	5	..	3	..	5	1	3	..	..	..	19	1	65	75	35	25	14	..	..	..	3	7	10
Jugehta	13	7	1	1	5	..	..	..	4	..	5	..	4	..	19	1	20	30	15	20	11	..	..	..	5	3	8
Chitowra	20	..	..	..	2	..	8	..	2	..	7	..	1	..	20	..	30	40	10	..	30	..	..	..	..	..	..
Tajpoor	20	..	7	..	5	..	3	..	..	..	1	..	4	..	20	..	30	10	..	..	19	..	..	..	..	..	..
Khatowli	16	4	1	..	5	..	..	..	10	..	3	..	1	..	20	..	60	15	10	10	20	..	..	..	1	3	4
Muhmoodpoor Lahora	18	2	..	..	9	..	2	..	5	..	1	..	3	..	20	..	35	25	30	5	20	..	..	..	..	2	2
Sutheree	17	3	4	..	4	..	1	..	3	..	7	..	1	..	20	..	55	15	20	7	22	..	..	..	..	3	3
Sulawah	19	1	2	..	8	..	1	..	4	..	4	1	..	..	19	1	20	25	5	5	20	..	..	..	1	1	2
Jowalagurh	19	1	2	..	5	..	..	..	4	..	8	..	1	..	20	..	40	50	30	2	25	..	..	..	..	1	1
Sirdhana	36	4	5	..	6	..	..	..	13	..	12	..	4	..	40	..	32	35	17	5	20	..	..	..	2	2	4
Nanoon	19	1	..	..	..	..	14	1	3	..	..	..	1	1	18	2	35	35	35	7	17	..	..	..	2	1	3
Bhalsowna	16	4	4	..	10	..	..	..	..	..	3	..	3	..	20	..	35	30	5	10	24	..	..	..	..	4	4
Doongur	20	..	3	..	9	..	..	..	1	..	4	..	3	..	20	..	25	20	20	..	35	..	..	..	..	..	..
Bhola	19	1	6	..	1	..	1	..	3	..	5	..	4	..	20	..	20	25	10	2	22	..	..	..	1	..	1
Peeplee Adureespoor	19	1	5	1	8	..	3	..	..	..	1	..	2	..	19	1	25	5	10	5	25	..	..	1	1	..	2
Meerut Cantonment	77	3	1	..	2	..	3	..	33	..	30	..	11	..	80	..	29	29	16	2	12	..	..	..	2	1	3
Bhoorbural	18	2	6	..	8	..	..	..	..	2	1	..	2	1	17	3	35	25	30	12	19	..	..	..	2	3	5
Begumabad	19	1	3	2	2	..	1	1	4	..	5	..	2	..	17	3	35	30	25	10	27	..	..	..	..	4	4
Seekree	18	2	3	..	16	..	..	..	..	..	..	..	1	..	20	..	..	..	..	5	29	..	..	1	..	1	2
Dohaee	20	..	4	..	8	..	..	..	4	..	1	..	3	..	20	..	35	40	20	..	32	..	..	..	..	..	..
Kurkurree	20	..	3	..	14	..	..	..	1	..	..	..	2	..	20	..	30	30	10	..	35	..	..	..	..	..	..
Bagouth	18	2	1	..	17	..	..	..	..	..	..	..	2	..	20	..	20	20	20	5	36	..	..	..	..	2	2
Bhyrapoor	19	1	7	..	12	..	..	..	..	..	..	..	1	..	20	..	35	10	25	2	38	..	..	..	..	1	1
Powyss	15	5	4	..	15	..	..	..	..	..	..	..	1	..	20	..	20	10	10	12	44	..	..	..	3	2	5
Sunowli	19	1	..	..	16	1	..	..	..	..	1	..	2	..	19	1	35	15	10	5	35	..	..	..	..	2	2
Sherpoor	17	3	..	..	13	..	1	..	1	..	..	..	5	..	20	..	55	30	10	7	38	..	..	..	1	2	3
Solana	14	6	4	..	12	..	..	..	..	..	..	..	3	1	19	1	45	50	10	17	36	..	..	..	1	6	7
Mokundpoor	15	5	1	..	13	..	2	..	1	1	1	..	1	..	19	1	45	50	30	15	33	..	..	..	3	3	6
	663	96	87	5	277	4	52	3	114	5	122	2	77	3	729	22	37	31	20	8	24	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Twenty Unirrigated Villages, of which Five are in the N. W. Khadir of the Ganges, and Fifteen are situated on the High Land of the Dooab.

Situation.—Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water from the Surface of Ground.	Detail of Sizes of enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.
Ganges Khadir:—																											
Kunkhul	14	..	8	1	1	1	..	..	4	..	4	..	..	1	17	3	30	35	30	22	18	..	..	1	4	4	9
Jowalapoor	19	1	6	1	..	..	..	..	3	..	8	..	2	..	19	1	35	30	30	5	56	..	..	..	..	2	2
Buhadurabad	17	3	1	..	3	2	2	..	4	1	2	..	4	1	16	4	25	40	35	17	34	..	..	1	2	4	7
Santul Shah	11	9	4	1	4	5	..	..	..	..	1	3	1	1	10	10	60	60	20	47	9	1	..	3	9	6	19
Budheree	17	3	5	..	..	..	8	2	1	..	2	..	2	..	18	2	55	45	25	12	9	..	.	..	4	1	5
Total	78	22	24	3	8	8	10	2	12	1	17	3	9	3	80	20	41	42	28	21	25	—	—	—	—	—	—
Bangur or high land of the Dooab:—																											
Punniala	15	5	4	..	8	1	1	..	1	..	3	..	2	..	19	1	60	60	20	15	18	..	..	..	3	1	4
Roorkhi	17	3	3	..	3	..	5	..	1	..	3	..	5	..	20	..	25	45	25	7	28	..	..	..	3	..	3
Munglour	30	..	4	..	2	..	8	1	5	..	6	..	4	..	29	1	32	37	22	2	45	..	..	..	..	1	1
Hurriabas	18	2	..	..	15	..	..	..	..	..	3	..	2	..	20	..	35	5	10	5	15	..	..	..	..	2	2
Liburheree	20	..	5	..	8	..	..	..	1	..	4	..	2	..	20	..	35	20	5	..	49	..	..	..	..	..	..
Muhmoodpoor	19	1	7	..	11	..	..	..	..	..	..	..	2	..	20	..	5	30	5	2	58	..	..	..	1	..	1
Poor	19	1	2	..	1	..	8	..	..	..	7	..	2	..	20	..	35	25	15	2	..	..	..	..	1	..	1
Togulpoor	19	1	1	..	3	..	..	..	5	..	9	..	2	..	20	..	45	50	25	2	62	..	..	..	..	1	1
Khai Khera	20	..	3	..	11	1	..	..	1	..	1	..	2	1	18	2	30	35	10	5	62	..	..	1	..	1	2
Nirgajni	20	..	1	..	16	..	..	..	..	..	1	..	2	..	20	..	25	20	5	..	73	..	..	..	..	..	..
Belra	20	..	2	..	4	..	..	..	8	..	5	..	1	..	20	..	55	35	15	..	58	..	..	..	..	..	..
Bhopa	20	..	5	..	6	..	..	..	1	..	5	..	3	..	20	..	30	15	..	..	54	..	..	..	..	..	..
Yusufpoor	20	..	2	..	10	..	2	..	1	..	2	..	3	..	20	..	15	30	5	..	52	..	..	..	..	..	..
Jaolee	20	..	3	..	1	..	10	..	1	1	2	..	2	..	19	1	20	30	20	2	40	..	..	..	1	..	1
Kowal	19	1	2	..	..	..	4	..	5	1	5	..	3	..	19	1	30	10	10	5	29	..	..	..	1	1	2
Total	296	14	44	..	99	2	38	1	30	2	56	..	37	1	304	6	32	30	13	3	46	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Nineteen Irrigating Villages, situated within half a mile of the Suharunpore, or Eastern Jumna Canal, in the Southern Division.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Adults. Hindoo Cultivators.		Adults. Mussulman Cultivators.		Adults. Bunnias.		Adults. Artisans, &c.		Adults. Menials, &c.		Adults. Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water from the Surface of Ground.	Detail of Sizes of Enlarged Spleens.						Annual Average Amount of Canal Irrigation. Tor.	Annual Average Amount of Canal Irrigation. Daul.	Annual Average Amount of Canal Irrigation. Total.	Average Annual Amount of Irrigated Rice.
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.	Beegas.	Beegas.	Beegas.	Beegas.
Selimpoor	5	15	1	2	11	6	..	..	..	..	..	..	..	..	12	8	50	50	45	57	7	..	2	1	12	8	23	47	..	47	10
Behtuh	9	11	2	1	4	1	7	1	..	1	2	1	..	..	15	5	40	30	30	40	19	..	..	2	10	4	16	365	19	384	26
Sukulpoor	17	3	..	..	18	1	..	..	..	..	1	..	..	..	19	1	50	35	15	10	32	..	..	..	3	1	4	216	37	253	..
Surrowli	18	2	3	..	15	1	..	..	..	..	..	1	..	..	18	2	50	45	25	10	24	..	..	1	..	3	4	217	284	501	4
Duggurpoor	15	5	1	1	11	..	..	..	3	..	2	..	2	..	19	1	45	40	10	15	30	..	..	1	2	3	6	342	88	430	16
Binnapoor	20	..	..	..	11	1	1	..	..	..	4	..	3	..	19	1	65	40	5	2	32	..	..	..	..	1	1	12	25	37	..
Rutowl	15	5	..	..	..	..	15	1	..	..	1	..	1	2	17	3	..	..	..	20	33	..	..	..	6	2	8	633	338	971	22
Moobarikpoor	16	4	5	2	10	1	..	..	..	..	..	..	2	..	17	3	40	40	..	17	33	..	..	..	4	3	7	63	504	567	23
Muhrumpoor	18	2	1	..	16	1	..	..	..	..	..	..	2	..	19	1	40	60	10	7	37	..	..	..	2	1	3	103	155	258	18
Deola	13	7	2	..	4	2	5	1	2	1	1	..	2	..	16	4	70	60	20	27	24	..	..	1	5	5	11	673	844	1,516	41
Busode	14	6	..	..	..	..	15	2	..	..	1	..	2	..	18	2	65	50	25	20	24	..	..	..	4	4	8	209	622	831	22
Nugla	15	5	3	1	8	1	..	..	..	..	2	3	1	1	14	6	60	50	10	27	21	..	1	..	4	6	11	59	131	190	21
Ulawalpoor	11	9	1	..	7	5	..	..	1	2	2	..	1	1	12	8	25	30	5	42	18	..	..	4	7	6	17	757	6	763	76
Barote	11	9	1	1	6	2	..	..	3	..	2	1	3	1	15	5	65	55	20	35	26	..	1	3	8	2	14	970	819	1,789	155
Romalla	12	8	2	3	7	2	..	1	..	..	1	..	3	1	13	7	50	40	25	37	21	..	..	2	5	8	15	2,366	50	2,416	320
Kukripoor	12	8	1	..	12	2	..	1	..	..	1	1	1	1	15	5	45	15	5	32	27	..	..	..	5	8	13	1,491	6	1,497	209
Nalla	10	10	4	..	11	..	..	..	1	..	2	..	1	1	19	1	45	15	10	27	21	..	..	3	5	3	11	1,062	489	1,551	182
Kandla	13	7	1	..	8	2	4	1	2	..	1	..	1	..	17	3	30	20	15	25	23	..	..	..	4	6	10	2,314	1,591	3,905	268
Khundraoli	13	7	..	1	14	2	..	..	..	..	..	1	2	..	16	4	35	40	25	27	14	..	..	1	3	7	11	1,898	18	2,015	107
Total	257	123	28	12	173	30	47	8	12	4	23	8	27	8	310	70	48	40	17	25	24	—	—	—	—	—	—	—	—	—	—

ABSTRACT of Medical Examinations of Twelve Irrigating Villages more than half a mile distant from the Suharunpore, or Eastern Jumna Canal, in the Southern Division.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Adults. Hindoo Cultivators.		Adults. Mussulman Cultivators.		Adults. Bunnias.		Adults. Artisans, &c.		Adults. Menials, &c.		Adults. Totals.		Percentage of Adults having suffered from Fever, in			Percentage of enlarged Spleens.	Depth of Water from the Surface of Ground.	Detail of Sizes of Enlarged Spleens.						Annual Average Amount of Canal Irrigation.			Average Annual Amount of Irrigated Rice.
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.	Tor. Beegas.	Daul. Beegas.	Total. Beegas.	Beegas.
Gunowli	20	..	..	..	18	1	..	..	..	..	..	..	1	..	19	1	60	15	10	2	27	..	..	..	1	..	1	278	27	305	..
Meethlee	18	2	2	..	14	1	..	..	1	..	..	..	2	..	19	1	50	40	15	7	32	..	..	..	3	..	3	172	253	425	33
Jounmana	11	9	4	..	12	2	..	..	..	..	..	..	..	2	16	4	30	15	15	32	29	..	..	1	8	4	13	89	202	291	4
Dukana	10	10	2	1	8	1	..	..	2	..	3	..	2	1	17	3	50	50	30	32	30	..	..	1	10	2	13	136	228	364	29
Loharra	12	8	2	..	11	..	..	..	1	..	4	..	2	..	20	..	30	30	5	20	35	..	..	..	5	3	8	224	26	250	19
Bazeedpoor	15	5	1	..	9	..	..	..	..	..	5	..	5	..	20	..	25	15	..	12	36	..	..	..	3	2	5	25	55	80	..
Bujwarra	17	3	4	..	8	1	..	..	2	..	2	..	1	2	17	3	45	30	10	15	43	..	..	..	2	4	6	179	281	460	15
Fazilpoor	12	8	2	..	12	1	..	..	..	..	3	..	2	..	19	1	70	20	5	22	36	..	..	1	5	3	9	339	122	460	41
Kumalla	18	2	3	..	12	1	..	..	1	..	..	..	3	..	19	1	30	25	25	7	43	..	..	..	1	2	3	199	..	199	12
Ramnuggur	16	4	7	1	4	..	..	..	..	..	6	..	2	..	19	1	60	25	20	12	34	..	..	..	2	3	5	64	..	64	4
Tetrouda	15	5	..	..	12	3	..	..	1	..	..	..	3	1	16	4	50	60	15	22	33	..	..	..	4	5	9	924	12	936	56
Soontee....................	10	10	3	..	6	2	..	1	..	..	5	1	2	..	16	4	60	30	20	35	28	..	..	..	3	11	14	518	3	521	82
Total.........	174	66	30	2	126	13	..	1	8	..	28	1	25	6	217	23	47	30	14	18	34	..	..	—	—	—	—	—	—	—	—

Abstract of Medical Examinations of Eighteen Villages, Irrigating from the Suharunpore or Eastern Jumna Canal, in the Centre Division, of which Nine Villages are within half a mile of the Canal, and Nine Villages are at a greater distance.

Situation.—Villages.	Children of all Classes.		Adults.																Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below the Surface of Ground.	Detail of Sizes of Enlarged Spleens.						Annual Average Amount of Canal Irrigation.			Average Annual Amount of Irrigated Rice.
			Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.														Tor.	Daul.	Total.	
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.		Beegas.	Beegas.	Beegas.	Beegas.
Within half a mile of Canal:—																																
Bhynswal	4	16	1	2	7	4	..	..	1	2	1	..	2	..	12	8	40	35	30	60	7	..	..	2	12	10	24	2,108	289	2,397	542
Khyle	2	18	2	..	3	7	..	..	1	..	..	2	4	1	10	10	60	45	40	70	6	..	2	4	18	4	28	779	58	836	249
Kheree Gudhai...	3	17	1	..	8	3	..	..	1	1	1	3	1	1	12	8	85	65	15	62	3	..	..	2	15	8	25	485	3	488	143
Manukpoor	6	14	2	3	7	..	1	..	..	..	1	4	2	..	13	7	75	65	35	52	8	..	..	1	12	8	21	371	87	458	130
Berkheree	6	14	1	..	1	..	..	..	..	1	1	..	8	8	11	9	50	65	40	57	8	..	1	5	7	10	23	230	65	294	143
Poojna	6	14	2	..	5	4	..	..	1	1	3	1	3	..	14	6	50	45	15	50	9	..	..	2	8	10	20	242	57	299	74
Munowra	5	15	1	..	10	3	..	..	..	..	2	..	3	1	16	4	70	50	30	47	9	..	..	..	9	10	19	370	23	393	104
Abba	6	14	1	1	..	..	6	4	..	4	1	1	1	1	9	11	50	40	5	62	11	..	2	5	10	8	25	455	32	487	159
Anutmhow	1	19	..	..	7	7	..	..	1	..	2	1	2	..	12	8	90	80	65	68	7	..	..	5	14	8	27	491	116	607	208
Total	39	141	11	6	48	28	7	4	5	9	12	12	26	12	109	71	63	54	31	59	8	–	–	–	–	–	—	—	—	—	—
District more than half a mile from the Canal:—																																
Mundait	2	18	1	..	7	7	..	..	..	..	..	..	4	1	12	8	35	35	25	65	20	..	..	6	16	4	26	503	145	648	121
Mulhendee	8	12	2	..	11	2	..	..	1	..	1	1	2	..	17	3	50	40	25	37	14	..	1	3	5	6	15	38	17	55	..
Papuree	1	19	1	..	..	..	9	7	..	..	1	..	1	1	12	8	55	65	35	67	11	..	..	5	12	10	27	592	20	613	252
Teetroon	8	12	2	..	7	1	1	..	2	2	3	..	..	2	15	5	75	45	25	42	16	..	..	3	4	10	17	600	13	613	45
Teekrowl	4	16	2	..	10	2	..	..	1	1	1	1	2	..	16	4	85	60	30	50	11	..	1	3	8	8	20	1,530	80	1,610	523
Hingowli	5	15	2	1	5	3	..	..	..	2	1	1	4	1	12	8	60	55	35	57	17	..	..	1	10	12	23	329	55	384	..
Dhakaday.........	8	12	1	1	9	2	2	..	..	..	1	..	4	..	17	3	55	55	20	37	18	..	..	..	5	10	15	117	..	117	78
Sejour	3	17	..	..	2	1	10	..	..	..	2	1	2	2	16	4	50	65	50	52	11	..	..	1	11	9	21	496	143	639	201
Kunjowlee	15	5	..	1	..	..	11	2	..	..	1	..	5	..	17	3	70	60	35	20	12	..	..	..	3	5	8	160	108	268	78
Total	54	126	11	3	51	18	33	9	4	5	11	4	24	7	134	46	60	53	33	47	14	–	–	–	–	–	—	—	—	—	—

Abstract of Medical Examinations of Fifteen Villages, &c., under various circumstances in the Northern Division of the Suharunpore, or Eastern Jumna Canal.

Circumstances.—Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials, &c.		Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water from Surface of Ground.	Detail of Size of enlarged Spleens.						Annual average Amount of Canal Irrigation.			Average Annual Amount of irrigated Rice.
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.	Tor. Beegas.	Daul. Beegas.	Total. Beegas.	Beegas.
Irrigating within half a mile of Canal:—																															
Reeree	7	13	3	..	8	3	..	..	1	..	3	..	2	..	17	3	55	65	25	40	3	..	..	1	6	9	16	436	72	508	56
Rutnakhera	13	7	..	1	5	2	..	..	..	..	7	1	3	1	15	5	40	55	25	30	9	..	..	..	5	7	12	82	10	92	15
Manickmhow ...	12	8	4	..	5	1	..	..	1	..	3	2	3	1	16	4	25	35	5	30	12	..	..	..	6	6	12	403	123	526	148
Rundole	17	3	1	..	4	1	..	..	2	..	8	1	3	..	18	2	10	50	55	12	7	..	..	1	2	2	5	643	86	729	413
Kulsea	19	1	3	..	8	..	..	..	3	..	..	..	5	1	19	1	10	15	10	5	8	..	..	..	1	1	2	..	..	..	..
Raipoor	19	1	5	..	4	..	2	..	1	..	5	..	3	..	20	..	20	15	45	2	..	..	..	..	1	..	1	52	3	55	..
Total	87	33	16	1	34	7	2	..	8	..	26	4	19	3	105	15	27	39	27	20	8	—	—	—	—	—	—	—	—	—	—
Irrigating distant more than half a mile from Canal:—																															
Nowabas	11	9	..	..	13	1	..	..	1	1	2	..	2	..	18	2	55	40	40	27	9	..	..	..	3	8	11	272	180	452	117
Hurpal	12	8	..	..	..	..	5	1	5	1	6	..	2	..	18	2	40	70	30	25	16	..	..	1	4	5	10	41	18	59	6
Suhujwa	17	3	4	..	10	..	..	..	1	..	..	..	4	1	19	1	10	25	10	10	11	..	..	..	..	4	4	99	183	282	14
Beetia	15	5	2	1	7	2	..	..	..	1	4	..	3	..	16	4	60	60	20	22	18	..	..	..	3	6	9	3	..	3	..
Suharunpore ...	31	29	4	1	7	6	5	2	8	1	13	4	7	2	44	16	33	45	40	38	8	..	3	5	20	17	45	..	..	..	..
Behut	18	2	..	..	2	1	7	..	4	1	3	..	2	..	18	2	25	40	40	10	18	..	..	..	1	3	4	41	4	45	..
Total	104	56	10	2	39	10	17	3	19	5	28	4	20	3	133	27	37	47	30	22	13	—	—	—	—	—	—	—	—	—	—
Unirrigated near head of Canal:—																															
Nyashuhur	19	1	1	..	6	..	1	..	..	..	8	..	4	..	20	..	25	30	10	2	..	..	..	..	..	1	1	..	..	..	..
Tanda	20	..	..	..	6	..	..	..	..	..	3	..	11	..	20	..	35	40	30	..	..	..	..	..	..	..	..	..	..	..	..
Fyzabad	15	5	2	..	6	..	..	..	2	..	3	1	6	..	19	1	45	60	40	15	..	..	..	..	3	3	6	..	..	..	..
Total	54	6	3	..	18	..	1	..	2	..	14	1	21	..	59	1	35	43	27	6	—	—	—	—	—	—	—	—	—	—	—

Summary or General Abstract of Medical Examinations.

—		Percentage of Enlarged Spleens. Adults and Children of all Classes.	Percentage of Adults having suffered from Fever in 1844.	1845.	1846.	Average Depth of Water from Surface of Ground. Feet.
Irrigated from the Western Jumna Canals:—						
Delhi Branch	Within half a mile of the Canal	58	51	45	41	11
	Distant more than half a mile	49	51	49	40	18
Rohtuk Branch	Within half a mile of the Canal	44	47	38	27	28
	Distant more than half a mile	29	34	34	27	48
Bootana Branch	Distant more than half a mile	16	41	36	22	102
Hansi Branch	Within half a mile of the Canal	39	50	41	22	92
	Distant more than half a mile	18	40	31	16	118
Irrigated from the Eastern Jumna Canals:—						
Northern Division	Within half a mile of the Canal	20	27	39	27	8
	Distant more than half a mile	22	37	47	30	13
Centre Division	Within half a mile of the Canal	59	63	54	31	8
	Distant more than half a mile	47	60	53	33	14
Southern Division	Within half a mile of the Canal	25	48	40	17	24
	Distant more than half a mile	18	47	30	14	34
Irrigated from wells in the high land of the Doab		8	37	31	20	24
Unirrigated:—						
Sikh States	Connected with the Canal	44	47	52	26	—
	Unconnected with the Canal	29	43	61	30	—
Delhi Territory	Unconnected with the Canal	11	32	28	11	88
Northern Doab	High or Bangor land	3	32	30	13	46
	Ganges Khadir	21	41	42	28	25
	Near head of Eastern Jumna Canal	6	35	43	27	—
Naturally malarious localities	Nujufgurh Jheels	44	42	59	57	15
	Valleys of Jumna and Hindun	34	46	42	31	14

Appendix E.

Abstract of the Medical Examinations, affording the principal data for the foregoing Report.

The recorded numbers of natural and enlarged spleens may be received as representing authentic facts.

The percentage of sufferers from fever in the several years is deduced from the records of oral testimony collected by the Committee, and may possibly in many instances be not strictly correct. It is hoped, however, that in the general averages will be found an approximation to the truth, and the means of comparing with tolerable certainty the salubrity of different years.

The depths of water from the surface of ground were ascertained by actual measurement, and the information regarding the extent and nature of canal irrigation was furnished by the superintendents of the respective canals.

Explanation of the headings, used in the subjoined Abstracts.

N. Natural or healthy spleen.
E. Enlarged spleens.
VL. L. &c. Sizes of spleens as in Appendix C.
Tor irrigation is where the water flows naturally over the soil as distinguished from
Daul irrigation, where the water is artificially raised to the level of the ground.
The areas of irrigated land are stated in beegas of 3,025 square yards, 640 beegas being equal to one square mile.

Appendix F.

Measures connected with the Execution and Management of the proposed Ganges Canal, alluded to in paragraph 15 *of the Report, as deserving the attention of Government.*

The Committee would recommend as follows:—

1st. That the Ganges Canal be kept as much as possible within soil, *i.e.*, that its ordinary surface level should be below that of the country.

2nd. That earth wanted to complete embankments, be never obtained from excavations made outside of the canal, except in such localities as will readily admit of drainage.

3rd. That the canal and its branches be taken as much as possible along the water-shed line of the country, so as not to interfere with drainage, and in all cases where such interference may be unavoidable, that the executive office be instructed to provide otherwise for the drainage.

4th. That masonry drains be constructed under Rajbuhas or Bridge Ramps, whenever these cross the drainage of the country.

5th. That no private watercourses be allowed, but that irrigation be practised exclusively from Rajbuhas or main watercourses.

6th. That irrigation be prohibited within five miles of a military station and within one or two miles of large native towns.

7th. That in clearing embankments, the grass, weeds, &c., be not suffered to rot on the ground, but that they be burned as soon as possible after they are cut.

8th. That irrigation be altogether prohibited in localities which appear naturally to possess a malarious character.

The Committee are aware that the adoption of the measures above recommended would involve an expense not contemplated in the original estimates for the Ganges Canal.

(Signed) W. E. Baker, *Major, Engineers, and President.*
(Signed) T. E. Dempster, *Surgeon, Member.*

Appendix G.

Comparative Abstract showing the Ratio of Population to Area in certain Irrigated and Unirrigated Districts of the North-Western Provinces.

Name of Collectorate.	Number of Villages.	Aggregate Area in Beegas of 3,025 Square Yards.	Aggregate Population.	Population per Square Mile.	Average Population per Square Mile.
Irrigated from Canals:—					
Paniput	96	329,947	74,360	231	317
Delhi	49	101,472	33,754	341	
Rohtuk	52	221,262	60,007	278	
Hissar	35	224,563	11,485	54	
Mozuffernuggur	15	23,195	15,406	680	
Irrigated from wells:—					
Mozuffernuggur	100	118,856	57,665	497	—
Unirrigated:—					
Paniput	29	61,194	12,320	206	165
Rohtuk	61	373,531	59,895	164	
Hissar	40	323,207	16,014	51	
Mozuffernuggur	73	95,416	22,189	238	

This Abstract is referred to in paragraph 19 of the Report.

(Signed) W. E. Baker, *Major,—President.*
(Signed) T. E. Dempster, *Surgeon,—Member.*

Appendix H.

Abstract of some of the principal facts recorded in the Report of a Medical Committee appointed in the Government of Madras to investigate the causes of an epidemic fever which prevailed in the Provinces of Coimbatore, Dindigul, Madura, and Tinnevelly, during the years 1809, 1810, *and* 1811.

The soil of Coimbatore is in general dry, but there is no want of extensive tanks. In the vicinity of the Hills is much low marshy ground, and many villages in such situations are proverbially unhealthy. On the whole, the Coimbatore country may be called healthy in common years.

Dindigul is a mountainous and woody country, encompassed by high lands, and more or less covered by jungle of prodigious height. Climate stated to be proverbially healthy in common years.

Madura is a more open and less mountainous country than Dindigul; it is hotter in the hot season and not quite so cold in the months of December and January. The climate of this district, in common seasons, cannot by any means be considered unhealthy, although the fort has been so for several years, and before the epidemic prevailed. Like most mountainous countries in the torrid zone, Madura has situations where fever never fails, at certain seasons, to be endemic; but the disease does not generally spread beyond these localities. There are some villages close to, and amongst the hills, lying in the most western parts of the province, in which, in the months of March and April, no man can pass a single night without suffering an attack of fever soon after. Both the houses and clothing of the inhabitants are of a very inferior description.

Tinnevelly is considerably lower than any of the other provinces in which the epidemic prevailed; it may, in the strictest sense, be called an open country; as few hills are to be found in it, and those are isolated or detached. It contains several waste and jungly tracts, especially towards the east. There are also, here and there, extensive low and marshy lands in the vicinity of the mountains, &c. Situations at a certain distance from the hill, are higher and drier than those which are nearer to them. Culpettie, standing in a fine elevated country, was comparatively comfortable and healthy, whilst Tewancootshie, due west from the former and close to high land, was found nearly surrounded with wet ground, damp, ruinous and almost depopulated. Towards the southern and eastern extremity of the peninsula, there are many salt marshes, formerly distinct from each other, but four of them now (date of report) joined together, owing to recent inundations. They are separated from the sea by high sand hills, and have no natural communication with it. In common years there is not much water collected in them, but since the heavy monsoon of 1810, and especially since the rains which fell in February and March, out of all season, they have been filled to a depth of 5, 7, or 10 feet, and the water by remaining long in a state of stagnation has been productive of infinite mischief. In December, 1810, the inhabitants of villages near these salt swamps (ten or twelve in number), complained that their houses were rendered uninhabitable, their lands flooded, and that water had risen so high on their Palmyra trees that they were unable to draw the "Toddy." The valley of Courtallum, however delightful its climate in June, July, August, and September, is far otherwise in February, March, April, and May; it partakes of both monsoons, and from its singular topographical position is, in a great measure, deprived of the salutary influence of the southerly winds. At the last-mentioned period, it is close, hot and sultry in the greatest degree, and never fails to be most unhealthy. Endemic fever, at such times, is as certainly met with here, as at Gambia or Senegal. On the whole the epidemic fever has raged with the greatest violence in Tinnevelly.

General Causes—Believed to be unusual and irregular seasons. Several remarkably dry seasons (themselves healthy), followed by seasons in which an unusual quantity of rain fell, prevailing winds blew with less regularity. Many cattle died, as much from an unnatural state of the atmosphere, as from a want of hands to feed and take care of them.

Progress.—The epidemic was first noticed in certain places close to the hills, marshy and proverbially unhealthy; and afterwards spread over tracts naturally drier and more healthy. Certain parts of the Madura Collectorate near the sea, or rather further removed from the range of mountains, escaped the disease altogether; with the exception of the inhabitants in the vicinity of a salt marsh. Tinnevelly appears to have been last in suffering from the epidemic. The fever invariably proved most destructive in those villages nearest the hills, in villages standing low, or in the vicinity of marshy lands, and among the poor ill-fed and badly-lodged population.

The disease, which proved so fatal in the southern provinces, does not differ from the common endemic of the country, which, at certain seasons, and in particular situations, may be every year met with. Its having been rendered epidemic on the present occasion, is altogether to be ascribed to the causes already mentioned.

(Signed) W. E. Baker, *Major*,
President.

(Signed) T. E. Dempster, *Surgeon*,
Member.

APPENDIX I.

From A. KEIR, *Civil Surgeon, Ajmeer, to* Major W. E. BAKER, *President Canal Committee.*

SIR,— *Ajmeer, 18th January,* 1847.

I have the honour, in reply to your letter, No. 886 of 1846–47, under date the 11th December last, to submit the following observations, as the result of the inquiries I have made regarding the effect of irrigation practised in this district upon the health of the cultivators.

In the first place, relative to the expression made use of in your communication, " extensive irrigation," I would beg to remark that it seems applicable rather to denote the condition of the district *as it now is*, with reference to its former unimproved state before coming under Major Dixon's management, than the actual amount of *irrigated* as compared with *unirrigated* land to be found within its limits.

External Feature of the Country.—Characteristic of this part of the country generally, and of the Ajmeer district in particular, are the numerous ranges of rocky hill which give a bold and rugged aspect to the scenery, but which tend in no less degree to modify the soil and its productions. From these hills come down numerous small streams, the channels of which remain dry during a great part of the year, but speedily fill after a heavy fall of rain. It is by taking advantage of the water thus poured upon the ground, by making embankments, and so laying it under contribution, that some degree of fertility is imparted to a district otherwise of a highly unpromising and unfruitful description. Wonderful, indeed, and pleasing is the change which has been effected by such means. The waste has been subdued in many places, and instead of a bare, barren-looking surface, producing only a few thorny shrubs, there is now to be seen a smiling sheet of cultivation ; and this extending year by year as the skill and industry of the people can be brought to bear on the work of improvement.

Geological Character of the Hills.—The hills of this district of country belong to the primitive formation. They consist principally of granite rock (granite and gneiss), quartz-mica, and hornblende schist; crystaline limestone is found in the valleys, but the crystals large and the stone of a coarse description. The materials composing the rocky masses are aggregated in every variety of way and proportion, and hence occurs a great diversity in the colour, aspect, and consistence of the different rocks.

Inclination of the Strata.—The general structure of the rocks is schistose, and the strata for the most part have a very high inclination. The dip varies exceedingly. Hereabouts it seems to be more often from west to east; but in other parts the opposite direction prevails. There can be no particular rule laid down in this respect, as regards the lakes or reservoirs for irrigation. These are found on one side of the hill as well as the other, and in the valleys between different ranges. Without minute investigation, the direction of the strata may generally be judged of by the appearance of the hill, the steep abrupt face showing the broken termination of the strata, the opposite more inclined face indicating their direction upwards. In many places the strata seem perpendicular to the surface, or very nearly so.

Soil and its Qualities —The soil of the district is composed of the *débris* of these different rocks. It is in a large part silicious; but mica abounds in it, and also felspar. The latter ingredient, washed down by the nullahs, exists abundantly in the beds of talaos or tanks, and there gives a clayey consistence to the soil. A " light reddish loam " may perhaps be the appellation most generally applicable to designate the character of the soil. Tried with acids it effervesces tolerably freely. A correct analysis, however, I am not prepared to offer. Calcareous earth is very abundant in some situations, particularly so along the margins of nullahs, where it exists in the form of " kunkur," mixed with other gravelly matter. The proportion of material of vegetable origin is not in general great. Hence the practice of " manuring " is one diligently followed, and the crop in general rises in proportion. Indeed, without " manuring " there is little to be got from a soil so naturally poor. An exception is to be found in this respect in the beds of " talaos," where, from the washings of the stream, there is a rich alluvial deposit, and where, in consequence, excellent crops are raised independent of manure. The ground so favourably situated, however, forms but a small space. The salts which seem most to abound in the soil are those of soda, the muriate and carbonate in particular. In some parts the effervescence on the surface is very abundant, and this has sometimes an alkaline and sometimes a strongly saltish taste. Dr. Irvine remarks that the quantity of potash in the soil, comparatively with the quantity of decomposing felspar and mica, is small.

But not only is the soil poor as respects the proportion of fertilizing ingredients, it is likewise, over a considerable part of the district, deficient as to quantity. The nearness of the rock to the surface may in general be guessed at from its coming into view every here and there. In some places there appear round or tabular masses of rock ; in others sharp spinous looking ridges. These latter are generally of quartz, and indicate the direction of " dykes or veins ;" the material from its hardness having withstood the action which has disintegrated and decomposed the softer rocky masses around.

Country adapted for Tanks.—Happily, a country of this description is well adapted to illustrate what may be done for its improvement by artificial means. The materials are on the spot, and by means of embankment way even the smallest stream can be made to produce its full fertilizing influence upon the soil. To discern the places where embankments may be most fittingly raised requires considerable skill. But an eye accustomed to such observations will detect the ground where the water may be most easily retained, and where the work can be most advantageously undertaken.

Embankments, their Uses.—The object of the embanking process is not merely to have a body of water that may be run off for the purposes of irrigation. This, though a legitimate end in many situations, is not always attainable. A tank, although it holds water only for a certain period of the year, may still serve a useful purpose by its effects in diffusing moisture throughout the neighbouring soil, and which may thus be rendered fit for cultivation. Some of the richest looking cultivation in the district is to be seen immediately along the margins of the tanks, and, progressively, in its bed as the waters recede. Another grand object, and the primary one in many cases, in the formation of these tanks, is the replenishment of the wells. Very many of the wells in this district would completely fail in bad seasons, or yield a most insufficient supply, except for the influence they derive from the neighbourhood of tanks: and here may be seen the admirable beauty and utility of such works, and the inestimable benefit they confer in a district of country where the fall of rain is frequently scanty and at all times precarious. The water, whatever the season supplies, is kept as in a stone house. It may sink into the earth; but can be again drawn forth and poured upon the surface, which thus becomes fertilized in the time of need.

Wells.—The wells, as to quantity of water and its distance from the surface, will of course vary with the state of the tank, at least all those so situated as to be affected by tanks. After a season of plentiful rain like the past, the water in most of the wells is abundant and moderately near the surface. From 30 to 40 or 45 feet* may be about the average depth at which water is obtained, but in this there is considerable variety according to situation and other circumstances. When the rains have been scanty, the supply in the wells is also apt to be scanty, and may fail during the hot weather. With the ground so saturated as it is now there need be no apprehension on this point. Even a season of "drought" ensuing after one like the past would be but partially felt.

Water of the Wells and Tanks, the Difference.—There is a considerable difference in the chemical proportion of the water as taken from wells or from tanks. The tank water is generally much less impregnated with salts, and therefore preferable for domestic purposes and most agricultural ones; so much so is this the case, that in many parts the villages may be seen to use the muddied "tank water" in preference to that from the wells. Where the soil contains a large amount of salt, the well water becomes *entirely* unfit for irrigation. This is the case in some parts of the Ramsir district, where the salt effloresces abundantly on the surface. The evil is corrected in some degree by the use of tank water, and but for this the extensive khêts to be seen in that neighbourhood could have no existence. Some crops, however, as the barley, suffer less from this saline impregnation. At the station of Nusseerabad, from the want of tank water, little or nothing can be done in the way of cultivation. Gardens there are next to useless, and the best efforts lead but to disappointment. At Ajmeer, and this neighbourhood generally, the case is different. The well water is good, and answers for irrigation.

Re-agents, effects of, with the Water.—Water entirely free from saline impregnation is not to be found either in the wells or the tanks. From the water of all the wells I have examined the nitrate of silver throws down a copious precipitate. The "Ana Sagur" water, which is that of the lake, gives a precipitate, but very much fainter. In other parts of the district I have observed the same difference in relation to tank and well water. The oxalate of ammonia gives a distinct precipitate with the "well water" of Ajmeer, but there is none with that of the lake. Solution of pure potass causes a faintish precipitate with the well, but not with the lake water. The nitrate of barytes causes a precipitate with the well, but not with the tank water.

Irrigation, its Effects as to the Health of Cultivators.—As to the effect of the irrigation practised in this district upon the health of the cultivators, information will be best gathered by a reference to the result of my inquiries on that point contained under the head marked B. The investigation was carried on by myself on the spot, and in the manner directed. Taking the results obtained as affording a criterion by which to judge of the healthiness of the cultivators throughout this district, it certainly leads to the conclusion that irrigation, as here practised, is not in any high degree injurious. The sufferers from spleen are chiefly children. As regards European children, particularly young children, I may remark that the climate of this part of India, as far as my experience goes, is not the most favourable. To my questions on the subject of fever, I found it difficult, I may say impossible, often to obtain precise answers. Whether from wilfulness or forgetfulness, the latter I believe most generally, there seemed very often no distinct recollection on the part of individuals as to whether they had suffered from attacks of fever in previous years or not. On this subject a good many mis-statements may have been made. The probability is, that when there was an indistinct recollection as to the occurrence of fever, it could not, in such cases, have been of a serious or debilitating kind.

Cultivators, their Healthy Looks.—To form a judgment as to the health of the inhabitants from their looks and appearance there was the best evidence everywhere that they were far from an unhealthy race. Indeed, in few of the villages visited could I make out any considerable amount of disease. Among the most common complaints were chronic skin diseases, rheumatism, old and indolent ulcers. A good many *prematurely* old looking persons were to be found, but there is more reason to believe this a consequence of hard work and indifferent food than any effect on their constitutions produced by the climate or soil.

Questions as to Effect of Irrigation.—I made inquiries on many occasions, as to whether, with the increase of irrigation, there had been observed any increased amount of sickness. The reply was uniformly in the "negative." So much more, amongst them, does consideration attach to "plenty" than to health, that the inquiry seemed to be looked upon as a highly absurd one.

* I have not noticed the depth of water in the wells. I did not observe this was required till after visiting the villages. Here 30 feet water at depth of 30 feet, which may be near the average of permanent as distinguished from temporary wells this year.

The circumstances under which the irrigation is practised, and which tend to render it so little hurtful, I conceive to be chiefly the following:—

General Nature of the Climate; the Villages, how situated.—The climate is essentially a dry one, and at the same time salubrious. The villages, in respect to the irrigated land, are almost invariably high in point of situation. For the most part they rest on the slope of a hill, either near its base or on the steep itself; or they extend along some rocky ridge. The village of Ramsir, for instance, situated as it is with a lake on one hand (and this apt to dry up in some seasons), and a freely irrigated country on the other, might certainly, from its position, be looked upon as a very *focus* in respect to malaria, yet still, as far as inquiry enabled me to find out, no great unhealthiness appears to prevail. What, in the main, conduces to this favourable, and, so far as appearances go, unexpected state of things, is, I doubt not, the situation of the village, high and dry and upon a rocky ridge. The elevation of the ridge is inconsiderable, but still the houses built upon it may be considered well placed, and in some degree removed from the immediate influence of the soil.

Nature of Crops irrigated.—The most sickly time of the year is the month of October; and during this month and early in November the days are hot, and the atmosphere contains much moisture. Besides this, I believe, that the newly-upturned and newly-irrigated soil is the most apt to give forth noxious exhalations. The *after irrigation*, provided the fields be kept free of weeds, as they are here, has little, if any, injurious effect. The fields regularly irrigated are those of the wheat and barley, and the work goes on with little intermission until February. Irrigation is practised for other crops, at different seasons, but to a trifling extent only.

The Soil as affected by Irrigation.—The circumstance chiefly operative as regards the health of the people employed in irrigation in this district, I conceive to be the "absorbent nature of the soil." The underlying rocks, too, have a highly absorbent character, and hence water poured upon the surface sinks into the earth speedily. It is owing to this property of the soil that the clothing of herbage is everywhere so scanty. Soon after the first early rain the grass springs up, and the dry, burnt-up waste becomes overspread with *green*. When the rain has ceased, or very soon after, a change in the appearance of the scene takes place. The surface becoming dry, the more delicate grasses wither, and nothing has a thriving aspect but the wild shrubs and bushes such as the "ah," the kunserah, the "kenail," &c., which delight in a barren soil. Trees, when they have once struck their roots deep into the earth, and can draw from it moisture for their own support, thrive well, but, until they have arrived at this stage of growth, require much care and tending. Hence so few are to be seen, and those only in the vicinity of villages.

Inclination of the Surface; stagnant Water.—It is easy to understand why a soil of this kind should be less injurious under the influence of irrigation than one of a different description, where the vegetation becomes more luxuriant, and where, at certain times, it is liable to decay and decomposition. Another favourable circumstance as regards this district is the little disposition of water to stagnate. The ground being inclined more or less in all parts, water runs freely, and, conducted into a tank, is in the condition least of all likely to have any prejudicial effect. It is only in the immediate vicinity of Ajmeer itself (at the Daulut Baugh, and in front of the magazine), that I have observed any ground covered by water in a stagnant state, and in a state likely to give forth unwholesome exhalations. From the overflowing of the Ana Sagur Lake this was partly unavoidable, during the rains at least, but the evil has been allowed to exist long after the remedy, the simple one of draining, might have been applied. That this state of things has produced the great amount of fever that has prevailed in the town the last season, I am not prepared to say: but it may have had some effect. Other apparent causes exist; and the season, moreover, has been generally an unhealthy one, although not so, in a great degree seemingly in the smaller villages of the district.

Swamps and Marshes.—One point on which information is desired is as to the amount of ground in a state between "dryness and moisture." Of natural swamps or marshes there are none, so far as I know, in the district. A few swampy spots there may be after heavy rains, but not such as to give any cause for apprehension. The condition of the Ramsir Lake I have not observed at all seasons: some portion of its bed may possibly remain in the state of a swamp during the hot weather, but how much or in what *precise* condition, I am not able to say. The only *permanently* swampy ground I have observed has been immediately in the vicinity of tanks, and produced either by leakage through the bund, or by water finding its way by percolation underneath. The ground in this direction, so long as there is water in the tank, remains generally *moist*, and this term expresses its condition in most cases better than swamp.

The drying up of the tanks begins in the opposite direction, or towards the source of supply. When there is much clay in the ground, the surface becomes hard, and *cakes* as the water gradually recedes. When there is a due proportion of vegetable mould, the soil here is of the best description, and affords the richest cultivation.

Drying up of Tanks.—It is when lakes are in a process of drying that they are most likely to be injurious by giving out malaria. When there is plenty of water in the Ana Sagur Lake, no place is more desirable as a residence than the bund; but it is not so in particular seasons when a large portion of the bed of the lake has dried up. Most of the other lakes in the Ajmeer district are small in comparison, and injurious consequences from this source need not be apprehended.

(Signed) A. Keir, M.D., *Civil Surgeon.*

ABSTRACT of Medical Examinations referred to in the foregoing Report.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Hindoo Cultivators.		Mussulman Cultivators.		Bunnias.		Artisans, &c.		Menials.		Totals.		Percentage of enlarged Spleens.	Depth of Water below Surface of Ground.	Detail of Sizes of enlarged Spleens.						Percentage of Adults having suffered from Fever in		
	N.	E.	N	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.		Feet.	VL.	L.	M.	O.	S.	Total.	1844.	1845.	1846.
Tabeejee	17	3	4	1	5	1	..	..	5	..	1	..	2	1	17	3	15	30	..	..	..	..	6	6	5	20	30
Ramsir	17	3	..	1	2	1	6	2	6	..	1	..	1	..	16	4	17½	5	..	..	..	1	6	7	..	45	35
Dubreila	19	1	1	..	14	..	..	..	2	..	2	..	..	1	19	1	5	25	..	..	..	1	1	2	20	10	25
Neepoolie	20	..	..	..	18	..	..	..	2	..	..	..	..	..	20	..	..	12	..	..	..	..	..	..	5	5	5
Saproonda	18	2	..	..	9	2	..	..	1	1	2	..	5	..	17	3	12½	25	..	..	..	1	4	5	5	5	20
Teharie	14	6	2	1	6	1	..	..	5	3	..	1	1	..	14	6	30	5	..	..	..	1	11	12	30	25	5
Jalowrie	17	3	..	..	3	1	10	4	..	..	..	..	1	1	14	6	22½	..	..	..	1	3	5	9	20	75	90
Nareillee	12	8	..	..	16	..	..	..	..	..	..	..	4	..	20	..	20	15	..	..	..	3	5	8	..	15	25
Googra	18	2	..	..	18	2	..	..	..	..	..	..	..	..	18	2	10	12	..	..	..	1	3	4	..	5	15
Akhurrie	13	7	..	..	11	2	..	..	1	..	..	..	4	2	16	4	27½	25	..	..	3	2	6	11	..	35	45
Chacheawas	18	2	..	..	12	1	..	..	1	..	..	..	4	2	17	3	12½	28	..	..	..	..	5	5	5	10	20
Mohurwatee	17	3	..	..	10	1	1	..	5	1	1	..	..	1	17	3	15	..	..	..	..	1	5	6	5	10	10
Boorhee Pokhur	16	4	..	..	16	2	..	..	..	..	1	..	1	..	18	2	15	17	..	..	1	3	2	6	..	15	15
Sirhadana	17	3	2	..	9	3	..	..	2	1	..	..	1	2	14	6	22½	20	..	..	..	..	9	9	5	20	35
	233	47	9	3	149	17	17	6	30	6	8	1	24	10	237	43	16	18	..	..	..	–	–	—	7½	21	27

[True Abstract.] (Signed) W. E. BAKER, *Major, and President.*

APPENDIX K.

From N. COLLYER, Esq., *Assistant Surgeon Mhairwara Local Battalion, to* Major W. E. BAKER, *President Canal Committee.*

Dated Beawr, 4*th February,* 1847.

SIR,

I have the honour to forward for your information the accompanying statement of an examination of twelve villages conducted by me in accordance with the prescribed form contained in your letter, dated 11th December, 1846; and I beg to state that for the purpose of investigation I have selected those villages which have the largest tanks and the most extensive irrigation. I am sorry to state that I have not succeeded in procuring the full complement of children, from their parents having taken them away into the jungle at hearing of my presence, being influenced, I suppose, by fear or prejudice through ignorance of the cause for which I required their presence. I trust, however, that the number of children contained in my report, will be found sufficient to indicate the general healthiness of the district and its freedom from ague and spleen.

The general character of the cultivated soil in the immediate vicinity of the hills is of a dark, rich, loamy description, and very productive. It consists of disintegrated mica, schist, and felspar, combined with decomposed vegetable matter and salts of alumina, silica, and potash, with oxide of iron. In other parts it is of a lighter kind, and abounds with aluminous and cretaceous marls. It is of a highly absorbent nature, the surface of the land quickly becoming dry after the heaviest falls of rain. The surface of the irrigated parts inclines naturally from the bed of the tulao.

The rain crops consist of bajra, til and moong with moth, and are sown without manure in June, and likewise mukka, tobacco, and cotton, which are manured.

The rubbee cultivation commences at the end of October, and consists of wheat, barley, gram, sursoo, and opium; and such as are irrigated, if they escape the severe frosts and hail storms, yield a plentiful crop. Irrigation commences in November, and is continued until the end of February or beginning of March.

On the secession of the water the land is ploughed up as soon as it can be worked, and sown with the rubbee crop until the 15th of December. Such portion of the bed of the tank as becomes available for cultivation is sown during the months of February, March and April, with mukka. Thus the inconveniences likely to arise from the gradual drying up of the soil is obviated by its being immediately sown with corn. In view to increase the subsistence of the people, the water-rut is freely cultivated on the surface of various of the tulaos, and without any apparent detriment to health. Moist swampy ground abounding with a variety of coarse grasses, and covered with a saline efflorescence (impure sub-carbonate of soda) prevails very generally on the rear of the embankments of all the tulaos.

The diet of the inhabitants consists chiefly of barley and mukka with dal of moth, moong, lobya and oorud ; they are clothed in coarse cotton cloths, and appear very cheerful and contented.

It is a characteristic of the Mhairs that they always locate their villages on heights ; hence in a measure may be attributed their general good health.

From about the 15th January to the end of September the prevailing wind is from the south-west. During this period it generally blows strong and steady. During the remaining portion of the year, should any wind blow, it is from the east.

The hills in Mhairwara are all of the primitive formation, and embrace all the varieties of rocks usual under such circumstances : they are principally formed of granite, having separate beds of mica, quartz, felspar with hornblende, and veins of granular limestone ; gneiss is in great abundance, and is used for slabbing the roofs of houses.

The depth of the soil varies greatly in different situations. It is formed of the *débris* of the hills, mixed up with decomposed vegetation. As a consequence, it is deeper in the valleys than on the slopes of the hills ; the greatest depth may be taken at 10 feet, while in other places it is restricted to a slight covering of only a few inches.

In conclusion, I would beg leave to remark that from the observations I have made, and from information I have gleaned from other sources, the impression on my mind is that hitherto no deleterious effects have arisen affecting the health of the inhabitants of Mhairwara either from the large bodies of water which have been collected by the tanks, or from the use of that water while being employed largely for the purposes of irrigation.

I have, &c.,

(Signed) N. COLLYER, *Assistant Surgeon,*
Mhairwara Local Battalion, in Medical charge.

ABSTRACT of Medical Examinations alluded to in the foregoing Report.

Villages.	Children of all Classes.		Adults. Brahmins, Fukeers, &c.		Adults. Hindoo Cultivators.		Adults. Mussulman Cultivators.		Adults. Bunnias.		Adults. Artisans, &c.		Adults. Menials.		Adults. Totals.		Percentage of Adults having suffered from Fever in			Percentage of enlarged Spleens.	Depth of Water below Surface of Ground.	Detail of Sizes of enlarged Spleens.					
	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	N.	E.	1844.	1845.	1846.		Feet.	VL.	L.	M.	O.	S.	Total.
Dilwara	20	..	1	..	8	..	..	..	2	..	4	1	3	1	18	2	..	5	40	5	2	..	..	..	1	1	2
Bulhar	20	..	..	..	13	2	1	..	1	..	2	..	1	..	18	2	..	5	15	5	6	..	..	..	1	1	2
Purvrish	10	..	..	..	10	..	..	..	..	..	2	..	7	1	19	1	..	..	10	$3\frac{1}{3}$	..	..	..	..	1	..	1
Beawr	20	..	1	..	5	..	..	..	6	1	7	..	..	..	19	1	..	..	15	$2\frac{1}{2}$	18	..	..	..	1	..	1
Kullinjur	20	..	..	..	16	..	..	..	1	..	2	..	1	..	20	..	10	..	..	..	6	..	..	..	..	..	..
Gohanna	..	..	..	..	18	..	..	..	..	..	1	..	1	..	20	..	..	..	..	..	$7\frac{1}{2}$	..	..	..	..	..	..
Nurbudea Khera	17	..	..	1	12	..	..	..	..	..	1	..	6	..	19	1	..	15	..	$2\frac{2}{3}$	6	..	..	..	1	..	1
Dewanta	8	..	..	..	6	..	..	..	..	..	1	..	8	2	15	2	..	..	..	8	6	..	..	..	2	..	2
Jowaja	16	1	..	..	15	..	..	..	3	..	..	..	2	..	20	..	..	..	..	$2\frac{2}{3}$	$4\frac{1}{2}$	..	..	..	..	1	1
Loosanee	15	1	..	..	9	1	..	..	1	..	4	..	5	..	19	1	$2\frac{3}{4}$	..	..	$5\frac{1}{2}$	$4\frac{1}{2}$	..	..	..	1	1	2
Kabree	15	1	1	..	13	1	..	..	..	..	4	..	1	..	19	1	$2\frac{3}{4}$	$2\frac{3}{4}$	..	$5\frac{1}{2}$	$4\frac{1}{2}$	..	..	1	1	..	2
Kallee Konkur	11	..	1	..	6	..	..	..	2	..	1	..	9	1	19	1	..	$9\frac{2}{3}$	..	$3\frac{1}{4}$	9	..	..	..	1	..	1
	172	3	4	1	131	4	1	..	16	1	29	1	44	5	225	12	$1\frac{1}{4}$	3	$6\frac{2}{3}$	$3\frac{1}{4}$	6	..	..	–	–	–	–

[True Abstract.] (Signed) W. E. BAKER, *Major, and President.*

Dr. EXPENDITURE on the Canals West of the Jumna in Account

—	Original Work. RS. A. P.	Establishment. RS. A. P.	Current Repairs. RS. A. P.	Total. RS. A. P.
Previous to 1820	... ...	... ...	... ...	... ...
As per Capt. Blane's bills, from comt. to May 18, 1821	1,42,164 10 9½	52,264 9 11	5,319 13 7½	1,99,749 2 4
As per Captain Colvin and Tickell's bills, from 19th May, 1821, to 30th April, 1822	... ...	19,095 9 4	6,586 11 6	25,682 4 10
" " " 1822–23	... ...	27,612 15 6	9,303 2 3	36,916 1 9
" " " 1823–24	... ...	43,815 5 7⅓	6,743 10 6	50,559 0 1⅓
" " " 1824–25	... ...	53,381 2 5⅔	4,181 12 5	57,562 14 10⅔
" " " 1825–26	... ...	59,029 9 2⅓	4,580 4 5	63,609 13 7⅓
" " " 1826–27	4,141 10 0	64,484 13 2	6,830 12 5	75,457 3 7
As per Captain Colvin's bills of 1827–28	18,145 9 10	73,141 7 7	7,288 13 8½	98,575 15 1½
" " " 1828–29	... ...	74,216 1 1	9,661 9 1	83,877 10 2
" " " 1829–30	4,938 14 0	74,851 15 7	10,435 9 3	90,226 6 10
" " " 1830–31	... ...	77,121 1 1	16,252 14 2	93,373 15 3
" " " 1831–32	... ...	79,718 14 7	20,401 5 11	1,00,120 4 6
" " " 1832–33	... ...	82,242 5 7	22,959 8 5	1,05,201 14 0
" " " 1833–34	72,010 15 4	81,100 0 3	21,402 14 8	1,74,513 14 3
" " " 1834–35	90,278 8 8	77,646 8 4	36,165 5 3	2,04,090 6 3
" " " 1835–36	6,22,222 9 3½	78,949 5 0	25,657 8 6½	7,26,829 6 10
As per Lieut. Baker's bills of 1836–37	3,383 7 8	65,492 5 5	21,892 14 10½	90,768 11 11½
" " " 1837–38	31,743 2 1	58,727 7 2	34,804 7 4	1,25,275 0 7
" " " 1838–39	46,044 0 11	57,201 10 4	21,073 11 5	1,24,319 6 8
" " " 1839–40	5,562 14 0	54,855 13 10	27,758 0 8	88,869 12 6
As per Captain Baker's bills of 1840–41	31,181 1 7	57,066 8 5	25,785 11 3	1,14,033 5 3
" " " 1841–42	12,120 15 9	55,425 14 8	28,197 9 7	95,744 8 0
" " " 1842–43	25,115 14 0	53,104 15 11	43,915 4 5	1,22,136 2 4
" " " 1843–44	8,408 11 9	59,721 3 0	31,712 15 9	99,842 14 6
Total cost up to end of 1843–44	11,18,156 1 8	14,80,267 11 0⅓	4,48,912 7 5	30,47,336 4 1⅓
As per Captain Baker's bills of 1844–45	2,639 6 3	67,069 11 3	89,689 14 5	1,59,399 0 0
" " " 1845–46	17,184 0 5	68,238 1 4	62,559 2 4	1,47,981 3 11
" " " 1846–47	56,769 6 4	71,859 4 0	53,976 10 6	1,82,605 4 11
Total cost up to end of 1846–47	11,94,748 14 8	16,87,344 11 7⅓	6,56,138 2 8	35,37,321 12 11⅓

Dr. EXPENDITURE on the Dooab Canal in Account Current

	Original Work.	Establishment.	Current Repairs.	Total.
As per Captain Smith's bill from commencement to 31st December, 1830	3,11,239 12 4½	1,22,831 0 6	... ...	4,34,070 12 10¼
As per Captain Cautley's audited bills from 1st January to 30th April, 1830	... ...	3,924 12 0	... ...	3,924 12 0
" " " 1830–31	... ...	29,658 10 2¾	3,958 1 9 1/12	33,616 12 0⅜
" " " 1831–32	12,022 4 9¼	47,905 11 2½	4,476 0 9¼	64,404 0 9
" " " 1832–33	11,153 7 5	27,870 5 9	10,929 13 0½	49,953 10 2½
" " " 1833–34	19,370 13 10	31,767 14 5	20,517 13 0½	71,656 9 3½
" " " 1834–35	40,256 10 6	30,999 10 7	24,295 8 3½	95,551 13 4½
" " " 1835–36	36,583 7 0	29,870 1 11	24,234 8 0	90,688 0 11
" " " 1836–37	26,599 7 10	41,044 4 8	30,274 0 5½	97,917 12 11½
" " " 1837–38	8,744 8 10	32,727 8 0	24,909 11 5	66,381 12 3
" " " 1838–39	33,208 1 10	33,820 2 1	33,453 9 9	1,00,481 13 8
" " " 1839–40	1,138 14 6	33,462 7 10	40,518 8 4	75,119 14 8
Total cost up to end of 1839–40	5,00,317 8 10½	4,65,882 9 2¼	2,17,567 10 11⅛	11,83,767 11 11 1/12
As per Capt. Cautley's audited bills from 1840–41	25,168 5 8	34,479 2 0	34,642 5 1	94,289 12 9
" " " 1841–42	99,396 10 3	34,794 10 1	30,644 11 9	1,64,836 0 1
" " " 1842–43	10,609 4 9	33,971 13 9	37,740 2 7	82,321 5 1
" " " 1843–44	1,19,605 1 3	31,230 7 1	35,876 7 11	1,86,712 0 3
Total cost up to end of 1843–44	7,55,096 14 9½	6,00,358 10 1¼	3,56,471 6 3⅛	17,11,926 15 1 1/12
As per Capt. Cautley's audited bills from 1844–45	30,385 2 5	30,738 11 0	30,931 12 1	92,055 9 6
" " " 1845–46	11,427 0 0	33,900 10 8	34,054 2 6	79,381 3 2
" " " 1846–47	17,683 2 1	34,588 9 0	38,800 7 9	91,072 2 10
Total cost up to end of 1846–47	8,14,592 3 3½	6,99,586 8 9¼	4,60,257 12 7⅛	19,74,436 8 0 1/12

Current with direct Canal Revenue derived thereupon. CR.

Water-rent on Land Irrigation.	Rent on the Water-mills.	Rent on Cattle Watered.	Rent for Rafting Timbers.	Sale of the Canal Produce and all Sundry Rents.	Fines for Breach of Canal Regulations.	Total Direct Revenue.
RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
876 4 0	... ...	... ...	... ...	... ...	... ...	876 4 0
14,646 2 1	... ...	... ...	14 4 0	635 11 0	504 8 5	15,800 9 6
24,618 8 11	... ...	... ...	84 4 0	1,180 9 4	911 8 2	26,794 14 5
21,458 5 0	3,026 13 6,	... ...	... ...	741 7 11	1,039 2 10	26,265 13 3
36,015 6 1	6,868 10 0	... ...	... ...	656 0 10	1,882 3 8	45,422 4 7
26,646 9 7	3,964 5 4	... ...	... ...	545 7 7	1,082 8 8	32,238 15 2
48,374 6 9	2,991 3 11	... ...	... ...	370 9 9	2,423 4 4	54,159 8 9
33,975 0 0	3,682 13 2	... ...	500 4 0	713 13 11	3,283 1 6	42,155 0 7
34,160 14 7	11,676 10 9	... ...	1,013 1 10	1,460 13 9	4,471 1 9	52,782 10 8
52,952 10 7	16,267 0 6	3,772 10 8	1,187 1 10	1,289 8 8	2,847 6 2	78,316 6 5
53,375 0 0	19,786 3 0	3,568 7 10	1,932 10 4	1,142 15 4	2,801 12 4	82,607 0 10
57,700 0 5	19,464 0 0	2,968 12 2	2,132 8 4	1,265 4 8	2,508 9 6	86,039 3 1
51,016 4 11	19,002 3 7	4,210 9 7	2,061 15 0	2,127 7 0	2,463 2 10	80,881 10 11
65,804 11 3	19,238 2 3	3,396 2 5	1,611 8 7	2,651 2 11	3,410 4 5	96,111 15 10
1,48,783 2 6	13,882 4 6	1,257 3 11	2,950 1 6	3,894 6 11	6,064 11 3	1,76,831 4 7
1,14,065 8 3	18,294 9 9	1,669 6 7	3,238 9 5	3,682 2 10	4,303 2 10	1,45,253 17 8
1,10,602 11 3	22,837 3 7	2,145 15 6	1,993 9 0	4,957 11 9	2,603 13 4	1,45,141 0 5
1,53,176 15 1	26,894 10 5	2,197 1 7	3,365 0 0	2,245 6 0	2,930 5 3	1,90,809 6 4
2,72,377 13 5	5,782 0 9	760 3 6	6,048 9 5	5,221 8 8	9,480 8 9	2,99,670 12 6
1,89,644 15 3	9,732 7 10	1,838 15 3	8,228 11 4	6,171 4 2	5,783 12 0	2,21,400 1 10
2,24,382 15 3	14,566 8 3	2,286 13 2	6,579 5 1	4,822 14 10	6,188 2 2	2,58,826 10 9
2,25,817 15 3	9,524 0 6	1,955 13 2	9,730 4 3	5,481 6 0	6,077 13 0	2,88,587 4 2
2,63,068 13 0	8,203 14 3	1,554 1 8	11,505 15 3	5,607 3 7	4,632 9 6	2,94,572 9 3
2,79,300 10 11	9,882 11 9	1,172 5 2	7,934 14 9	6,756 12 3	6,218 1 0	3,11,265 7 10
2,60,555 8 9	12,598 13 0	1,680 4 9	5,570 12 6	4,827 5 2	5,760 14 3	2,90,993 10 5
27,93,397 5 1	2,78,167 6 7	36,434 14 11	76,837 6 5	68,449 2 10	89,672 7 11	33,43,804 11 9
2,31,022 8 9	8,220 6 3	2,979 7 2	6,598 10 8	5,149 11 1	6,341 3 2	2,60,311 15 1
2,60,693 13 2	13,250 7 11	2,293 3 3	7,830 0 4	7,056 0 1	7,753 4 6	2,98,876 13 3
2,62,529 13 8	14,709 15 5	1,687 0 0	6,799 9 1	10,167 10 4	6,991 2 9	3,02,885 3 3
35,47,643 8 8	43,394 9 4	43,394 0 0	98,911 10 6	90,822 8 4	1,07,758 2 4	42,05,878 11 4

with direct Canal Revenue derived thereupon. CR.

—	—	—	—	—	—	—
—	—	—	—	—	—	—
6,083 5 9	884 12 5¾	2 4 4½	... ...	592 15 3	730 0 3½	8,293 6 1¾
7,551 2 2	2,476 10 2	107 3 2	9 7 9½	606 6 2	1,209 0 8	11,959 14 1½
22,107 . 0 0	4,902 15 10¾	83 14 5	11 12 3½	665 7 7½	1,075 13 0	28,846 15 2¾
46,964 15 2	4,435 13 4½	52 5 6½	7 5 2½	773 11 8	1,270 1 5	53,504 5 4½
37,918 5 6	3,335 6 5	100 12 5	... ...	815 15 5¼	1,250 12 1	43,421 3 10¼
37,081 5 3	4,728 0 7¼	63 13 0	... ...	1,034 9 4	1,325 1 4	44,232 13 6¼
44,308 6 0	5,154 11 2½	61 10 0	88 12 4½	1,168 5 2	735 10 7	51,517 7 4
91,315 9 1	5,001 6 9	189 13 0	262 3 0	1,222 5 2	2,847 14 6	1,00,839 3 6
73,014 15 10	4,358 4 6	104 0 0	426 8 1	1,073 9 1	2,967 13 0	81,945 2 6
78,543 9 11	4,288 4 2	65 14 0	566 12 7	1,282 8 0	3,812 6 9	88,559 7 5
4,44,888 10 8	39,566 5 6¾	831 9 11	1,372 13 4	9,235 12 10¾	17,224 10 7½	5,13,119 15 0
89,135 14 6	3,297 9 2	97 14 0	... ...	2,470 0 5	4,322 8 11	99,323 15 0
78,885 8 5	5,733 12 6	153 14 0	963 2 11	1,645 3 5	3,785 6 1	91,164 15 4
1,07,064 0 8	6,194 0 9	32 10 0	522 2 8	1,940 7 6	3,683 0 3	1,19.436 5 10
86,147 1 3	8,178 13 0	137 4 0	351 5 11	1,413 12 9	4,535 4 4	1,00,763 9 3
8,06,121 3 6	62,970 8 1¾	1,253 3 11	3,209 8 10	16,705 4 11¾	33,548 14 2½	9,23,808 12 5
84,786 2 0	6,045 4 3	217 15 0	280 14 5	1,704 1 11	5,736 4 7	98,770 10 2
96,534 4 4	8,121 15 8	103 8 0	414 10 9	1,725 11 1	3,086 6 11	1,09,986 8 9
1,07,725 1 8	7,838 0 6	305 0 10	609 2 1	1,842 0 11	3,433 6 7	1,21,752 21 7
10,95,166 11 6	84,975 12 6¾	1,879 11 9	4,514 4 1	21,977 2 10¾	45,805 0 3½	12,54,318 11 11

General Summary of Expenditure on the Ganges Canal to 31*st August,* 1845.

	RS.	A.	P.
Establishment—From commencement to 31st August, 1845, and general superintendence from 1st September, 1843 to 31st August, 1845	95,285	14	1
Sundries—Including extra draughtsmen in Superintendent's office	4,215	8	4
Excavation—Comprising about 10 miles of canal channel completed, including the first annual repairs and grassing of slopes, about 6 miles of canal channel in progress, and heavy excavation of shingle at site of the Myapoor dam and regulator also in progress	3,77,639	1	1
Masonry works—Comprising the foundations of the Myapoor dam and regulating bridge, revetments of the high gravel banks adjoining thereto up to the height of 5 feet. The foundations of a bathing ghat and the bythuk wall at Myapoor. The road and inlet bridges of the bochna nulla, workshops at Myapoor, model room and offices, and range of smith's and carpenter's shops, store-rooms, &c., at Roorkee, first-class chokies at Myapoor, Muhmoodpoor and Belra, and second-class chokies at Munglour, Dimat and Toghulpoor (not including cost of bricks used in them)	18,585	11	6
Brick-making—Comprising the preparation of Government and contract kilns, as near the site of the principal masonry works as fuel could be obtained. Many of the kilns have totally or partially failed; and those of last year having not yet been unstacked, the precise number of serviceable bricks is not known, but may be roughly estimated at 200 lakhs	1,19,318	0	1
Workshops and purchase of store materials, such as lime, iron, stone, &c.	36,460	0	9
Bullocks—Cost of maintaining to be charged hereafter to the works on which they were employed	2,418	3	2
Compensation—For land and property, and remission of land revenue	5,730	4	8
Grand total expenditure up to 31st August, 1845, Co.'s rupees	6,59,652	11	8
Present monthly establishment of the Ganges Canal (including half the expense of the director's office, the other half being fairly chargeable to the other canals under his superintendence) ...	3,800	0	0

(Signed) W. E. BAKER, *Captain, Director of the Works, Ganges Canal.*

Statement of the Gross Value of Crops grown on Land Irrigated from the Delhi Canals in 1837–38, *the Greater Part of which Land would have been Totally Unproductive without the Use of Canal Water.*

KHUREEF CROPS.

20,490 Beegas of sugar-cane and indigo at 50 rupees per beega	10,24,500	0	0
75,242 Beegas of cotton at 12 maunds of kupas (or cotton with seed) per beega, and 16 seers of kupas per rupee	22,57,200	0	0
74,010 Beegas of rice, jowar, &c., at 15 maunds per beega, and 25 seers per rupee, or 24 rupees per beega...	17,76,240	0	0
RUBBEE CROPS.			
19,000 Beegas of wheat, barley, gram, mustard, &c., &c., at 15 maunds per beega, and 20 seers per rupee, or 30 rupees per beega	95,70,000	0	0
	1,46,27,940	0	0

In the above statement, the produce per beega is stated at the lowest average of the statements I have collected from zemindars of the produce of their fields, and will not be considered more than might be expected from land well cultivated and plentifully irrigated. The valuation is also lower than the market prices have been within my experience during the last six months. Of this sum of 146 lakhs of rupees, about one-tenth is recovered by Government on account of land-tax and water-rent; the remainder covers the expenses of cultivation, and provides maintenance for the population of near 500 villages.

(Signed) W. E. BAKER, *Lieutenant, Superintendent Canals.*

APPENDIX C.

QUARTERLY SYSTEM *of* ACCOUNTS *and* BILLS *as practised on the* GANGES CANAL.

THE accompanying papers are drawn up so as to represent the entire working of a quarter's accounts of a division, and consist of the following papers:—

APPENDIX A.—The Daily Cash Account of the Division. This paper scarcely needs remark, as it is sufficiently explanatory in itself. It is similar to that used in all offices of account. It should be kept neatly and carefully, and duly posted every day, and should show clearly all the cash transactions of the divisional office; it is debited with all cash received from the Government treasuries, and credited with disbursements to subordinates in charge of sub-divisions, and contractors, agents, &c., with whom the superintendent deals largely for the purchase of stores, &c.; all petty purchases of materials being made by the subordinates in charge of sub-divisions. This account should be closed and balanced regularly on the first of every month, and handed in to the superintendent, who, after satisfying himself of its correctness, signs it, noting the balance in hand in letters as well as figures, and marking off each item in the account in the red ink characters that will be described hereafter.

APPENDIX X.—These papers exhibit the forms of accounts submitted by the subordinates in charge of sub-divisions, each month's accounts being supposed to be that of a separate sub-division, though for convenience' sake the materials in them are used to make up a quarterly bill for one work only, which bill, being the largest and most detailed in the series of bills periodically submitted, I selected as the most illustrative of the system. On the receipt of the sub-divisional papers, the head clerk of the office examines them, carefully corrects any errors that may exist, and, this being done, he returns them to the superintendent, who proceeds to mark off each item in characters to be noticed presently, and which characters show the head clerk distinctly to what heading in the office accounts every item belongs. There are other periodical papers, independently of those illustrated, which are submitted from the sub-divisions, such as monthly and quarterly store reports, detailed progress reports, abstracts of accounts, &c.; but, as these are not indispensable to the illustration of the system of accounts, I have not thought it necessary to introduce them here. On the receipt of all the monthly papers back again from the superintendent, and duly marked off, the head clerk proceeds to draw up his own monthly papers as follows.

APPENDIX B.—This is an office account current between the sub-divisional subordinate and the superintendent. It differs only from the subordinate's own account current in so far that in the latter the subordinate debits himself only with cash received from the superintendent, and credits himself only with the cost of labour expended on his works, as well as with expenditure for the petty purchases of materials, &c.; whereas, in the former, he is debited with the value of all materials delivered into his charge, and credited with the entire value of work executed, including the cost of both labour and materials. This has been found a very convenient method of procedure, inasmuch as it saves the office much labour and valuable time; and although it entails a very small amount of extra labour on each individual subordinate, that extra labour is amply compensated for in the information it gives the subordinate of the actual cost of the work done, which he could never possess, did he not know and calculate the cost of all the materials expended upon his works. This system enables the superintendent also, when going over his subordinates' accounts, to detect any extravagant expenditure and to correct it, or to observe where work is being economically carried out, and to bestow praise on the subordinate so doing, which he could not have done had he to wait for a month or two until the accounts were completed in the office. The subordinates are supplied periodically with lists of the current rates to be charged for materials; these rates are average ones, being struck quarterly or half-yearly as most convenient or most needed: the subordinates then, when entering the quantities of materials expended, carry out their cost also, and thus exhibit in their daily reports the cost in labour and materials of all works executed during the month.

APPENDIX C.—This is a divisional account current, showing at one view the sum of the transactions of the sub-divisions and the office during the month. It is debited with all cash received from Government, and is credited with the cost of all work executed, and purchases, &c., made throughout the division during the month.

APPENDIX Y.—This is an abstract of the sub-divisional daily accounts, showing the total expenditure during the month, in labour, materials, &c., under each of the headings of Original Works, Stores, Executive Officer of Materials (Mr. Finn), Sundries, Tools, Current Expenses, and any other specific headings the superintendent may adopt, and from this paper all these items are debited off to their respective places in the books, which are in three volumes; viz.:—

ORIGINAL WORKS, Account Book ... ... APPENDIX E.
STORES, Account Book ... ... „ F.
MISCELLANEOUS, Account Book ... ... „ G.

We now come to the method adopted by the superintendent in dividing off his accounts to their separate headings, and the characters used to distinguish them, which are simple enough—they are always represented in red ink, to distinguish them from the rest of the writing, and are as follow—any letters being used that may be convenient:—

A. EXCAVATION.
1. Head Digging.
2. Contract Digging.
3. Rutmoo Digging.
4. Peeran Kulleeur Digging.
5. Assoffnuggur Digging.
&c. &c. &c.

B. BRIDGES.
1. Kunkhul Bridge.
2. Jowalapoor Bridge,
3. Roorkee Bridge.
4. Peeran Kulleeur Bridge.
5. Muhewur Bridge.
6. Synibas Bridge.

C. SOLANI AQUEDUCT.
1. Coffer Dam.
2. Contingencies.
3. Masonry Aqueduct.
4. Earthern Aqueduct.
5. Solani cuts and bunds.

R. RUTMOO WORKS.
1. Dam.
2. Inlet.
3. Revetments.
4. Regulating Bridge.
5. Cuts and Bunds.
6. 1st Class Choki.

M. STORES.
1. Timber Account.
2. Brick Account.
3. Lime Account.
4. Charcoal Account.
&c. &c. &c.

MISCELLANEOUS.
F. MR. FINN'S ACCOUNT.
S. SUNDRIES' ACCOUNT.
T. TOOL ACCOUNT.
N. CURRENT EXPENSES.
1. Establishment.
2. Ordinary Repairs.
&c. &c. &c.

The accounts being all properly prepared for entry, the several items of expenditure and receipts are duly posted to their respective pages of account under the headings just described. The first of which

APPENDIX E is a very simple and useful account book, and is that from which the superintendent makes out his bills. It consists of two pages to each work or heading, the first of which contains the debits and credits to the account (the former being posted from the abstract book, and the latter from the bill book). The second page is a very useful appendage, and makes the whole a very valuable and complete record, as it shows, at once, the nature of all the items of expenditure, the work done and the nature of it, for each individual item; and it enables the superintendent to take up the book and make out his bills without any trouble or reference whatsoever. It possesses, moreover, the value of making the account perfectly clear to anybody.

APPENDICES F and G are filled in, in the same way, with exception to the detailed explanation of debits, which may, or may not be kept as the nature and extent of the transactions may demand, it being decidedly advisable to maintain the detailed explanation, whenever the accounts are heavy and extensive. The store accounts get credit for the materials expended on the works, and the miscellaneous accounts get their credits as the state of his works and accounts enables the superintendent to adjust them. These miscellaneous accounts may all be called fluctuating accounts, with exception to the current expense accounts, which are adjusted by monthly current bills.

APPENDIX H is a check book, which it is necessary to keep to enable the head clerk to determine the correctness of his accounts. It is kept on the system of double entry, and needs no explanation, being a repetition in as abstract a form as possible of the former papers—the debits and credits of every account agreeing exactly with each other. The balance sheet of this check book shows at a glance the state of the affairs of the division, and, being closed, the head clerk can at once make up his general (Sayer) account current given in

APPENDIX D.—This account current is, however, submitted only half-yearly—it is submitted to the accountant North-Western Provinces, by whom it is checked—and any errors that may exist are officially notified to the superintendent for correction. This account is debited with all charges made by the Government against the division, either for cash or stores supplied from the different Government departments, and is credited only with bills duly audited; the way in which the balance unaudited or unaccounted for is disposed of, being explained under the head of inefficient balance.

C. SCANLAN, *Accountant-Director's Office, Ganges Canal Works.*

Roorkee, 11th March, 1854.

APPENDIX A.

DAY BOOK.—CASH ACCOUNT PARTICULAR,

Northern Division, Ganges Canal.

DAILY PARTICULAR CASH ACCOUNT of the Northern Division of the Ganges Canal.

Date.	Description.	Received. RS.	A.	P.	Expended. RS.	A.	P.
1853.	Camp Muhewur.						
February 1	To balance of last account	10,000	0	0			
	To cash received from the collector of Suharunpoor, in lieu of assignment (No. 10, of 1852-53, dated 15th ult.,) drawn by the accountant N. W. P. on the Suharunpoor Treasury ...	75,000	0	0			
„ 2	Camp Muhewur.						
	Advanced to Ramsook, contractor for Buhera timbers ...	...	...		2,000	0	0
	Advanced to Mr. Finn, executive officer of materials ...	...	...		20,000	0	0
„ 15	Camp Roorkee.						
	Amount remitted to overseer	...	...		5,000	0	0
	Advanced to Mr. Finn, executive officer of materials ...	...	...		20,000	0	0
„ 25	Amount remitted to overseer	...	...		4,000	0	0
	Advanced to Mr. Finn, executive officer of materials ...	...	...		20,000	0	0
„ 28	Advanced to Ramjuss, contractor for the purchase of Sal timbers	...	...		5,000	0	0
	Totals	85,000	0	0	76,000	0	0
	Balance in hand	...	...		9,000	0	0
	Grand total	85,000	0	0	85,000	0	0

DAILY PARTICULAR CASH ACCOUNT—*continued.*

Date.		Description.	Received.			Expended.		
			RS.	A.	P.	RS.	A.	P.
March	1	Camp Dhunouree.						
		To balance of last account	9,000	0	0			
,,	9	Amount paid to Bildar, sent into hospital yesterday from Roorkee bank digging, being wages for 8 days, at 2 *a.* per day ...	...	...		1	0	0
		To cash received from the collector of Suharunpoor, in lieu of assignment (No. 12 of 1852–53, dated 25th ultimo), drawn by the accountant N. W. P. on the Suharunpoor Treasury ...	75,000	0	0			
,,	10	Camp Peeran Kulleeur.						
		Amount remitted to overseer	...	...		5,000	0	0
		Advanced to Mr. Finn, executive officer of materials ...	...	...		20,000	0	0
,,	15	Camp Roorkee.						
		Amount remitted to overseer	...	...		10,000	0	0
		Paid Yoozoof Ali, contractor, amount of his bill for completion of well for aqueduct	...	...		291	4	5
,,	25	Roorkee.						
		Advanced Mr. Finn, executive officer of materials	...	...		20,000	0	0
,,	31	Remitted to Calcutta agents, being amount of their bill for purchase of iron and miscellaneous metals	...	...		25,000	0	0
		Totals	84,000	0	0	80,292	4	5
		Balance in hand	...	...		3,707	11	7
		Grand total	84,000	0	0	84,000	0	0
April	1	To balance of last account	3,707	11	7			
,,	5	Roorkee.						
		To cash received from the collector of Suharunpoor, in lieu of assignment (No. 15 of 1852–53, dated the 23rd ultimo), drawn by the accountant N. W. P. on the Suharunpoor Treasury ...	75,000	0	0			
,,	10	Amount remitted to deputy superintendent	...	...		1,000	0	0
		Advanced to executive officer of materials	...	...		20,000	0	0
,,	15	Amount remitted to deputy superintendent	...	...		15,000	0	0
,,	16	Ditto ditto ditto	...	...		5,000	0	0
,,	25	Advanced to executive officer of materials	...	...		20,000	0	0
,,	31	Remitted to deputy superintendent to pay regular establishment for current month	...	...		41	0	0
		Ditto, ditto, to pay fluctuating ditto	...	...		180	0	0
		Amount paid to treasurer for 209 mds. 32 srs. 12 chks. of gram supplied to horses employed on excavation in the 15th and 16th miles, at yearly contract rate of 2 *rs.* per maund ...	...	...		419	10	2
		Totals	78,707	11	7	61,640	10	2
		Balance in hand	...	...		17,067	1	5
		Grand total	78,707	11	7	78,707	11	7

Balance in hand (17,067 *rs.* 1 *a.* 5 *p.*) seventeen thousand and sixty seven rupees, one anna, and five pie.

(Signed) A. G. GOODWYN, *Captain,*
Superintendent Northern Division, Ganges Canal.

APPENDIX X.

——— Overseer in Account Current with the Superintendent of the Northern Division, Ganges Canal, for the Month of February, 1853.

DR. CR.

Date.	Receipts.	Amounts. Rs. A. P.	Total Rs. A. P.	Numbers.	Expenditure.	Amounts. Rs. A. P.	Total. Rs. A. P.
Feb. 1	To balance in hand ...	... ...	300 0 0		By amount paid for labour during the month of February, 1853: viz., as per daily account:—		
„ 15	„ cash received from the Superintendent ...	5,000 0 0	—		No. 1. Earthwork	1,446 9 8	
„ 25	„ „ „ ...	4,000 0 0	9,000 0 0		„ 2. „	1,474 13 10	
					„ 3. „	668 2 0	
					„ 4. „	1,117 8 8	
					„ 5. „	538 6 4	
					„ 6. „	190 12 5	
					„ 7. „	40 10 4	
					„ 8. „	269 0 0	
					„ 9. „	904 6 4	
					„ 10. Plantations	9 0 0	
					„ 11. Brick kilns	10 9 4	
					„ 12. „ „	28 15 8	
					„ 13. Lime kilns	5 0 0	
					„ 14. Repairs	18 15 4	
					„ 15. „	0 8 0	
					„ 16. „	5 0 0	
					By regular establishment for February, 1853	10 0 0	
					„ fluctuating „ „ ...	144 11 1	
					„ purchase of country paper	1 0 0	6,884 1 0
					Balance in hand	... ...	2,415 15 0
	Total	... ...	9,300 0 0		Total	... ...	9,300 0 0

Roorkee, 1st March, 1853.

(Signed) ——— *Overseer.*

Daily Account of Expenditure on the undermentioned Works of the

C 4. No. 1. Excavation, 15th Mile. Wagons drawn by Horses.

Date	Mates, at 6 rs.	Bildars, at 4 rs.	Syces, at 5 rs.	Baskets, at 2 rs.	Horses' feed	Oil, at 5 rs. (s.)
1	25	200	100	100	...	2
2	25	200	100	100	...	4
3	25	200	100	100	...	4
4	25	200	100	100	...	4
5	25	200	100	100	...	4
6	25	200	100	100	...	4
7	25	200	100	100	...	4
8	25	200	100	100	...	4
9	25	200	100	100	...	4
10	25	200	100	100	...	4
11	25	200	100	100	...	4
12	25¼	200	100	100	...	8
13	24	200	100	100	...	8
14	24	200	100	100	...	8
15	24	200	100	100	...	8
16	24	200	100	100	...	8
17	24	200	100	100	...	8
18	24	200	100	100	...	8
19	24	200	100	100	...	8
20	24	200	100	100	...	8
21	24	200	100	100	...	8
22	24	200	100	100	...	4
23	24	200	100	100	...	4
24	24	200	100	100	...	4
25	24	200	100	100	...	4
26	24	200	100	...	...	4
27	24	200	100	...	...	9
28	24	200	100	...	...	9
Totals	684¼	5,600	2,800	2,500	...	4 0 0
Amounts (Rs. A. P.)	146 9 8	800 0 0	500 0 0	50 0 0	300 0 0	19 9 9
Totals	1,446 9 8			369 9 9		

Total cost on No. 1: 1,816 3 5

5,00,966 cubic feet of earth excavated, filled into ballast wagons, and propelled along railway by horses an average distance of 8540 feet, and emptied by side of railway.

C 4. No. 2. Excavation, 16th Mile. Wagons drawn by Horses.

Date	Mates, at 6 rs.	Bildars, at 4 rs.	Syces, at 5 rs.	Tallow (s.)	Baskets, at 4 rs.	Horses' Feed
1	10	212	110	2	10	...
2	10	226	110	2	10	...
3	10	212	110	2	10	...
4	10	212	110	2	10	...
5	15	212	110	2	10	...
6	10	212	110	2	10	...
7	10	212	110	2	10	...
8	10	212	110	2	10	...
9	10	212	110	2	10	...
10	15	212	110	2	10	...
11	20	212	110	2	10	...
12	20	212	110	2	10	...
13	15	212	110	1	10	...
14	20	212	110	1	10	...
15	15	212	110	1	10	...
16	20	212	110	1	10	...
17	10	212	110	1	10	...
18	19¼	212	110	1	10	...
19	10	212	110	1	10	...
20	10	212	110	1	10	...
21	10	212	110	1	10	...
22	10	212	110	1	10	...
23	10	212	110	1	10	...
24	10	212	110	1	10	...
25	10	212	110	1	10	...
26	10	212	110	1	...	...
27	10	212	110	1	...	...
28	10	212	110	1	...	...
Totals	349¼	5,950	3,080	1 0 0	250	...
Amounts	74 13 10	850 0 0	550 0 0	10 0 0	10 0 0	472 13 2
Totals	1,474 13 10				492 13 2	

Total cost on No. 2: 1,967 11 0

3,99,300 cubic feet of earth excavated, &c., as in the foregoing, an average distance of 11,555 ft., and emptied as before.

C 4. No. 3. Same as No. 2. Wagons propelled by Men.

Date	Mates, at 6 rs.	Bildars, at 4 rs.	Baskets, at 4 rs.	Grease (s. c.)
1	2	165	1200	6 10
2	2	165	...	...
3	2	165	...	...
4	2	165	...	...
5	2	165	...	...
6	2	165	...	...
7	2	165	...	...
8	2	165	...	...
9	2	165	...	...
10	2	165	...	...
11	1	165	...	...
12	1	165	...	...
13	1	165	...	...
14	1	165	...	...
15	1	165	...	...
16	1	165	...	...
17	1	165	...	...
18	1	165	50	...
19	1	165	...	...
20	1	165	...	...
21	1	165	...	...
22	1	165	...	...
23	1	165	...	...
24	1	165	...	...
25	1	165	...	...
26	1	165	...	...
27	1	165	...	...
28	1	165	...	...
Totals	38	4,620	1,250	0 6 10
Amounts	8 2 3	659 15 9	50 0 0	1 10 6
Totals	668 2 0		51 10 6	

Total cost on No. 3: 719 12 6

2,02,112 cubic ft. of earth, as before; average distance being 7,000 feet.

C 4. No. 4. Spreading Nos. 1, 2, and 3.

Date	Mates, at 6 rs.	Bildars, at 4 rs.
1	20	250¾
2	20	250
3	20	250
4	20	250
5	20	250
6	20	250
7	20	250
8	20	250
9	20	250
10	20	250
11	20	250
12	20	250
13	20	250
14	20	250
15	20	250
16	20	250
17	20	250
18	20	250
19	20	250
20	20	250
21	18	250
22	18	250
23	18	250
24	18	250
25	19	250
26	19	250
27	19	250
28	19	250
Totals	548	7,000¾
Amounts	117 6 10	1,000 1 10

Total cost on No. 4: 1,117 8 8

11,02,378 cubic feet of earth spread in channel.

C 4. No. 5. Excavation. Roorkee Banks. Men.

Date	Mates, at 6 rs.	Bildars, at 4 rs.
1	7¼	125
2	7	125
3	7	125
4	7	125
5	7	125
6	7	125
7	7	125
8	7	125
9	7	125
10	7	125
11	7	125
12	6	125
13	6	125
14	6	125
15	6	125
16	6	125
17	6	125
18	6	125
19	6	125
20	6	125
21	6	125
22	6	125
23	6	125
24	6	125
25	6	125
26	6	125
27	6	125
28	6	125
Totals	179¼	3,500
Amounts	38 6 4	500 0 0

Total cost of No. 5: 538 6 4

1,94,525 cubic feet, as before, but propelled by men, average distance being 5,000 ft.

C 4. No. 6. Spreading No. 5.

Date	Mates, at 6 rs.	Bildars, at 4 rs.
1	2	45
2	2	45
3	2	45
4	2	45
5	2	45
6	2	45
7	2	45
8	2	45
9	2	45
10	2	45
11	2	45
12	2	45
13	2	45
14	2	45
15	2	45
16	1	45
17	2	45
18	2	45
19	2	45
20	2	45
21	2	44
22	2	44
23	2	44
24	2	44
25	2	44
26	2	44
27	2	44
28	2	44
Totals	55	1,253
Amounts	11 12 5	179 0 0

Total cost on No. 6: 190 12 5

The foregoing quantity spread in channel.

C 4. No. 7. Removing Sand from Aqueduct.

Date	Mates, at 6 rs.	Bildars, at 4 rs.
1	...	10
2	...	10
3	3	90
4	...	10
5	...	10
6	...	10
7	...	10
8	...	10
9	...	10
10	...	10
11	...	10
12	...	10
13	...	10
14	...	10
15	...	10
16	...	10
17	...	10
18	...	10
19	...	10
20	...	10
21	...	...
22	...	...
23	...	...
24	...	...
25	...	...
26	...	...
27	...	...
28	...	...
Totals	3	280
Amounts	0 10 4	40 0 0

Total cost on No. 7: 40 10 4

16,250 cubic feet of surplus sand removed from top of aqueduct, and deposited in channel.

Roorkee, 1st March, 1853.

Northern Division Ganges Canal during the month of February, 1853.

C 4. No. 8. Spreading.	C 4. No. 9. Puddling.	N 3. No. 10. Plantations.				M 2. No. 11. Brick Kiln at Muhewur.				
269 0 0	904 6 4	9 0 0		1 0 0	10 0 0	10 9 4		9 6 8		20 0 0
... ...	... ...	5 0 0	4 0 0	...	...	1 9 4	9 0 0	8 12 0	0 10 8	...
Bildars, at 4 rs.	Bildars, at 4 rs.	Bildars, at 4 rs.	Malee, at 4 rs.	Baskets......	Total cost on No. 10 ...	Bildars, at 4 rs.	Contractors	Oopla	Baskets......	Total cost on No. 11 ...
68	228	4	1	50		1	...	2	60	
68	226	4	1	...		1	...	2	...	
68	226	4	1	...		1	...	2	...	
68	226	4	1	...		1	...	2	...	
68	226	4	1	...		1	...	2	...	
68	226	4	1	...		1	...	2	...	
68	226	4	1	...		1	...	2	...	
67	226	4	1	...		1	...	2	...	
67	226	3	1	...		1	...	2	...	
67	226	...	1	...		1	...	2	...	
67	226	...	1	...		1	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	...	...	
67	226	...	1	...		...	...	..	...	
1,883	6,330¾	35	28	50		11	...	20 cart-loads.	60	
1,35,000 cubic feet of earth spread.	2,90,828 cubic feet of earth puddled.	30 trees planted. 1,000 do. cleared.				600 cubic feet of earth excavated. 20,000 bricks placed in kilns.				

M 2. No. 12. Brick Kiln at Roorkee.					M 3. No. 13. Lime Kiln at Myapoor.			
28 15 8		21 0 4		50 0 0	5 0 0		5 0 0	10 0 0
1 13 8	27 2 0	20 0 0	1 0 4	...	1 9 4	3 6 8	...	...
Bildars, at 4 rs.	Bildars, at 2 a.	Oopla	Firewood ...... MDS.	Total cost on No. 12 ...	Bildars, at 4 rs. ...	Chuprasee, at 4 rs. ...	Wood ...... MDS.	Total cost on No. 13 ...
1	10	2	10		1	1	50	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
1	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	10	2	...		1	1	...	
...	3	...	...		1	1	...	
...	2	...	...		1	1	...	
...	2	...	...		...	1	...	
...	2	...	...		...	1	...	
...	2	...	...		...	...	...	
...	2	...	...		...	...	...	
...	2	...	...		...	...	...	
...	2	...	...		...	...	...	
13	217	40 cart-loads.	10 maunds.		22	24	50 maunds.	
50,000 bricks loaded into kilns. 20,000 pukka and 1,000 peela bricks received from contractors.					One kiln, containing 500 mds. of stone, filled and ready for lighting.			

N 2. No. 14. Repairing Banks.						N 2. No. 15. Ironwork of Gates.			N 2. No. 16. Repairing Kulseea Choki.					
18 15 4			1 0 8		20 0 0			5 0 0	5 0 0		32 4 10			37 4 10
3 11 4	0 4 0	15 0 0	0 2 8	0 14 0	...	0 8 0	4 8 0	...	4 8 0	0 8 0	5 0 0	22 8 0	4 12 10	...
Bildars, at 4 rs. ...	Bildars, at 2 a.	Roller, at 1 r.	Grass......	Baskets......	Total cost on No. 14 ...	Smiths, at 4 a.	Iron ...... MD.	Total cost on No. 15 ...	Masons, at 4 a.	Mistri, at 8 a.	Bricks	Lime ...... M.	Soorkee...... M.	Total cost on No. 16 ...
1	1	1	50	50		2	1		1	1	1000	60	60	
1	1	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	1	...	...		...	...		1	...	...	...	...	
1	...	...	...	...		...	...		1	...	...	...	...	
1	...	...	...	...		...	...		1	...	...	...	...	
1	...	...	...	...		...	...		1	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
1	...	...	...	...		...	...		...	...	...	...	...	
...	...	...	...	...		...	...		...	...	...	...	...	
...	...	...	...	...		...	...		...	...	...	...	...	
26	2	15	50 bundles.	50		2	1 maund.		18	1	1,000	60 mds.	60 mds.	
One mile of embankment repaired.						15 feet of chain added to regulator gates.			110 cubic feet of masonry executed. 50 square feet of plaster, white-washing, &c.					

(Signed) —————— *Overseer.*

PAY BILL of Establishment attached to the Northern Division of the Ganges Canal during the month of February, 1853.

Roorkee, 1st March, 1853.

Description.	Names.	Amounts.			Total.			Nature of Establishment.
		RS.	A.	P.	RS.	A.	P.	
Mutsuddi	Jyram	......			10	0	0	Permanent.
Misturi	Kulloo	20	0	0				
Mutsuddi	Jaffeer Ali	15	0	0				
,, ...	Bridj Lal	8	0	0				
,, ...	Saadut Ali	7	0	0				
Chupprasee	Kulloo	5	0	0				
,, ...	Juhangeer Khan	5	0	0				
,, ...	Sahib Singh	5	0	0				
,, ...	Heera Singh	5	0	0				
,, ...	Sirnee	5	0	0				
,, ...	Dowlut Ram	5	0	0				
,, ...	Debee Singh	5	0	0				
,, ...	Nuttun Singh	5	0	0				
,, ...	Kadirbux	5	0	0				
,, ...	Bhoput	5	0	0				
Classee	Lalla	4	0	0				
,, ...	Oree	4	0	0				
,, ...	Debee	4	0	0				
,, ...	Garao	4	0	0				
,, ...	Kwajoo	4	0	0				
,, ...	Doonda Khan	4	0	0				
,, ...	Jallee	4	0	0				
,, ...	Gunga Ram	4	0	0				
,, ...	Ram Lal	4	0	0				
,, ...	Poorun	4	0	0				
,, ...	Ramdeen	4	0	0				
,, ...	Debeedeen, 5 days at 4*rs.* ...	0	11	1	144	11	1	Fluctuating.
	Total	......			154	11	1	

The above men were all paid in my presence.

(Signed) ________________

Overseer.

Appendix X.

——— Overseer in Account Current with the Superintendent of the Northern Division of the Ganges Canal for the month of March, 1853.

Dr. Cr.

Date.	Receipts.	Amount. Rs.	A.	P.	Total. Rs.	A.	P.
Mar. 1	To balance in hand ...	...	...		5,000	0	0
„ 10	„ cash received from the Superintendent ...	5,000	0	0			
„ 15	„ „ „ ...	10,000	0	0	15,000	0	0
	Total	...	...		20,000	0	0

Numbers.	Expenditure.	Amount. Rs.	A.	P.	Total. Rs.	A.	P.
	By amount paid for labour during the month of March, 1853, as per daily account, viz.:—						
	No. 1. Earthwork	8,038	10	8			
	„ 2. „	2,805	3	10			
	„ 3. „	3,842	0	3			
	„ 4. „	42	2	0			
	„ 5. „	37	11	0			
	„ 6. „	802	4	5			
	„ 7. „	477	10	8			
	„ 8. „	212	0	0			
	„ 9. „	151	0	4			
	„ 10. „	221	13	11			
	„ 11. „ (dressing slopes) ...	100	0	0			
	„ 12. Plantations	1	15	8			
	„ 13. Brick kilns	1	15	8			
	„ 14. Lime kilns	1	3	0			
	„ 15. Charcoal kilns	1	3	0			
	„ 16. „ „	0	12	8			
	„ 17. Masonry	18	8	6			
	„ 18. Soorkee	20	0	0			
	By regular establishment for March, 1853	10	0	0			
	„ fluctuating do. do. ...	144	0	0			
	„ purchase of country paper	2	0	0			
	„ repairs of banks (contract) 20 miles at 30 *rs.* per mile	600	0	0	17,532	3	7
	Balance in hand	...	...		2,467	12	5
	Total	...	...		20,000	0	0

Roorkee, 1st *April*, 1853.

(Signed) ——— *Overseer.*

DAILY ACCOUNT of Expenditure on the undermentioned Works of

	C 4.							C 4.					
	No. 1. Excavation, 15th Mile.							No. 2. Excavation, 16th Mile.					
Totals.	8,038 10 8			2,154 3 2			10,192 13 10	2,805 3 10			601 13 3		3,407 1 1
Amounts.	RS. A. P. 338 0 0	4,500 10 8	3,200 0 0	2,000 0 0	150 0 0	4 3 2	... ...	107 3 10	2,198 0 0	500 0 0	600 0 0	1 13 3	... ...
Date and Description.	Mates, at 6 rs....	Bildars, at 4 rs.	Syces, at 5 rs.	Horses' Food ...	Baskets, at 4 rs.	Grease.........	... ...	Mates, at 6 rs....	Bildars, at 4 rs.	Syces, at 5 rs....	Horses' Food ...	Grease	... ...
						s. c.						s. c.	
1	57⅛	1126¼	640	...	1000	4 12	Total cost of No. 1	18	550½	100	...	2 0	Total cost of No. 2
2	57	1126	640	..	...	...		18	550	100	...	...	
3	57	1126	640	...	...	...		18	550	100	...	...	
4	57	1126	640	...	...	...		18	550	100	...	...	
5	57	1126	640	...	...	...		18	550	100	...	...	
6	57	1125	640	...	...	...		18	550	100	...	...	
7	57	1125	640	...	...	...		18	550	100	...	...	
8	57	1125	640	...	...	...		18	550	100	...	...	
9	57	1125	640	...	...	...		18	550	100	...	...	
10	57	1125	640	...	...	...		18	550	100	...	...	
11	56	1125	640	...	...	...		18	550	100	...	...	
12	56	1125	640	...	1000	4 0		18	550	100	...	...	
13	56	1125	640	...	...	...		18	550	100	...	2 0	
14	56	1125	640	...	...	...		18	550	100	...	...	
15	56	1125	640	...	...	...		18	550	100	...	...	
16	56	1125	640	...	...	...		18	549	100	...	...	
17	56	1125	640	...	...	...		18	549	100	...	...	
18	56	1125	640	...	...	...		18	549	100	...	...	
19	56	1125	640	...	...	...		18	549	100	...	...	
20	56	1125	640	...	...	...		18	549	100	...	...	
21	56	1125	640	...	...	...		18	549	100	...	...	
22	56	1125	640	...	...	4 0		18	549	100	...	...	
23	56	1125	640	...	...	...		18	549	100	...	2 0	
24	56	1125	640	...	1000	...		18	549	100	...	...	
25	56	1125	640	...	...	...		18	549	100	...	...	
26	56	1125	640	...	...	...		18	549	100	...	...	
27	56	1125	640	...	...	...		18	549	100	...	...	
28	56	1125	640	...	...	...		17	549	100	...	...	
29	56	1125	640	...	...	...		17	549	100	...	...	
30	56	1125	640	...	...	4 0		17	549	100	...	...	
31	56	1125	640	...	750	...		17	549	100	...	1 5	
Totals.	1,746⅛	34,880¼	19,840	...	3,750	16·12		554	17,034½	3,100	...	7·5	
	21,30,206 cubic feet of excavation from the 15th mile, filled into ballast wagons, propelled along railway by horses, and emptied by the side of railway, average distance 10,760 feet.							7,55.758 cubic feet of excavation, same as in the foregoing, average distance being 10,775 feet.					

	C 4.				C 4.	C 4.	C 4.			C 4.			C 4.
	No. 3. Spreading, Nos. 1 and 2.				No. 4. Excavation, 16th Mile.	No. 5. Excavation, 19th Mile.	No. 6. Excavation, Roorkee Banks.			No. 7. Spreading, Nos. 5 and 6.			No. 8. Removing Earth already Deposited.
Totals.				3,842 0 3	42 2 0	37 11 0			802 4 5			477 10 8	212 0 0
Amounts.	200 8 3	3,641 0 0	0 8 0	... ...	... ...	... ...	0 14 5	801 6 0	... ...	5 6 8	472 4 0	... ...	... ...
Date and Description.	Mates, at 6 rs....	Bildars, at 4 rs.	Bildars, at 2 a.	... ...	Bildars, at 2 a.	Bildars, at 2 a.	Bildars, at 4 rs.	Bildars, at 2 a.	... ...	Mates, at 6 rs....	Bildars, at 2 a.	... ...	Bildars, at 2 a.
1	34	917	1	Total cost of No. 3	37	11	1	231	Total cost of No. 6	1	148	Total cost of No. 7	76
2	34	910	1		10	10	1	206		1	121		54
3	34	910	1		10	...	1	206		1	121		54
4	34	910	1		10	10	1	206		1	121		54
5	34	910	...		10	10	1	206		1	121		54
6	34	910	...		10	10	1	206		1	121		54
7	34	910	...		10	10	1	206		1	121		54
8	34	910	...		10	10	...	206		1	121		54
9	34	910	...		10	10	...	206		1	121		54
10	34	910	...		10	10	...	206		1	121		54
11	34	910	...		10	10	...	206		1	121		54
12	34	910	...		10	10	...	206		1	121		54
13	34	910	...		10	10	...	206		1	121		54
14	33	910	...		10	10	...	206		1	121		54
15	33	910	...		10	10	...	206		1	121		54
16	33	910	...		10	10	...	206		1	121		54
17	33	910	...		10	10	...	206		1	121		54
18	33	910	...		10	10	...	206		1	121		54
19	33	910	...		10	10	...	206		1	121		54
20	33	910	...		10	10	...	206		1	121		54
21	33	910	...		10	10	...	206		1	121		54
22	33	910	...		10	10	...	206		1	121		54
23	33	910	...		10	10	...	206		1	121		54
24	33	910	...		10	10	...	206		1	121		54
25	33	910	...		10	10	...	206		1	121		54
26	33	910	...		10	10	...	206		1	121		54
27	33	910	...		10	10	...	206		1	121		54
28	33	910	...		10	10	...	206		1	121		54
29	33	910	...		10	10	...	206		...	121		54
30	33	910	...		10	10	...	206		...	121		54
31	33	910	...		10	10	...	206		...	121		54
Totals.	1,036	28,217½	4		337	301½	7	6,411		28	3,778		1,696
	'28,85,964 cubic feet of earth spread.				14,250 cubic feet (virgin soil) carried in baskets a distance of 150 ft. up a slope of 26 ft., and spread in embankments.	12,195 cubic feet from 19th mile, propelled in wagons by men, average distance 5,000 feet.	2,89,074 cubic ft. from Roorkee banks same as in No. 5, average distance 4,720 ft.			3,01,269 cubic feet of earth spread.			1,07,875 cubic ft. of earth formerly deposited in channel removed to embankments and spread.

Roorkee, 1st *April*, 1853.

the Northern Division of the Ganges Canal during the month of March, 1853.

C 4.		C 4.		C 4.	N 3.			M 2.	
No. 9. Spreading.		No. 10. Ramming.		No. 11. Dressing Slopes.	No. 12. Plantations.			No. 13. Muhewur Brick-kiln.	
Bildars, at 4 rs.	Bildars, at 2 a.	Bildars, at 4 rs.	Bildars, at 2 a.	Bildars, at 2 a.	Coolies, at 7 p.	Teak Trees ...	Twine .... (s.)	Coolies, at 7 p.	Oopla ....
1	42	1	64	50	1	10	1	1	10
1	48	1	56	25	1	10	...	1	10
1	48	1	56	25	1	10	...	1	10
1	38	1	56	25	1	10	...	1	10
1	38	1	56	25	1	10	...	1	10
1	38	1	56	25	1	10	...	1	10
...	38	1	56	25	1	10	...	1	10
...	38	1	56	25	1	10	...	1	10
...	38	1	56	25	1	10	...	1	10
...	38	1	56	25	1	10	...	1	4
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	1	...	...	1	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	1	56	25	...	...	...	...	...
...	38	...	56	25	...	...	...	...	...
6	1,202	30	1,744	800	20	100	1	20	94 cart-loads.
0 12 4	150 4 0	3 13 11	218 0 0	...	...	27 0 0	1 0 4	...	...
					1 15 8	28 0 4		1 15 8	48 0 4
Total cost of No. 9: 151 0 4		Total cost of No. 10: 221 13 11		100 0 0	Total cost of No. 12: 30 0 0			Total cost of No. 13: 50 0 0	
50,340 cubic feet of earth spread a distance of 200 ft.		Earth round quadrantal and other steps well rammed.		17,807 cubic ft. of excavation preparatory to dressing. 22,800 square feet slopes dressed.	500 teak trees planted on east bank of canal. 1,000 young plants set out on west bank of canal.			15,000 bricks piled, 30,000 bricks made and kiln in active progress.	

M 3.			M 4.			M 4.		
No. 14. Lime-kiln at Roorkee.			No. 15. Charcoal-kiln at Roorkee.			No. 16. Charcoal-kiln at Mullikpoor.		
Coolies, at 7 p.	Oopla	Kunkur	Coolies, at 7 p.	Keekur .... (MDS.)	Rope .... (S.)	Coolies, at 7 p.	Keekur .... (MDS.)	Baskets ....
1	5	5	1	1	½	1	1	2
1	5	5	1	1	...	1	1	...
1	5	5	1	1	...	1	1	...
1	5	5	1	1	...	1	1	...
1	2	4	1	1	...	1	1	...
1	...	...	1	1	...	1	1	...
1	...	...	1	1	...	1	...	...
1	...	...	1	1	...	1	...	...
1	...	...	1	1	...	...	...	...
1	...	...	1	½	...	...	...	...
1	...	...	1	...	...	...	...	...
1	...	...	1	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...
12	22 cart-loads.	24 cart-loads.	12	9 20 0	½	8	6	2
...	11 0 0	12 13 0	...	23 12 0	0 1 0	...	19 2 0	0 1 4
1 3 0	23 13 0		1 3 0	23 13 0		0 12 8	19 3 4	
Total cost of No. 14: 25 0 0			Total cost of No. 15: 25 0 0			Total cost of No. 16: 20 0 0		
240 maunds of kunkur loaded into kiln.			One kiln containing 9½ mds. of wood, packed and lighted.			Six maunds of wood piled in kiln, and work in progress.		

B 6.									M 5.	
No. 17. Synebas Bridge.									No. 18. Soorki.	
Masons, at 9 p.	Masons, at 8 p.	Masons, at 7 p.	Bildars, at 7 p.	Bildars, at 5 p.	Bricks	Lime	Soorkee	Baskets	Contractors ...	Bricks ....
2	2	1	2	5	5000	100	100	100	...	...
2	2	1	2	5	5000	100	100	48	...	...
2	2	1	2	5	5000	100	100	...	...	...
2	2	1	2	5	5000	100	100	...	...	...
2	2	1	2	5	5000	100	100	...	...	...
2	1	...	2	5	5000	10	10	...	...	...
2	1	...	2	3	5000	...	...	...	...	...
2	1	...	2	3	5000	...	...	...	...	...
2	1	...	2	3	500	...	...	...	...	...
2	1	...	2	3	...	...	...	...	...	...
2	1	...	2	3	...	...	...	...	...	...
2	1	...	2	3	...	...	...	...	...	...
2	1	...	2	2¼	...	...	...	...	...	...
2	1	...	2	5	...	...	...	...	...	...
2	1	...	1	5	...	...	...	...	...	...
2	1	...	1	5	...	...	...	...	...	...
2	1	...	1	5	...	...	...	...	...	...
2	1	...	1	5	...	...	...	...	...	...
2	...	...	...	5	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...
38	23	5	32	80¼	40,500	510	510	148	2	22,400
5 5 6	2 14 0	0 8 9	3 8 0	6 4 3	202 8 0	51 0 0	40 12 10	1 7 6	...	...
18 8 6					295 12 4				20 0 0	112 8 0
Total cost of No. 17: 314 4 10									Total cost of No. 18: 132 8 0	
3,000 cubic feet of masonry work in wing walls and foundations.									400 pymanas of Soorkee made.	

Pay Bill of Establishment attached to the Northern Division of the Ganges Canal during the month of March, 1853.

Roorkee, 1*st April*, 1853.

Description.	Names.	Amounts.	Total.	Nature of Establishment.
		RS. A. P.	RS. A. P.	
Mutsuddi	Jyram	... ...	10 0 0	Permanent.
Misturi	Kulloo	20 0 0		
Mutsuddi	Jaffeer Ali	15 0 0		
"	Bridj Lal	8 0 0		
"	Saadut Ali	7 0 0		
Chupprasee	Kulloo	5 0 0		
"	Juhangeer Khan	5 0 0		
"	Sahib Singh	5 0 0		
"	Heera Singh	5 0 0		
"	Sirnee	5 0 0		
"	Dowlut Ram	5 0 0		
"	Debee Singh	5 0 0		
"	Nuttun Singh	5 0 0		
"	Kadirbux	5 0 0		
"	Boputh	5 0 0		
Classee	Lalla	4 0 0		
"	Oree	4 0 0		
"	Debee	4 0 0		
"	Garao	4 0 0		
"	Kwajoo	4 0 0		
"	Doonda Khan	4 0 0		
"	Jallee	4 0 0		
"	Gunga Ram	4 0 0		
"	Ram Lal	4 0 0		
"	Poorun	4 0 0		
"	Ramdeen	4 0 0	144 0 0	Fluctuating.
	Total	... ...	154 0 0	

The above men were paid in my presence.

(Signed) ————————

Overseer.

Daily Account of Expenditure on the undermentioned Works of the Northern Division Ganges Canal during the month of April, 1853.

C 4.

No. 1. Excavation for Foundations.

Date and Description.	Bildars, at 4 rs.	Bildars, at 2 a.	Total cost of No. 1
Amounts (Rs. A. P.)	2 4 3	288 12 0	291 0 3
1	1	77	
2	1	77	
3	1	77	
4	1	77	
5	1	77	
6	1	77	
7	1	77	
8	1	77	
9	1	77	
10	1	77	
11	1	77	
12	1	77	
13	1	77	
14	1	77	
15	1	77	
16	1	77	
17	1	77	
18	...	77	
19	...	77	
20	...	77	
21	...	77	
22	...	77	
23	...	77	
24	...	77	
25	...	77	
26	...	77	
27	...	77	
28	...	77	
29	...	77	
30	...	77	
Totals	17	2,310	

Breaking up revetment for foundations of lions, and 34,224 cubic feet of excavation in foundations of lions and embankment steps.

C 4.

No. 2. Clearance.

Date and Description.	Bildars, at 4 rs.	Bildars, at 2 a.	Total cost of No. 2
Amounts (Rs. A. P.)	1 11 9	91 0 0	92 11 9
1	1	32	
2	1	24	
3	1	24	
4	1	24	
5	1	24	
6	1	24	
7	1	24	
8	1	24	
9	1	24	
10	1	24	
11	1	24	
12	1	24	
13	1	24	
14	...	24	
15	...	24	
16	...	24	
17	...	24	
18	...	24	
19	...	24	
20	...	24	
21	...	24	
22	...	24	
23	...	24	
24	...	24	
25	...	24	
26	...	24	
27	...	24	
28	...	24	
29	...	24	
30	...	24	
Totals	13	728	

Clearing away argillaceous deposit from revetment.

C 4.

No. 3. Solani Aqueduct Revetments. Plain Masonry.

Date and Description.	Mistri, at 20 rs.	Masons, at 8 rs.	Masons, at 7 rs.	Masons, at 6 rs.	Masons, at 5 rs.	Masons, at 4 rs.	Masons, at 3 rs.	Mates, at 7 rs.	Mates, at 6 rs.	Bildars, at 4 rs.	Bheestees, at 5 rs.	Bheestees, at 4 rs.	Bheestees, at 2 a.	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.	Total cost of No. 3
Amounts (Rs. A. P.)	20 0 0	1,200 0 0	1,001 0 0	300 0 0	60 0 0	16 0 0	6 0 0	161 0 0	284 0 0	2,142 12 9	10 0 0	196 0 0	3 2 0	20,000 0 0	6,000 0 0	13,296 8 1	44,696 6 10
Totals	5,399 14 9													39,296 8 1			
1	1	150	143	50	12	4	2	23	57	555	2	49	1	...	...	...	
2	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
3	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
4	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
5	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
6	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
7	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
8	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
9	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
10	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
11	1	150	143	50	12	4	2	23	47	535	2	49	1				
12	1	150	143	50	12	4	2	23	47	535	2	49	1				
13	1	150	143	50	12	4	2	23	47	535	2	49	1				
14	1	150	143	50	12	4	2	23	47	535	2	49	1				
15	1	150	143	50	12	4	2	23	47	535	2	49	1				
16	1	150	143	50	12	4	2	23	47	535	2	49	1	20 lakhs.	30,000 maunds.	1,10,804¼ maunds.	
17	1	150	143	50	12	4	2	23	47	535	2	49	1				
18	1	150	143	50	12	4	2	23	47	535	2	49	1				
19	1	150	143	50	12	4	2	23	47	535	2	49	1				
20	1	150	143	50	12	4	2	23	47	535	2	49	1				
21	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
22	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
23	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
24	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
25	1	150	143	50	12	4	2	23	47	535	2	49	1	...	...	...	
26	1	150	143	50	12	4	2	23	47	535	2	49	...	...	...	...	
27	1	150	143	50	12	4	2	23	47	535	2	49	...	...	...	...	
28	1	150	143	50	12	4	2	23	47	535	2	49	...	...	...	...	
29	1	150	143	50	12	4	2	23	47	535	2	49	...	...	...	...	
30	1	150	143	50	12	4	2	23	47	535	2	49	...	...	...	...	
Totals	30	4,500	4,290	1,500	360	120	60	690	1,420	16,071	60	1,470	25	20,00,000	30,000	1,10,804¼	

2,91,372 cubic feet masonry.

Mortar—

1 Lime, 1 Sand, 1 Soorkee.

C 4.

No. 4. Ramming, &c.

Date and Description.	Bildars, at 4 a.	Bildars, at 2 a.	Total cost of No. 4
Amounts (Rs. A. P.)	22 6 5	3 15 6	26 5 11
1	68	...	
2	30	20	
3	30	11¾	
4	30	...	
5	10	...	
6	...	...	
7	...	...	
8	...	...	
9	...	...	
10	...	...	
11	...	...	
12	...	...	
13	...	...	
14	...	...	
15	...	...	
16	...	...	
17	...	...	
18	...	...	
19	...	...	
20	...	...	
21	...	...	
22	...	...	
23	...	...	
24	...	...	
25	...	...	
26	...	...	
27	...	...	
28	...	...	
29	...	...	
30	...	...	
Totals	168	31¾	

Parapets of Roorkee cattle ghats commenced, and ramming earth below esplanade of cattle ghats.

C 4.

No. 5. Solani Aqueduct Revetments. Step Masonry.

Date and Description.	Masons, at 8 rs.	Masons, at 7 rs.	Masons, at 6 rs.	Mates, at 6 rs.	Bildars, at 4 rs.	Bildars, at 2 a.	Bullees, at 10 rs.	Rope, at 4 rs. (MDS.)	Twine, at 1 r. (S. C.)	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.	Total cost of No. 5
Amounts (Rs. A. P.)	1,200 0 0	791 0 0	284 0 0	84 0 0	400 4 3	19 11 0	360 0 0	40 0 0	2 5 0	13,000 0 0	796 0 0	204 0 0	17,181 4 3
Totals	2,778 15 3						14,402 5 0						
1	150	113	57	14	102	100	360	40	2 5				
2	150	113	47	14	100	57½	...	...	...				
3	150	113	47	14	100	...	...	...	...				
4	150	113	47	14	100	...	...	...	...				
5	150	113	47	14	100	...	...	...	...				
6	150	113	47	14	100	...	...	...	...				
7	150	113	47	14	100	...	...	...	...				
8	150	113	47	14	100	...	...	...	...				
9	150	113	47	14	100	...	...	...	...				
10	150	113	47	14	100	...	...	...	...				
11	150	113	47	14	100	...	...	...	...				
12	150	113	47	14	100	...	...	...	...				
13	150	113	47	14	100	...	...	...	...				
14	150	113	47	14	100	...	...	...	...				
15	150	113	47	14	100	...	...	...	...				
16	150	113	47	14	100	...	...	...	...	13 lakhs.	3,980 maunds.	1,700 maunds.	
17	150	113	47	14	100	...	...	...	...				
18	150	113	47	14	100	...	...	...	...				
19	150	113	47	14	100	...	...	...	...				
20	150	113	47	14	100	...	...	...	...				
21	150	113	47	14	100	...	...	...	...				
22	150	113	47	14	100	...	...	...	...				
23	150	113	47	14	100	...	...	...	...				
24	150	113	47	14	100	...	...	...	...				
25	150	113	47	14	100	...	...	...	...				
26	150	113	47	14	100	...	...	...	...				
27	150	113	47	14	100	...	...	...	...				
28	150	113	47	14	100	...	...	...	...				
29	150	113	47	14	100	...	...	...	...				
30	150	113	47	14	100	...	...	...	...				
Totals	4,500	3,390	1,420	420	3,002	157½	36 score.	10 mds.	0 2 5	13,00,000	3,980	1,700	

1,08,342 cubic feet of masonry.

Mortar—

Same as before.

DAILY ACCOUNT of Expenditure on the undermentioned Works of the Northern

C 4. No. 6. Dressing Centres.

Date and Description.	Mates, at 7 rs.	Bildars, at 2 a.
1	20	1,000
2	1	434
3	...	...
4	...	...
5	...	...
6	...	...
7	...	...
8	...	...
9	...	...
10	...	...
11	...	...
12	...	...
13	...	...
14	...	...
15	...	...
16	...	...
17	...	...
18	...	...
19	...	...
20	...	...
21	...	...
22	...	...
23	...	...
24	...	...
25	...	...
26	...	...
27	...	...
28	...	...
29	...	...
30	...	...
Totals.	21	1,434
Amounts.	4 14 5	179 4 0
Totals.	284 2 5 (Total cost of No. 6)	

Dressing earthen centres for main arch masonry.

C 4. No. 7. Solani Aqueduct Revetments. Main Arch Masonry.

Date and Description.	Masons, at 8 rs.	Masons, at 7 rs.	Mates, at 6 rs.	Bildars, at 4 rs.	Bildars, at 2 a.	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.	Rope, at 4 rs.	Oil, at 5 rs.	Bhabur, at 1 r.
1	75	30	1	122	30	...	...	...	...	...	...
2	75	30	1	100	30	...	...	...	...	...	...
3	75	30	1	100	31	...	...	...	...	...	...
4	75	30	1	100	...	...	...	...	...	...	...
5	75	30	1	100	...	...	...	...	...	...	...
6	75	30	1	100	...	...	...	...	...	...	...
7	75	30	1	100	...	...	...	...	...	...	...
8	75	30	1	100	...	...	...	...	...	...	...
9	75	30	1	100	...	...	...	...	...	...	...
10	75	30	1	100	...	...	...	...	...	...	...
11	75	30	1	100	...	...	...	...	...	...	...
12	75	30	1	100	...				...	...	...
13	75	30	1	100	...				...	...	...
14	75	30	1	100	...				...	...	...
15	75	30	1	100	...				...	...	...
16	75	30	1	100	...	4 lakhs	5,000 maunds	10,000 maunds	...	...	...
17	75	30	1	100	...				...	...	...
18	75	30	1	100	...				...	...	...
19	75	30	1	100	...				...	...	...
20	75	30	1	100	...	...	...	...	...	...	...
21	75	30	1	100	...	...	...	...	...	...	...
22	75	30	1	100	...	...	...	...	...	...	...
23	75	30	1	100	...	...	...	...	...	...	...
24	75	30	1	100	...	...	...	...	...	...	...
25	75	30	1	100	...	...	...	...	...	...	...
26	75	30	1	100	...	...	...	...	...	...	...
27	75	30	1	100	...	...	...	...	...	...	...
28	75	30	1	100	...	...	...	...	...	...	...
29	75	30	1	100	...	...	...	...	...	...	...
30	75	30	1	100	...	...	...	...	...	...	...
Totals.	2,250	900	30	3,022	91	4,00,000	5,000	10,000	50 mds.	10 mds.	M. S. C. 23 17 1
Amounts.	600 0 0	210 0 0	6 0 0	402 14 11	11 6 0	4,000 0 0	1,000 0 0	1,200 0 0	200 0 0	50 0 0	23 6 10
Totals.	1,230 4 11					6,473 6 10					
Total cost of No. 7	7,703 11 9										

48,242 cubic feet of masonry in arches.

Mortar as before.

C 4. No. 8. Lions.

Date and Description.	Masons, at 8 rs.	Masons, at 7 rs.	Bildars, at 4 rs.	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.
1	27	22	24	...	...	...
2	12	22	24	...	...	...
3	12	22	24	...	...	...
4	12	22	24	...	...	...
5	12	22	24	...	...	...
6	12	22	24	...	...	...
7	12	22	24	...	...	...
8	12	22	24	...	...	...
9	12	22	24	...	...	...
10	12	22	24	...	...	...
11	12	22	24	...	...	...
12	12	22	24	...	...	...
13	12	22	24			
14	12	22	24			
15	12	22	24			
16	12	22	24	2 lakhs	1,000 maunds	3,346½ maunds
17	12	22	24			
18	12	22	24			
19	12	22	24			
20	12	22	24	...	...	...
21	12	22	24	...	...	...
22	12	22	24	...	...	...
23	12	22	24	...	...	...
24	12	22	24	...	...	...
25	12	22	24	...	...	...
26	12	22	24	...	...	...
27	12	22	24	...	...	...
28	12	22	24	...	...	...
29	12	22	24	...	...	...
30	12	22	24	...	...	...
Totals.	375	660	720	2,00,000	1,000	3,346½
Amounts.	100 0 0	154 0 0	96 0 0	2,000 0 0	200 0 0	401 9 3
Totals.	350 0 0			2,601 9 3		
Total cost of No. 8	2,951 9 3					

19,734 cubic feet of plain masonry in foundations and pedestals of lions.

Mortar as before.

C 4. No. 9. Lions.

Date and Description.	Masons, at 8 rs.	Masons, at 7 rs.	Bildars, at 4 rs.	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.
1	36	44	30½	...	...	...
2	25	44	23	...	...	...
3	25	44	23	...	...	...
4	25	44	23	...	...	...
5	25	44	23	...	...	...
6	25	44	23	...	...	...
7	25	44	23	...	...	...
8	25	44	23	...	...	...
9	25	44	23	...	...	...
10	25	44	23	...	...	...
11	25	44	23	...	...	...
12	25	44	23			
13	25	44	23			
14	25	44	23			
15	25	44	23			
16	25	44	23	50,000	1,200 maunds	2,558½ maunds
17	25	44	23			
18	25	44	23			
19	25	44	23			
20	25	44	23	...	...	...
21	25	44	23	...	...	...
22	25	44	23	...	...	...
23	25	44	23	...	...	...
24	25	44	23	...	...	...
25	25	44	23	...	...	...
26	25	44	23	...	...	...
27	25	44	23	...	...	...
28	25	44	23	...	...	...
29	25	44	23	...	...	...
30	25	44	23	...	...	...
Totals.	761	1,320	697½	50,000	1,200	2,558½
Amounts.	202 14 10	308 0 0	93 0 0	500 0 0	240 0 0	307 0 6
Totals.	603 14 10			1,047 0 6		
Total cost of No. 9	1,650 15 4					

Bodies of lions.

In progress.

C 4. No. 10. Excavation.

Date and Description.	Bildars, at 2 a.
1	200
2	98
3	...
4	...
5	...
6	...
7	...
8	...
9	...
10	...
11	...
12	...
13	...
14	...
15	...
16	...
17	...
18	...
19	...
20	...
21	...
22	...
23	...
24	...
25	...
26	...
27	...
28	...
29	...
30	...
Totals.	298
Amounts.	37 4 0
Totals.	37 4 0

Below the canal bed, for plastering and refilling the same.

No measurements.

C 4. No. 11. Plastering.

Date and Description.	Masons, at 8 rs.	Mates, at 5 rs.	Bildars, at 2 a.	Lime, at 20 rs.	Soorkee, at 12 rs.
1	389	2	323	...	...
2	375	2	319	...	...
3	375	2	319	...	...
4	375	2	319	...	...
5	375	2	319	...	...
6	375	2	319	...	...
7	375	2	319	...	...
8	375	2	319	...	...
9	375	2	319	...	...
10	375	2	319	...	...
11	375	2	319	...	...
12	375	2	319		
13	375	2	319		
14	375	2	319		
15	375	2	319		
16	375	2	319	3,000 maunds	9,680½ maunds
17	375	2	319		
18	375	2	319		
19	375	2	319		
20	375	2	319	...	...
21	375	2	319	...	...
22	375	2	319	...	...
23	375	2	319	...	...
24	375	2	319	...	...
25	375	2	319	...	...
26	375	2	319	...	...
27	345	2	319	...	...
28	375	2	319	...	...
29	375	2	319	...	...
30	375	2	319	...	...
Totals.	11,264	60	9,574	3,000	9,680½
Amounts.	3,003 11 9	10 0 0	1,196 12 0	700 0 0	1,161 10 6
Totals.	4,210 7 9			1,861 10 6	
Total cost of No. 11	6,072 2 3				

1,56,203 square feet of pukka plaster.

38,032 square feet of the above are not finished.

Roorkee, 1st May, 1853.

Division, Ganges Canal, during the month of April, 1853—*continued.*

C 4. No. 12. Excavation, 15th mile. Mates, at 6 rs.	No. 12. Bildars, at 4 rs.	C 4. No. 13. Excavation, 16th Mile. Mates, at 6 rs.	No. 13. Bildars, at 4 rs.	C 4. No. 14. Spreading Nos. 12 and 13. Bildars, at 2 a.	C 4. No. 15. Excavation, 19th Mile. Bildars, at 4 rs.	No. 15. Bildars, at 2 a.	C 4. No. 16. Excavation, Roorkee Banks. Bildars, at 4 rs.	No. 16. Bildars, at 2 a.	C 4. No. 17. Spreading Nos. 15 and 16. Bildars, at 2 a.	C 4. No. 18. Filling. Vaults. Mates, at 6 rs.	No. 18. Bildars, at 2 a.	C 4. No. 19. Solani Aqueduct Revetments. Plain and Rora Masonry. Masons, at 8 rs.	Masons, at 7 rs.	Masons, at 6 rs.	Mates, at 6 rs.	Bildars, at 5 rs.	Bildars, at 4 rs.	Bricks, at 1,000 rs.	Lime, at 20 rs.	Soorkee, at 12 rs.	Rora, at 6 rs.
1	134	2	229⅛	105	12	1	1	2	...	15	1220	75	86	100	1	3	170				
1	106	2	214	85	11	1	26	30	...	15	1231	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	1	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170	6 lakhs.	15,000 maunds.	17,346 maunds.	1,00,000 cubic feet.
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	...	...	...	75	86	100	1	3	170				
1	106	2	214	85	11	...	...	...	152	...	...	75	86	100	1	3	170				
30	3,208	60	6,435⅛	2,570	331	8	27	32	152	30	2,451	2,250	2,580	3,000	30	90	5,100	6,00,000	15,000	17,346	1,00,000

Work	Item	Cost (Rs. a. p.)	Total
No. 12.	Mates, at 6 rs. ...	6 0 0	
	Bildars, at 4 rs. ...	427 11 6	
	Total cost of No. 12 ...	...	433 11 6
No. 13.	Mates, at 6 rs. ...	12 0 0	
	Bildars, at 4 rs. ...	858 0 3	
	Total cost of No. 13 ...	...	870 0 3
No. 14.	Bildars, at 2 a. ...	321 4 0	321 4 0
No. 15.	Bildars, at 4 rs. ...	44 2 1	
	Bildars, at 2 a. ...	1 0 0	
	Total cost of No. 15 ...	...	45 2 1
No. 16.	Bildars, at 4 rs. ...	3 9 8	
	Bildars, at 2 a. ...	4 0 0	
	Total cost of No. 16 ...	...	7 9 8
No. 17.	Bildars, at 2 a. ...	19 0 0	19 0 0
No. 18.	Mates, at 6 rs. ...	6 0 0	
	Bildars, at 2 a. ...	306 6 0	
	Total cost of No. 17 ...	...	312 6 0
No. 19.	Masons, at 8 rs. ...	600 0 0	
	Masons, at 7 rs. ...	602 0 0	
	Masons, at 6 rs. ...	600 0 0	
	Mates, at 6 rs. ...	6 0 0	
	Bildars, at 5 rs. ...	15 0 0	
	Bildars, at 4 rs. ...	680 0 0	2,503 0 0
	Bricks, at 1,000 rs. ...	6,000 0 0	
	Lime, at 20 rs. ...	3,000 0 0	
	Soorkee, at 12 rs. ...	2,081 8 4	
	Rora, at 6 rs. ...	6,000 0 0	17,081 8 4
	Total cost on No. 19 ...	...	19,584 8 4

Work	Description
No. 12.	1,24,668 cubic feet of earth excavated in 15th mile, filled into wagons propelled along rail by horses, and emptied by side of rail, an average distance of 8,840 feet.
No. 13.	2,26,215 cubic feet of earth, as in the foregoing, average distance 9,650 feet.
No. 14.	3,50,883 cubic feet of earth spread.
No. 15.	10,800 cubic feet of earth wagons propelled by men, average distance 5,000 feet.
No. 16.	1,822 do. do., from Roorkee banks, do., do.
No. 17.	12,623 cubic feet of earth spread.
No. 18.	66,356 cubic feet of earth, formerly deposited in channel, removed to revetment vaults, and rammed.
No. 19.	1,27,008 cubic feet of miscellaneous masonry, chiefly plain, in embankment steps. Mortar as before.

(Signed) ———, *Lieut., Deputy Superintendent.*

PAY BILL of Establishment attached to the Northern Division of the Ganges Canal Works during the month of April, 1853.

Roorkee, 1st *May,* 1853.

Description.	Names.	Amounts.			Total.			Nature of Establishment.
		RS.	A.	P.	RS.	A.	P.	
Misturi	Loutee	25	0	0				
Moonshee	Kooshiab Singh	10	0	0				
Chupprasee	Ramdeen	6	0	0	41	0	0	Permanent.
Jemadar	Heera Singh	12	0	0				
Misturi	Thakoordass	12	0	0				
"	Ram Singh	12	0	0				
"	Ukbur Ali	12	0	0				
"	Imam Ali	12	0	0				
Moonshee...............	Deean Singh	10	0	0				
"	Iftekar Ali	10	0	0				
"	Wuzeeut Ali	10	0	0				
"	Imam-ood-deen	10	0	0				
"	Aman Khan	10	0	0				
Chupprasee	Beeharee Lal	5	0	0				
"	Sirdan	5	0	0				
"	Ellibuksh	5	0	0				
"	Imambuksh	5	0	0				
"	Koodhabuksh	5	0	0				
"	Mahumdee Khan...	5	0	0				
Classee	Jylal	4	0	0				
"	Ram Singh	4	0	0				
"	Gungaram	4	0	0				
"	Gungadeen	4	0	0				
"	Nebbibuksh	4	0	0				
"	Govind	4	0	0				
"	Huzzaree Lal	4	0	0				
"	Nuttoo Khan	4	0	0				
"	Wuzee-ood-deen	4	0	0				
"	Lutfoolla Khan	4	0	0	180	0	0	Fluctuating.
	Total	...		...	221	0	0	

The above men were paid in my presence.

(Signed) ————————

Lieutenant,
Deputy Superintendent.

APPENDIX X.

Lieutenant ————, Deputy Superintendent, in Account Current with the Superintendent of the Northern Division Ganges Canal, for the month of April, 1853.

DR.

Date.	Receipts.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
April 1	To balance in hand ...	...	...		4,000	0	0
" 10	" cash received from the Superintendent ...	1,000	0	0			
" 15	" " " ...	15,000	0	0			
" 16	" " " ...	5,000	0	0			
					21,000	0	0
	Total	...	...		25,000	0	0

CR.

Numbers.	Expenditure.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
	By amount paid for labour during the month of April, 1853, as per daily report, viz.:—						
	No. 1. Earthwork	291	0	3			
	" 2. Clearance	92	11	9			
	" 3. Masonry	5,399	14	9			
	" 4. Earthwork	26	5	11			
	" 5. Masonry	2,778	15	3			
	" 6. Arch centres	284	2	5			
	" 7. Masonry	1,230	4	11			
	" 8. "	350	0	0			
	" 9. "	603	14	10			
	" 10. Earthwork	37	4	0			
	" 11. Plastering	4,210	7	9			
	" 12. Earthwork	433	11	6			
	" 13. "	870	0	3			
	" 14. "	321	4	0			
	" 15. "	45	2	1			
	" 16. "	7	9	8			
	" 17. "	19	0	0			
	" 18. "	312	6	0			
	" 19. Masonry	2,503	0	0			
	By well-sinkers employed on masons' well	7	0	0			
	Presents to drivers on extra work in Roorkee banks	25	0	0			
	Contract carriage of bricks at aqueduct...	500	0	0			
	Paid contract for building workpeople's houses	2,081	5	10			
	Purchase of country pens and ink ...	2	0	0			
					22,432	9	2
	Balance in hand	...	...		2,567	6	10
	Total	...	...		25,000	0	0

Roorkee, 1st *May*, 1853.

Appendix B.

————, Overseer, in Account Current with Captain A. G. Goodwyn, Superintendent of the Northern Division of the Ganges Canal, for the month of February, 1853.

Dr. Cr.

Date.	Receipts.	Amounts.	Total.	Numbers.	Expenditure.	Amounts.	Total.
		RS. A. P.	RS. A. P.			RS. A. P.	RS. A. P.
Feb. 1	To balance of last account	... ...	1,000 0 0		By Solani earthen aqueduct, as per daily report, viz.:		
,, 15	,, cash received from the superintendent ...	5,000 0 0			Expended on:— RS. A. P.		
,, 25	,, ,, ,, ...	4,000 0 0	9,000 0 0		No. 1. Excavation ... 1,816 3 5		
					,, 2. ,, ... 1,967 11 0		
					,, 3. ,, ... 719 12 6		
					,, 4. Spreading ... 1,117 8 8		
					,, 5. Excavation ... 538 6 4		
					,, 6. Spreading ... 190 12 5		
					,, 7. Removing sand 40 10 4		
					,, 8. Spreading ... 269 0 0		
					,, 9. Puddling ... 904 6 4	7,564 7 0	
					By expense incurred on the undermentioned works, as per daily report, viz:		
					No. 10. Plantations	10 0 0	
					,, 11. Brick-kiln at Muhewur	20 0 0	
					,, 12. ,, Roorkee	50 0 0	
					,, 13. Lime-kiln at Myapoor	10 0 0	
					,, 14. Repairing banks	20 0 0	
					,, 15. Iron-work of gates	5 0 0	
					,, 16. Repairing Kulseea Choki ...	37 4 10	
					By regular establishment for February, 1853	10 0 0	
					,, Fluctuating ,, ,, ...	144 11 1	
					,, Purchase of country paper	1 0 0	7,872 6 11
					Balance in hand	... ...	2,127 9 1
	Total	... ...	10,000 0 0		Total	... ...	10,000 0 0

Roorkee, 1st *March*, 1853. (Signed) ———— *Head Clerk.*

———, Overseer, in Account Current with Captain A. G. Goodwyn, Superintendent Northern Division of the Ganges Canal during the month of March, 1853.

DR. CR.

Date.	Receipts.	Amounts. RS. A. P.	Total. RS. A. P.
March 1	To balance of last account	... ...	10,000 0 0
„ 10	„ cash received from the superintendent ...	5,000 0 0	
„ 15	„ „ ...	10,000 0 0	
			15,000 0 0
	Total	... ...	25,000 0 0

Office No.	Expenditure.	Amounts. RS. A. P.	Total. RS. A. P.
	By Solani earthen aqueduct, as per daily report, viz.:—		
	Expended on No. 1. Excavation ...	10,192 13 10	
	„ 2. „ ...	3,407 1 1	
	„ 3. Spreading	3,842 0 3	
	„ 4. Excavation ...	42 2 0	
	„ 5. „ ...	37 11 0	
	„ 6. „ ...	802 4 5	
	„ 7. Spreading	477 10 8	
	„ 8. Removing earth ...	212 0 0	
	„ 9. Spreading	151 0 4	
	„ 10. Ramming	221 13 11	
	„ 11. Dressing slopes ...	100 0 0	
			19,486 9 6
	By expense incurred on the undermentioned works, as per daily report, viz.:		
	No. 12. Plantations	30 0 0	
	„ 13. Muhewur brick-kiln	50 0 0	
	„ 14. Lime-kiln at Roorkee	25 0 0	
	„ 15. Charcoal-kiln, ditto	25 0 0	
	„ 16. Ditto at Mullikpoor	20 0 0	
	„ 17. Synebas bridge	314 4 10	
	„ 18. Soorkee	132 8 0	
	By regular establishment for March, 1853	10 0 0	
	„ fluctuating „ „	144 0 0	
	„ purchase of country paper	2 0 0	
	„ repairs of banks (contract), 20 miles, at 30 *rs.* per mile	600 0 0	
			1,352 12 10
			20,839 6 4
	Balance in hand	... ...	4,160 9 8
	Total	... ...	25,000 0 0

(Signed) ———

Roorkee, 1st April, 1853. *Head Clerk.*

Lieutenant ———, Deputy Superintendent, in Account Current with the Superintendent of the Northern Division Ganges Canal for the month of April, 1853.

Dr.

Date.	Receipts.	Amounts. RS. A. P.	Total. RS. A. P.
April 1	To balance of last account	... ...	9,000 0 0
„ 10	To cash received from the superintendent ...	1,000 0 0	
„ 15	„ „ ...	15,000 0 0	
„ 15	To 10 lakhs of bricks received, at 1,000 *rs.* per lakh	10,000 0 0	
„ 16	„ 40 ditto, at ditto ...	40,000 0 0	
„ 16	„ cash received from the superintendent ...	5,000 0 0	
„ 20	„ 1,00,000 maunds of stone lime, at 20 *rs.* per 1,000 maunds ...	20,000 0 0	
„ 20	„ 1,25,000 maunds of Soorkee, at 12 *rs.* per do.	15,000 0 0	1,06,000 0 0
	Total	... ...	1,15,000 0 0

Cr.

Office No.	Expenditure.	RS. A. P.	Amounts. RS. A. P.	Total. RS. A. P.
	By Solani aqueduct revetments and earthwork, as per daily report, viz. :—			
	No. 1. Excavation for foundations	291 0 3		
	„ 2. Clearance	92 11 9		
	„ 3. Plain masonry ...	44,696 6 10		
	„ 4. Ramming	26 5 11		
	„ 5. Step masonry ...	17,181 4 3		
	„ 6. Dressing centres ...	284 2 5		
	„ 7. Main arch masonry..	7,703 11 9		
	„ 8. Masonry of lions ...	2,951 9 3		
	„ 9. „ „ ...	1,650 15 4		
	„ 10. Excavation preparatory to plastering .	37 4 0		
	„ 11. Plastering ...	6,072 2 3		
	„ 12. Excavation ...	433 11 6		
	„ 13. „ „ ...	870 0 3		
	„ 14. Spreading ...	321 4 0		
	„ 15. Excavation ...	45 2 1		
	„ 16. „ „ ...	7 9 8		
	„ 17. Spreading ...	19 0 0		
	„ 18. Filling vaults ...	312 6 0		
	„ 19. Plain and rora masonry ...	19,584 8 4	1,02,581 3 10	
	By paid to well-sinkers employed on well for masons' houses		7 0 0	
	„ present to drivers on Roorkee banks, extra work		25 0 0	
	„ contractors for carriage of bricks from upper to lower end of aqueduct ...		500 0 0	
	„ contractors for building masons' and bildars' houses		2,081 5 10	
	„ purchase of country pens and ink ...		2 0 0	1,05,196 9 8
	Balance in hand		... ...	9,803 6 4
	Total		... ...	1,15,000 0 0

Roorkee, May, 1853.

(Signed) ———, *Head Clerk.*

APPENDIX Y.

OFFICE ABSTRACT of Overseer ————'s Accounts for the month of February, 1853.

Number of Work.	Description of Work.	Labour. Rs.	A.	P.	Materials. Rs.	A.	P.	Total. Rs.	A.	P.
C. 4	Excavation, 15th mile	1,446	9	8	369	9	9	1,816	3	5
	„ 16th mile	1,474	13	10	492	13	2	1,967	11	0
	„ „	668	2	0	51	10	6	719	12	6
	Spreading the above	1,117	8	8	...	...		1,117	8	8
	Excavation, Roorkee banks	538	6	4	...	...		538	6	4
	Spreading the above	190	12	5	...	...		190	12	5
	Removing sand from aqueduct	40	10	4	...	...		40	10	4
	Spreading	269	0	0	...	...		269	0	0
	Puddling	904	6	4	...	...		904	6	4
	Totals on original works	6,650	5	7	914	1	5	7,564	7	0
M. 2	Brick-kiln at Muhewur	10	9	4	9	6	8	20	0	0
	„ Roorkee	28	15	8	21	0	4	50	0	0
M. 3	Lime-kiln at Myapoor	5	0	0	5	0	0	10	0	0
	Totals on stores	44	9	0	35	7	0	80	0	0
N. 1	Regular establishment	...	...		...	...		10	0	0
N. 2	Repairing banks	18	15	4	1	0	8	20	0	0
	„ iron-work of gates	0	8	0	4	8	0	5	0	0
	„ Kulseea Choki	5	0	0	32	4	10	37	4	10
N. 3	Plantations	9	0	0	1	0	0	10	0	0
N. 4	Purchase of country paper	...	...		...	...		1	0	0
	Totals on current expenses	33	7	4	38	13	6	83	4	10
S.	Fluctuating establishment	...	...		...	...		144	11	1
	Total on sundries	...	...		...	...		144	11	1
	Total expenditure during the month ...	6,728	5	11	988	5	11	7,872	6	11

OFFICE ABSTRACT of Overseer ———'s Account for the month of March, 1853.

Number of Work.	Descriptions.	Labour.			Materials.			Total.		
		RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
B. 6	Synabas bridge	18	8	6	295	12	4	314	4	10
C. 4	Excavation, 15th mile	8,038	10	8	2,154	3	2	10,192	13	10
	„ 16th mile	2,805	3	10	601	13	3	3,407	1	1
	Spreading the above	3,842	0	3	...	...		3,842	0	3
	Excavation, 16th mile	42	2	0	...	...		42	2	0
	„ 19th mile	37	11	0	...	...		37	11	0
	„ Roorkee banks	802	4	5	...	...		802	4	5
	Spreading last two items	477	10	8	...	...		477	10	8
	Removing earth already deposited	212	0	0	...	...		212	0	0
	Spreading	151	0	4	...	...		151	0	4
	Ramming	221	13	11	...	...		221	13	11
	Dressing slopes	100	0	0	...	...		100	0	0
	Totals on original works	16,749	1	7	3,051	12	9	19,800	14	4
M. 2	Muhewur brick-kiln	1	15	8	48	0	4	50	0	0
M. 3	Roorkee lime-kiln	1	3	0	23	13	0	25	0	0
M. 4	Charcoal-kiln at Roorkee	1	3	0	23	13	0	25	0	0
	„ Mullikpoor	0	12	8	19	3	4	20	0	0
M. 5	Making Soorkee	20	0	0	112	8	0	132	8	0
	Totals on stores	25	2	4	227	5	8	252	8	0
N. 1	Regular establishment	...	...		...	...		10	0	0
N. 2	Repairs of banks	...	...		...	...		600	0	0
N. 3	Plantations	1	15	8	28	0	4	30	0	0
N. 4	Purchase of country paper	...	...		...	...		2	0	0
	Totals on current expenses ...	1	15	8	28	0	4	642	0	0
S.	Fluctuating establishment	...	...		...	...		144	0	0
	Totals on sundries	...	...		...	...		144	0	0
	Total expenditure during the month ...	10,776	3	7	3,307	2	9	20,839	6	4

OFFICE ABSTRACT of Deputy Superintendent ————'s Account for the Month of April, 1853.

Number of Work.	Description of Work.	Labour.			Materials.			Totals.		
		RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
C. 4	Excavation for foundations	291	0	3	...	...		291	0	3
	Clearance	92	11	9	...	...		92	11	9
	Plain masonry	5,399	14	9	39,296	8	1	44,696	6	10
	Ramming, &c.	26	5	11	...	...		26	5	11
	Step masonry	2,778	15	3	14,402	5	0	17,181	4	3
	Dressing centres	284	2	5	...	...		284	2	5
	Main arch masonry	1,230	4	11	6,473	6	10	7,703	11	9
	Masonry of lions	350	0	0	2,601	9	3	2,951	9	3
	" "	603	14	10	1,047	0	6	1,650	15	4
	Excavation preparatory to plastering	37	4	0	...	...		37	4	0
	Plastering	4,210	7	9	1,861	10	6	6,072	2	3
	Excavation, 15th mile	433	11	6	...	...		433	11	6
	" 16th mile	870	0	3	...	...		870	0	3
	Spreading the above	321	4	0	...	...		321	4	0
	Excavation, 19th mile	45	2	1	...	...		45	2	1
	" Roorkee banks	7	9	8	...	...		7	9	8
	Spreading the above	19	0	0	...	...		19	0	0
	Filling vaults	312	6	0	...	...		312	6	0
	Plain and rora masonry	2,503	0	0	17,081	8	4	19,584	8	4
	Totals on original works	19,817	3	4	82,764	0	6	1,02,581	3	10
M. 2	Carriage of bricks	...	...		...	...		500	0	0
	Total on stores	...	...		...	...		500	0	0
N. 4	Purchase of country pens and ink	...	...		...	...		2	0	0
	Total on current expenses	...	...		...	...		2	0	0
S.	Paid well-sinkers at aqueduct well	...	...		...	...		7	0	0
	Presents to drivers on Roorkee digging	...	...		...	...		25	0	0
	Cost of workpeoples' houses	...	...		...	...		2,081	5	10
	Total on sundries	...	...		...	...		2,113	5	10
	Total expenditure during the month ...	...	...		...	...		1,05,196	9	8

APPENDIX C.

The Northern Division, Ganges Canal, in Account Current with the Honourable Company for the Month of February, 1853.

DR.

Date.	Receipts.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
Feb. 1	To balance of last account	..	..		11,000	0	0
„	„ amount of assignment (No. 10 of 1852–53, dated the 15th ultimo) drawn by the Accountant N. W. P. on the Suharunpoor treasury	..	..		75,000	0	0
	Total ..	..	..		86,000	0	0

CR.

Numbers.	Expenditure.	RS.	A.	P.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
	By original works, viz.:—									
C. 4	Expended on the Solani earthen aqueduct				7,564	7	0	7,564	7	0
	By current expenses, viz.:—									
N. 3	Plantations				10	0	0			
N. 2	Ordinary repairs:—									
	Repairing banks ..	20	0	0						
	„ Kulseea Choki	37	4	10						
	Iron-work of gates ..	5	0	0						
					62	4	10			
N. 1	Regular establishment				10	0	0			
N. 4	Office contingent expenses				1	0	0			
								83	4	10
	By sundries account:—									
S.	Fluctuating establishment				..	..		144	11	1
F.	By Mr. Finn: advances				..	..		60,000	0	0
	By materials accounts, viz.:—									
M. 1	Advance to timber contractors ..				7,000	0	0			
M. 2	Muhewur brick-kiln				20	0	0			
M. 2	Roorkee „				50	0	0			
M. 3	Myapoor lime-kiln				10	0	0			
								7,080	0	0
								74,872	6	11
	Balance in hand				..	..		11,127	9	1
	Total				..	..		86,000	0	0

The Northern Division, Ganges Canal, in Account Current with the Honourable Company for the Month of March, 1853.

Dr.

Date.	Receipts.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
Mar. 1	To balance of last account	..			19,000	0	0
„ 9	„ amount of assignment (No. 12 of 1852–53, dated the 25th ultimo) drawn by the accountant N. W. P. on the Suharunpoor treasury	75,000	0	0	75,000	0	0
	Total ..	..	..		94,000	0	0

Cr.

Numbers.	Expenditure.	Amounts. RS.	A.	P.	Total. RS.	A.	P.
	By original works, viz.:—						
C. 4	Expended on Solani earthen aqueduct (office)	1	0	0			
C. 4	Expended on the Solani earthen aqueduct (overseer)	19,486	9	6			
B. 6	„ on the Synebas bridge ..	314	4	10	19,801	14	4
	By current expenses, viz.:—						
N. 1	Regular establishment	10	0	0			
N. 2	Ordinary repairs: repairs of banks ..	600	0	0			
N. 3	Plantations	30	0	0			
N. 4	Purchase of country paper	2	0	0	642	0	0
S.	By sundries account:—						
	Fluctuating establishment	144	0	0			
	Well at aqueduct for workpeople, &c. .	291	4	5	435	4	5
F.	By Mr. Finn: advances	..	..		40,000	0	0
	By materials accounts, viz.:—						
M. 2	Muhewur brick-kiln	50	0	0			
M. 3	Roorkee lime-kiln	25	0	0			
M. 4	Charcoal-kiln at Roorkee	25	0	0			
„	„ „ Mullikpoor	20	0	0			
M. 5	Soorkee	132	8	0			
M. 6	Iron and miscellaneous metals ..	25,000	0	0	25,252	8	0
					86,131	10	9
	Balance in hand	..	..		7,868	5	3
	Total	..	..		94,000	0	0

The Northern Division, Ganges Canal, in Account Current with the Honourable Company for the Month of April, 1853.

DR. CR.

Date.	Receipts.	Amounts. RS. A. P.	Total. RS. A. P.
Apr. 1	To balance of last account		12,707 11 7
„ 5	„ amount of assignment (No. 15, of 1852–53, dated the 23rd ultimo) drawn by the Accountant N. W. P. on the Suharunpoor Treasury ..	75,000 0 0	
	„ Mr. Finn: amount value of undermentioned materials delivered to deputy superintendent:		
	50 lakhs of bricks at 1,000 *rs.* .. 50,000		
	1,00,000 maunds of stone, lime at 20 *rs.* 20,000		
	1,25,000 maunds of Soorkee at 12 *rs.* 15,000	85,000 0 0	1,60,000 0 0
	Total	... ...	1,72,707 11 7

Numbers.	Expenditure.	Amounts. RS. A. P.	Total. RS. A. P.
	By original works, viz.:—		
C. 4	Expended on Solani earthen aqueduct (deputy superintendent) ..	1,02,581 3 10	
„	Expended on Solani earthen aqueduct (office)	419 10 2	1,03,000 14 0
N.	By current expenses, viz.:—		
N. 1	Regular establishment	41 0 0	
N. 4	Office contingent expenses	2 0 0	43 0 0
S.	By sundries, viz.:—		
	Well-sinkers at masons', &c., well at aqueduct	7 0 0	
	Presents to drivers on Roorkee banks, digging	25 0 0	
	Cost (contract) of houses for work-people	2,081 5 10	
	Fluctuating establishment	180 0 0	2,293 5 10
F.	By Mr. Finn: advances	.. ..	40,000 0 0
M. 2	By materials account: carriage of bricks	.. ..	500 0 0
			1,45,837 3 10
	Balance in hand	.. ..	26,870 7 9
	Total	.. ..	1,72,707 11 7

Appendix D.

Sayer Account Current of the Northern Division, Ganges Canal Works, for the Half-year ending the 30th April, 1853.

Dr.

	RS.	A.	P.	RS.	A.	P.
To balance, viz.:—						
Cash	19,300	0	0			
Inefficient	12,55,000	0	0	12,74,300	0	0
To civil building remittances, viz.:—						
To amount of assignment (No. 10 of 1852–53, dated 15th January, 1853) drawn by the Accountant N.W.P. on the Suharunpoor treasury	75,000	0	0			
To amount of assignment (No. 12 of 1852–53, dated 25th February, 1853) drawn by the Accountant N.W.P. on the Suharunpoor treasury	75,000	0	0			
To amount of assignment (No. 15 of 1852–53, dated 23rd March, 1853) drawn by the Accountant N.W.P. on the Suharunpoor treasury	75,000	0	0	2,25,000	0	0
Grand total ..	..	..		14,99,300	0	0

Cr.

	RS.	A.	P.	RS.	A.	P.
By Ganges Canal, viz.:—						
Bill (No. 220, Book of 1852–53, Military Boards' Office) for amount expended on the Solani masonry aqueduct during the quarter ending 31st January, 1853, passed by the Military Board on the 1st April, 1853	1,00,000	0	0			
Bill (No. 221, same book and office) for amount expended on the Solani earthen aqueduct, passed by the Military Board on the 1st February, 1853	1,00,000	0	0	2,00,000	0	0
By Balance, viz.:—						
Cash	24,518	3	8			
Inefficient, viz.:—						
Amount of bills submitted to the Military Board for audit as per last account ..	2,00,000	0	0			
Add since submitted—						
Bill No. 15, for Solani earthen aqueduct ..	1,36,249	6	4			
„ „ 25, „ Synabas bridge	314	4	10			
„ „ 2, „ establishment for Feb. 1853 ..	10	0	0			
„ „ 3, „ „ March, 1853	10	0	0			
„ „ 4, „ „ April, 1853 .	41	0	0			
„ „ 5, „ ordinary repairs for Feb. 1853	62	4	10			
„ „ 6, „ „ „ Mar. 1853	600	0	0			
„ „ 7, „ plantations for February, 1853	10	0	0			
„ „ 8, „ „ March, 1853 ..	30	0	0			
„ „ 9, „ office contingent expenses for February, 1853	1	0	0			
„ „ 10, „ „ „ for March, 1853	2	0	0			
„ „ 11, „ „ „ for April, 1853	2	0	0			
	3,37,332	0	0			
Deduct bills passed as above ..	2,00,000	0	0			
	1,37,332	0	0			
Advances on account of original works ..	5,00,000	0	0			
„ „ stores	4,30,772	14	10			
„ „ tools	46,676	13	6			
„ to Mr. Finn	1,55,000	0	0			
	11,32,449	12	4			
Value of magazine stores on hand	5,000	0	0	12,99,300	0	0
Grand total ..	..	..		14,99,300	0	0

Roorkee, 1*st May*, 1853. (Signed) A. G. GOODWYN, *Captain, Superintendent Northern Division, Ganges Canal.*

APPENDIX E. . . . . . .

ORIGINAL WORKS

DR. Solani Earthen Aqueduct. CR.

C 4.

Date.	Description.	Amounts.	Total.	Description.	Total.
		RS. A. P.	RS. A. P.		RS. A. P.
1853. Feb. ..	To overseer	.. ..	7,564 7 0	By bill No. 15, for the quarter ending 30th April, 1853	1,36,249 6 4
March	To overseer	19,487 9 6			
	,, cash	1 0 0	19,487 9 6		
	Carried forward ...	... ...	27,052 0 6	Carried forward ...	1,36,249 6 4

. . . . . . Appendix E.

Account Book.

Detailed explanation of Debits.

Date.	Description.	Labour.			Materials.			Totals.		
		RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
1853. February	Excavation, 5,00,966 cubic feet:—15th mile; wagons drawn by horses, average distance 8,540 feet ..	1,446	9	8	369	9	9	1,816	3	5
	Excavation, 3,99,300 cubic feet:—16th mile; wagons drawn by horses, average distance 11,555 feet ..	1,474	13	10	492	13	2	1,967	11	0
	Excavation, 2,02,112 cubic feet:—16th mile; wagons propelled by men, average distance 7,000 feet ..	668	2	0	57	10	6	719	12	6
	11,02,378 cubic feet in above three items spread ..	1,117	8	8	..		..	1,117	8	8
	Excavation, 1,94,525 cubic feet:—Roorkee banks; wagons propelled by men, average distance 5,000 feet	538	6	4	..		..	538	6	4
	Spreading the foregoing	190	12	5	..		..	190	12	5
	Removing 16,250 cubic feet of surplus sand from top of aqueduct and depositing it in channel	40	10	4	..		..	40	10	4
	Spreading 1,30,000 cubic feet of earth already deposited	269	0	0	..		..	269	0	0
	Puddling 2,90,828 „ „	904	6	4	..		..	904	6	4
	Total	6,650	5	7	914	1	5	7,564	7	0
March ..	Excavation, 21,30,206 cubic feet:—15th mile; wagons drawn by horses, average distance 10,760 feet ..	8,038	10	8	2,154	3	2	10,192	13	10
	Excavation, 7,55,758 cubic feet:—16th mile; wagons drawn by horses, average distance 10,775 feet ..	2,805	3	10	601	13	3	3,407	1	1
	28,85,964 cubic feet in above two items spread ..	3,842	0	3	..		..	3,842	0	3
	Excavation, 14,250 cubic feet:—(virgin soil) 16th mile; baskets, average distance 150 feet, up a slope of 50 feet, and spread	42	2	0	..		..	42	2	0
	Excavation, 12,195 cubic feet:—19th mile; wagons propelled by men, average distance 5,000 feet ..	37	11	0	..		..	37	11	0
	Excavation, Roorkee banks, as above, distance 4,720 ft.	803	4	5	..		..	803	4	5
	3,01,269 cubic feet in above two items, spread ..	477	10	8	..		..	477	10	8
	1,07,875 cubic feet earth, formerly deposited in channel, removed to embankments and spread	212	0	0	..		..	212	0	0
	50,340 cubic feet of earth spread a distance of 200 feet	151	0	4	..		..	151	0	4
	Ramming earth round quadrantal and other steps ..	221	13	11	..		..	221	13	11
	Dressing slopes, 17,807 cubic feet of excavation, preparatory to dressing, and 22,800 square feet of slopes dressed	100	0	0	..		..	100	0	0
	Total	16,731	9	1	2,756	0	5	19,487	9	6

DR. Solani Earthen Aqueduct—*continued.* CR.

Date.	Description.	Amounts.	Total.	Description.	Total.
		RS. A. P.	RS. A. P.		RS. A. P.
1853.	Brought forward ..	.. ..	27,052 0 6	Brought forward ..	1,36,249 6 4
April ..	To deputy superintendent	1,02,581 3 10			
	,, cash	419 10 2			
	,, sundries account ..	2,873 5 4			
	,, tools account ..	3,323 2 6	1,09,197 5 10		
	Total	.. ..	1,36,249 6 4	Total	1,36,249 6 4

DR. Synabas Bridge. CR.
B 6.

March	To overseer	.. ..	314 4 10	By bill No. 25, for the quarter ending 30th April, 1853	314 4 10

Detailed explanation of Debits—*continued.*

C 4.

Date.	Description.	Labour. RS.	A.	P.	Materials. RS.	A.	P.	Totals. RS.	A.	P.
1853. April ..	Breaking up revetment for foundation of lions, and 34,224 cubic feet of excavation in foundations of lions and embankment steps	291	0	3	..		..	291	0	3
	Clearing away argillaceous deposit from revetments ..	92	11	9	..		..	92	11	9
	2,91,372 cubic feet plain masonry in revetments ..	5,399	14	9	39,296	8	1	44,696	6	10
	Parapets of Roorkee cattle ghats commenced and ramming earth below esplanade of cattle ghat	26	5	11	..		..	26	5	11
	1,08,342 cubic feet step masonry in revetments ..	2,778	15	3	14,402	5	0	17,181	4	3
	Dressing earthen centres for main arches	284	2	5	..		..	284	2	5
	48,242 cubic feet arch masonry	1,230	4	11	6,473	6	10	7,703	11	9
	19,734 cubic feet plain masonry in foundations and pedestals of lions	350	0	0	2,601	9	3	2,951	9	3
	Bodies of lions in progress	603	14	10	1,047	0	6	1,650	15	4
	Excavation below canal bed preparatory to plastering and refilling the same	37	4	0	..		..	37	4	0
	1,56,203 square feet plaster (38,032 feet not polished)	4,210	7	9	1,861	10	6	6,072	2	3
	Excavation, 1,24,668 cubic feet:—15th mile; wagons drawn by horses, average distance 8,840 feet ..	433	11	6	156	7	1	590	2	7
	Excavation, 2,26,215 cubic feet:—16th mile; wagons as before, distance 9,650 feet	870	0	3	263	3	1	1,133	3	4
	3,50,883 cubic feet in last two items spread	321	4	0	..		..	321	4	0
	Excavation, 10,800 cubic feet:—19th mile; wagons propelled by men, average distance 5,000 feet ..	45	2	1	..		..	45	2	1
	Excavation, 1,822 cubic feet:—Roorkee banks, same as before, same distance	7	9	8	..		..	7	9	8
	12,622 cubic feet in last two items spread	19	0	0	..		..	19	0	0
	66,356 cubic feet filled into vaults and rammed ..	312	6	0	..		..	312	6	0
	1,27,008 cubic feet plain and rora masonry	2,503	0	0	17,081	8	4	19,584	8	4
	Totals	19,817	3	4	83,183	10	8	1,03,000	14	0
	Share of sundries divisible on quarter's work	..		..	..		..	2,873	5	4
	Share of tools divisible on quarter's work	..		..	..		..	3,323	2	6

March ..	3,000 cubic feet, masonry in foundations and wing walls of Synebas Bridge	18	8	6	295	12	4	314	4	10

APPENDIX F.

STORE ACCOUNT-BOOK.

DR. M 1. TIMBER ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
February	To balance	1,00,000 0 0	February	By lime account	5 0 0	
	„ advances to contractors	7,000 0 0		„ brick „	1 0 4	
						6 0 4
			March ...	„ charcoal account	... ...	42 14 0
			April ...	„ Solani aqueduct revetments	... ...	360 0 0
				By balance	... ...	1,06,591 1 8
	Total	1,07,000 0 0		Total	... ...	1,07,000 0 0

DR. M 2. BRICK ACCOUNT. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.	RS. A. P.
	To balance	... ...	1,00,000 0 0	February	By ordinary repairs account	... ...	5 0 0
February	„ Muhewur kiln	20 0 0		March ...	„ Synabas bridge	202 8 0	
	„ Roorkee kiln	50 0 0			„ Soorkee account	112 8 0	
			70 0 0				315 0 0
March ...	„ Muhewur kiln	... ...	50 0 0	April ...	„ Solani aqueduct revetments ...	... ...	51,500 0 0
April ...	„ carriage	500 0 0			By balance	... ...	98,900 0 0
	„ 50 lakhs 2½-inch pukka, at 1,000 *rs.*	50,000 0 0					
			50,500 0 0				
	Total	... ...	1,50,620 0 0		Total	... ...	1,50,620 0 0

DR. M 3. LIME ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.
	To balance	50,000 0 0	February	By ordinary repairs account	22 8 0
February	„ Myapoor lime-kiln	10 0 0	March ...	„ Synabas bridge	51 0 0
March ...	„ Roorkee lime-kiln	25 0 0	April ...	„ Solani aqueduct revetments	11,936 0 0
April ...	„ 1 lakh of maunds of stone lime, at 20 *rs.*	20,000 0 0		By balance	58,025 8 0
	Total	70,035 0 0		Total	70,035 0 0

DR. M 4. CHARCOAL ACCOUNT. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
	To balance	... ...	1,000 0 0		By balance	1,045 0 0
March ...	„ Roorkee kiln	25 0 0				
	„ Mullikpoor	20 0 0				
			45 0 0			
	Total	... ...	1,045 0 0		Total	1,045 0 0

DR. **M 5.** SOORKEE ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
	To balance	50,000 0 0	February	By ordinary repairs	4 12 10	
March ...	„ 1,104 maunds Soorkee, at 12 *rs.*	132 8 0	March ...	„ Synabas bridge	40 12 10	
April ...	„ 1,25,000 „ „	15,000 0 0	April ...	„ Solani aqueduct revetments ...	18,652 4 8	
						18,697 14 4
				By balance	... ...	46,434 9 8
	Total	65,132 8 0		Total	... ...	65,132 8 0

DR. **M 6.** IRON ACCOUNT. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
	To balance	... ...	9,000 0 0	February	By ordinary repairs account	4 8 0
March ...	„ 2,000 maunds of bar iron, at 8 *rs.* ...	16,000 0 0			By balance	33,995 8 0
	„ 1,000 maunds of angle iron at 9 *rs.* ...	9,000 0 0				
			25,000 0 0			
	Total	... ...	34,000 0 0		Total	34,000 0 0

DR. **M 7.** LIVE STOCK ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
	To balance	50,000 0 0	February	By Solani earthen aqueduct	772 13 2	
			March ...	„ „ „	2,600 0 0	
						3,372 13 2
				By balance	... ...	46,627 2 10
	Total	50,000 0 0		Total	... ...	50,000 0 0

DR. **M 8.** MISCELLANEOUS ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
	To balance	40,000 0 0	February	By Solani earthen aqueduct	141 4 3	
				„ plantations account	1 0 0	
				„ brick account	29 6 8	
				„ ordinary repairs account	1 0 8	
						172 11 7
			March ...	„ Synabas bridge	157 7 11	
				„ charcoal account	0 2 4	
				„ lime account	23 13 0	
				„ brick account	48 0 4	
				„ plantations account	28 0 4	
						257 7 11
				„ Solani earthen aqueduct and revetments	... ...	315 11 10
				By balance	... ...	39,254 0 8
	Total	40,000 0 0		Total	... ...	40,000 0 0

APPENDIX G.

MISCELLANEOUS ACCOUNTS-BOOK.

DR. N 1. REGULAR ESTABLISHMENT. CR.

1853.		RS. A. P.	1853.		RS. A. P.
February	To Overseer ——'s bill for establishment	10 0 0	February	By current bill No. 2 of 1853, for establishment ...	10 0 0
March ...	„ Overseer ——'s „ „	10 0 0	March ...	„ „ No. 3 „ „	10 0 0
April ...	„ Deputy Superintendent ——'s bill for establishment	41 0 0	April ...	„ „ No. 4 „ „	41 0 0
	Total	61 0 0		Total	61 0 0

DR. N 2. ORDINARY REPAIRS. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
February	To one mile of embankment repaired ...	20 0 0		February	By current bill No. 5 of 1853, for ordinary repairs ...	62 4 10
	„ repairs of regulating bridge chains ...	5 0 0		March ...	„ „ No. 6 „ „ ...	600 0 0
	„ „ Kulseea Choki	37 4 10				
			62 4 10			
March ...	„ contract repairs of banks—20 miles, at 30 *rs.*	... ...	600 0 0			
	Total	... ...	662 4 10		Total	662 4 10

DR. N 3. PLANTATIONS ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.
February	To planting 300 and clearing 1,000 trees	10 0 0	February	Bill No. 7 of 1853, for plantations	10 0 0
March ...	„ 500 teak-trees and 1,000 young plants planted ...	30 0 0	March ...	„ No. 8 „ „	30 0 0
	Total	40 0 0		Total	40 0 0

DR. N 4. CONTINGENT EXPENSES. CR.

1853.		RS. A. P.	1853.		RS. A. P.
February	To 10 quires country paper	1 0 0	February	By bill No. 9 for 1853, for office contingent expenses ...	1 0 0
March ...	„ 20 „ „	2 0 0	March ...	„ No. 10 „ „ „ ...	2 0 0
April ...	„ purchase of country pens and ink	2 0 0	April ...	„ No. 11 „ „ „ ...	2 0 0
	Total	5 0 0		Total	5 0 0

DR. F. MR. FINN'S ACCOUNT. CR.

Date	Particulars	RS. A. P.	RS. A. P.	Date	Particulars	RS. A. P.	RS. A. P.
1853.				1853.			
	To balance	... ...	1,00,000 0 0	April ...	By 50 lakhs 2½ pukka bricks, at 1,000 *rs.*	50,000 0 0	
February	„ advances	60,000 0 0			„ 1,00,000 maunds stone lime, at 20 *rs.* ...	20,000 0 0	
March ...	„	40,000 0 0			„ 1,25,000 maunds Soorkee, at 12 *rs.* ...	15,000 0 0	
April ...	„	40,000 0 0					85,000 0 0
			1,40,000 0 0		By balance	... ...	1,55,000 0 0
	Total	... ...	2,40,000 0 0		Total	... ...	2,40,000 0 0

DR. T. TOOL ACCOUNT. CR.

Date	Particulars	RS. A. P.	Date	Particulars	RS. A. P.
1853.	To balance	50,000 0 0	1853. April ...	By Solani earthen aqueduct	3,323 2 6
				By balance	46,676 13 6
	Total	50,000 0 0		Total	50,000 0 0

DR. S. SUNDRIES ACCOUNT. CR.

Date	Particulars	RS. A. P.	RS. A. P.	Date	Particulars	RS. A. P.
1853.				1853.		
February	To fluctuating establishment	... ...	144 11 1	April ...	By Solani earthen aqueduct	2,873 5 4
March ...	„ „ „	144 0 0				
	„ well at aqueduct for workpeople ...	291 4 5				
			435 4 5			
April ...	„ fluctuating establishment	180 0 0				
	„ cost (contract) of workpeople's houses at aqueduct	2,113 5 10				
			2,293 5 10			
	Total	... ...	2,873 5 4		Total	2,873 5 4

Appendix H.

CHECK BOOK.

Accountant N. W. P.

Dr. | Cr.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.	RS. A. P.
February	To bills	1,00,000 0 0		February	By balance	... ...	12,74,300 0 0
April ...	,, ,, ...	1,00,000 0 0			,, cash	75,000 0 0	
			2,00,000 0 0	March ...	,, ,, ...	75,000 0 0	
	To balance	... ...	12,99,300 0 0	April ...	,, ,, ...	75,000 0 0	
							2,25,000 0 0
	Total	... ...	14,99,300 0 0		Total	... ...	14,99,300 0 0

Bills Account.

Dr. | Cr.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.	RS. A. P.
February	To balance	... ...	2,00,000 0 0	February	By Accountant N. W. P.	1,00,000 0 0	
	,, current expenses	... ...	83 4 10	April ...	,, ,, ,, ...	1,00,000 0 0	
March ...	,, ,, ,, ...	... ...	642 0 0				2,00,000 0 0
April ...	,, ,, ,, ...	43 0 0			By balance	... ...	1,37,332 0 0
	,, original works	1,36,563 11 2					
			1,36,606 11 2				
	Total	... ...	3,37,332 0 0		Total	... ...	3,37,332 0 0

Cash Account.

Dr. | Cr.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.	RS. A. P.
	To balance	... ...	10,000 0 0	February	By Overseer	9,000 0 0	
February	,, Accountant N. W. P.	75,000 0 0			,, Mr. Finn	60,000 0 0	
March ...	,, ,, ,, ...	75,000 0 0			,, stores	7,000 0 0	
April ...	,, ,, ,, ...	75,000 0 0					76,000 0 0
			2,25,000 0 0	March ...	,, labour	1 0 0	
					,, Mr. Finn	40,000 0 0	
					,, Overseer	15,000 0 0	
					,, sundries	291 4 5	
					,, stores	25,000 0 0	
							80,292 4 5
				April ...	,, Deputy Superintendent	21,000 0 0	
					,, Mr. Finn	40,000 0 0	
					,, sundries	180 0 0	
					,, original works	419 10 2	
					,, current expenses	41 0 0	
							61,640 10 2
					By balance	... ...	17,067 1 5
	Total	... ...	2,35,000 0 0		Total	... ...	2,35,000 0 0

Dr. CURRENT EXPENSES. Cr.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
February	To labour ...	33 7 4		February	By bills ...	83 4 10
	„ stores ...	38 13 6		March ...	„ „ ...	642 0 0
	„ Overseer ...	11 0 0	83 4 10	April ...	„ „ ...	43 0 0
March ...	„ labour ...	1 15 8				
	„ stores ...	28 0 4				
	„ Overseer ...	612 0 0	642 0 0			
April ...	„ cash account ...	41 0 0				
	„ Deputy Superintendent ...	2 0 0	43 0 0			
	Total ...	... ...	768 4 10		Total ...	768 4 10

Dr. DEPUTY SUPERINTENDENT ———'s ACCOUNT. Cr.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
April ...	To balance ...	4,000 0 0	April ...	By labour ...	19,817 3 4	
	„ cash ...	21,000 0 0		„ sundries ...	2,113 5 10	
				„ stores ...	500 0 0	
				„ current expenses ...	2 0 0	22,432 9 2
				By balance ...	... ...	2,567 6 10
	Total ...	25,000 0 0		Total ...	... ...	25,000 0 0

Dr. MR. FINN'S ACCOUNT. Cr.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
	To balance ...	... ...	1,00,000 0 0	April ...	By stores ...	85,000 0 0
February	„ cash ...	60,000 0 0			By balance ...	1,55,000 0 0
March ...	„ „ ...	40,000 0 0				
April ...	„ „ ...	40,000 0 0	1,40,000 0 0			
	Total ...	... ...	2,40,000 0 0		Total ...	2,40,000 0 0

Dr. MR. OVERSEER ———'s ACCOUNT. Cr.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
February	To balance ...	300 0 0	February	By labour ...	6,728 5 11	
	„ cash ...	9,000 0 0		„ current expenses ...	11 0 0	
				„ sundries ...	144 11 1	6,884 1 0
				By balance ...	... ...	2,415 15 0
	Total ...	9,300 0 0		Total ...	... ...	9,300 0 0

DR. MR. OVERSEER ———'S ACCOUNT. CR.

1853.		RS. A. P.	1853.		RS. A. P.	RS. A. P.
March ...	To balance	5,000 0 0	March ...	By labour	16,776 3 7	
	" cash	15,000 0 0		" current expenses	612 0 0	
				" sundries	144 0 0	
						17,532 3 7
				By balance	... ...	2,467 12 5
	Total	20,000 0 0		Total	... ...	20,000 0 0

DR. LABOUR ACCOUNT. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.	RS. A. P.
February	To Overseer	... ...	6,728 5 11	February	By original works	6,650 5 7	
March ...	" "	16,776 3 7			" current expenses	33 7 4	
	" cash	1 0 0			" stores	44 9 0	
			16,777 3 7				6,728 5 11
April ...	" Deputy Superintendent	... ...	19,817 3 4	March ...	" original works	16,750 1 7	
					" stores	25 2 4	
					" current expenses	1 15 8	
							16,777 3 7
				April ...	" original works	... ...	19,817 3 4
	Total	... ...	43,322 12 10		Total	... ...	43,322 12 10

DR. MAGAZINE STORES. CR.

1853.		RS. A. P.	1853.		RS. A. P.
	To balance	5,000 0 0		By balance	5,000 0 0

DR. ORIGINAL WORKS. CR.

1853.		RS. A. P.	RS. A. P.	1853.		RS. A. P.
	To balance	... ...	5,00,000 0 0	April ...	By bills	1,36,563 11 2
February	" labour	6,650 5 7			By balance	5,00,000 0 0
	" stores	914 1 5				
			7,564 7 0			
March ...	" labour	16,750 1 7				
	" stores	3,051 12 9				
			19,801 14 4			
April ...	" cash	419 10 2				
	" labour	19,817 3 4				
	" stores	82,764 0 6				
	" sundries account	2,873 5 4				
	" tool account	3,323 2 6				
			1,09,197 5 10			
	Total	... ...	6,36,563 11 2		Total	6,36,563 11 2

STORE ACCOUNT.

Dr. 1853.		Rs. A. P.	Rs. A. P.	Cr. 1853.		Rs. A. P.	Rs. A. P.
February	To balance	... ...	4,00,000 0 0	February	By original works	914 1 5	
	,, cash	7,000 0 0			,, current expenses	38 13 6	
	,, labour	44 9 0			,, stores	35 7 0	
	,, store	35 7 0					988 5 11
			7,080 0 0	March...	,, original works	3,051 12 9	
March...	,, cash	25,000 0 0			,, current expenses	28 0 4	
	,, labour	25 2 4			,, stores	227 5 8	
	,, store	227 5 8					3,307 2 9
			25,252 8 0	April ...	,, original works	... ...	82,764 0 6
April ...	,, Deputy Superintendent	500 0 0			By balance	... ...	4,30,772 14 10
	,, Mr. Finn	85,000 0 0					
			85,500 0 0				
	Total	... ...	5,17,832 8 0		Total	... ...	5,17,832 8 0

SUNDRIES ACCOUNT.

Dr. 1853.		Rs. A. P.	Rs. A. P.	Cr. 1853.		Rs. A. P.	Rs. A. P.
February	To Overseer	... ...	144 11 1	April ...	By original works	... ...	2,873 5 4
March ...	,, Overseer	144 0 0					
	,, cash	291 4 5					
			435 4 5				
April ...	,, Deputy Superintendent	2,113 5 10					
	,, cash	180 0 0					
			2,293 5 10				
	Total	... ...	2,873 5 4		Total	... ...	2,873 5 4

TOOL ACCOUNT.

Dr. 1853.		Rs. A. P.	Cr. 1853.		Rs. A. P.
	To balance	50,000 0 0	April ...	By original works	3,323 2 6
				By balance	46,676 13 6
	Total	50,000 0 0		Total	50,000 0 0

BALANCE SHEET.

Dr. Rs. A. P.		Cr. Rs. A. P.
... ...	Accountant, N. W. P.	12,99,300 0 0
1,37,332 0 0	Bills account	... ...
17,067 1 5	Cash account	... ...
2,567 6 10	Deputy Superintendent's account	... ...
2,415 15 0	Mr. Overseer ———'s account	... ...
2,467 12 5	Mr. Overseer ———'s account	... ...
1,55,000 0 0	Mr. James Finn's account	... ...
5,000 0 0	Magazine stores account	... ...
4,30,772 14 10	Store account	... ...
5,00,000 0 0	Original works	... ...
46,676 13 6	Tool account	... ...
12,99,300 0 0	... ... Totals	12,99,300 0 0

For the Quarter ending 30th April, 1853.

NORTHERN DIVISION, GANGES CANAL.

Bill No. 15.

The Honourable Company ———————, Dr.

To the following expenditure incurred in the partial construction of an earthen aqueduct with masonry revetments, &c., across the Solani Valley during the quarter ending 30th April, 1853; being part of the project of the Ganges Canal.—*Vide* Colonel Cautley's Report of 1845, pages 25, 31, and revised estimate of 1850, pages 64–67.

Description of Expenditure.	Labour.	Materials.	Sundries.	Tools.	Totals.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
CHANNEL.					
Excavation from 15th mile; wagons drawn by horses	1,446 9 8	369 9 9	54 1 2	46 12 1	1,917 0 8
„ 16th mile; „ „	1,474 13 10	492 13 2	57 15 0	50 10 3	2,076 4 3
„ „ pushed by men ...	668 2 0	51 10 6	7 3 2	18 2 10	745 2 6
Spreading the above three items	1,117 8 8	... ...	8 15 0	28 2 7	1,154 10 3
Excavation from Roorkee banks; wagons pushed by men	538 6 4	... ...	5 4 11	13 9 2	557 4 5
Spreading the above	190 12 5	... ...	1 8 5	4 13 0	197 1 10
Surplus sand carried from top of aqueduct arches and deposited in channel	40 10 4	... ...	0 5 3	1 0 5	42 0 0
Spreading earth already deposited	269 0 0	... ...	2 2 5	6 12 5	277 14 10
Puddling „ „	904 6 4	... ...	7 3 9	22 12 9	934 6 10
EMBANKMENTS.					
Excavation from 15th mile; wagons drawn by horses	8,038 10 8	2,154 3 2	282 14 0	262 10 4	10,738 6 2
„ 16th mile; „ „	2,805 3 10	601 13 3	103 3 1	87 12 1	3,598 0 3
Spreading the above two items	3,842 0 3	... ...	31 3 9	96 13 4	3,970 1 4
Excavation in 16th mile (virgin soil) carried in baskets and spread...	42 2 0	... ...	0 5 4	0 15 3	43 8 4
Excavation in 19th mile; wagons pushed by men...	37 11 0	... ...	0 5 4	1 1 0	38 15 7
„ Roorkee banks; „ „ ...	803 4 5	... ...	7 15 11	20 4 6	831 8 10
Spreading the above two items	477 10 8	... ...	3 13 3	12 0 7	493 8 6
Earth formerly deposited in channel removed to embankments	212 0 0	... ...	1 11 2	5 5 6	219 0 8
Spreading earth already deposited	151 0 4	... ...	1 3 4	3 12 10	156 0 6
Ramming earth round steps...	221 13 11	... ...	1 12 5	5 9 6	229 3 10
Dressing slopes	100 0 0	... ...	0 12 10	2 8 4	103 5 2
REVETMENTS.					
Excavation for foundations of lions and embankment-steps and breaking-up revetment for former	291 0 3	... ...	2 5 3	7 5 4	300 10 10
Clearance of argillaceous deposit on revetment ...	92 11 9	... ...	0 12 0	2 5 5	95 13 2
Plain masonry...	5,399 14 9	39,296 8 1	995 11 1	1,143 1 10	46,835 3 9
Ramming earth below esplanade of cattle ghats ...	22 6 5	... ...	0 3 0	0 9 1	23 2 6
Step masonry	2,778 15 3	14,402 5 0	383 14 0	439 9 0	18,004 11 3
Earth centering for main archwork dressed ...	284 2 5	... ...	2 4 4	7 2 7	293 9 4
Main arch masonry	1,230 4 11	6,473 6 10	172 3 3	196 14 4	8,072 13 4
Parapets of Roorkee cattle ghats	3 15 6	... ...	0 0 11	0 1 8	4 2 1
Plain masonry in foundation and pedestals of lions	350 0 0	2,601 9 3	65 9 2	75 6 10	3,092 9 3
Masonry of bodies of ditto	603 14 10	1,047 0 6	36 10 6	42 3 1	1,729 12 11
Excavation below canal bed for plastering, and refilling that excavation	37 4 0	... ...	0 4 9	0 15 1	38 7 10
Plastering	4,210 7 9	1,861 10 6	135 15 6	155 11 3	6,363 13 0
Excavation from 15th mile; wagons drawn by horses	433 11 6	156 7 1	17 14 0	12 11 3	620 11 10
„ 16th mile; „ „	870 0 3	263 3 1	35 15 0	29 3 7	1,198 5 11
Spreading the above two items in vaults	321 4 0	... ...	2 9 0	8 1 6	331 14 6
Excavation from 19th mile; wagons pushed by men	45 2 1	... ...	0 6 2	1 2 2	46 10 5
„ Roorkee banks	7 9 8	... ...	0 0 3	0 3 1	7 13 0
Spreading the last two items	19 0 0	... ...	0 2 5	0 7 8	19 10 1
Earth taken from channel filled into vaults and rammed	312 6 0	... ...	2 8 0	7 14 0	322 12 0
Plain and rora masonry in bank steps	2,503 0 0	17,081 8 4	438 1 3	500 9 0	20,523 2 7
Grand total	43,199 2 0	86,853 12 6	2,873 5 4	3,323 2 6	1,36,249 6 4

Roorkee, 1st May, 1853.

AVERAGES covering the above Expenditure.

		RS.	A.	P.	RS.	A.	P.
	CHANNEL.						
5,00,966	cubic feet excavation from 15th mile, filled into ballast-wagons, propelled along railway, by horses, an average distance of 8,540 feet, and emptied by side of rail, at 3 *rs.* 13 *a.* 2 *p.* per 1,000 cubic feet	1,917	0	8			
3,99,300	ditto from 16th ditto, filled ditto, and propelled ditto, ditto, 11,555 ditto, ditto, at 5 *rs.* 3 *a.* 2 *p.* per ditto	2,076	4	3			
2,02,112	ditto, ditto, propelled along rail, by men, ditto, ditto, 7,000 ditto, at 3 *rs.* 11 *a.* per ditto	745	2	6			
11,02,378	ditto in last three items, spread in channel, at 1 *r.* 0 *a.* 9 *p.* per ditto ...	1,154	10	3			
	Giving aggregate rates as follow:— 15th mile, work by horses, at 4 *rs.* 13 *a.* 11 *p.* per 1,000 cubic feet. 16th ditto, ditto, at 6 *rs.* 3 *a.* 11 *p.* per ditto. Ditto, ditto, work by men, at 4 *rs.* 11 *a.* 9 *p.* per ditto.						
1,94,525	ditto excavation from Roorkee banks, filled into ballast-wagons, propelled along railway, by men, an average distance of 5,000 feet, and emptied by side of rail, at 2 *rs.* 13 *a.* 10 *p.* per 1,000 cubic feet	557	4	5			
1,94,525	ditto in last item, spread in channel, at 1 *rs.* 0 *a.* 3 *p.* per ditto ...	197	1	10			
	Giving an aggregate rate of 3 *rs.* 14 *a.* 1 *p.* per 1,000 cubic feet.						
16,250	cubic feet of surplus sand removed from top of aqueduct arches, and deposited in channel, at 3 *rs.* 13 *a.* per 1,000 cubic feet	42	0	0			
1,35,000	ditto of earth, already deposited in channel, spread, at 2 *rs.* 0 *a.* 11 *p.* per ditto. N.B.—This is, generally speaking, shallow digging, finishing off bed of canal	277	14	10			
2,90,828	ditto of earth, already deposited in channel, puddled, at 3 *rs.* 3 *a.* 5 *p.* per 1,000 cubic feet	934	6	10			
					7,901	13	7
	EMBANKMENTS.						
21,30,206	cubic feet excavation, from 15th mile, filled into ballast-wagons, propelled along railway by horses an average distance of 10,760 feet, and emptied by side of rail at 5 *rs.* 0 *a.* 8 *p.* per 1,000 cubic feet	10,738	6	2			
7,55,758	ditto, from 16th ditto, ditto, 10,775 feet, and ditto, ditto, at 4 *rs.* 12 *a.* 2 *p.* per 1,000 cubic feet	3,598	0	3			
28,85,964	ditto in last two items spread, at 1 *r.* 6 *a.* per ditto	3,970	1	4			
	Giving aggregate rates as follow:— 15th mile, work by horses, 6 *rs.* 6 *a.* 8 *p.* per 1,000 cubic feet. 16th ditto, ditto, 6 *rs.* 2 *a.* 2 *p.* ditto						
14,250	ditto, ditto (virgin soil), carried in baskets a distance of 150 feet up a height of 25 feet, and spread in embankments, at 3 *rs.* 0 *a.* 10 *p.* per 1,000 cubic feet	43	8	4			
12,195	ditto, ditto, from 19th ditto, filled into ballast-wagons, propelled along railway by men an average distance of 5,000 feet, and emptied by side of rail, at 3 *rs.* 3 *a.* 2 *p.* per 1,000 cubic feet	38	15	7			
2,89,074	ditto, ditto, from Roorkee banks, ditto, ditto, 4,720 feet, and ditto, ditto, at 2 *rs.* 14 *a.* 7 *p.* per 1,000 cubic feet	831	8	10			
3,01,269	ditto in last two items spread, at 1 *rs.* 10 *a.* 2 *p.* per ditto	493	8	6			
	Giving aggregate rates as follow:— 19th mile, work by men, 4 *rs.* 13 *a.* 4 *p.* per 1,000 cubic feet. Roorkee banks, ditto, 4 *rs.* 8 *a.* 9 *p.* ditto.						
1,07,875	ditto earth, formerly deposited in channel, removed to embankments, and spread at 2 *rs.* 0 *a.* 6 *p.* per 1,000 cubic feet	219	0	8			
50,340	ditto, ditto, in embankments, spread a distance of 200 feet, at 3 *rs.* 1 *a.* 7 *p.* per ditto	156	0	6			
	Cost of ramming earth round quadrantal and other steps	229	3	10			
17,807	cubic feet of excavation, preparatory to dressing slopes, at 3 *rs.* per 1,000 cubic feet ... ... RS. 53 A. 6 P. 9						
22,800	square feet slopes dressed, at 2 *rs.* 3 *a.* per 1,000 square feet 49 14 5						
		103	5	2			
					20,421	11	2
	Carried forward	...		...	28,323	8	9

		RS. A. P.	RS. A. P.
	Brought forward	... ...	28,323 8 9
	Revetments.		
	Cost of breaking up revetment for foundations of lions, together with 34,224 cubic feet of excavation for foundations of lions and of embankment steps	300 10 10	
	Clearance of argillaceous deposit on revetment	95 13 2	
2,91,372	cubic feet of plain masonry in revetments, mortar being equal portions of lime, soorkee, and sand, at 16 *rs.* 1 *a.* 2 *p.* per 100 cubic feet ...	46,835 3 9	
	Parapets of Roorkee cattle ghats, commenced by Lieutenant Price, and cost of ramming earth below esplanade of cattle ghats	27 4 7	
1,08,342	cubic feet of step masonry in revetments, mortar as before, at 16 *rs.* 9 *a.* 10 *p.* per 100 cubic feet	18,004 11 3	
	Cost of dressing earthen centering for main archwork	293 9 4	
48,242	cubic feet arch masonry of revetment, mortar as before, at 16 *rs.* 11 *a.* 9 *p.* per 100 cubic feet	8,072 13 4	
19,734	ditto plain masonry in foundations and pedestals of lions, mortar as before, at 15 *rs.* 10 *a.* 9 *p.* per ditto	3,092 9 3	
	Masonry of bodies of lions in progress	1,729 12 11	
	Excavation below canal bed for plastering, and refilling the same—no measurements	38 7 10	
1,56,203	square feet pukka plaster, 1,18,171 square feet being completely finished, and remainder being unpolished, at 4 *rs.* 1 *a.* 2 *p.* per 100 square feet	6,363 13 0	
1,24,668	cubic feet excavation from 15th mile, filled into ballast-wagons, propelled along railway by horses an average distance of 8,840 feet, and emptied by side of rail, at 4 *rs.* 15 *a.* 8 *p.* per 1,000 cubic feet	620 11 10	
2,26,215	ditto, ditto, 16th ditto, ditto 9,650 feet, and ditto, ditto, at 5 *rs.* 4 *a.* 9 *p.* per 1,000 cubic feet	1,198 5 11	
3,50,883	ditto in last two items, spread in revetment vaults and slightly rammed, at 15 *a.* 1 *p.* per ditto	331 14 6	
	Giving aggregate rates as follow:— 15th mile, work by horses, at 5 *rs.* 14 *a.* 9 *p.* per 1,000 cubic feet. 16th ditto, ditto, at 6 *rs.* 3 *a.* 10 *p.* ditto.		
10,800	cubic feet excavation from 19th mile, filled into ballast-wagons, propelled along railway by men an average distance of 5,000 feet, and emptied by side of rail, at 4 *rs.* 5 *a.* 1 *p.* per 1,000 cubic feet	46 10 5	
1,822	ditto, ditto from Roorkee banks, ditto, ditto 5,000 feet, and ditto, ditto, at 4 *rs.* 4 *a.* 7 *p.* per 1,000 cubic feet	7 13 0	
12,622	ditto in last two items, spread in vaults and rammed slightly, at 1 *r.* 8 *a.* 11 *p.* per 1,000 cubic feet	19 10 1	
	Giving aggregate rates as follow:— 19th mile, work by men, at 5 *rs.* 14 *a.* per 1,000 cubic feet. Roorkee banks, ditto at 5 *rs.* 13 *a.* 6 *p.* ditto.		
66,356	cubic feet earth, formerly deposited in channel, removed to revetments, vaults, and rammed, at 4 *rs.* 13 *a.* 10 *p.* per 1,000 cubic feet ...	322 12 0	
1,27,008	ditto miscellaneous masonry (chiefly plain) in embankment steps, mortar as before, at 16 *rs.* 2 *a.* 6 *p.* per 100 cubic feet	20,523 2 7	
			1,07,925 13 7
	Grand total	... ...	1,36,249 6 4
	Carried forward	... ...	1,36,249 6 4

REMARKS on the Rates.

Rates.					
Last Quarter.	Present Quarter.		RS.	A.	P.
		Brought forward	1,36,249	6	4
5 *rs.* 9 *a.* 10 *p.* per 1,000 cubic feet —9,400 feet distance.	3 *rs.* 13 *a.* 2 *p.* per 1,000 cubic ft. — 8,540 feet distance.	Earthwork in channel in ballast-wagons drawn by horses appears this quarter at about its natural rate. Last quarter, owing to the number of horses in training, and consequently not effective for work, the rate was very high. But if comparison is made with the rate of the quarter ending 31st July, due allowance for distance being afforded at 8 *a.* per 1,000 feet, which is perhaps fair, the present rate brought forward will be shown to be correct enough. This will appear better by comparison of the 16th mile rate as per margin. The two rates are here shown to be almost identical.			
1st August, 1852. 5 *rs.* 2 *a.* per 1,000 cub. ft.—11,540 feet distance.	5 *rs.* 3 *a.* 2 *p.* per 1,000 cubic ft. —11,555 feet distance.				
3 *rs.* 11 *a.* 3 *p.* per 1,000 cubic feet —7,215 feet distance.	3 *rs.* 11 *a.* per 1,000 cubic ft. — 7,000 feet distance.	Same work in ballast-wagons propelled by men, 16th mile.			
12 *a.* 2 *p.* per 1,000 cubic feet.	1 *rs.* 0 *a.* 9 *p.* per 1,000 cubic ft.	Spreading earth in channel. This rise in rate is due, I believe, to an expression of my opinion that the spreaders under Mr. Parker actually had some slight ground of complaint that too much work was exacted from them. Certain it is, that they were leaving our works; and I therefore, without giving in to them immediately, requested Mr. Parker to relax his rate as early as he could consistently with the maintenance of discipline. Reference to old back rates and consideration of the fact that we are not in a position to be able to quarrel with our workmen will, I am sure, bear me out in this.			
	2 *rs.* 13 *a.* 10 *p.* per 1,000 cubic feet—5,000 ft. distance.	Earthwork in channel in ballast-wagons propelled by men from Roorkee banks agrees very well with same work from the 16th mile, due regard being had to difference of distance.			
1st May, 1852. 4 *rs.* 2 *a.* per 1,000 cubic feet.	3 *rs.* 3 *a.* 5 *p.* per 1,000 cubic ft.	Puddling earth already deposited. Comparison of rates here is little more than a form. Distances from which earth already deposited is moved, and facilities for watering that earth, vary so much in different localities that great varieties of rates must always exist.			
		It is not supposed necessary to notice rates of earthwork further.			
1st August, 1852. 15 *rs.* 3 *a.* per 100 cubic feet.	16 *rs.* 1 *a.* 2 *p.* per 100 cubic feet.	Plain masonry cannot properly be compared with the plain and rubble masonry of last quarter, the rate of which, moreover, was then presumed to be incorrect. If, however, the comparison is made with the plain masonry of cattle ghats, &c., of the quarter ending 31st July, 1852, and it is considered that a rise in the price of bricks should affect the cost of 100 cubic feet of masonry to the extent of 14 *a.* 5 *p.*, the rates compared will agree within 3 *p.* of each other. Great part of this quarter's masonry is in bricking-out.			
1st May, 1852. 15 *rs.* 3 *a.* 2 *p.* per 100 cubic feet.	16 *rs.* 11 *a.* 9 *p.* per 100 cubic feet.	Arch masonry under steps is here compared with that in cattle ghats, than which, after making allowance for rise in price of bricks, it is 10 *a.* 2 *p.* per 100 cubic feet dearer. The difference is due entirely to the different quantity of materials used, the rate of labour in the present instance being one-sixth lower than before.			
		Carried forward	1,36,249	6	4

Rates.			RS. A. P.
Last Quarter.	Present Quarter.	Brought forward	1,36,249 6 4
1st May, 1852. 15 *rs.* 10 *a.* 3 *p.* per 100 cubic feet.	16 *rs.* 9 *a.* 10 *p.* per 100 cubic feet. 4 *rs.* 1 *a.* 2 *p.* per 100 square ft.	Step masonry, after due consideration of rise in the price of bricks, is within one anna exactly of its proper rate. Last quarter's rate is purposely rejected as incorrect. Pukka plaster has been executed before on this work as per bill dated 1st May, 1850, at 5 *rs.* 0 *a.* 9 *p.* per 100 square feet; as per bill dated 1st February, 1851, at 5 *rs.* 0 *a.* 5 *p.* per 100 square feet; and as per bill dated 1st May, 1851, at 4 *rs.* 15 *a.* 4 *p.* per 100 square feet; but I am sorry that this rate does not afford ground for congratulation, as, in addition to the work not being all finished, it is not, I confess, as well done as before. This will be carefully looked to for the future.	

Assets to Account.	RS. A. P.	
To cash received in part of the general assignments for the Ganges Canal Works...	1,36,249 6 4	
By cash expended, being the amount of this bill	1,36,249 6 4	
Grand total—Co.'s rupees, one lakh thirty-six thousand two hundred and forty-nine	... ...	1,36,249 0 0

(Signed) A. G. Goodwyn, *Lieutenant, Executive Engineer,*
Northern Division, Ganges Canal Works.

To the Secretary, Military Board, Fort William.

I declare upon my honour that the sum charged in this bill has been duly expended for the purpose set forth.

(Signed) A. G. Goodwyn, *Lieutenant, Executive Engineer,*
Northern Division, Ganges Canal Works.

Abstract by the Director of Works, showing the Amount expended and the Quantity of Work executed on the Solani Earthen Aqueduct up the 30th April, 1853.

Work executed.		Expended.	Amounts.
Earthwork of all Sorts.	Masonry of all Sorts.		
Cubic Feet.	Cubic Feet.		RS. A. P.
4,60,95,937·242	43,41,875·062	Up to 31st January, 1853	8,62,571 0 7
48,95,948·0	5,94,698·0	Captain Goodwyn's bill, No. 15, for the quarter ending 30th April, 1853	1,36,249 6 4
5,09,91,885·242	49,36,573·062		
86 curb frames; 798 piles driven; 2,71,610 square feet of pukka plaster; 54,779 rg. feet undersinking blocks; 2,29,402 square feet slopes dressed.		Total	9,98,820 6 11

Comparing the rates with those of the revised estimate, we have,—

	RS.	A.	P.	RS.	A.	P.
Earthwork as per Estimate.—5,09,91,885 cubic feet of excavation of all sorts, at 3 *rs.* 13 *a.* 3 *p.* per 1,000 cubic feet ...				1,95,203	4	11
Add 5 per cent. for contingencies ...				9,760	2	8
Amount ...				2,04,963	7	7
Earthwork as per Bill.—5,09,91,885 cubic feet of earthwork of all sorts at 4 *rs.* 1 *a.* 9 *p.* nearly per 1,000 cubic feet ...				2,09,659	12	3
Showing an excess of ...				4,696	4	8
Masonry as per Estimate.—49,36,573 cubic feet of masonry of all sorts, at 16 *rs.* 4 *a.* 3 *p.* per 100 cubic feet ...	8,02,964	7	2			
Add 5 per cent. contingencies ...	40,148	3	7			
Amount ...	8,43,112	10	9			
Masonry as per Bill.—49,36,573 cubic feet of masonry of all sorts at 15 *rs.* 5 *a.* 4 *p.* nearly per 100 cubic feet ...	7,56,894	2	10			
Showing a saving of ...				86,218	7	11
On the whole work executed up to the 30th of April, 1853, there is therefore a saving of ...				81,522	3	3

On the 30th April, 1853, the average rate of the earthwork was increased by a further sum of 3 *a.* 8 *p.* per 1,000 cubic feet, and the rate is now 4½ *a.* above that of the estimate; but the rates of the period under review are fair.

On masonry the average rate has also increased 2 *a.* per cubic foot beyond that exhibited on the 31st January, 1853, but there is still a considerable margin when comparing it with the estimate.

I beg to refer the Board to Captain Goodwyn's remarks and comparisons with former quarters which meet with my approval, and to recommend that the bill be sanctioned.

(Signed) P. T. Cautley, Lieut.-Colonel,
Director Ganges Canal Works.

For the Quarter ending 30*th April*, 1853.

NORTHERN DIVISION GANGES CANAL.

Survey Report and Statement of Measurements of Certain Works executed in the Partial Construction of an Earthen Aqueduct with Masonry Revetments across the Solani Valley during the Quarter ending 30th April, 1853.

Description.	Measurements.						Masonry.				Pukka Plaster.
	L.	B.	D.	Area.	No.	Contents.	Plain.	Step.	Arch.	Miscellaneous.	
	′ ″	′ ″	′ ″								
Revetments	270 0	3 1	3 0	...	...	2,498					
	117 0	...	...	13·10	...	1,532					
	10 0	...	...	21·32	4	853					
	260 0	...	...	6·20	...	2,132					
	300 0	...	...	7·30	...	2,190					
	1,465 0	...	...	4·36	...	6,387					
	1,725 0	...	...	13·10	...	22,598					
						38,190					
Deduct	5 0	...	...	13·10	15						
"	5 0	...	...	4·36	10						
						1,201					
							36,989				
	200 0	...	...	5·50	...	1,100					
	640 0	...	...	18·80	...	12,032					
	350 0	...	...	9·63	...	3,371					
	93 0	...	...	3·48	...	324					
							...	16,827			
	250 0	...	...	10·30	...	2,575					
							...	...	2,575		
	375 0	3 1	4 0	...	...	4,625					
	9 6	1 7	4 0	...	...	60					
	310 0	3 9	1 9	...	...	2,034					
	250 0	4 5	3 0	...	...	3,313					
	110 0	1 7	2 9	...	...	479					
	110 0	3 7	1 9	...	...	690					
	1,300 0	...	...	2·60	...	3,380					
	1,250 0	...	...	1·00	...	1,250					
	630 0	3 1	6 9	...	...	13,112					
	1,030 0	3 1	11 0	...	...	34,934					
	1,250 0	...	...	13·10	...	16,375					
	515 0	3 1	0 6	...	...	794					
	9 6	1 7	10 0	...	5	752					
	10 0	3 1	7 6	...	2	463					
	10 0	3 1	13 0	...	3	1,202					
	10 0	...	...	7·06	3	212					
	735 0	...	...	8·20	...	6,027					
	430 0	...	...	8·20	...	3,526					
	10 0	3 1	5 6	...	...	170					
	10 0	...	...	9·60	...	96					
	1,400 0	...	...	3·86	...	5,404					
	10 0	3 1	13 0	...	...	401					
	10 0	...	...	7·06	...	71					
							99,370				
	1,300 0	...	...	23·93	...	31,109					
Deduct previously reported ...	...	...	...	...	...	21,462					
							...	9,647			
	1,904 0	...	...	10·30	...	19,611					
" " "	...	...	...	...	...	10,258					
							...	...	9,353		
	280 0	2 0	2 0	...	...	1,120					
	683 0	3 1	5 0	...	...	10,530					
	455 0	3 1	6 6	...	...	9,119					
	360 0	3 1	6 9	...	...	7,492					
	554 0	3 1	5 0	...	...	8,541					
	380 0	3 1	1 0	...	...	1,171					
							37,973				
Carried forward	...	...	...	...	...	...	1,74,332	26,474	11,928		

Description.	Measurements.						Masonry.				Pukka Plaster.
	L.	B.	D.	Area.	No.	Contents.	Plain.	Step.	Arch.	Miscellaneous.	
	′ ″	′ ″	′ ″								
Brought forward......	...	...	...	...	...	...	1,74,332	26,474	11,928		
	270 0	...	...	8·00	...	2,160					
	190 0	...	...	23·93	...	4,547					
							...	6,707			
	280 0	...	...	9·0	...	2,520					
	657 0	...	...	10·3	...	6,767					
							...	...	9,287		
	212 0	3 1	6 8	...	...	4,358					
	190 0	3 1	6 9	...	...	3,954					
	108 0	3 1	6 0	...	...	1,998					
	100 0	...	...	13·10	...	1,310					
	600 0	4 3	1 0	...	...	2,550					
	5 0	...	...	16·60	6	498					
							14,668				
	270 0	...	...	11·11	...	3,000					
	100 0	...	...	21·18	...	2,118					
	200 0	...	...	23·93	...	4,786					
	400 0	...	...	18·00	...	7,200					
							...	17,104			
	1,584 0	...	...	10·30	...	16,315					
Deduct previously reported ...	...	...	...	...	...	6,767					
							...	...	9,548		
	558 0	4 3	1 0	...	...	2,371					
	1,040 0	4 3	0 9	...	...	3,315					
	535 0	...	...	2·94	...	1,573					
	1,250 0	...	...	1·94	...	2,425					
	25 0	...	...	16·59	...	415					
	180 0	...	...	21·32	...	3,838					
	500 0	...	...	8·22	...	4,110					
	50 0	3 1	7 0	...	...	1,079					
	350 0	...	...	13·10	...	4,585					
	600 0	...	...	2·60	...	1,560					
	600 0	...	...	7·06	...	4,236					
	855 0	...	...	21·32	...	18,229					
	9 0	1 7	2 6	...	...	35					
							47,771				
	400 0	...	...	5·93	...	2,372					
	1,412 0	...	...	23·93	...	33,789					
							...	36,161			
	900 0	...	...	10·50	...	9,270					
							...	...	9,270		
	1,370 0	...	...	2·54	...	3,480					
	568 0	...	...	13·10	...	7,441					
	788 0	...	...	2·60	...	2,049					
	944 0	...	...	2·94	...	2,775					
	400 0	3 1	0 9	...	...	925					
	5 0	...	...	18·12	8	725					
	1,170 0	...	...	7·06	...	8,260					
	863 0	...	...	21·32	...	18,399					
	651 0	...	...	13·10	...	8,528					
	498 0	...	...	2·94	...	1,464					
	10 0	3 1	6 0	...	3	555					
							54,601				
	915 0	...	...	23·93	...	21,896					
							...	21,896			
	797 0	...	...	10·30	...	8,209					
							...	...	8,209		
	46 1½	7 0	15 9	...	...	5,085					
	28 8	2 6	2 0	...	...	144					
Embankment steps	18 10	2 6	29 6	...	...	1,389					
	7 4	2 0	2 0	...	2	59					
	7 4	2 0	22 0	...	...	323					
	4 0	7 0	2 0	...	...	56					
					18	7,056					
							...	...	...	1,27,008	
Pedestals of lions	23 0	11 0	10 6	...	4	10,626					
	23 0	11 0	9 0	...	4	9,108					
							19,734				
Carried forward	...	...	...	...	...	...	3,11,106	1,08,342	48,242	1,27,008	

Description.	Measurements.						Masonry.				Pukka Plaster.
	L.	B.	D.	Area.	No.	Contents.	Plain.	Step.	Arch.	Miscellaneous.	
	' "	' "	' "								
Brought forward......	...	...	...	...	...	...	3,11,106	1,08,342	48,242	1,27,008	
Ogees and revetments	315 0	6 3	...	1,969·00	...						
	8 0	9 3	...	74·00	...						
	646 0	0 3	...	161·00	...						
	648 0	0 2½	...	135·00	...						
	648 0	1 11	...	1,242·00	...						
	648 0	0 3	...	162·00	...						
	647 0	0 3	...	162·00	...						
	646 0	0 3	...	161·00	...						
	646 0	0 7½	...	404·00	...						
	646 0	1 2	...	753·00	...						
				5,223·00	3¾	19,586					
	350 0	...	...	...	2	25,795					
	350 0	...	...	...	...	2,450					
	512 0	...	...	...	...	17,579					
	100 0	...	...	...	...	667					
	4 0	...	...	...	2	24					
	54 0	...	...	...	...	486					
							...	...	...	...	66,587
Area, as above......................	...	...	...	5,223·00	¼	1,306					
	350 0	15 10	...	...	...	5,542					
	320 0	11 0	...	...	...	3,520					
	320 0	3 8	...	...	...	1,173					
	10 0	9 4	...	...	2	187					
	170 0	15 10	...	...	...	2,692					
	170 0	0 8	...	...	...	114					
	320 0	7 0	...	...	...	2,240					
	104 0	28 4	...	...	...	2,946					
	100 0	6 7	...	...	...	658					
	104 0	1 10	...	...	...	572					
	104 0	1 10	...	...	...	2,097					
	104 0	8 2	...	...	...	849					
							...	...	...	...	23,896
	835 0	...	...	7·10	...	5,928					
	1,261 0	...	...	16·75	...	21,122					
	957 0	...	...	5·00	...	4,785					
	2,274 0	...	...	6·87	...	15,622					
	...	...	...	4,565·75	4	18,263					
							...	...	...	...	65,720
Grand total contents......	...	...	...	...	...	...	3,11,106	1,08,342	48,242	1,27,008	1,56,203

EXCAVATION, &c.

Measurements.					Earthwork.			Remarks.
L.	B.	D.	No.	Contents.	Channel.	Banks.	Filling Vaults.	
'	' "	' "						
100	10 0	15 0	...	15,000				
540	7 0	5 6	...	20,790				
1,250	19 0	16 6	...	3,91,875				
				4,27,665	3,29,066	5,264	93,335	From 15th mile in horsed wagons, distance 8,500 feet.
220	42 0	17 0	...	1,57,080				
270	6 0	7 6	...	12,150				
164	18 0	1 9	...	5,166				
234	15 0	13 0	...	45,630				
34	18 0	15 0	...	9,180				
				2,29,206	52,400	1,76,806	...	From 16th mile, by rail by men, 6,200′ distance, and ditto in horsed wagons 8,500 feet distance.
Carried forward		...		...	3,81,466	1,82,070	93,335	

Measurements.					Earthwork.			Remarks.
L.	B.	D.	No.	Contents.	Channel.	Banks.	Filling Vaults.	
Brought forward......		...	...	...	3,81,466	1,82,070	93,335	
	′ ″	′ ″						
52	22 0	10 0	...	11,440				
110	15 0	11 0	...	18,150				
100	25 0	7 0	...	17,500				
				47,090				
Deduct...	... ...	... ...	...	4,990				
				42,100	20,400	21,700	...	From Roorkee banks, by rail by men, 5,250 feet distance.
62	13 0	23 0	...	18,538				
958	15 0	9 0	...	1,29,330				
642	5 6	14 6	...	51,200				
333	12 0	26 6	...	1,05,894				
593	19 0	14 6	...	1,63,372				
295	8 0	5 6	...	12,980				
				4,81,314	1,48,000	3,28,081	5,233	From 15th mile in horsed wagons, distance 9,000 feet.
50	15 0	8 3	...	6,187				
210	28 0	16 0	...	94,080				
140	15 0	12 6	...	26,250				
30	15 0	26 0	...	11,700				
50	area.	691 0	...	34,550				
					...	...	1,72,767	From 16th ditto, ditto.
61	10 0	8 0	...	4,880				
111	9 0	8 0	...	7,992				
70	30 0	2 6	...	5,250				
40	10 0	5 0	...	2,000				
180	12 0	5 0	...	10,800				
				30,928	1,225	16,775	{ 10,800 18,22 }	{ From 19th mile, by rail by men, 5,000 feet distance. From Roorkee banks, ditto, ditto.
375	10 0	14 0	...	52,500				
845	10 0	9 0	...	76,050				
940	5 0	13 9	...	64,625				
460	16 0	7 0	...	51,520				
825	10 0	15 0	...	1,23,750				
50	area.	1,239 0	...	61,950				
				4,30,395	23,900	3,80,395	26,100	From 15th mile, in horsed wagons, 10,500 feet distance.
90	18 0	26 0	...	42,120				
64	27 0	16 0	...	27,648				
150	43 0	16 0	...	1,03,200				
300	55 0	2 6	...	41,250				
				2,14,218	...	2,14,218	...	From 16th ditto, ditto.
340	30 0	6 0	...	61,200				
38	31 0	4 3	...	5,006				
155	11 0	11 6	...	19,608				
271	12 0	2 6	...	8,130				
271	5 0	3 0	...	4,065				
				98,009	39,100	{ 12,195 46,714 }	...	{ From 19th mile, by rail by men, 5,000 feet distance. From Roorkee banks, ditto, ditto.
287	30 0	16 0	...	1,37,760				
654	10 0	14 0	...	91,560				
440	15 0	16 0	...	1,05,600				
324	30 0	2 0	...	19,440				
700	20 0	4 0	...	56,000				
50	area.	1,857 0	...	92,550				
					...	5,02,910	...	From 15th mile, in horsed wagons, 10,500 feet distance.
Carried forward		...	...	...	6,14,091	17,05,058	3,10,057	

Measurements.					Earthwork.			Remarks.
L.	B.	D.	No.	Contents.	Channel.	Banks.	Filling Vaults.	
Brought forward	...	...	...		6,14,091	17,05,058	3,10,057	
′	′ ″	′ ″						
145	28 0	26 0	...	1,05,560				
90	10 0	26 0	...	23,400				
768	48 0	1 9	...	64,512				
231	14 0	16 0	...	51,744				
50	45 0	11 0	...	24,750				
167	45 0	5 6	...	41,332				
49	49 0	17 0	...	40,817				
620	6 6	5 8	...	22,837				
50	12 0	9 6	...	5,700				
50	area.	179 0	...	8,950				
				3,89,602	70,900	2,56,090	...	From 16th ditto, ditto.
					62,612	...	...	Ditto, ditto, by rail by men, 7,200 feet distance.
253	47 0	2 0	...	23,782				
106	47 0	1 6	...	7,473				
353	47 0	7 3	...	1,20,285				
106	46 0	7 0	...	34,132				
144	13 0	5 3	...	9,828				
				1,95,500	58,000	1,37,500	...	From Roorkee banks, ditto, ditto, 4,200 feet distance.
555	10 0	3 0	...	16,650				
205	5 0	15 6	...	15,887				
205	9 0	5 0	...	9,225				
200	20 0	3 0	...	12,000				
1,212	10 0	16 3	...	1,97,556				
1,212	10 0	4 3	...	52,116				
30	15 0	16 0	...	7,200				
150	56 0	5 6	...	46,200				
17	54 0	9 9	...	8,951				
50	area.	1,357 0	...	67,850				
					...	4,33,635	...	From 15th mile, in horsed wagons, 11,300 feet.
30	54 0	9 9	...	15,795				
213	50 0	5 0	...	53,250				
40	10 0	5 0	...	2,000				
230	50 0	1 9	...	20,125				
1,330	50 0	2 0	...	1,33,000				
130	10 0	16 6	...	21,450				
130	10 0	2 0	...	2,600				
50	area.	740 0	...	37,000				
				2,85,220	1,01,600	79,565	17,555	From 16th ditto, ditto.
					86,500	...	...	Ditto, ditto, by rail by men, 7,200 feet distance.
252	34 0	2 0	...	17,136				
252	14 0	8 0	...	28,224				
250	22 0	8 0	...	44,000				
100	30 0	6·815	...	20,625				
				1,09,985	54,500	55,485	...	From Roorkee banks, ditto, ditto, 5,400 feet distance.
543	10 0	2 3	...	1,09,957				
543	3 0	3 6	...	5,702				
477	5 0	21 0	...	50,085				
477	3 0	5 0	...	7,155				
200	16 0	2 0	...	6,400				
557	11 9	17 0	...	1,11,261				
Carried forward...	...	...	...	2,90,560	10,48,203	26,67,333	3,27,612	

Measurements.					Earthwork.								Remarks.
L.	B.	D.	No.	Contents.	Channel.	Banks.	Filling Vaults.	Spreading Earth already deposited.	Pud-dling.	Removing from Channel.	Mis-cella-neous.	Dress-ing Slopes.	
Brought forward ...			...	2,90,560	10,48,203	26,67,333	3,27,612						
′	′ ″	′ ″											
160	12 6	30 0	...	60,000									
131	43 0	1¼ 0	...	7,041									
120	17 0	5¼ 0	...	10,710									
230	62 0	6 0	...	85,560									
10	10 0	7 0	...	700									
50	area.	507 0	...	25,350	...	4,79,921	...	...	...	...	...	...	From 15th mile in horsed wagons, 12,000 feet.
50	19 0	15½ 0	...	9,975									
200	22 0	15½ 0	...	68,200									
383	19½ 0	5½ 0	...	41,077									
30	32 0	9 0	...	8,640									
680	53 0	2 0	...	72,080									
880	53 0	1½ 0	...	63,600									
400	9 0	8 0	...	28,800	2,26,800	29,079	35,893	...	...	...	...	...	From 16th ditto, ditto.
				2,92,372	600	...	...						Ditto, ditto, rail by men, 9,000 feet distance.
200	23 0	7 0	...	32,200	21,300	10,900	...	...	...	...	...	...	From Roorkee Banks, ditto, ditto, 5,800 ditto.
500	30 0	3 0	...	45,000									
1,100	8 0	3 0	...	26,400									
1,100	6 0	1 0	...	6,600									
788	56 0	2 0	...	88,256									
25	10 0	2 0	...	500	...	...	...	...	...	60,000			In embankments.
				1,66,756	...	...	...	80,000	...	...	...	...	In channel.
500	65 0	2 0	...	65,000	...	...	...	...	...	26,756			In vaults.
150	35 0	1½ 0	...	7,875	...	...	...	...	...	47,875			To embankments.
				72,875	...	...	...	25,000	...	.:.	...	...	In channel.
1,000	10 0	3 0	...	... ...	...	...	...	30,000	...	...	...	...	In ditto.
60	12 0	10 0	2	14,400									
15	15 0	8 0	2	3,600									
140	33 0	7 0	...	32,340									
				50,340	...	...	...	50,340	...	...	...	...	In embankments.
550	10 0	3 0	...	... ...	...	...	...	...	...	16,500	...	...	To vaults.
45	15 0	2 0	6	... ...	...	...	...	...	...	8,100	...	...	Ditto.
300	10 0	5 0	...	... ...	...	...	...	...	...	15,000	...	...	Ditto.
400	16 0	4 10	...	30,933									
240	90 0	1 0	...	21,600									
2,360	100 0	1 0	...	2,36,000	...	...	...	...	2,88,533	...	...	...	In channel.
34	15 0	4½ 0	...	... ...	...	...	...	...	2,295	...	...	...	Ditto.
54	25 0	2½ 0	2	6,750									
100	75 0	1 0	...	7,500	...	14,250	...	...	...	...	...	...	From 16th mile in baskets, distance 150 feet.
50	25 0	13 0	...	... ...	...	...	...	...	...	...	16,250	...	Sand removed from top of aqueduct.
36	26 0	7 0	...	6,550									
115	5 0	3½ 0	2	4,025									
120	7 0	7 0	...	5,880									
60	5 0	4½ 0	...	1,350	...	...	...	...	...	...	17,807	...	Preparatory to dressing slopes.
600	38 0	...	...	... ...	...	...	...	...	...	...	...	22,800	
33	11 0	1 0	4	1,012									
23	11 0	11 0	4	11,132									
45	12 0	10 0	4	21,600									
10	18 0	6 0	...	480	...	...	...	...	...	...	34,224	...	For foundation of lions and embankment steps.
Grand Total...		...	...	...	12,96,903	32,01,483	3,63,505	1,85,340	2,90,828	1,74,231	68,281	22,800	Earthwork, &c.

(Signed) A. G. Goodwyn, *Lieutenant,*
Executive Engineer, Northern Division, Ganges Canal Works.

ABSTRACT of the foregoing.

Description.	Masonry.				Pukka Plaster.	Earthwork. By Rail.				
	Plain.	Step.	Arch.	Miscellaneous.		15th Mile. Horses.	16th Mile. Horses.	16th Mile. Men.	19th Mile. Men.	Roorkee Banks. Men.
	Cubic feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Sq. Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.
Revetments	2,91,372	1,08,342	48,242	...	1,56,203*	1,24,668	2,26,215	...	10,800	1,822
Embankment steps.........	...	...	...	1,27,008	...	...	...	...	...	...
Pedestals of Lions	19,734	...	...	...	...	...	...	...	...	...
Channel	...	...	...	...	...	5,00,966	3,99,300	2,02,112	...	1,94,525
Embankments...............	...	...	...	...	...	21,30,206	7,55,758	...	12,195	2,89,074
Totals	3,11,106	1,08,342	48,242	1,27,008	1,56,203	27,55,840	13,81,273	2,02,112	22,995	4,85,421

ABSTRACT of the foregoing—*continued.*

Description.	Earthwork.							
	16th Mile. In baskets.	Spreading Earth already deposited.	Removing from Channel.	Puddling.	Removing Sand from Top of Aqueduct.	Foundations.	Preparatory to dressing Slopes.	Dressing Slopes.
	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Square Feet.
Revetments	...	...	66,356	...	...	...	...	...
Embankment steps.........	...	...	...	...	...	} 34,224	...	...
Pedestals of Lions	...	...	...	...	...	}	...	...
Channel	...	1,35,000	...	2,90,828	16,250	...	...	...
Embankments...............	14,250	50,340	1,07,875	...	...	...	17,807	22,800
Totals	14,250	1,85,340	1,74,231	2,90,828	16,250	34,224	17,807	22,800

Earth rammed round quadrantal and other steps, and below esplanade of cattle ghat.
Revetment broken up for foundations of lions. Lions commenced.
Clearance of argillaceous deposit on revetment.
Parapets of Roorkee cattle ghats commenced.
Earthen centering for main arch work dressed.
Earth excavated below canal bed for plastering, and refilled.

(Signed) A. G. GOODWYN, *Lieutenant,*
Executive Engineer, Northern Division, Ganges Canal Works.

Roorkee, 1st *May*, 1853.

* Of this quantity 1,18,171 square feet are completely finished. The remainder is unpolished.

APPENDIX D.

General Instructions *for the* Executive Officers *of the* Third, Fourth, Fifth, *and* Sixth Divisions *of the* Ganges Canal Works.

The establishment authorized for the executive supervision of each of the new divisions of works on the Ganges Canal is as follows:— European establishment for supervision.

1. Executive officer and two assistant executives.

Overseers, as they may be required, for the supervision of work; but only one in the first instance.

2. The Schedule given below* shows the limit of the permanent establishment as sanctioned by Government, but it will be understood that a portion only will be required at present, and that no addition to the numbers and salaries specified in the following paragraphs will be made without the special sanction of the director of the works. Ultimate limit of establishment as sanctioned.

3. English Office.—An accountant and one English writer will suffice in the first instance. Their salaries must depend on the nature of their qualifications. To secure the services of known and efficient men, the full salaries of 100 rupees and 45 rupees, respectively, may be given; but considering how small the expenditure and how simple the accounts will be for some time, I would prefer, in the first instance, that a young man be taken on trial as an accountant on a salary of from 60 to 80 rupees per mensem. English office, as now required.

4. Native Office.—The undermentioned native office establishment may be entertained at once. Native office, as now required.

1 Moonshee	at 20 rupees per mensem.
2 Native levellers	„ 15 or 20 rupees per mensem.
(According to qualifications.)	
1 Native doctor	at 15 rupees per mensem.
2 Sowars	„ 15 „ each per mensem.
1 Duffadar	„ 6 „ „
4 Burkundauzes	„ 4 „ „
1 Chupprassy	„ 5 „ „
2 Chupprassies	„ 4 „ „
4 Classies	„ 4 „ „

* English Office.

	RS.	A.	P.	RS.	A.	P.
1 European accountant	100	0	0			
1 English writer	45	0	0			
1 Assistant „	25	0	0			
				170	0	0
Native Office.						
1 Moonshee	30	0	0			
1 Assistant moonshee	15	0	0			
1 Native surveyor	25	0	0			
1 Native doctor	15	0	0			
2 Sowars, at 15 rupees each	30	0	0			
1 Duffadar of burkundauzes	6	0	0			
4 Burkundauzes, at 4 rupees each	16	0	0			
1 Chupprassy	6	0	0			
2 Chupprassies, at 5 rupees each	10	0	0			
4 Classies, at 4 rupees each	16	0	0			
				169	0	0
Carried forward				339	0	0

	RS.	A.	P.	RS.	A.	P.
Brought forward				339	0	0
Treasury.						
1 Treasurer	20	0	0			
1 Assistant treasurer	10	0	0			
1 Jemadar	8	0	0			
1 Duffadar	6	0	0			
16 Burkundauzes, at 4 rupees each ...	64	0	0			
				108	0	0
Works.						
1 Mistry smith	25	0	0			
1 „ carpenter	25	0	0			
1 „ bricklayer...	15	0	0			
1 Assistant mistry bricklayer	12	0	0			
1 Jemadar of Chupprassies	8	0	0			
10 Chupprassies, at 5 rupees each	50	0	0			
				135	0	0
Total...				582	0	0

And permission to employ, with detached parties on works under overseers, one moossuddie at 10 rupees, one chupprassy at 5 rupees, and a guard proportionate to the stores and treasure in his charge.

Treasury office, not now required.

5. The Treasury Office and Guard will not at first be required.

Establishment for works.

6. Works.—The executive engineer may entertain at once, one mistry smith, one ditto carpenter, one ditto bricklayer, at salaries not exceeding 15 rupees, for employment in the workshops; at 12 rupees, to superintend the building of the workshops and pukka bench-marks.

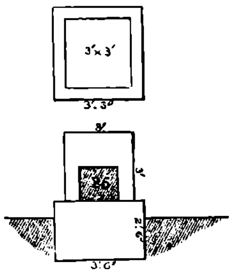
Establishment with detached assistants and overseers.

7. Each assistant or overseer, detached, to have a mootsuddie at 10 rupees, a chupprassy at 5 rupees, and a guard of four Burkundauzes, of whom one would receive 5 rupees, the others 4 rupees per mensem.

First business of the executive officer.

8. The first business of the executive officer will be to obtain by his own labour and that of his assistants and native levellers accurate information of the surface levels of the country throughout his division.

A longitudinal line of levels to be first carefully laid down.



9. He will first select two masonry bench-marks, respectively at the upper and lower extremities of his district, as near the probable line of canal as possible, using for this purpose some distinguishable existing object not liable to displacement, or, in the absence of such, he will build a masonry pillar of the form noted in the margin. The relative levels of these two points will be accurately ascertained by several trials, and the level of the upper one will be *provisionally* assumed as the zero, or starting point, for the general levels of the division.

These levels to be ultimately referred to that of the Myapoor regulating bridge.

10. In the foregoing paragraph, I use the word "provisionally," because the levels of all the divisions must ultimately be referred to the sill of the Myapoor regulating bridge; and the executive engineer of the Munglour division, who has already referred his levels to the work above mentioned, as a zero point, will be instructed to fix the level of bench-marks at the south-eastern extremity of his division on both sides of the *Kalee Nuddee,* and to communicate these levels respectively to the executive officers of the Bolundshuhur and Futtehgurh divisions, who, having referred their levels to the same standard, will communicate the result to the next in succession: and so on.

Connected series of cross levels to be laid down.

11. In connection with the work above described, the executive engineer will take, or cause to be taken, a combined series of longitudinal and cross levels over the whole of his district. The proximity of these lines to each other will be regulated by the nature of the country (whether undulating, flat, or having a uniform slope), but should be such as to mark clearly the principal water-shed lines, as well as all the lines of drainage.

Mode of exhibiting the result of the levels.

12. The results of this examination would be best exhibited on a map, drawn to a scale (say 4 inches to a mile), that will admit of each level point being shown, with its height (referred to the Myapoor zero) written in figures.

Specific object of the inquiry.

13. The object for which this information is required, and which, therefore, should be kept steadily in view while collecting it, is to facilitate the selection of the best possible line for the main and branch canals as well as for the irrigation channels or *rajbuhas* for distributing the water to the villages.

Principal considerations in selecting the lines of main canal.

14. In selecting the line for the main canal, the following points will be carefully considered:—

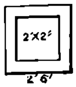
I. To keep the canal as much as possible on the highest ridge, so as to facilitate the distribution of water for irrigation, and not to interfere with the drainage of the country.

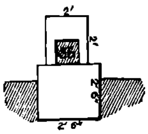
II. To ensure a depth of cutting which will provide earth sufficient for the requisite embankments, and keep the canal nearly, if not entirely, "within soil."

III. To keep the canal as much as possible in straight lines, and when a curve is unavoidable, that it should be of not less than two miles radius.

Selection of lines for Rajbuhas.

15. In selecting lines for *rajbuhas,* the first only of these considerations need be observed. The level of the water in these channels should be as a general rule slightly *above* that of the adjacent lands, and their general direction would of course be regulated by the position of the villages to be irrigated.





16. In carrying on the series of levels above described, it is very important that permanent bench-marks should be established at short intervals, and where wells, tombs or small religious buildings may not be met with in localities suitable for this purpose, it will be advisable to build small blocks of masonry of the size and form noted in the margin, and numbered. It is evident that the utility of bench-marks will depend, in a great degree, on the facility and certainty of their identification, the means of which must therefore be carefully provided by the surveying officer.

Bench-marks to be established at short intervals.

17. When an existing building may be used as a bench-mark, a sketch of the building should be made in the Field Book with such a degree of accuracy and detail as would enable another person to recognize the object without difficulty. The part of the building on which the levelling stave is placed should be that least exposed to injury, and should be carefully marked in the sketch.

Existing buildings used as bench-marks to be accurately noted in the Field Book.

18. To obviate mistakes from indifferent drawing or the general similarity of wells, suttees, &c., the dimensions of one or two principal parts of the building should be accurately measured, and noted in the sketch. As an additional precaution, it would also be advisable to take compass-bearings from the bench-marks, to two or three conspicuous objects within sight.

Precautions against mistakes.

19. Where pillars of masonry are built as bench-marks, the numbers (which will be cut in 3-inch figures on the plaster in a niche or recess of the pillar) would afford a sure means of identification; but lest these numbers should be defaced, it would also be expedient to fix the position of the bench-mark, by bearings to conspicuous objects, as above described. The levelling stave should be placed both on the top of the pillar and on the plinth, and the level of both these surfaces should be recorded, as a precaution in the event of one of them being injured.

Means to be used for the identification of the pillars.

20. Bench-marks, fixed with the care and precautions above prescribed, will be exceedingly useful for future reference, and as a check on the native levellers, whose work will always begin and close upon these fixed points, and may be received with confidence, when it is found to agree with a standard with which the operators were not previously acquainted.

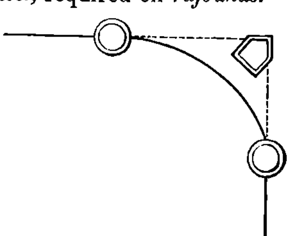
Uses to be made of the bench-marks.

21. During the examination of the country, the attention of the executive officers, and assistants, should be directed to ascertain the localities and quality of building materials to be obtained in the district, such as kunkur, or marle, fit for the preparation of cements, block-kunkur suitable for building purposes, and brick, earth, &c. The value of different kinds of kunkur for cement should be tested by experiment, and the result reported for the information of the director.

Inquiries regarding building materials, &c.

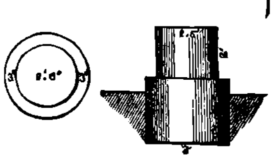
22. After the main line of canal shall have been approximately fixed, arrangements may be entered into for the manufacture of bricks on that line, wherever fuel may be available; the quantity being regulated by a rough calculation of the requirements, according to the printed estimates, and with reference to the bridges, &c., required on *rajbuhas.*

Arrangements for bricks.

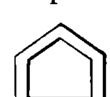


23. When the direction of the main line has been definitely decided on, the central, or mesial line, should be laid down with the greatest care, and marked with small masonry pillars, at distances of not less than one-third of a mile apart, so as to be easily visible, one from the other; and in cases of change of direction, a pillar would be built at each of the tangential points, and a third at the intersection of the tangents.

Main line to be carefully marked with masonry pillars.



24. The pillars built for the above purpose (and which will serve as points of reference for levels as well as for direction) will be circular in plan, and of dimensions as per margin. Those at the intersection of tangents will be of a different pattern; thus:



Description of pillars.

Bridge sites to be determined upon; 25. The sites of the bridges and other masonry works would then be determined in communication with the director, by whom specific instructions would be issued, regarding the details of their construction.

and chokies built. 26. It will generally be advisable to construct the first and second class chokies, as soon as the line of canal and sites of bridges, have been determined.

Estimate of earthwork to be prepared. 27. The exact length and longitudinal section of the main and branch lines of canal being determined, the quantity of earth-work will be calculated, and an estimate will be framed and submitted to the director, of the time probably required to complete the excavation, with reference to the resources of the country and facility of procuring contractors. The director will then communicate his orders, regarding the period for commencing the work.

Workshops to be established, and how employed. 28. In the schedule of Establishment, in paragraphs 1 and 2, are included one European overseer, a blacksmith, and a carpenter mistry. The object of the early entertainment of these men, is the establishment of a workshop, at or near the place, where the executive officer may fix his head-quarters. The blacksmith's department would be employed in the manufacture of tools, such as mamooties (fourahs), pickaxes, felling axes, &c., and the carpenters in the preparation of brick-moulds, soorkhi mallets, cubic measures for lime and soorkhi, 10 feet and 5 feet rods, and wheelbarrows, &c.

Nature of building for the workshops. 29. The building for the workshops may be on the same general plan as that sanctioned for the Munglour division, of which I inclose a ground-plan and elevation (Appendix A.), and for which an estimate must be submitted.

Levelling and surveying instruments, how to be provided. 30. The executive officer will be provided, in the first instance, with one large levelling instrument, and as many smaller ones, up to six, as can be obtained, previous to the arrival of those commissioned from Europe. He will also be supplied with a theodolite, if such can be obtained from the magazines; otherwise, he will have to wait for those ordered from home. Some pairs of levelling rods (probably as many as may be required) will be forwarded from the director's office.

Certain indents to be submitted. 31. For iron measuring chains, and as many mamooties, felling axes, &c., as are likely to be required in carrying on the levelling operations, indents on the nearest magazine will be prepared by the executive officer, and transmitted through the director's office, for sanction.

Bills for salaries of establishment, how prepared. 32. Bills for establishment salaries will be submitted monthly in the usual form, the general authority being quoted in the heading, and the special authority for any change or increase of salary being separately stated. The usual form of attestation will be appended to the bill, which must also be accompanied by acquittance rolls, in English and Persian, signed or sealed by each of the establishment in the receipt of a salary amounting to 10 rupees a month or upwards. The names as well as the designations of all the establishment receiving 10 rupees a month or upwards, must also be entered in the body of the bill.

Expenditure on works to be charged quarterly. 33. All expenditure on works will be charged and submitted quarterly, agreeably to the appended copy of "Rules" (Appendix B.) promulgated by Government, North-Western Provinces, and communicated to me in Mr. Secretary Thornton's letter No. 500 A. of the 25th August, 1847.

Form of the quarterly bills. 34. The first bills will consist of little more than the contingent expenses of surveying, but when there may be occasion to charge for work admitting of measurement, the bill will be prepared in the usual departmental form, and will consist of a statement of expenditure on labour and materials (separately) for each work, an exhibition of the rates at which each description of work was actually executed, and a comparison of the actual and estimated rates.

Measurement of work and survey report. 35. To each bill will be appended a statement of measurements of the work charged for, and a survey report in the usual form.

Detail of the quarterly bills. 36. The whole quarterly expenditure, though included in one bill, will be shown in separate items specifying the several descriptions of work on which it was incurred. The precise detail of this sub-division, for each principal work, will be prescribed by the director.

The rates to be deduced bonâ fide. 37. In preparing the comparison of actual and estimated rates, the executive officer will bear in mind, that it is the object of Government, that the rates exhibited should be those of the *actual* cost of each description of work. The heading of this part of the bill will be worded accordingly, and the attestation, on honour, will be held to apply to the rates as well as the amounts charged.

38. The "comparison of rates" will be followed by an "explanation of differences," in all cases where there may be a discrepancy, one way or the other, between the estimated and actual rates. Explanation of differences.

39. The expenditure on materials will be brought forward in the manner described in clause IV. and in paragraphs 5, 6, and 7 of clause III. of the annexed "Rules." Expenditure on materials.

40. The accounts of expenditure kept by the executive officer and required by him from his subordinates must be closed monthly, and will be prepared with special reference to the system of accounts embodied in the Agra Government "Rules." Accounts to be kept by the executive officer.

41. The forms prescribed by the Military Board for the accounts of the Department of Public Works, are appended to this communication (Appendix C.), but a modification of this system has been generally adopted in the Canal Department. Forms of accounts prescribed by the Military Board.

42. The "Day Book," as prescribed, is intended to be sent in daily to the executive officer, and this would be attended with much advantage, where extensive works are being carried on at one spot under the immediate supervision of the executive officer. As, however, it generally happens in the Canal Department that the expenditure is incurred by assistants or overseers at different localities, and not under the immediate supervision of the executive officer, whose duty it is to control the whole, it has been found convenient in practice to combine all the information contained in the "Day Book," in a monthly statement, the form of which is appended. (See Appendix D.) Modification of these forms adopted in the Canal Department.

43. The only real difference between this method and that of the Department of Public Works is, that the expenditure is reported, in the one case daily, in the other monthly, to the executive officer; the degree of detail in both plans may be the same. Difference between the two methods.

44. The precise form in which the daily expenditure shall be reported to the executive officer is left, in some measure, to his own discretion, under the proviso that the accounts of all his subordinates shall be susceptible of easy check, and that they, as well as the books prepared from them in the executive engineer's office, shall contain all the details of information expected or required by the Military Board or by Government. The accounts to contain all the information required.

45. A list of periodical papers, to be transmitted to the director's office, is subjoined. (See Appendix E.) List of periodical papers.

46. Whenever it may be necessary to take up ground for canal purposes, or to cut down trees, or remove wells or buildings, interfering with the line of canal, the proprietors of such land, trees, or buildings will be entitled to compensation, which will be awarded in strict accordance with the rules laid down in Mr. Secretary Thornton's letter to the Sudder Board of Revenue, No. 360, of 27th January, 1845, a copy of which forms Appendix F. Rules for compensation.

47. In accordance with the instructions of his Honour the Lieutenant-Governor, North-Western Provinces, communicated to the Sudder Board of Revenue, North-Western Provinces, under date the 25th August, 1847, the revenue officers of the districts through which the Ganges Canal will pass have been apprised of the approaching commencement of the work, and have been directed to afford every necessary assistance to the officers of the canal in their progress through the country. It must be understood, however, that the executive engineers are not to rely upon the assistance of the civil officers to procure labour or carriage for the works. These will be generally obtainable by good management, and by a system of regular payment and considerate treatment of the parties employed. Assistance from the civil authorities of districts.

48. The executive engineers will impress upon all their subordinates the necessity of treating with the consideration due to their official functions the native officers of the revenue and police departments with whom they may be brought in contact in the discharge of their public duties. Due respect to be paid to native revenue and police officers.

49. In the execution of work, it is advisable to adopt a system of contracts, whenever such can be obtained on reasonable terms. The works most easily susceptible of contract are—the excavation of a cut or formation of an embankment, of a given section; manufacture and carriage of bricks, lime, and soorkhi; quarrying and carrying blocks of kunkur, &c. Contract work recommended

50. When hired labour is employed, that supplied by the neighbouring villages, and paid daily, is generally the most economical; but when larger parties are required than the neighbourhood can supply, or Remarks upon hired labour.

when any particular work is in progress (such as block-sinking), which requires practised workmen, it then becomes necessary to employ labourers (beldars) on monthly pay, and to enforce strictly a system of task work.

Organization and description of beldars.

51. The beldars should be divided into mudduts, or squads of thirty to forty men each, under charge of a tindal, who will receive 6 rupees per mensem, and who will be generally held responsible for the conduct of his men, and may be punished for their remissness, at the same time that his authority is strictly upheld.

Collective preferable to individual tasks.

52. It will be generally found advisable to assign collective rather than individual tasks, *i. e.*, to measure out a certain portion of work to a whole squad, and not to each beldar. On this plan, each man has a direct interest in seeing that the others work, and in preventing truancy and skulking.

Terms on which absence on the plea of sickness can be granted.

53. When large parties of monthly paid labourers are employed, it is important that the terms on which absence on the plea of sickness can be allowed should be well understood. The method in use in the northern division of the Ganges Canal is recommended for general adoption. It is as follows:—

Hospital accommodation is provided for the workpeople in the event of sickness. Men who have been injured on the works receive full pay during their hospital treatment. The other hospital patients receive half-pay. Men who absent themselves from work under the plea of sickness, but do not go into hospital, receive no pay while non-effective.

Indents for stationery.

54. The executive engineers of the Ganges Canal are supplied with stationery from the Government stores, on which an indent, prepared agreeably to the accompanying form (see Appendix G.), should be submitted through the director's office, as soon as possible after the 1st July of each year.

Decisions on references on different subjects.

55. To prevent the necessity of future references, I subjoin (Appendix H.) a list of questions which have been referred from time to time by executive officers, and the authoritative decisions thereon, in parallel columns.

W. E. Baker, *Major.*

Roorkee, September 30th, 1847. *Director, Ganges Canal Works.*

Appendix B.

Rules for keeping the Accounts on the Grand Ganges Canal.

1. The works shall be executed agreeably to Major Cautley's designs. No deviation from the principles which have been sanctioned by Government to be made without the previous approval of the Military Board. The director will be competent to authorize such modifications as may be necessary to the efficiency of the work in progress, reporting the same immediately to the Military Board.

2. When money is required for the execution of works, application will be made by the executive engineer, through the director, to the accountant, North-Western Provinces, who will issue an assignment for the amount.

3. For the Northern Division.

(i.) The executive engineer of *Works* will submit to the director a bill for three (3) months' work prepared in the usual departmental form, *i. e.*, exhibiting quantities, rates, and amounts, and accompanied by detailed measurements of work done.

(ii.) The materials used to be charged for on rates furnished by the executive officer of *Materials.*

(iii.) When the rates of work differ from the estimated rates, full explanations to be given at the foot of bills in the usual manner.

(iv.) The bills after careful examination by the director will be submitted with his remarks to the Military Board.

(v.) The executive officer, whose duty will be to collect and prepare materials, and to take charge of bullocks, carts, &c., will submit quarterly to the director, for transmission to the Military Board, a detailed statement of expenditure and results in each item of his charge, including carts and bullocks, accompanied by such explanations as may appear to be necessary.

(vi.) To the above statement will be appended a balance sheet, showing on one side the actual expenditure on each item, and on the other the amounts received from the executive engineer of works, and the stock in hand.

(vii.) He will also submit a list deduced from the above-mentioned accounts of prices of materials, bullock hire, &c., which he proposes to charge, during the ensuing quarter, to the executive engineer, to whom it will be communicated by the director, if approved.

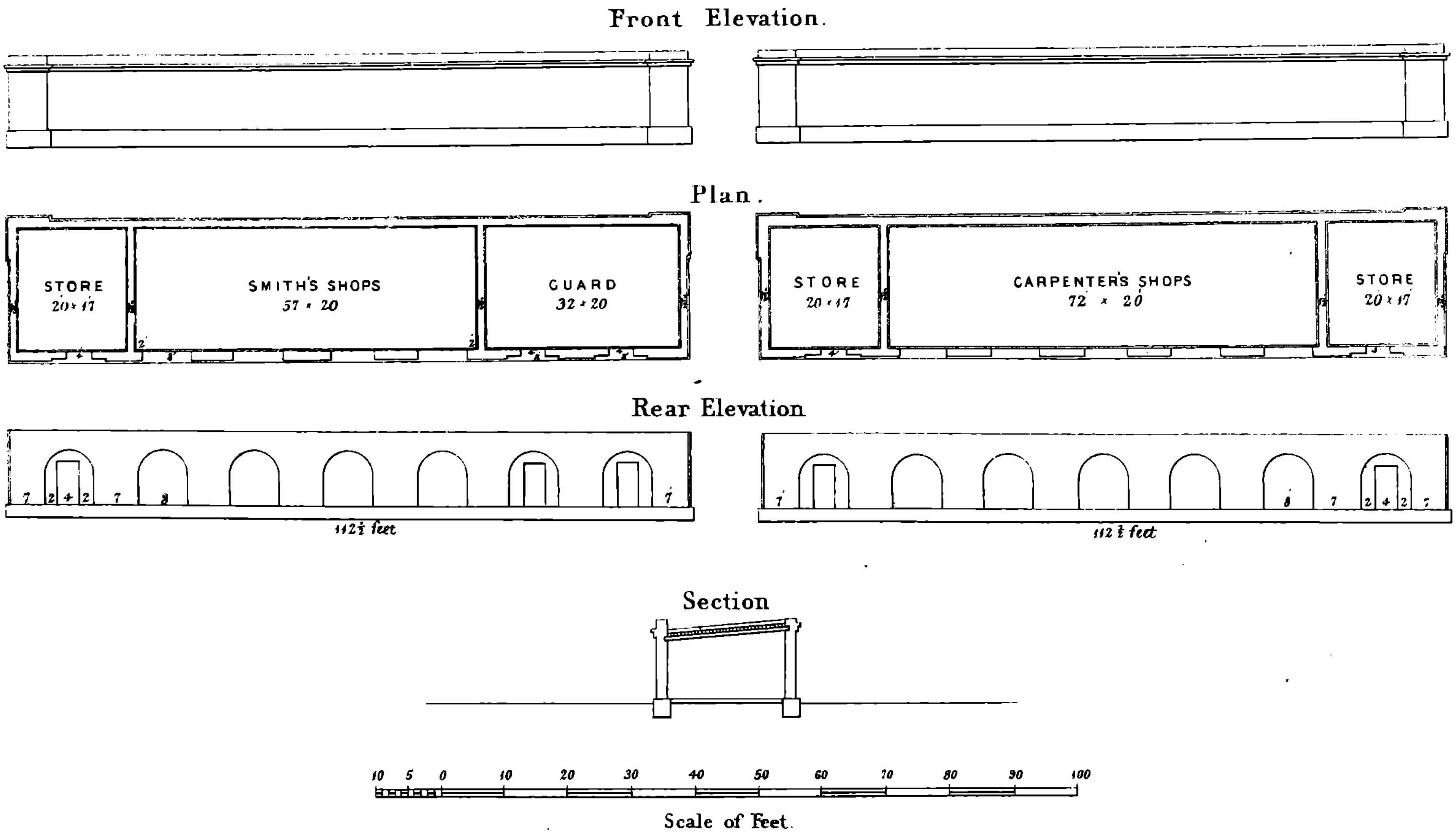
(viii.) The executive officer for materials will get advances from the executive engineer of works, and will write off per contra the value of materials supplied.

APPENDIX A.

General Plan of Workshops

FOR THE

GANGES CANAL.



London Smith, Elder & C° 65, Cornhill

4. In the smaller divisions it may be expedient from motives of economy to unite in one officer the functions of the two allowed to the 1st division.

(ii.) The executive engineer of a smaller division will therefore keep and submit quarterly to the director distinct accounts of works and materials as laid down for the *two* officers of the 1st division.

5. On completion of any work extending through more than one quarter, the director will draw out and submit to the Military Board a comparison of its actual cost with that estimated, at the same time reporting on the quality of work, &c., &c. Every work commenced and completed within the quarter will, by the director, be separately reported on, as to its quality, &c.

6. General accounts of expenditure on the canal works of all descriptions will be kept in the director's office, and balance sheets will be submitted to Government, quarterly or half-yearly, as may be required.

J. Thornton, *Sec. to Govt. N. W. Provinces.*

Appendix C.

Forms to be observed by Barrack Masters in keeping Accounts; approved and adopted by the Military Board, on the 1*st May*, 1821.

As an uniform system of accounts should be adhered to throughout the barrack department, the following forms are selected as the most convenient, with reference to the documents required to accompany bills for work executed.

Each district barrack master must keep five books, viz., No. 1, a Journal or Day Book; No. 2, an Abstract of Daily Cash Payments; No. 3, an Abstract of the Daily Expenditure of Materials and Labour; No. 4, a Stock Book; and No. 5, a Book for Advances in the shape of an Account Current.

In Book No. 1, all the disbursements of every description must be inserted each day, under its proper head; when a payment is made for general purposes and not for any particular building, it must be entered under that head.

Book No. 2 is intended for easy reference. The horizontal columns show at one glance of the eye the amount expended each day on the several works, as well as the total expense of the day. The vertical columns, when added up, show at once the total sum expended on any work up to any fixed date, as well as the total expenditure. This book by being kept up regularly will be found to save much time.

Book No. 3 is intended to record the labour and materials expended each day on different parts of the same buildings. For this purpose several pages or half pages must be allotted to one building, viz., half a page for the foundations, one or more pages for the superstructure, roof, floor, cornice, &c., &c. It affords the means of adding up separately and readily the expenditure on each part of a building, and when this book is accurately kept, nothing is more simple than the making out the bill at the completion of the work. All that is required is to take the total of each description of work, and the bill is ready.

No. 4 is to show readily what materials have been purchased, the average cost of them, and their appropriation.

No. 5 is the same description of book, but has reference to individuals instead of materials; it is a personal account current with each contractor, merchant, agent, or head mechanic, showing what advances have been made and what has been received for the money, or what is due. Each account with a native must be balanced monthly, and the man's signature affixed, or his acknowledgment of its being correct tacked to it. With Europeans it may be sufficient to balance the account quarterly.

The book No. 3 cannot be kept accurately unless a sufficient number of lallahs or mohurrurs are kept at the works to see what labour and materials are used, and to send to the office a daily report in writing, which should be filed as soon as it has been entered in the books.

Experience has shown that the first expense of keeping up a sufficient number of writers is amply compensated by the advantages of an early adjustment of accounts, and it will be readily seen that it is much easier to write a few lines in the books daily, than to have intricate accounts to make out when any work is finished; and in the event of any sudden removal or any accident occurring to a barrack master, his successor will easily continue the accounts and adjust all claims. A set of books of the prescribed form must be kept at each post or station, and when this cannot be done in the English language it must be done in Persian or Bengalee.

When money is sent to a native agent or overseer to carry on works at an outpost, he must be ordered to send regular monthly accounts, and to show by the attestation of the parties concerned, that all advances on account have been regularly balanced and adjusted for the past month. Receipts in duplicate for all advances must be regularly executed.

No. 1.—Form of Day Book.

1816. February.		Rs.	A.	P.	Rs.	A.	P.
	Stable No. 2 Line.						
1	1 mate mason	0	4	0			
	44 masons, at 2½ annas each	6	14	0			
	27 beldars, at 3¾ pice each	2	15	8			
	105 coolies 1st at 2½ annas each	7	11	6			
	35 „ 2nd at 1 anna each	2	3	0			
	19 boys, at 2 pice each	1	2	11			
	1 mate bheestie	0	2	6			
	15 bheesties, at 2 annas each	1	14	0			
	10 bundaries	1	4	0			
	1 mate and 8½ carpenters, at 2½ annas each	1	8	3			
	6 sawyers	0	15	0			
	16 chakees	4	15	4			
					31	13	2
	Stable No. 4 Line.						
	1 mate mason	0	3	0			
	12 masons, at 2½ annas each	1	14	0			
	15 beldars, at 3¾ pice each	1	10	6			
	27 coolies 1st at 2½ each	1	15	9			
	7 „	...		...	5	11	3
	Total expended 1st February, as per figured cash abstract	...		...	37	8	5
	Advances for General use of the Department.						
2	To Shaek Ramjaun, for lime	300	0	0			
	„ Googee Churn, Mistry, for bricks	200	0	0			
	„ Jugun Churn, ditto for firewood	50	0	0			
	„ Ramgeeon, for Soorkhi	20	0	0			
					570	0	0
	Workmen.						
	Quartermaster Sergeant's House, Infantry Lines.						
	1 mate mason	0	4	0			
	50 masons, at 2½ annas each	9	8	0			
					9	12	0
	Hospital of 2nd Battalion 9th.						
	1 mate mason	0	4	0			
	61 masons, at 2½ annas each	9	8	6			
					9	12	6
	Cantonment Road.						
	7 beldars	0	14	0			
	2 „ boys	0	3	0	1	1	0
	Total expended 2nd February, ditto	...		...	590	9	6
3	Advanced to Jan Ullee, native agent at Mullye	100	0	0			
	Advanced to Lallah Gunga Ram, at Kishen Gunj	50	0	0			
	Advanced to Goolmahomed ditto Chuppra	500	0	0			
					650	0	0

No. 2.—Form of Cash Abstract of Daily Cash Payments.

Date.	Stable No. 2.	Stable No. 4.	Quarter-master Sergeant's House Infantry Lines.	Hospital 2nd Battalion 9th Regiment.	Canton-ment Roads.	Advances for general use of the Depart-ment.	Kunkur.	Lime kiln.	Magazine.				Total Disbursements each day. For particulars, see Day Book.
1816.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS.							RS. A. P.
February 1	31 13 2	5 11 3	...	...	...	...	...	...	...				37 8 5
„ 2	...	...	9 12 0	9 12 6	1 1 0	570	...	...	...				590 9 6
„ 3	...	...	...	...	...	650	...	...	...				650 0 0

No. 3.—Figured Abstract of Daily Cash Expenditure of Labour and Materials.

Number of Feet.	Description of Building.	Head Masons.	Masons.	Beldars.	Coolies, 1st.	Coolies, 2nd.	Boys.	Bheesties.	Carpenters.	Sawyers.	Grammies.	Bricks.	Lime.	Sand.	Soorkhi.		Total Expense.
C. FT.													MDS.	MDS.	SRS.		
192 9	Foundation wall, 19th December, 1815	1	3	5	4	1	3	1	...	...	...	1000	2	3	20		—
		4	5	10	6	1	1·6	2	...	...	...	5	1–8	1–8	3		10 0 6
257 3	„ „ 20th „ „	1	3	4	4	1	3	1	...	...	...	500	1	1½	20		—
		4	7·6	8	6	1	1·6	2	...	...	...	2–8	12	12	3		6 1 0
480	Total cubic feet in foundation ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16 1 6
200	Superstructure, 21st December ...	...	...														
210	„ 22nd „ ...	...	...														
		...	...														
210	„ 23rd „ ...	...	...														
620	Total cubic feet in superstructure																
300	Plaster wall, 23rd December ...																
250	Roof wall, 23rd December																
230	Cornice wall, 23rd December ...																
230	Total running feet of cornice ...																

No. 4.—FORM of Stock Book.

1815. January -	— bricks, received from Ramjaun, brick contractor, at — per —	—	1815. February -	— bricks issued for the quarter guard of the 9th Regiment Native Infantry, at — per — ...	—
			March 1	Balance in store	—
March -	— maunds of lime, received from Mr. A.B., at—per 100 maunds	—	May -	— maunds lime issued for white-washing Artillery Barracks, at per 100 maunds	—
			May -	— maunds lime despatched to Captain A. B., for Commercial Buildings at Malda, at per 100 maunds	—
			June 1	Balance in store	—
March -	— ferrahs of Kooah received from C. D., contractor, at per 100 ferrahs	—	April -	— ferrahs of Kooah issued for the Cantonment Road, at per 100 ferrahs	—
				Balance in store	—
April -	— saul timbers, received, &c., &c.	—	June -	— saul timbers issued, &c. ...	—
				Balance in store	—

No. 5.—FORM of a Book for Advances in the shape of an Account Current.

1819.	DR. Mr. A. B. Lime Contractor.		1819.	CR. Mr. A. B., Lime Contractor.	
June	To amount advanced to you in cash, as per receipt ...	—	June -	By — maunds of lime delivered at per — maunds	—
July -	„ „ „ ...	—	July -	„ — maunds of lime to Malda, at per — maunds	—
August -	„ „ „ ...	—	August -	„ „ „ „ ...	—
		—			—
				„ balance due to barrack department	—
		—			—
	DR. RAMTONOO, Brick Contractor.			CR. RAMPTONOO, Brick Contractor.	
June 2	To amount advanced to you in cash, as per receipt ...	—	June 9	By — 11-inch bricks delivered at...	—
			„ 23	„ — 12 inch „ „ ...	—
			„ 30	„ — 11-inch „ „ ...	—
					—
			July 1	„ balance due to barrack department	—
	(Signed) C. D., *Brick Contractor.*			(Signed) A. B., *Barrack Master.*	

APPENDIX D.

GANGES CANAL WORKS ——— DIVISION.

DAILY ACCOUNT of Work People employed and Materials used, on the undermentioned Works, during the Month of ———, 1857.

No. 1. Regulating Bridge.

	Masons, at 8 rs.	Masons, at 7 rs. 8 a.	Masons, at 7 rs.	Masons, at 4 rs.	Masons, at 3 rs. 8 a.	Masons, at 3 rs.	Masons, at 2 rs.	Masons, at 1 r.	Mates, at 7 rs.	Mates, at 6 rs.	Beldars, at 4 rs.
1	10	3	8	1	1	1	6	2	...	2	70
2	12	22	6	1	1	1	6	2	1	6	221
3	16	22	7	...	1	1	6	2	1	3	113
4	9	12	3	...	1	1	6	2	1	3	102
5	18	18	4	...	...	...	...	...	1	4	167
6	29	17	3	...	...	...	...	...	1	4	167
7	32	18	4	...	...	...	...	...	1	5	193
8	11	17	3	...	...	...	...	...	1	5	219
9	14	18	4	...	...	...	...	...	1	4	198
10	12	17	3	...	...	...	...	...	1	4	184
11	12	18	3	...	...	...	...	...	1	9	320
12	15	17	3	...	...	...	...	...	1	9	328
13	17	18	4	...	...	...	...	...	1	9	327
14	16	16	3	...	...	...	...	...	1	9	330
15	13	15	4	...	...	...	...	...	1	4	161
16	1	5	1	...	...	...	...	...	...	2	76
17	5	11	1	...	...	...	...	...	1	3	118
18	5	9	...	...	...	...	...	...	1	2	112
19	5	10	1	...	...	...	...	...	1	...	55
20	5	9	...	...	...	...	...	...	1	...	55
21	3	6	1	...	...	...	...	...	1	...	34
22	1	...	...	...	...	...	...	...	...	...	...
23	4	3	1	...	...	...	...	...	...	...	12
24	4	4	1	...	...	...	...	...	...	...	31
25	5	4	1	...	...	...	...	...	...	...	31
26	5	1	1	...	...	...	...	...	...	...	12
27	1	...	...	...	...	...	...	...	...	...	12
28	...	...	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	...	...
	280	310	70	2	4	4	24	8	19	87	3,650

No. 1. Regulating Bridge (continued).

	Classies, at 4 rs.	Lime.	Soorkhi.	Sand.	2¼ Bricks.	Oil.	Earthen Vessels.	Baskets.	Bullocks.
1	1	...	...	...	...	6¼	26	55	4
2	1	240	240	240	...	...	17	199	4
3	1	...	...	...	...	...	...	...	4
4	1	...	...	...	...	...	7	...	4
5	1	...	...	...	...	...	6	...	4
6	1	...	...	...	...	...	...	...	4
7	1	130	130	130	...	...	...	...	2
8	1	236	236	236	...	...	...	18	2
9	1	...	...	...	...	...	...	18	2
10	1	...	...	...	...	...	...	...	2
11	1	...	...	...	...	...	...	197	2
12	1	...	...	...	...	...	...	...	2
13	1	...	...	...	...	...	...	...	2
14	1	...	...	...	...	...	...	230	2
15	1	...	...	...	...	...	...	...	2
16	1	...	...	...	66,308	...	8	30	2
17	...	...	...	...	...	...	...	...	2
18	...	...	...	...	...	...	6	...	2
19	...	...	...	...	...	...	4	...	2
20	...	...	...	...	...	...	...	...	2
21	...	...	...	...	...	...	...	...	2
22	...	...	...	...	...	...	...	...	2
23	...	...	...	...	...	...	...	...	...
24	...	40	40	40	...	...	...	...	...
25	...	30	30	30	...	...	...	...	...
26	...	...	...	...	...	...	...	...	...
27	...	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...	...
29	...	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...
	16	676	676	676	66,308	6¼	74	747	56

No. 2. Excavation in the Canal for Railway. — **No. 3. Excavation for Channel of the Earthen Aqueduct.**

	No. 2: Mates, at 8 rs.	Mates, at 7 rs.	Mates, at 6 rs.	Beldars, at 4 rs.	Baskets.	No. 3: Mates, at 8 rs.	Mates, at 7 rs.	Mates, at 6 rs.	Mistree, at 9 rs.	Classies, at 4 rs.	Beldars, at 4 rs.	Baskets.
1	...	3	2	212	100	...	5	10	...	1	423	...
2	...	3	2	213	40	...	5	10	...	1	455	100
3	...	3	2	218	...	...	5	10	...	1	465	...
4	...	3	2	229	...	...	5	10	...	1	460	...
5	...	3	1	229	...	...	5	10	...	1	460	100
6	...	3	1	127	...	...	4	10	...	1	443	...
7	...	3	2	127	40	...	4	9	...	1	580	...
8	...	3	2	124	...	...	4	9	...	1	698	135
9	1	3	3	173	95	...	4	9	...	1	611	...
10	1	3	3	169	...	...	4	9	...	1	595	...
11	...	3	1	96	...	1	4	11	...	1	561	...
12	...	3	1	93	...	1	4	11	1	1	558	...
13	...	2	1	59	...	1	5	11	1	1	605	145
14	...	2	1	60	...	...	5	11	1	1	560	...
15	...	2	1	66	...	1	5	11	1	1	609	...
16	...	2	1	65	...	1	5	11	1	1	576	...
17	...	1	2	60	...	1	4	8	1	1	479	...
18	...	2	1	60	...	...	4	10	1	1	388	...
19	...	2	1	60	...	...	4	9	1	1	384	...
20	...	1	...	27	...	1	4	6	1	1	450	185
21	...	1	...	27	...	1	4	6	1	1	305	...
22	...	1	...	27	...	...	3	6	1	1	250	120
23	...	...	...	...	...	...	4	6	1	1	268	...
24	...	...	...	...	...	...	2	2	1	1	114	...
25	...	...	...	...	...	...	2	1	1	1	81	112
26	...	...	...	...	...	...	2	1	1	1	81	...
27	...	...	...	...	...	1	3	1	1	1	297	...
28	...	...	...	...	...	1	3	2	1	1	425	...
29	...	...	...	...	...	...	4	3	1	1	295	...
30	...	...	...	...	...	1	4	2	1	1	287	...
	2	52	30	2,521	275	11	120	225	19	30	12,758	897

No. 4. Bricks. — **No. 5. Bridge Centerings.** — **No. 6. Excavation for Embankment.**

	No. 4: Mates, at 7 rs.	Mates, at 6 rs.	Beldars, at 4 rs.	Baskets.	No. 5: Carpenters, at 10 rs.	Carpenters, at 8 rs.	Carpenters, 7 rs. 8 a.	Carpenters, at 7 rs.	Carpenters, at 6 rs.	Mates, at 6 rs.	Beldars, at 4 rs.	Rope.	No. 6: Mates, at 8 rs.	Mates, at 7 rs.	Mates, at 6 rs.	Beldars, at 4 rs.
1	1	1	59	...	1	7	3	6	2	1	23	...	...	...	...	...
2	1	1	60	...	1	3	3	3	...	1	25	1	...	...	...	...
3	...	...	...	...	1	4	3	1	...	1	37	...	...	...	...	...
4	...	...	6	...	...	2	1	2	...	1	37	...	...	...	...	...
5	...	...	...	...	...	1	2	2	...	1	38	...	...	...	...	...
6	...	...	...	...	...	2	2	2	...	1	38	...	...	...	...	...
7	...	...	...	...	1	4	2	...	...	1	38	...	...	...	...	...
8	...	...	...	...	...	...	...	...	...	1	38	...	...	...	...	...
9	...	...	...	...	...	...	...	...	...	1	38	...	...	...	...	...
10	...	...	...	...	...	...	1	...	...	1	37	...	...	...	...	...
11	1	...	40	...	...	...	...	...	...	...	...	...	...	...	...	...
12	1	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...
13	1	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...
14	1	...	37	...	...	...	...	...	...	...	...	...	...	...	...	...
15	1	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...
16	1	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...
17	1	...	39	20	...	...	...	...	...	...	...	...	...	2	2	107
18	1	...	41	...	...	...	...	...	...	...	...	...	1	1	1	244
19	1	...	41	10	...	...	...	...	...	...	...	...	1	1	2	244
20	1	...	41	...	...	...	...	...	...	...	...	...	...	2	4	162
21	1	...	41	...	...	...	...	...	...	...	...	...	...	2	4	440
22	1	1	74	39	...	...	...	...	...	...	...	...	1	3	4	455
23	1	...	39	...	...	...	...	...	...	...	...	...	1	3	4	498
24	...	...	15	...	...	...	...	...	...	...	...	...	1	5	8	551
25	...	...	12	...	...	...	...	...	...	...	...	...	1	5	9	554
26	...	...	11	...	...	...	...	...	...	...	...	...	1	5	9	554
27	...	...	11	...	...	...	...	...	...	...	...	...	...	4	9	357
28	...	...	...	...	...	...	...	...	...	...	...	...	...	4	8	225
29	...	...	...	...	...	...	...	...	...	...	...	...	1	3	7	368
30	...	...	...	...	...	...	...	...	...	...	...	...	...	3	8	392
	15	3	731	69	4	23	18	16	2	10	349	1	8	43	79	5,151

GANGES CANAL WORKS ——— DIVISION.

Abstract of Workmen employed and Materials used on the undermentioned Works during the Month of ——— 1847.

Number.	Description.	Masons, at 8 *rs.*	Masons, at 7 *rs.* 8 *a.*	Masons, at 7 *rs.*	Masons, at 4 *rs.*	Masons, at 3 *rs.* 8 *a.*	Masons, at 3 *rs.*	Masons, at 2 *rs.*	Masons, at 1 *r.*	Mistrees, at 9 *rs.*	Mates, at 8 *rs.*	Mates, at 7 *rs.*	Mates, at 6 *rs.*	Classies, at 4 *rs.*	Beldars, at 4 *rs.*	Carpenters, at 10 *rs.*	Carpenters, at 8 *rs.*	Carpenters, at 7 *rs.* 8 *a.*	Carpenters, at 7 *rs.*	Carpenters, at 6 *rs.*	Materials. $2\frac{1}{2}$-inch Bricks.	Lime.	Soorkhi.	Sand.	Rope.	Oil.	Earthen Vessels.	Bullocks.	Baskets.
																									SR	SR			
1	Regulating bridge	280	310	70	2	4	4	24	8	...	...	19	87	16	3,650	...	...	...	...	...	66,308	676	676	676	...	$6\frac{1}{4}$	74	56	747
2	Excavation in canal for railway..........	...	...	...	...	...	...	...	...	...	2	52	30	...	2,521	...	...	...	...	...	...	...	...	...	...	...	...	...	275
3	Excavation for channel of earthen aqueduct	...	...	...	...	...	...	...	...	19	11	120	225	30	12,758	...	...	...	...	...	...	...	...	...	...	...	...	...	897
4	Brick kilns	...	...	...	...	...	...	...	...	...	...	15	3	...	731	...	...	...	...	...	...	...	...	...	...	...	...	...	69
5	Bridge centres...............	...	...	...	...	...	...	...	...	...	...	...	10	...	349	4	23	18	16	2	...	...	...	...	1	–	–	–	—
6	Excavation for embankment	...	...	...	...	...	...	...	...	...	8	43	79	...	5,151	–	–	–	–	–	—	—	—	—	–	–	–	–	—
	Total	280	310	70	2	4	4	24	8	19	21	249	434	46	25,160	4	23	18	16	2	66,308	676	676	676	1	$6\frac{1}{4}$	74	56	1,988

Appendix E.

List of Periodical Papers.

Monthly.

Statement of correspondence.
List of letters despatched by executive engineer.
Estimate of funds required by executive engineer for the current and five ensuing months.
Report on disposal of assistants.
Progress report.
Current expense bill.
Statement of assignments received and realized during month.

Quarterly.

Return of warrant and non-commissioned officers' bill for expenditure on works, with abstracts of quantity completed, &c.

Half-Yearly.

General sayer account, to accountant North-Western Provinces, and director.

Yearly.

Indent for stationery.
Return of magazine tools.
Return of levelling and surveying instruments.
Descriptive roll and confidential report of overseers.
Return of uncovenanted servants.

GANGES CANAL WORKS ——— DIVISION.

PROGRESS REPORT on the undermentioned Works during the Month of ——— 1847.

No. 1—REGULATING BRIDGE.

Part of Work.	Description.	L. Feet.	L. Inches.	B. Feet.	B. Inches.	D. Feet.	D. Inches.	Number.	Contents. C. FT.	IN.	
Pillars	Brick-work, masonry, mortar { 1 Lime, 1 Soorki, 1 Sand }	5	6	5	6	2	9	4	332	9	0
"	" " "	5	..	5	..	1	3	4	125	0	0
"	" " "	5	6	5	6	..	9	4	90	9	0
"	" " "	5	..	5	..	..	6¾	4	56	3	0
"	" " "	9	6½	4	1½	2	9	2	216	5	7
"	" " "	9	0½	3	7½	1	3	2	81	11	3
"	" " "	3	7½	3	7½	1	3¼	2	34	5	10
"	" " "	4	2½	4	7½	1	3¼	2	51	0	10
"	" " "	7	1½	..	3	..	9	2	2	8	0
"	" " "	9	7½	1	..	1	9	2	33	8	0
Pier	" " "	6	4½	3	1½	1	7	2	63	0	10
Pillar walls	" " "	5	7½	2	4½	7	9	2	206	11	10
"	" " "	7	8	..	3	1	..	2	3	10	0
Cutstone, cornice ..	" " "	10	..	1	..	1	5	2	28	4	0
Pillar walls	" " "	2	3	2	3	9	4	2	94	6	0
Parapet	" " "	10	9	2	6	2	..	2	107	6	0
"	" " "	7	..	2	..	3	9	2	105	0	0
" cornice ..	" " "	4	3	2	3	1	..	2	19	1	6
"	" " "	2	..	1	9	1	3	2	8	9	0
Wing wall cornice ..	" " "	29	3	3	..	1	9	4	614	3	0
" and bench	" " "	29	3	5	6	1	..	4	321	9	0
"	" " "	29	9	1	6	1	3	4	223	1	4
"	" " "	29	3	2	..	..	10½	4	204	9	0
Bench	" " "	29	3	2	..	..	6	2	58	6	0
"	" " "	29	3	1	9	1	..	2	102	4	6
Wing wall	" " "	29	3	2	..	1	..	2	117	0	0
Pillar	" " "	7	..	4	8½	2	9	2	181	3	2
" cornice	" " "	12	..	1	..	1	9	2	42	0	0
"	" " "	6	6	4	2½	2	6¾	2	140	2	3
" cornice	" " "	9	..	..	3	..	9	2	3	9	0
Piers	" " "	4	1½	2	5½	4	6	9	410	10	6
Walls to crown of arch	" " "	12	..	2	6	4	6	9½	1,282	6	0
" "	" " "	12	..	2	6	1	7	10	475	0	0
" "	" " "	6	2½	4	1½	1	7	9	365	9	9
Arch	" " "	41	9	9	9	1	6¼	..	636	0	7
"	" " "	41	9	23	4	1	6¼	..	1,522	1	5
Total contents ..	.. ..	..	..	..	..	..	..	..	8,363	5	2

Deduct Piers .. .. 1′ 1″ × 1′ 1″ × 1′ 7″ × 9 = 16′ 8″ 8‴

" .. .. 1 1 × 1 1 × 4 6 × 9 = 47 6 6

" grooves .. .. 1 0 × 0 9 × 1 7 × 9 = 10 8 3

74 11 5

Balance total cubic feet of masonry 8,288 5 9

16,992 cubic feet of excavation done in making roadway across arches .. L. 177 × B. 32 × D. 3 = 16,992 cubic ft.

No. 2.—Excavation in Canal for Roadway.

Earth excavated ... ... 584·14 long × 50 broad × 5 deep = 1,39,035 cubic feet.

No. 3.—Excavation for Channel of Earthen Aqueduct.

Earth excavated ... ... 4,590·64 long × 50 broad × 3 deep = 6,88,596 cubic feet.

No. 4.—Brick Kiln.

30,000 pukka bricks taken out of kiln ... ... 12″ × 6″ × 2½″
83,308 peela " " ... ... 12″ × 6″ × 2½″

No. 5.—Bridge Centres.

Centres, planks, &c., all taken down and sent into store, and planks all stacked at shop.

No. 6.—Excavation for Embankment.

Earth excavated ... ... 4,353 long × 25 broad × 4 deep = 4,35,300 cubic feet.

GANGES CANAL WORKS ——— DIVISION.

ABSTRACT of EXPENDITURE during the Month of ——— 1847.

Description.	Rate.	Amount Price.	Amount.	Total.	Grand Total.
	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.
WORK PEOPLE.					
280 masons, at per month	8 0 0	..	74 10 8		
310 " "	7 8 0	..	77 8 0		
70 " "	7 0 0	..	16 5 4		
2 " "	4 0 0	..	0 4 3		
4 " "	3 8 0	..	0 7 5½		
4 " "	3 0 0	..	0 6 5		
24 " "	2 0 0	..	1 9 7		
8 " "	1 0 0	..	0 4 3		
19 mistrees "	9 0 0	..	5 11 2½		
21 mates "	8 0 0	..	5 9 7		
249 " "	7 0 0	..	58 1 7		
434 " "	6 0 0	..	86 12 9½		
46 classies "	4 0 0	..	6 2 1½		
25,160 beldars "	4 0 0	..	3,354 0 8		
4 carpenters "	10 0 0	..	1 5 4		
23 " "	8 0 0	..	6 2 1½		
18 " "	7 8 0	..	4 8 0		
16 " "	7 0 0	..	3 11 2½		
2 " "	6 0 0	..	0 6 5		
				3,704 9 0	
MATERIALS WITHDRAWN FROM STORE.					
66,308 2½-inch pukka bricks					
676 cubic feet lime					
676 cubic feet soorkhi					
676 cubic feet sand					
56 Government bullocks in use ..					
MATERIALS PURCHASED.					
1 seer rope, at 2 seers per rupee ..	..	..	0 8 0		
6½ seers oil, at 6½ seers per rupee ..	..	..	1 0 0		
74 earthen vessels, each	0 0 2	72	2 0 10		
1,988 baskets, at 2 *rs.* per 100	..	..	39 12 1		
				43 4 11	
Total expenditure	..	..	.. ..	.. ..	3,747 13 11

GANGES CANAL ——— DIVISION.

ACCOUNT CURRENT of EXPENDITURE for the Month of ——— 1847.

DR. CR.

Date.		Amount.			Total.			Date.		Amount.			Total.		
		RS.	A.	P.	RS.	A.	P.			RS.	A.	P.	RS.	A.	P.
1847.	To balance in hand on 1st ——— as per last account current ..	500	4	0				1847. 1	By amount expended during the month of ——— as per abstract	3,747	13	11			
17	To cash received from	1,500	0	0				30	By balance in hand ..	252	6	1			
20	To " "	2,000	0	0	4,000	4	0						4,000	4	0
	Total	..	..		4,000	4	0		Total	..	..		4,000	4	0

APPENDIX F.

No. 360.

From J. THORNTON, Esq., *Secretary to the Government, N. W. P., to* H. M. ELLIOT, Esq., *Secretary to the Sudder Board of Revenue, N. W. P., Agra, dated the* 27*th January,* 1845.

Revenue Dept.

SIR,

With reference to the correspondence noted below,* I am desired to request that you will inform the Board that the Lieutenant-Governor, on the occasion of his late visit to Hurdwar, found that some difficulty and delay were still experienced in adjusting the amount of compensation for property required for the Ganges Canal. Advantage was taken of the presence on the spot of all the local revenue and of the Canal officers to come to a better understanding on the subject.

2. The great object to be attained is promptitude in the adjustment of all claims of this nature, and security that payment for property taken, or suspension of demand for land occupied, be not delayed when the right of the claimant has once been recognized.

3. These ends will generally be best attained by entrusting the award of compensation to the canal officers who are on the spot; but it is found that, with regard to property in land, those officers have difficulty in ascertaining the principles on which remission of the Government demand on the land is to be adjusted, or the persons who are entitled to claim the benefit of compensation on account of the land occupied by the Government. With respect, therefore, to this class of claims, the agency of the collector must still be employed, and due provision made for fixing on the right party the responsibility for any delay which may occur.

4. The Lieutenant-Governor, therefore, proposes the following rules for adoption, and requests that they may be communicated, through the commissioner and director of the canals, to those whom they may concern, unless the Board are aware of any objections to their immediate adoption.

5. The canal officers shall settle all compensation regarding houses, trees, crops, wells, and buildings, and shall pay the money from their own treasury, taking receipts as vouchers and acquittances from the owners. The revenue officers are always at liberty to represent any case in which they find the compensation awarded to be inadequate, or the proceeding to have been conducted in any objectionable way.

6. The collector shall settle compensation regarding land, however occupied,—whether by crops or gardens; whether cultivated, culturable, or barren; whether *khalisah* or *lakhuraj*. In such cases, the canal officer, as soon as he has laid down his line (*dagh bel*), should give certificates to the tehseeldar and collector, stating the quantity of land he requires and which he has marked off, and the date on which he requires that it be vacated. This date should generally be that on which all the standing crops will be cut at the termination of the current Fussily year. It will then rest with the tehseeldar immediately to ascertain and report to the collector how and by whom the land is occupied, and on what terms remission of jumma or compensation should be given, under existing rules. It will rest with the collector to provide that the terms be definitively settled by the time when the land is required by the canal officers, or as soon after as possible, and that no unnecessary demand is made on the zumeendars for the land thus taken. The collector, when reporting to the commissioner his proposed remission for the confirmation of Government, will furnish a copy of his report to the director of the canal, in order that an opportunity may be afforded to that officer of offering any remarks on the transaction that may occur to him as affecting the charge on his works.

* Letter to Secretary, Sudder Board of Revenue, dated 4th June, 1844, No. 2,111; letter from ditto, ditto, dated 2nd July, 1844, No. 309; letter to ditto, ditto, dated 20th July, 1844, No. 2,726; letter from Commissioner Meerut Division to Secretary Sudder Board of Revenue, No. 216, dated 24th July, 1844; letter to Secretary, Sudder Board of Revenue, No. 3,956, dated 7th September, 1844.

7. The remission ultimately sanctioned by the Government will be notified to the director of the canal at the same time as to the accountant revenue department.

8. The Lieutenant-Governor requests that the Board will impress upon the commissioner and the director of the canal the importance of paying attention to the regular and punctual performance of this duty.

I am, &c.,

Agra, the 27th January, 1845. J. Thornton, *Secretary to Government, North-Western Provinces.*

Appendix G.

Indent for Stationery required for the use of the Executive Engineer of the ——— Division of the Ganges Canal, ————, 1st July, 18—.

Names of Articles.	Received in December, 1846.			Balance on the 1st July, 1847.			Quantity Indented for, for 1848.			Number of Clerks, Assistants, &c.	Remarks.	Admitted.
	Reams.	Quires.	No.	Reams.	Quires.	No.	Reams.	Quires.	No.			
Double-elephant Drawing-Paper												
Book Paper												
General Letter Paper												
Foolscap Paper												
Quarto Post Paper												
Blotting Paper												
Serampoor Paper												
Marble Paper												
Cartridge Paper												
Quills												
Black Ink Powders												
Red Ink Powders												
Penknives												
Erasers												
Hones												
Strops												
Slices												
Scissors												
Office Pencils												
Drawing Pencils												
Red Tape												
Indian-rubber												
Chest Inkstands												
Round Rulers												
Wafers, Boxes												
Wafer Seals												
Sand, Europe												
Pounce												
Pasteboards												
Camel-hair Pencils												
Crimson Lake												
Prussian Blue												
Gamboge												
Burnt Sienna												
Indian Ink												
Books, General Letter, &c.												

(Signed) ————————, *Executive Engineer,*

——— *Division Ganges Canal.*

Appendix H.

Authoritative decisions on certain points submitted by Executive Officers.

QUESTION. *Lieutenant Strachey's letter No.* 53 *of 20th June*, 1843. *Inquires how he is to obtain the cost of packing-cases sent with stores from magazines, how it is to be debited, and what is to be done with the articles themselves? Also, in case he is directed to sell them, how the amount should be charged in his accounts?*—ANSWER. Secretary Military Board's letter No. 1,939, of 22nd July, 1843, states "that it would probably be the best plan to sell the packing-cases in question, if they are not required in the department; and Lieutenant Strachey might indemnify himself for any loss in the sale by submitting a bill for the difference, and the proceeds might be brought forward in the periodical account current." "Lieutenant Strachey can be furnished from the Board's office with the rates of any articles supplied to him from the Ordnance Department, whenever applied for."

The plan generally adopted is to return to the magazine all the packing-cases, &c., received, and to submit a bill for their value, supported by the magazine officer's receipt.

QUESTION. *Lieutenant Strachey's letter No.* 49 *of* 30*th May*, 1843. *Understands that Major Cautley had proposed to Government the employment of public cattle on the Ganges Canal works, for the conveyance of materials; such a measure being undoubtedly a great saving, requests that he may be informed of the decision of Government on the subject.*—ANSWER. Commissary-General's letter No. 1,173, dated 9th June, 1843, protests against the proposed measure, as being most inexpedient at any time. "We have no carts to give, but if our elephants and camels are so employed, there would be few or none amongst them with sound backs in the course of a month."

"The objection applies to a particular employment, and holds good not only now but at all times."

The above view was concurred in by the Honourable the Lieutenant-Governor, North-Western Province, *vide* secretary's letter No. 3,706 of 15th August, 1843.

QUESTION. *Major Baker's letter No.* 389 *of* 1*st April*, 1845, *inquires, first*, "*whether in the prosecution of public works it be necessary that the undermentioned documents should be engrossed on stamped paper, viz., contracts or agreements for excavation of earth, manufacture of brick, or supply of materials, and security bonds for the repayment of Government money advanced on the above account; secondly, whether in the event of the documents above mentioned being engrossed on other than stamped paper of the prescribed value, the executive engineer can, in a civil court, enforce the fulfilment of a contract, or recover the amount of security, when justly forfeited; or, in other words, thirdly, whether the general exemption appended to Regulation X. of* 1829 *be intended to apply to the Department Public Works?*—ANSWER. The Secretary to the Government North-Western Provinces in his letter No. 2166 of 1845, dated 23rd May, 1845, to the Military Board states in reply "that the exemption which follows article 12, Schedule A. Regulation X. of 1829 (as copied below*) is, in his Honour's opinion, entirely applicable to the documents mentioned by Captain Baker. His Honour therefore conceives that there is no necessity for executing such documents on stamped paper.

QUESTION. *The Superintendent of Canals, having granted to commissioned officers, in the canal department, temporary leave of absence on private affairs.*—ANSWER. The Board, in their secretary's letter, No. 3,565 of 7th September, 1847, ruled "that the only pleas, under which a superintending engineer can, under existing orders, grant leave, are first on medical certificate, and in such case the party should furnish the requisite certificate, and secondly, on urgent private affairs, in which case the superintending engineer must satisfy himself of the validity of the plea before granting it."

QUESTION. *Major Baker's letter No.* 1,472 *of* 10*th April*, 1847, *inquires the power vested in him to grant leave of absence to uncovenanted subordinates in the canal department.*—ANSWER. Secretary Military Board's letter No. 1,600, dated 25th June, 1847, transmits copy of a letter No. 2,448 of 10th idem, with annexures from Mr. Secretary Thornton, "communicating the power vested in you by Government to grant leave of absence not exceeding one month in each year, over and above the occasional holidays, whenever you are of opinion that the indulgence can be granted without detriment to the public service, and is merited by the good conduct of the applicant."

QUESTION. *Lieutenant Strachey's letter No.* 105, *dated* 24*th October*, 1845, *asks for permission to advance to Assistant Overseer Sergeant Johnstone the sum of* 200 *rupees to assist him in building himself a bungalow at Roorkee.*—ANSWER. The Secretary Military Board's letter No. 6,223 of the 16th December, 1845, states, "that an advance of 200 rupees requested by Sergeant Johnstone, to enable him to build a house at Roorkee, is quite inadmissible."

QUESTION. *Lieutenant Smith's office and private carriage having been seized for military purposes and a complaint made.*—ANSWER. The Honourable the Lieutenant-Governor replied, in Mr. Secretary Thornton's letter, No. 4,853 of 11th November, 1846, that "when absolutely required for the march of troops, the seizure of carriage is authorized by Regulation XI. of 1806, Section 3."

QUESTION. *Lieutenant Turnbull's letter No.* 225, *dated* 10*th June*, 1847, *requests that sanction may be obtained, for placing the whole of his bricks under charge of the civil village powers, as he is anxious to remove his establishment.*—ANSWER. The Commissioner of Meerut, in reply (No. 257 of 14th June, 1847,) states that he has directed the collectors of Meerut, Mozuffurnuggur, and Suharunpoor, "to provide for the protection of the bricks by making the zumindars of the villages where they are collected responsible for their safe custody. The village chokidars ought likewise to be ordered to look after the heaps, and see that they be not pilfered by the inhabitants of the neighbourhood."

* Bonds given to or by the officers of Government on account of any matter or thing of or belonging to the Government in its political or territorial capacity.

QUESTION. *Reference having been made regarding a statement of conditions of service of beldars, &c., employed on the Ganges Canal Works.*—ANSWER. The Honourable the Lieutenant-Governor decided (in Mr. Secretary Thornton's letter, No. 617 A. of 1847), dated 29th September, 1847, that he could "only refer you to Sections 5 and 6 Regulation VII. of 1819, and to the constructions of the Nizamut Adawlut noted below,* which have reference to that enactment. By the first two, you will see that European British subjects are held not to be liable for prosecution as defendants under the regulation in question, though they may sue as complainants; and by the last you will perceive that there must be either a stipulated term of service, or a contract for specific work, to render artisans and other workmen liable under Section 5, of the regulation."

"The Lieutenant-Governor does not consider that there would be any difficulty in your having a simple form of agreement drawn up and lithographed, to which every labourer employed on the canal should be required to subscribe. In this contract the forfeiture of arrears for a certain period might be made the stipulated penalty of absconding without due notice. The conditions of such an engagement would necessarily become in a short time generally known."

In accordance with the above suggestion, an agreement paper has been drawn up and adopted in the northern division, a copy of which is hereto annexed.

Copies of the sections and constructions above referred to are also attached.

FORM OF AGREEMENT PAPER.

هم كه سب ٹنڈيل اور بيلدار نوكر علاقه نهرگنگ ضلع اوتر كي هين

جو هم سب بيلدار نوكر نهرگنگ ضلع اوتر كي هين اسواسطي اقرار كرتي هين اور لكهديتي هين كه هم لوگ هميشه موافق دستور نوكرون كي وقتضرورت آئينگي اگر نوكري چهوڑنا چاهين تو پندره دن پهلي خبر چهوڑني نوكري مذكور كي بحضور صاحب بهادر مهتمم نهرگنگ كي كرين اور جوكوئي هم مين سي بسببسستي كام يا شرارت اپني كي كار سركار چهوڑكر بيٹهه رهي يا بدونپندره دن پهلي خبر ديني كي نوكري چهوڑكر كهين چلاجاوي تو تنخواه چڑهي هوئي أسكيدو مهيني تلك كي سركار مين ضبط هرجاوي اور اگر بابت أس تنخراه كي وه شخص پهر كبهي دعوى كري تو جهوٹها هو اور جو واجبي حصه كام طرف ماحب بهادر مهتمم نهرگنگ سي مقرر هوجاوي وه كام هم پوراكردين يهه شرط نوكري اور ٹهيكه كام هماري كي هي اسواسطي يهه چند كلمه بطريق اقرار نامه كي للهدئيي كه سند هووين اوروقت حاجت كي كام آوين * تحريربتاريخ

Sections 5 and 6 of Regulation VII. of 1819.

V. All persons who may voluntarily engage to serve as workmen, of any description, for a stipulated term, or who may voluntarily contract for the performance of any specific work, and who, without good and sufficient cause, shall wilfully quit the service so engaged for, before the expiration of the term agreed upon, or shall wilfully neglect to perform the work so contracted for, shall be deemed guilty of a misdemeanour; and on conviction, before a magistrate or joint magistrate, shall be liable to a sentence of imprisonment, not exceeding one month. The magistrate or joint magistrate may likewise require the persons so convicted to complete their stipulated term of service, or to perform the work contracted for, if it appear just and proper to require the same; and any subsequent conviction of wilful neglect to comply with such requisition shall be punishable by a further sentence of imprisonment, not exceeding two months.

VI.—CLAUSE FIRST.—The provisions of the foregoing section are also declared applicable to domestic servants, who may engage to serve for any fixed term, or during the performance of any specific service, or though no such engagements have been entered into, may be employed from month to month, and without good and sufficient cause, shall wilfully quit the service of their employer before the expiration of the fixed term, or before the completion of the stipulated service, or with respect to monthly servants, without giving previous notice, for a period not less than fifteen days.

SECOND.—In like manner, no master, or other person, employing a servant for a fixed term, or for a specific service, or from month to month, shall be at liberty, without good and sufficient cause, to discharge such servant against his will before the expiration of the fixed term, or the completion of the specified service; or, with respect to servants employed from month to month, without giving previous warning of the intended discharge for a period of at least fifteen days, or paying his wages for that period.

* No. 340, dated May 25th, 1821; No. 345, dated July 20th, 1821; No. 384, dated April 29th, 1823; No. 1329, dated May 27th, 1842.

THIRD.—It shall be the duty of the magistrate or joint magistrate, on application made to him upon the stamp paper prescribed in section 18, of Regulation I., 1814 (viz., bearing a stamp of eight annas), to enforce the provisions of the above clause, by causing payment to any servant who may be discharged in opposition thereto, of a sum equal to half a month's wages, in addition to any arrear of wages which may be due to him at the time of his discharge; or if the servant have been engaged for a fixed term, or for a specific service, by causing payment to be made to him of such sum as may appear fully adequate to any loss sustained by him from being discharged before the time agreed upon.

FOURTH.—Provided, however, that no servant shall be entitled to recover more than his arrear of wages when he may be discharged for misconduct, proved to the satisfaction of the magistrate or joint magistrate, and appearing sufficient to warrant his discharge; nor shall any workman or servant be liable to punishment under the provisions of this regulation, when it may be proved, to the satisfaction of the magistrate or joint magistrate, that his quitting the service of his employer, without previous notice, or before the expiration of a stipulated term, or without having completed the performance of any work contracted for, was occasioned by gross maltreatment, or by non-payment of wages due, or by any other cause which may appear to the magistrate or joint magistrate sufficient to justify or excuse the act complained of.

VII.—The whole of the sentences which may be passed by a magistrate or joint magistrate under any part of this regulation will, of course, be open to the regular control of the Court of Circuit of the division, according to the general rules in force on this subject.

CONSTRUCTIONS OF THE NIZAMUT ADAWLUT.

To the Bareilly Court of Circuit.

Dated the 25th May, 1821.

I am directed by the Court of Nizamut Adawlut to acknowledge the receipt of a letter from you, dated 11th instant.*

2nd.—In reply, I am directed to communicate to you the opinion of the Court, that the rule contained in clause 3, section 6, Regulation VII., 1819, cannot be considered applicable to European British subjects, and that, consequently, under the general regulations, an award by a magistrate (even though a justice of the peace), of the nature alluded to in the latter part of the first paragraph of your letter, is unauthorized and illegal.

3rd.—You are, of course, at liberty to consult the Advocate-General as to how far he may consider such a decision legal under the Act of Parliament, to interpret which does not fall within the province of this Court.

4th.—It is at the same time obvious to remark, that from a conviction of a British subject by a magistrate, in his capacity of justice of the peace, under 53rd George III., cap. 155,† *the appeal is not to a Court of Circuit, but to the Supreme Court in Calcutta.*

To the Bareilly Court of Circuit.

Dated the 20th July, 1821.

I am directed by the Court of Nizamut Adawlut to acknowledge the receipt of a letter from you under date the 2nd instant, together with its enclosure from the magistrate of Zillah Moradabad, dated the 27th ultimo.‡

2nd.—The rule contained in clause 3, section 6, Reg. VII. of 1819, being clearly not applicable to European British subjects as defendants, and it appearing from Mr. Halhed's letter to your Court that he is in possession of a copy of my letter to your address, bearing date the 25th May last, the Court are not aware of the necessity of any further orders on the subject of Mr. Halhed's enclosure in your letter above acknowledged. With respect to the query occurring in the second and at the conclusion of the third paragraph of Mr. Halhed's letter, it is obvious that clause 4, section 16, of the above-cited Regulation, cannot be acted upon at all against such masters or persons as may not be liable to the Regulation and subject to the magistrate's authority; at the same time, that against such servants as are liable and subject, the Regulation may be acted upon, even in favour of those very masters who are exempted from being made defendants.

To the Acting Magistrate of Zillah Sylhet.

Dated the 29th April, 1825.

The Court of Nizamut Adawlut have had before them your letter, under date the 16th instant,§ requesting to be informed whether the second punishment directed by section 5, Regulation VII., 1819, in cases of workmen neglecting to finish their work, should be considered final and conclusive, or whether the magistrate is at liberty to repeat such punishment until the work is performed.

2nd.—In reply, I am desired to communicate to you the opinion of the Court, that the sentence of two months' imprisonment, prescribed in the section above quoted, is intended as punishment for wilful neglect to perform work

* No. 340, 1819, Regulation VII., section 6, clause 3.

† This is superseded by a Regulation which vests the appellate power in the Sessions Court.

‡ No. 345, 1819, Regulation VII., section 6.

§ No. 384, 1819, Regulation VII., section 5.

undertaken, and not as a means of compelling the performance of it; consequently, that the magistrates are not competent to repeat the punishment of two months' imprisonment or to take any further measures towards compelling an actual performance of the work engaged for.

The following queries* were submitted by the magistrate of the Twenty-four Pergunnahs, to which the replies in juxtaposition were given:—

QUESTIONS. 1st.—*Can workmen, such as mistrees, mooches, or other artisans, be brought within the meaning of the enactment quoted, supposing that they have taken advances from their employers and agreed to work for the same, without any stipulation as to the precise term or specification of the job that they are to perform?*

2nd.—*By what magistrate are cases, under the above-mentioned provisions, cognizable: the magistrate of the district wherein the agreement was entered into, or that of the district wherein the delinquents reside, or to which they may have decamped?*

ANSWERS. 1st.—There must be a stipulated term of service, or a contract for the performance of specific work, to render section 5, Regulation VII., 1819, applicable to the cases alluded to.

2nd.—Such cases may be prosecuted either in the district in which the agreement was executed, or in that in which the defendant resides.

Calcutta Court, 18th March: Western Court, 27th May, 1842.

* No. 1329, 1819, Regulation VII., sections 5 and 6.

APPENDIX E.

Report *on the State of the* Ganges Canal Works, *at about the Period when their General Direction was transferred from* Major W. E. Baker *to* Major P. T. Cautley.

Camp, Gurhmookteesur, 11th January, 1848.

The space occupied by the Myapoor Dam and the escape channel in rear of it, was once excavated to the proper depth, but has since received considerable deposits of gravel and sand. From the space in front of the dam and regulating bridge, a vast quantity of soil has been removed; but the lower 4 or 5 feet of excavation not having been completed before the rains of 1845, has been purposely left, under the impression that if this space were now excavated, it would soon be refilled with silt similarly to that in rear of the dam. The cause of this deposit appears to be the sudden change from the rapid fall above the dam to the diminished slope below it. It is probable that some inconvenience will always attend this unavoidable disposition of the fall, but it will doubtless be felt in a far less degree than at present, when the projected uniform slope from the Pyree Ghat to the dam shall be carried out. The excavation is completed at the site of the regulating bridge, and the portion of canal channel in rear of that work, left by Lieut. Strachey, is now being cleared out. The Bochna Nulla has been deepened to suit the level of the works.

2. The foundations and floor of the Myapoor Dam have been completed, and a portion of the east and west abutments has also been built. The piers of the dam and the attached sluice-work are purposely deferred until near the period when they are likely to be required to retain the canal supply. The deviations from the original design for this work are as follow:—

Cross foundations, connecting the front and rear curtain walls, have been added under every fourth pier, and the floor has been made of stone, instead of brick on edge, with reference to the heavy boulders which will be annually washed over it during floods. The edges of the floor are made with chisel-dressed stone, the remainder is formed of smooth surfaces of broken boulders carefully fitted together and grouted in.

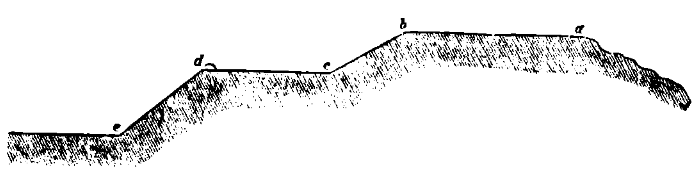
The Myapoor regulating bridge has been founded, the floor and piers built, the arches turned, and the spandril walls completed to level of crown of the extrados of the arches. The deviations from the original design for this work, are as follow:—The foundations of the piers have been carried down to the same depth as those of the front and rear curtain walls. The length of the piers has been increased 8 feet; the cutwaters, both up and down stream, having been built beyond the floor instead of on it. A stone floor similar to that of the dam has been substituted for the brick counter-arches, as proposed, and the cutwaters of the piers have been built of dressed stone. The reason for increasing the length of the piers is to allow more room for stowing the sluice planks or sleepers that will be employed to close the bays; the weight and number of these being so great as to preclude the possibility of their being frequently removed to a store-room. It is proposed that sluice-gates should be used instead of sleepers for closing the waterways; that they should be from 2′ to 3′ in depth, and of varying thickness to resist the pressure at different depths; and that they should be worked by cast-iron crab capstans fixed on the piers. The increased length of the piers will admit of this arrangement being adopted, without curtailing the intended width of the roadway. The ghat steps on both the up-stream flanks of this bridge are completed very nearly as designed. The Bochna inlet is completed, but with considerable deviations from the design. The width of waterway was reduced from

50 to 20 feet, the latter dimension having been considered sufficient, after further acquaintance with this little torrent. The overfall was at first built by Lieut. Strachey as a perpendicular drop, semicircular in plan; but it was found that the floor, though faced with the largest stones procurable, was unable to withstand the impost of boulders, &c., falling vertically 7¾ feet, and the form of the overfall was subsequently converted into an ogee by Lieut. Yule.

The Bochna bridge is completed as designed. The masonry revetments connecting the Bochna inlet, the regulating bridge and the dam, are completed to their full height, and are now being plastered. The Bythuk wall is completed on the same design on which it was begun in Major Cautley's time, but will perhaps require some modification to suit the ghat steps. The ghat, including the revetment, the descent from the upper to the lower terrace, and the long line of steps for bathing, is completed—except that the last-mentioned steps are not yet faced with dressed stone, for which funds were wanting. The Fukeer's revetment is completed in two portions, with a terrace between, at the level of the lower terrace of the ghat. This arrangement was adopted to save masonry, as the mean thickness of the wall must have been much increased, had not the height been divided into two portions. The first-class choki at Myapoor is completed with no material difference from the design.

3. The Lounda Lana Walla inlet is left for the present. The Kunkhul drainage inlet, enumerated in the printed report among the works of the Northern Division, but not included in the estimate, has been built; but as it is not desirable at present that the waters discharged by it should be delivered into the canal, they are conducted across the channel between embankments, as a temporary arrangement. A bridge on the old road between the towns of Kunkhul and Jowallapoor near the Ranikooa, has been conceded by the Government of the North-Western Provinces to the inhabitants of those towns, and is now in course of construction. The bridge will be built of three arches, according to the general design, except that curtain walls and a floor will be added to the foundations, which rest on compact boulders and gravel, and that the abutments will be considerably strengthened. These foundations and the massive parts of the abutments will be built of boulders (which abound on the spot) and of pukka cement. The foundations of this work are now in progress. The site of the Jowallapoor bridge has been shifted from opposite the old tuhseel to a spot preferred by the inhabitants about a quarter of a mile lower down. The state of progress of this work is much the same as that of the Kunkhul bridge, which it will resemble in every respect. The boulders for its construction are not found on the spot, but have been brought from a short distance. The foundations will rest on good clay. The construction of the Ranipoor dam is in progress. The excavations are almost, if not quite completed, and materials for building are collected. The boulders for the massive parts of the foundations have been brought three or four miles. To obviate the difficulty of obtaining water for this work, as well as for the bridges of Kunkhul and Jowallapoor (the springs throughout this tract of country being very deep and scanty), arrangements have been made to bring a small stream down the canal. A cunette has been excavated for this along the centre of the channel, and galleries (supported by sheet planking) have been driven under the bars left for the communications of the country across the canal.

4. The excavation of the canal channel between Myapoor and the Ranipoor Rao was completed before Major Cautley relinquished the direction of the works; but the banks and slopes, which had cut into deep ravines, have been repaired and grassed, and an arrangement has been adopted whereby I hope that the lower slopes will be protected from further material injury, until the canal is opened, when, of course, it must



be superseded by some other device. The drainage of the surface *a*, *b*, may be without difficulty thrown to the rear, but that of *b*, *c*, *d*, *e*, must either be absorbed or must find its way to the bottom of the canal.

The absorbing process will only be effectual during light rain, and the means used to assist it, viz., making a slight edging at *d*, has frequently the effect of holding up a body of water, sufficient, when it does find vent, to cut out a large ravine. The method adopted, and which certainly answered well during the last rainy season, was to form open spouts or channels of masonry down the slopes *d*, *e*, at the lowest points, and to conduct to these points the drainage of the surface *b*, *c*, *d*, by means of a small drain excavated at *c*. The masonry spouts are made of inferior materials and with slight dimensions, as they are not intended to be permanent.

5. Between the Ranipoor Rao and Peeran Kulleeur, nothing has been done beyond a fresh reconnoissance of the line, with a view to avoiding the deep digging at Ghur. I have satisfied myself that this may be effected by dividing the double falls of Dhunowri into two, but I have not yet the data for calculating what would be the difference of cost of the respective lines.

6. Though the Rutmoo Dam is not yet commenced, I have considered carefully how it might be possible to prevent the dam from throwing a large sheet of backwater up the valley of that river. The only method which has suggested itself to me is that of a double dam (one in the alignement of each bank) connected by a small tunnel under the bottom of the canal. During floods both dams would be thrown open, and the tunnel would be closed to prevent its being choked or blown up. At ordinary times, the dams being planked up, would retain the canal supply, and the tunnel would carry off the leakage through the upper dam, and the natural stream of the Rutmoo.

7. The deep digging of Peeran Kulleeur is only partially commenced at the south end, as it has been determined to convey the excavated earth by a rail to form the Solani embankments, and the necessary iron-work has not yet been received from Calcutta, though daily expected. The line of canal has however been partly laid down, and is being extended to the Rutmoo; in the valley of which there will be excavation and embankments on which to employ surplus labourers, until the rail shall be formed.

8. In connection with the Peeran Kulleeur digging, I would record a suggestion which may possibly be of use hereafter. In forming the Solani embankments, it is certainly advisable that each successive layer of earth should be abundantly watered. In the part already formed, this object has been effected (at a considerable expense) by means of pumps and a fire-engine working in pukka wells. But as the level of water in the Rutmoo is higher than that of the canal bottom in the valley of the Solani, it may be found practicable to lead water from the former river in pipes or in an open channel, through the Peeran Kulleeur hill to the Solani embankments. I have not worked out the details of this scheme nor estimated its cost; but I have little doubt that it would be found both more efficient and more economical than the present system.

9. The earthen portion of the Solani aqueduct has been commenced. The soil in the valley of the Solani, east of the river, having been found on examination to be of good quality to a depth of from 2 to 4 feet below the surface, it was determined to obtain earth from side cuttings, and to dispose it in a uniform stratum about 3 feet thick over the proposed bottom of the canal (150 feet wide). Each layer of earth of 6″ thick was well watered and rammed. To this work was afterwards added from extra excavations a raised mound, 20 feet wide at top, along the centre of the canal. Its upper level is that of the canal bottom at the east side of the valley, but it has a slope to the south-west of 1 in 1,200. This mound is intended for the reception of the rails, which, when once placed, will not required to be shifted, until the whole channel and embankments are raised to their level, *i. e.*, until nearly three-fourths of the work is completed. The earthwork above described has been consolidated by the rains of one season, and has stood remarkably well.

10. The Muhewur brick-fields (to be more particularly mentioned hereafter) are intended to supply bricks for the aqueduct and masonry revetments on both sides of the canal; but the kilns being on the right or west bank, the bricks for the east revetment must necessarily cross the earthen mound and the railway. This contingency has been provided for by means of a tunnel under the mound, of height sufficient to admit of the passage of a loaded cart, the sill being at the same time so high as to prevent the passage of drainage water from the upper to the lower side of the aqueduct. As this structure is intended for a temporary

purpose only, it has been built of inferior materials, but of such dimensions as will, in my opinion, ensure its stability for six or seven years.

11. The ironwork of the rails having been expected to arrive soon after the rainy season, a considerable body of labourers, who might otherwise have been dispensed with, were retained with a view to their employment in setting up and working the rails; but when the expected ironwork did not arrive, it became necessary to provide other employment for the working-parties; and, in the absence of more profitable work, a portion of them were set to dig the more sandy strata of the side-cuttings and to throw it up on the line of embankments outside the masonry revetments. I would certainly have preferred that these embankments should consist entirely of tenacious soil, but I hope and believe that a small quantity of sandy earth, enclosed in an immense mass of good clay, and separated from the canal water by a double line of masonry revetment, will not injuriously affect the stability of the work. Had the labourers not been so employed, they must have been discharged, and much further delay must have been incurred in collecting them again after the arrival of the ironwork.

12. I have omitted to notice one piece of earthwork connected with the earthen aqueduct. Before entering on the valley of the Solani, the line of canal crosses a ravine or natural line of drainage flowing from north-west to south-east. It is intended that this drainage should not cross the canal, but that it should be directed into the Solani above the aqueduct, and this object has been effected by throwing a bund across the ravine in the line of the right embankment of the canal, so as to form a pond; and to prevent the water overtopping the bund in heavy rain, an escape channel has been provided, whose sill is three feet below the top of the bund. This pond was of some assistance in the brick-field, and as it is undergoing improvement by the present operations, will be more useful hereafter.

13. It is calculated that the number of earth waggons required to complete the channel and embankments of the aqueduct in four or five years is 200—for 100 of which the ironwork has been prepared in Calcutta under the orders of the Military Board. It is supposed that the remainder can be obtained more economically from England. The rail itself is to consist of flat bar iron (a quantity of which is also on its way from Calcutta) laid flat on longitudinal wooden bearings connected at short intervals by cross sleepers, which will also act as chairs. The only iron bars procurable being of various thicknesses, the level will be adjusted by cutting away more or less of the longitudinal sleepers.

14. The form to be adopted for earth-waggons has received the most careful consideration. The arguments for and against tilting-carts may be thus stated:—Tilting-carts would require little labour in unloading, and, by a well-arranged system of diverging branch rails, might be made to convey the earth so near to the requisite position, as to admit of its being spread with the fowra. On the other hand, the double frame and extra ironwork of a tilting-cart would greatly increase the weight of draught and the cost of construction. 2ndly. The diverging branch rails necessary to give effect to the tilting-carts would require to be frequently shifted, and relaid on different levels and in different positions, a process which, with inexperienced workpeople, and rails of different thickness, would be troublesome, tedious, and expensive. 3rdly. The quantity of rail requisite would be more than doubled.

Considering the balance of the arguments to be against the use of tilting-carts, I propose the following plan, as best suited to our means, and to the comparative cheapness of human labour in India:—Two central lines of rail (for the going and returning waggons) will be laid down on the mound above described, and will probably not require shifting for two or three years. The carts will be of the simplest construction—mere boxes, in fact, firmly framed and fixed to the iron axles. Their sides will open with a hinge to facilitate the unloading, and the bond forming the side will fall over and cover the rail, so as to prevent the earth from falling upon it and clogging it up. The soil will be conveyed in baskets to the required position. The woodwork of fifty carts such as are above described is now nearly ready.

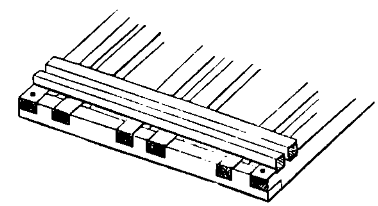
15. Some godowns and a smith's shop will be established at Mahewur (on the east bank of the Solani valley) for the protection of stores, fitting and repairing ironwork, &c., &c.

16. The masonry work of the Solani aqueduct was commenced in May, 1846, but the rate of progress has been throughout, and still continues, limited by the supply of bricks. Up to the present time, the

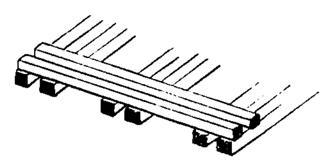
foundations of six piers have been sunk down to their full depth; two more piers are in course of sinking; both abutments, with their flanks or wing walls, are laid down, and are being built preparatory to sinking.

17. The foundation blocks of the piers are 22′ long, 20′ wide, and 20′ deep, and the spaces between them are exactly equalized. The plan and disposition of the abutment blocks has been modified, an addition of 6 feet has been made to the width of the abutment itself, and a corresponding reduction in the flank—the area of the whole foundation remaining nearly the same. A line of curtain blocks along the front and rear of the floor of the aqueduct, and connected with the piers by cross blocks, under the cutwaters, has, under my recommendation, been sanctioned by Government, and eleven of these additional blocks are built, but two only are yet sunk down to their full depth of 20 feet.

18. The curb frames or neemchuks of the large blocks are each made with twelve saul timbers of the usual scantling disposed in this manner (see fig.) In the frames first made, each crossing of the timbers was secured with an iron screw-bolt and nut, but for these we have since substituted trenails, except at the four external angles. In the frames first prepared, the bottoms were not made flush, as it was supposed that the timbers would be needlessly weakened by being halved into each other. The frame therefore rested on two of its opposite sides, the other two remaining hollow. No particular rule was observed in laying these frames, and it so happened that those in the line of the first pier were placed with the hollow side out, and the flush sides next to each other:



but when the undersinking commenced the inconvenience of this arrangement became apparent. The flush sides being deeper in the soil, supported the block, while the sand constantly flowed in through the hollows, and greatly impeded the progress of sinking. In the next pier, the disposition of the frames was altered—the flush sides being placed outside, and the hollows next to each other—and a marked difference in the rate of progress was immediately perceptible; so great, indeed, is this difference, that I believe the sinking of the first pier has cost more than double that of any other.



We have subsequently tried flush frames, without any apparent mischief arising from weakening the timbers—the external pieces only are, however, halved into each other.

19. In all the foundation blocks courses of hoop-iron are laid between the courses of brickwork, and crossing each other at every alternate foot up to the height of 10′ from the curb-frame.

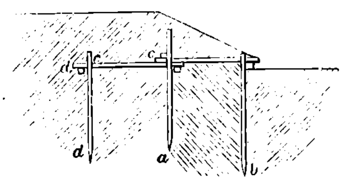
20. In consequence of the strength of the curb-frames and the use of hoop-iron, the occurrence of cracks in the masonry during the progress of sinking has been very rare, and confined to one or two blocks which had been disturbed by floods breaking through the coffer-dam.

21. The undersinking has been effected almost exclusively with simple machinery worked by common labourers, and without the aid of divers. The jham or tool used for excavation is raised by means of a simple windlass worked with fixed spokes. The saving effected by this method, as compared with that practised by divers, is very considerable, and the progress is certainly not less rapid. For a work of this extent, it would indeed have been difficult, if not impossible, to procure professional well-sinkers in sufficient numbers.

22. The soil hitherto passed through by the blocks has been sand, sometimes pure, sometimes largely mixed with clay. The purer the sand, the more rapid has been the progress; but no difficulty beyond delay has been experienced in any soil.

23. There was necessarily a good deal of preliminary excavation and other work connected with the aqueduct, of which few traces now remain. The first foundations laid were those on the right bank of the Solani, under which the principal current then flowed. A space was therefore enclosed in a coffer dam, and two new channels were dug to give the flood a centrical set in the bed of the river.

24. The coffer-dam consisted of two parallel rows of 12′ and 15′ kurries, driven close, and framed together, the whole being further supported by land ties, at short intervals, attached to piles in the rear. The current of the first floods set longitudinally through the enclosed space, but was checked by cross rows of bullies, the sand washed out being replaced by similar soil enclosed in mat bags. In spite of all precautions, however, the floods broke frequently into and over the coffer-dam, and considerably impeded the work. One of the new channels, too, was completely obliterated, but the final effect of the combined measures has been to set the Solani completely over to its left bank, which it has cut away to a considerable extent.



25. The river wall of the coffer-dam during the last rainy season consisted of one of the aqueduct pier foundations, sunk to its full depth, and surmounted by cuts filled with masses of vitrified brick, and backed by a sand bund. It is in rear of the old coffer-dam (the piles of which have been extracted) by the width of half a bay. These precautions effectually excluded the floods of the last year, which, however, were light.

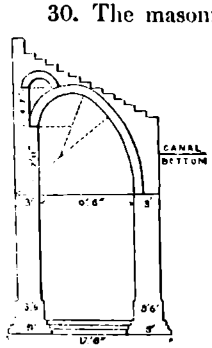
26. The coffer-dam last described has not been dismantled, the work within it remaining to be done can more conveniently be executed during the ensuing rainy season; and in the meantime as much work will be commenced outside the coffer-dam as there is reasonable hope of completing before the 15th of June.

27. It may here be remarked that the length of the masonry aqueduct is less than the breadth of the river on the line laid down for the canal; and it will, therefore, be necessary on both sides to give deep foundations to that part of the masonry revetment which will be built in the present bed of the river. I would propose that the upstream wall should be founded on blocks and the rest on piles.

28. The direction of the central line of the masonry aqueduct had been determined before my connection with the Ganges Canal, and was necessarily rather oblique to the Solani at that part of its course. It remained for me, however, to fix the exact position of the work on the selected line, and this was done with such reference to the windings of the river as would admit of the stream being brought down perpendicular to the aqueduct by a straight cut from one to two miles in length.

29. It merely remains to allude to the discussions which have arisen regarding the thickness of abutments of the masonry aqueduct. Lieutenant-Colonel Abbott, C.B., when referred to by the Governor-General, expressed an opinion that the abutments, as designed (*i.e.*, 15 feet), were too weak, and that they should have at least 18 feet of thickness, with counterforts. Mr. F. W. Simms, who was subsequently consulted, recommends 23 feet thickness, with counterforts. The foundations provided by me before this question was mooted will admit of 21 feet thickness of abutments; counterforts, if necessary, may be added, but I would recommend that they be founded on piles driven in the direction of the thrust. It appears to me, however, that neither Colonel Abbott nor Mr. Simms have properly taken into account the small height of the piers.

30. The masonry revetments have been commenced west of the Solani, and have made considerable progress. Each revetment consists of a double wall supporting a flight of steps. The exterior width of these walls is 15½ feet, and there is a clear space of 150 feet between them. The upper surface of the revetment will be a flight of steps as in the original design, but the method of supporting them on two circular arches has not been followed, partly with a view of saving the labour involved in so much arch-work, and partly because the proposed method would not easily admit of modification to suit varying heights of revetment. The section adopted consists of two perpendicular walls connected by an arch springing from unequal heights, like that of a flying buttress. The long walls are connected with each other at the bottom, but they have a wide footing, and cross walls are built between them at distances of 15 feet apart.



31. The material used in the revetments is not all of such good quality as that selected for the aqueduct. For the cross walls and for the inner faces of the long walls, some second-class bricks have been used; the exposed surfaces, arches, and steps being made of the best bricks; masses of

vitrified brick or jhama are also extensively used in the construction of the long walls, a bond of brickwork being interposed between every three feet in height of jhama work.

32. The model room—the building of which was completed before I assumed charge of the Ganges Canal—is now being furnished with tables, shelves, and glass cases, to receive the books and philosophical instruments granted to Major Cautley by the Honourable Court of Directors.

33. The workshops and warehouses have been extended all round the interior of the square provided for that purpose in rear of the model room, but still do not afford sufficient accommodation; they are occupied almost exclusively by smiths' forges. The carpenters, having been removed from their allotted quarter, now work in sheds erected both within and without the workshop yard.

34. The possession of an efficient workshop has enabled us, not only to prepare the implements absolutely necessary for carrying on the works, but to introduce many improved means not usually met with in the public works in India, at least in these provinces. Amongst these may be enumerated the whole of the machinery requisite for undersinking the foundation blocks; pumps, which are extensively used not only for watering the earthwork, but for supplying water to masons, &c.; wheelbarrows and hand-carts, which, on the excavation, on the masonry works, and in the brick fields, have in a great measure superseded the use of baskets; weighing machines, for weighing the loads of firewood, oopla, &c., brought in for the kilns; frame centres for the revetment arches, and for those of the canal bridges, 55 feet span; woodwork of earth waggons for the railway, &c. &c.

35. From the little success that attended Lieutenant Strachey's arrangement for contract bricks, and from the difficulty of obtaining fuel for Hindostani kilns, it soon became apparent that we must depend for our chief supply of this material on our own kilns, burned with wood fuel. A small commencement of the arrangements for this purpose was made in 1846, after the close of the Sutlej campaign, but it was then too late in the season to obtain any satisfactory results. In the cold weather of 1846-47 a number of new kilns were built both at Roorkee and Muhewur, and considerable quantities of firewood were cut in the forests and carted to the works. During the early part of the season many circumstances combined to render the results of these operations very unsatisfactory. Great pains had been taken to ascertain the method of burning bricks with wood, as practised at Umballa and elsewhere; but our people did not at first get into the way of loading the kilns properly, and this, combined with a long duration of unfavourable weather, and the greenness of the firewood, rendered the operations of the cold weather months almost entirely unprofitable. At the commencement of the hot season, however, a change for the better became apparent; two new descriptions of kiln were tried with better success, and before the setting in of the rains we had turned out about 38 lakhs of serviceable bricks from the English kilns. Early in October of the present season, the brick-making operations were resumed under the supervision of Mr. J. Finn, appointed executive officer for the preparation of materials in the Northern Division.

36. The experience gained in our former unsuccessful operations, and the establishment and workpeople who had been employed in carrying them on, were made available to Mr. Finn, together with a considerable stock of dry firewood, and these advantages, combined with that of Mr. Finn's undistracted attention being given to this branch of the work, have evidently told on the cost and quality of the bricks. Their price, however, is still very high, being for these three months' operations not less than 1,000 rupees per lakh for pukka bricks $2\frac{1}{2}''$ thick, and 250 rupees for peela bricks, and I fear that, with the present descriptions of kiln, no material reduction in this price can be looked for. Improvements, however, will doubtless suggest themselves; and a very promising experiment has lately been made with a new kind of kiln, such as is used in Sind, by which it is hoped that a considerable saving both in fuel and labour may be effected. Hindostani kilns are also being established in localities where the appropriate fuel is obtainable within such distance from the Roorkee works as will admit of their being brought in at a reasonable cost. A few of these Hindostani kilns are contracted for by parties on whom Mr. Finn thinks he may depend; the rest are being made by hired labour, and under the supervision of Government servants.

37. The establishment of extensive brick fields at Roorkee and Muhewur has, of course, rendered necessary a great many subordinate arrangements, besides the construction of clamps or kilns, such as the

formation of wells for supplying water, the construction of weighing-machines, &c., and the maintenance of a large establishment of bullocks and carts, with sheds for their accommodation.

38. Great efforts have been made (and with considerable success) to obtain contract carriage for timber, firewood, bricks, lime, &c.; but even were the extent of available hired carriage greater than it is, it could not be so surely depended upon as to admit of our dispensing with our own establishment of bullocks. The supply of hired carriage must at best be uncertain, and its failure at a critical period might be productive of infinite mischief to the works.

39. In the 35th paragraph I have adverted to the want of success attending our first attempts to burn bricks with wood fuel; but it may be proper to give some further details of these experimental operations, of which the cost was considerable in itself, though small in comparison with the future expenditure. The first method tried at Roorkee was that employed with considerable success by Major Napier, at Umballa; its failure with us, we now, by the light of experience, attribute to three causes: 1st. Using Dank wood, instead of Bubool or other hard wood. 2nd. Using koora, instead of the light refuse of chuppur grass employed at Umballa, to equalize the surface of the layers of wood. 3rd. Ignorance of the proper management of the fire by means of the flues and the surface covering of ashes. The second method attempted was that described in the 6th part (Vol. III.) of Weale's Quarterly Papers on Civil Engineering, as that practised in Holland, where wood fuel is often used. With us, however, it completely failed: the consumption of wood was greater than in the first experiment, and the result more unsatisfactory. The third experiment was made with a "flame" kiln, such as is used in England with faggots, for which we substituted brushwood cut near the spot. A few good bricks were obtained by this method, but not in such proportion as to warrant a repetition of the experiment. The fourth method was recommended by a native who chanced to be passing through Roorkee and offered to take service as a brick-burner. His plans, with a few exceptions, which did not appear to us very important, was the same as Major Napier's; but he understood the management of the fire, and the produce of his kilns was comparatively good. The fifth method was taught us by men whom we sent for from Benares, and which, I have since heard, is described in the *Barrack-Masters' Assistant* (of which there is no copy in the canal department). It is less certain than the fourth method, and more dependent on the quality of the wood; but the bricks are less broken, and of a better quality. A sixth method, such as is practised in Sind, has lately been introduced with great promise of success—it is a flame-kiln, but differs in some important respects from that first tried.

40. The brick-making operations of 1846–47 may be considered as experimental. The expenditure was 54,500 rupees, the result 38 lakhs of bricks, or about 1,435 rupees per lakh. During the present season, as far as it has gone, the bricks have cost about 1,000 rupees per lakh, but may perhaps be eventually reduced to an average of 800 rupees per lakh. From this we may deduce that the cost of our experience is about 24,000 rupees, or 3 per cent. on the probable outlay on bricks, supposing that 1,000 lakhs are required.

41. The Roorkee digging has undergone annual repair since my connection with the Ganges Canal, and is now in excellent order. The upper slopes and roadway drain to the outside, and the rain at Roorkee being much less heavy than at Hurdwar, it has not been necessary to provide masonry gutters down the lower slopes, as described in paragraph 4. The slopes have been grassed.

42. From Asufnuggur to the Muhmoodpoor Falls, it has become necessary to modify the longitudinal section first determined upon. This necessity arose partly from an error in the levels (to be adverted to again), and partly because the excavation provided was not sufficient to supply earth for the requisite embankments, and still less so to meet the requisitions of the medical committee. In two places, viz., between Asufnuggur and Munglour, and between the latter place and Liberheri, there was not more than from 0 to 3½ feet of excavation, which would have left the full water-surface level of the canal 6½ to 10 feet above the surrounding country. The error above adverted to occurred in a manner not easily accounted for. The levels of the country along the proposed line had been repeatedly and most accurately taken, they had been connected with Major Cautley's bench-marks, and the general agreement was highly satisfactory. The error, in fact, was not in taking the surface levels of the country, but in the calculation of the distance.

The unexcavated space between the end of the Munglour and the beginning of the Muhmoodpoor digging was miscalculated in excess by 5,650 feet, and the fall or bottom slope assigned to that length was proportionately excessive. The canal bottom, from the commencement of the Muhmoodpoor digging onwards, was therefore 20½ inches too low. It is obvious that such a mistake ought not to have occurred; but, considering the scrupulous and laborious accuracy of Lieut. Turnbull in taking the levels and laying down the directions of the straight and curved lines of the canal, this one oversight may well be excused: nor, as director of the works, do I wish to evade my share of the blame, in failing to check the distances as well as the levels.

43. The correction of the bottom level has been effected by giving a fall of 3 feet at the Asufnuggur Bridge, and reducing that at Muhmoodpoor from 8 to 6·31. The results of this error have been in some respects convenient, as we have combined with its correction a desirable modification of the original section, and have obtained earth to complete the embankments at a cost considerably below what must otherwise have been incurred, as a line of rails must have been laid down for that purpose.

44. The following is the present state of the earthwork in the Munglour Division. From the head of the division to the commencement of the Liburheri curve (1½ miles), the work is completed; from thence to Muhmoodpoor (4¼ miles) the contractors are now employed, and the work is well advanced. From Muhmoodpoor to the sand-hills near Toghulpoor (7 miles), the excavation is taken out to the full depth. The deep digging through the sand-hills is not yet commenced—the unexcavated space is about 1 mile. After which commences the Toghulpoor digging, which is 3½ miles long, and extends to the end of the Nugla curve, up to which point it is complete and all in excellent repair.

45. From the Nirgaujni to the end of the Jowli curve, the canal is lined out, the dagbels marked, and small brick pillars built at short intervals.

46. I have merely further to remark, with reference to the excavation of this division, that the soil at the level of the canal bottom from Munglour to Nugla is very sandy, and appears to me liable to future erosion by the strong current of the canal—a process which must be met by permanent bars across the channel. The addition of masonry floors and curtain walls to the bridges would partially serve this purpose, but if the disturbance of bed be considerable, intermediate bars of masonry (in other works, "pucca" sections of the canal) may be found requisite where the soil is bad.

47. The Military Board have supposed that the usefulness of the Ganges Canal, as an irrigating machine, will be impaired by the adoption of the Medical Committee's recommendation—that the water should be kept within soil. Had it been intended to irrigate directly from the canal itself, the water must certainly have been kept generally above the surface level of the country, but such was not the case. Major Cautley always intended that the water of the Ganges Canal should be distributed by means of rajbuhas or main watercourses, which would be of considerable length, and, having a less fall than that of the country, would soon bring water up to the level of the cultivated land. With further reference to this arrangement, the canal will be taken along the highest ridge of the country. The adoption of the Committee's recommendation will not involve any material departure from Major Cautley's design. A glance at his calculations for excavation (pages 19 to 21 of the Estimates in the printed report) will show that the average estimated depth is in most cases sufficient to fulfil the prescribed conditions.

48. The masonry works of the Munglour Division already completed, or nearly so, are the Munglour workshops, the first-class chokies of Muhmoodpoor and Bailra, and the second-class chokies of Munglour, Dimat, Toghulpoor, Nirgaujni, Bhopah, and Jowli. The workshops are on a smaller scale than those of Roorkee, but will, I believe, be found sufficient for the wants of the division.

49. The first and second-class chokies are built in accordance with the designs, but with deeper foundations. With exception to the Muhmoodpoor choki, they are built on the embankments, as more convenient for the required purpose, though involving the necessity of carrying the foundations through the made soil to the natural surface of the ground. The walls of the second-class chokies are, with the sanction of the Military Board, raised 3′ higher than was at first proposed, to admit of the use of a punkha.

50. Of the Munglour and Toghulpoor bridges, the foundations are complete; and of the former, the piers and abutments are built to spring of arch. The original design for this part of the work has been considerably modified. In both instances, the soil, to the greatest depth to which I have examined it—viz., 25 feet below the level of the bottom of the canal—consists of sand, with a slight mixture of clay, and having more or less solidity. I have, therefore, deemed it expedient to increase the depth of foundations from 10 feet to 12 and 15 feet, according to soil; and to prevent the erosion of the canal bottom, I have added front and rear curtain walls and a masonry floor. I have increased the surface supporting the structure, by adding a broad footing to all the foundations, and I have reinforced the abutments by the addition of strong counterforts. As a set-off to these additions, the thickness of the piers and of the abutments between the counterforts has been slightly reduced.

51. The excavation for founding several of the falls and bridges of the Munglour Division is in progress. In both cases, the channel at site of the work requires modification. The width of the bridges between the abutments is 179′; that of the canal bottom being 140′, it is arranged as in fig. *a*.

Fig. *a*.

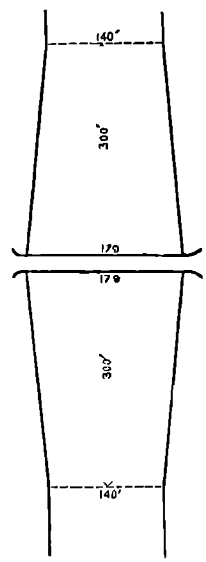
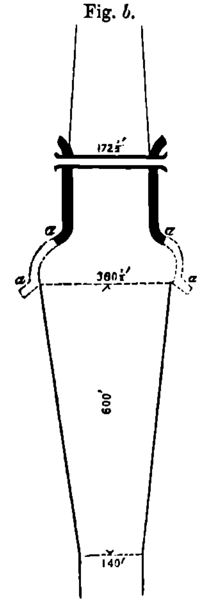


Fig. *b*.



The width of the falls between abutments is 172½ feet, which, above bridge, is similarly accommodated to the width of the canal. Below bridge, I have deemed it better to adopt at once the form of channel (*vide* fig. *b*) which the action of the water would inevitably cut out for itself. I would further strongly recommend the addition of the curved revetments, *a*, *a*.

52. I may here remark, that previous to the preparation of working plans for any bridge, the executive officer examines the soil to a depth of 25 feet below the canal bottom, by means of three vertical shafts or kutcha wells, and sends to the director's office a report of the results, and specimens of the soil taken at every 2½ feet. These samples are kept in the model-room, and a sheet of sections is also prepared, showing the depth of foundation of each work, and the nature and succession of strata at its site.

53. The greatest difficulty in this division has been experienced in burning bricks, the koora required for fuel being highly prized by the cultivators, and most unwillingly parted with by them. The requisite numbers for the several bridges have now, however, been nearly completed, and either wholly or in part carted to and stacked at the sites of the works. The larger numbers required for the falls are not yet complete; nor, at the present rate of progress, could they be got ready in many years. Arrangements will therefore be made to burn them with wood wherever that description of fuel is obtainable at a reasonable cost.

54. The bricks, as they are unloaded from the kilns, are taken to the sites of the works, and it is my wish that, when sufficient for that purpose are collected, the foundations should be got in at once, as the most convenient way of disposing of the bricks and releasing the ground covered by the stacks.

55. In the third, or Bolundshuhur Division, under Mr. Volk; in the fourth, or Futtigurh Division, under Lieut. Hodgson; and in the sixth, or Cawnpoor Division, under Lieut. C. W. Hutchinson, the preliminary examination of the country is in active progress, and printed instructions have been issued for the guidance of the executive engineers. No executive officer has yet been appointed to the Etawa Division, but Mr. Dodsworth is engaged in taking a series of levels in that direction.

56. In conclusion, it is but justice to the executive officers and assistants on the Ganges Canal, and more especially to Lieuts. Strachey, Turnbull, and Yule, to state to the Military Board my high estimation of the zeal, ability, and good feeling, which has animated their exertions in forwarding this great work.

The executive officers have had to struggle with many difficulties, the conquest of which, though it has smoothed the path of their successors, has doubtless enhanced the cost of their own work, and it is important to bear this in mind, and to be cautious in drawing unfavourable comparisons between the cost of the past and future work, and in attributing to the superior care and management of future executives an improvement in economy, which may be chiefly due to the results of their predecessor's labours. The power requisite to maintain the regular and equable motion of a vast machine, is no measure of the force required to set it going.

(Signed) W. E. Baker, *Major,*
Director Ganges Canal.

APPENDIX F.

DATA *on which the* PROJECTS *for the* GANGES CANAL, *submitted by* Captain CAUTLEY *with his* REPORT *of* 1845, *were founded.*

THE following points being conceded as axioms, the data for the discharge, and the capacity for the canal channel, have been framed upon them.

1st. That a discharge of 1 cubic foot per second, constant, is equal to the irrigation of 350 beegahs of 55 yards square each.

2nd. That from the results of the Delhi and Doab Canals, 800 cubic feet per second, constant, is a fair supply for irrigation for 100 miles in length of a canal.

3rd. That taking village estates with reference to their general character, a proportion of surface equal to one-third of the whole is a fair proportion requiring irrigation.

2. On each 100 miles in length, therefore, the canal would, on the second axiom, irrigate 280,000 beegahs, or 273·4 square miles, and, on the third axiom, this would be sufficient for an area of country equal to three times that amount, or to 820·2 square miles.

3. I assume, therefore, that a strip of country on each side of the canal from four to five miles, say five miles, in width, would be irrigated. The beneficial effects of irrigation being open to distant lands, when those in the immediate neighbourhood of the canal were not suited to irrigation.

4. Now the Ganges Canal on project No. 1 is proposed to run in an uninterrupted and direct line from Hurdwar to Allahabad, the total distance being 453 miles; from this main line branches will be taken off towards Futtigurh, Tuppul in the Bolundshuhur district, Etawa, and Cawnpoor.

5. The first part of the line, viz. that from Hurdwar to the village of Nusseerpoor (27½ miles in length), may be considered as removed from the influence of irrigation, from its passing through Khadir land in the early part of its course, and deep digging immediately above Nusseerpoor; there remains, therefore, 425½ miles, requiring, as above, 3,404 cubic feet of water for irrigation on the main line only.

6. The lengths of the branches are as follow:—

Futtigurh	160 miles.
Bolundshuhur	70 ,,
Etawa	172 ,,
Cawnpoor	43½ ,,

For the first five miles of these branches, the country may be considered under the influence of the main line, as far as irrigation is concerned. The total length of canal, therefore, including both the main line and the branches, for which irrigation must be provided, is as follows:—

Main line	453	—	27½	=	425½	miles.
Futtigurh branch	160	—	5	=	155	,,
Bolundshuhur branch	70	—	5	=	65	,,
Etawa branch	172	—	5	=	167	,,
Cawnpoor branch	43½	—	5	=	38½	,,
Total					851	,,

By referring to the sheet of sections of the main line, it will be observed that throughout the whole of the Futtipoor and Allahabad districts, or on the last 100 miles approaching the terminus, the excavation of the canal channel is so deep, that, although cuts may be taken off at right angles for the purposes of irrigating distant lands, the fields in the immediate vicinity of the canal will with difficulty be supplied with water, and that only by machinery. I have, therefore, reduced the supply of water for irrigation on this lower tract from 8 to 4·92 cubic feet per second for each mile—turning the difference to a more useful account in the Cawnpoor district.

7. The distribution of the whole body of the canal supply, therefore, which is calculated at 6,750 cubic feet per second, and which is supposed by the Committee to reach the high land of the Doab at Roorkee, will be thus:—

Main line	425½ miles	325½ at 8 cubic feet per mile ...	2,604
		100 „ 4·92 „ „ ...	492
Total			3,096
Futtigurh branch		155 miles, at 8 cubic feet per mile,	1,240
Bolundshuhur branch		65 „ „ „	520
Etawa branch		167 „ „ „	1,336
Cawnpoor branch		38½ „ „ „	308
Reserved portion for navigation at Allahabad			250
Grand total			6,750

8. The detail of discharges at the heads of branches, with that for the computation of the capacity of the main channel and transverse sectional area of excavation, will be thus:—

1st.	Distance from the head at Hurdwar to the departure of the Futtigurh branch	50 miles.
2nd.	Futtigurh branch to Bohundshuhur branch	60 „
3rd.	Bohundshuhur branch to Etawa branch	70 „
4th.	Etawa branch to Cawnpoor branch	100 „
5th.	Cawnpoor branch to terminus at Allahabad	173 „
	Total length	453 „

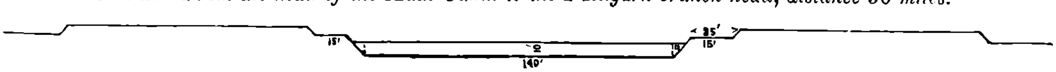
As noted in the 5th paragraph of this Appendix, 27½ miles must be deducted from the first item, leaving 22½ out of the 50 miles to be supplied with water for irrigation. From this results the following table:—

Expenditure on the main Canal to below	Water demanded for Irrigation.		Discharge below Branch on the Main Line.
	Main Line.	Branch.	
Futtigurh head	6,750 − (180 +	1,240)	= 5,330
Bolundshuhur head	5,330 − (480 +	520)	= 4,330
Etawa head	4,330 − (560 +	1,336)	= 2,434
Cawnpoor head	2,434 − (800 +	308)	= 1,326
To Allahabad	1,326 − (1,076 +	0)	= 250

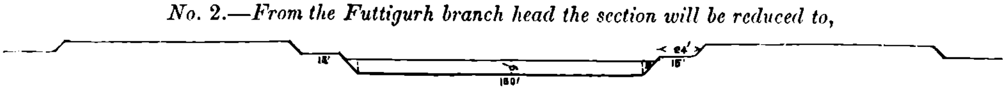
Leaving for the purposes of navigation 250 cubic feet per second.

9. The dimensions of the main channel are represented in the following sections:—

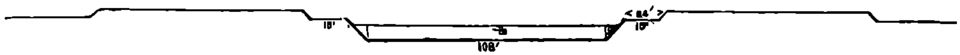
No. 1.—From the head of the Main Canal to the Futtigurh branch head, distance 50 *miles.*



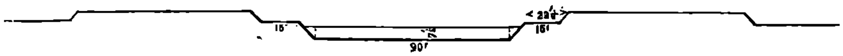
No. 2.—From the Futtigurh branch head the section will be reduced to,



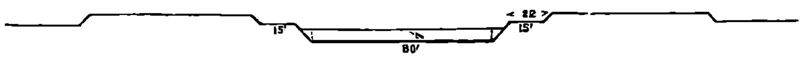
No. 3.—From the Bolundshuhur branch head, the section will be reduced to,



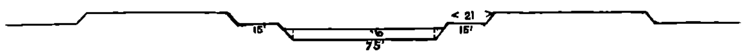
No. 4.—From the Etawa branch head, the section will be reduced to,



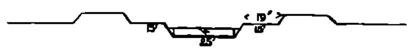
No. 5.—From the commencement of the 250th mile, the section will be reduced to,



No. 6.—From the commencement of the 281st mile, or from the Cawnpoor branch, the section will be reduced to,



No. 7.—At the Terminus the section will be reduced to,



The capacities of these sections are as follow; the values of R and $\frac{1}{b}$ being calculated on no fractional parts beyond ·5 in the former, and in round numbers in hundreds in the latter:—

Section.	Value of R.	Value of $\frac{1}{b}$.	Sectional Area Square Feet.	V in Feet.	Discharge.	
					Theoretical.	Required.
Number 1	106·96	$\frac{1}{3520}$	1,500·00	4·469	6,703·5	6,750
2	96·57	$\frac{1}{3520}$	1,251·00	4·245	5,310·0	5,330
3	94·67	$\frac{1}{3520}$	1,053·00	4·202	4,425·0	4,330
4	78·90	$\frac{1}{4224}$	731·25	3·461	2,530·9	2,434
5	73·23	$\frac{1}{4526}$	609·00	3·206	1,952·4	1,874
6	63·39	$\frac{1}{5280}$	486·00	2·733	1,328·2	1,326
7	38·33	$\frac{1}{5280}$	116·00	2·117	245·6	250

The formula is thus (Dubuat's):—

$$V = \frac{306 \cdot 55\ (\sqrt{R} - 0 \cdot 10325)}{\sqrt{b} - \text{Hyp. Log.}\ \sqrt{b + 1 \cdot 6}} - 0 \cdot 31\ (\sqrt{R} - 0 \cdot 10325)$$

When V = mean velocity per second,

R = mean radius, *i. e.* the area of the section in square inches, divided by its wall, or that part of the perimeter in contact with the fluid, in linear inches.

$\frac{1}{b}$ = the denominator of the fraction expressing the slope of the bed, or surface of the water; the numerator being unity, so that a slope of one inch in one thousand is equal to $\frac{1}{1000} = \frac{1}{b}$ and $b = 1000$.

The ratio between the velocities at the surface and those at the bottom is exhibited in the following table, where *v* denotes the former, and U the latter. The surface velocities have been deduced from Dubuat's formula; and the values of V and U of both Dubuat and Prony have been calculated.

Section.	Values in Feet of					Slope of Canal Bed per Mile, in Inches.
	v.	V.		U.		
		Dubuat.	Prony.	Dubuat.	Prony.	
Number. 1	5·13	4·46	4·15	3·79	3·18	18
2	4·88	4·24	3·95	3·60	3·02	18
3	4·83	4·20	3·91	3·57	2·99	18
4	4·04	3·47	3·27	2·90	2·50	15
5	3·77	3·21	3·05	2·65	2·33	14
6	3·27	2·76	2·64	2·25	2·02	12
7	2·55	2·10	2·06	1·65	1·58	12
	3·08	2·58	2·49	2·08	1·90	12
	3·20	2·69	2·59	2·18	1·98	12
	3·30	2·78	2·67	2·26	2·04	12

DUBUAT.

$$v = (\sqrt{V - \cdot 3} + \cdot 55)^2$$

$$V = (\sqrt{v - \cdot 55})^2 + \cdot 3$$

$$U = 2\,V - v$$

PRONY.

$$v = \frac{V}{\cdot 81}$$

$$V = \cdot 81\,v$$

$$U = \cdot 62\,v \left\{ \begin{array}{l}\text{Preserving the rule} \\ \text{quoted in the note.*}\end{array}\right.$$

With regard to the effect that the maximum velocity at the bottom, agreeably to the above table, may have upon the soil at the bed of the canal, I am only able to draw inferences from what has occurred on the Doab Canal, where the disarrangement of the bed, depending not only on excess of slope, but on the irregularity with which that slope existed, was great; the points in the bed which suffered severely were those where the declivity per mile varied from 4 to 5½ feet, or where, agreeably to the above formula, the velocity of the current at the bottom was equal to 4·1 and 6·6 feet per second of Dubuat, and 3·39 and 5·25 feet per second of Prony. From 2 to 4 feet declivity per mile, the action on the bed varied agreeably to the nature of the soil over which the current passed; but this action was not dangerous, though it must have been greatly influenced by the constant change of situation in the deposits of silt which took place at this period. In remodelling the slopes, a maximum declivity of 2 feet per mile was determined on, which, with the supply that the canal might be expected to hold, would, on the above formula, give a velocity at the bottom equal to 3·5 or 3 feet per second. Up to the present period, we have not had the means of testing the action on the remodelled slopes (from circumstances unconnected with these inquiries, the proposed slope of 24 inches was reduced to 23 inches per mile) with a mean radius of section greater than 40·7; this gives a velocity at the bottom equal to 2·7 and 2·3 feet per second, which might certainly be considerably exceeded, as far as I am able to judge from the stable state of the canal bed; the soil is good.

It will be observed that, in the project for the Ganges Canal, the declivity of bed is less than that above alluded to, but the magnitude of the mean radius of the section gives a velocity to the current due to the greater slopes of the Doab Canal. I have no reason for anticipating any dangerous effects from this velocity, but, at the same time, I would recommend that the branches should not be commenced upon until the main line is completed, and the action of the water necessary for that line carefully observed. A decrease in depth of water to the first section equal to 3½ feet would reduce the current at the bottom of the canal to 3·07 and 2·64 feet per second of Dubuat and Prony respectively, and would give a supply equal to

* Prony having giving no formula for the value of U, it has been calculated on Dubuat's rule $V = \frac{v + U}{2}$.

3,494 cubic feet per second, which is somewhat more than is required for the purposes of both irrigation and navigation.

The following table is explanatory of the capabilities of the Solani Aqueduct, the depth of water being retained as in section 1 :—

—	Area of Section in Feet.	R.	$\frac{1}{b}$.	Value in Feet of					Discharge per Second.
				v.	V.		U.		
					Dubuat.	Prony.	Dubuat.	Prony.	
Earthen aqueduct revetments	1,590	101·0	$\frac{1}{3520}$	5·00	4·35	4·05	3·70	3·10	6,906
Masonry aqueduct ...	1,700	97·1	$\frac{1}{3520}$	4·87	4·23	3·94	3·59	3·01	7,237

Were each of the masonry channels reduced to a breadth of 82½ feet, the equilibrium between their total value and that of the earthen aqueduct would be more perfectly established, but the stone piers, which are fixed in the bed of the channels at both extremities, may probably have some effect in interfering with the current, an evil which will be qualified by this additional width.

The formula for afflux (or rise to the water's surface level on the superior side, arising from the construction of a bridge over the course of a river) which has been used is this:—

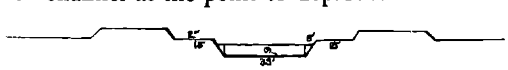
$$\left(\frac{V^2}{2\,G} + p\right) \times (K^2 - 1)$$

V = mean velocity of current before the erection of the bridge.
K = rates between sectional area of the river and the aggregate waterway of the bridge.
p = difference of level on contracted or narrowed part of the river.
G = the acquired velocity at the end of one second by a ponderous body falling freely: this is always an uncertain part of these equations, the reasons for which are explained by Dubuat; it has been used throughout my calculations as 330.

10. The berms of the canal, or the space between the interior slopes of the embankment and the channel, are proposed to be raised 12 inches above the high-water mark, and the top of the embankments are not to be less than 3 feet above the same level. The terreplein, or top of banks, to be not less than 20 feet wide, excepting on the last 100 miles of the canal, where this minimum width may be reduced to 16 feet; where earth is in excess, the extra soil will be used in extending the width to the rear; where there is a deficiency, the earth required for the completion of the banks to their full height and width will be obtained by digging superficial trenches, not deeper than 12 inches, either within or without the canal boundary; if without, the sides ought to be sloped off so as to admit of a plough passing over them. The limits to the canal ground ought to be marked off by a ditch 3 feet wide and as much deep.

Cawnpoor Branch.

11. Forty-three and a half miles long, with a slope of 12 inches per mile: the supply for this branch is 308 feet per second. The masonry head at Rousa, from which it receives its supply, consists of two openings of 20 feet each. The capacity of channel at the point of departure is—



Section.	Value of R.	Value of $\frac{1}{b}$.	Sectional Area Square Feet.	V in Feet.	Discharge.	
					Theoretical.	Required.
At the point of departure	56·81	$\frac{1}{5280}$	246	2·585	635·9	308·0

These dimensions decrease to a width of 21 feet until the branch terminates at the escape into the Pandoo at Gowri. The capacity of this channel is sufficient for twice the quantity that the supply for irrigation demands, to admit of surplus water being thrown down it.

Ground occupied by the Canal.

12. It is proposed that plantations of forest trees should be established on each side of the canal—the berms, slopes, and embankments, being kept entirely free from either trees or vegetation. Where, however, the terreplein, or top of bank, exceeds the proposed width of 20 feet, it will be desirable to keep a space not exceeding 30 feet in width clear for the purposes of a roadway. It will be evident, on a reference to the table of excavation, that beyond that required merely for the formation of embankments, much superfluous earth will remain; this would be spread out up to the boundary ditch. On the early portion of the canal the excavation is so extensive, that the whole of the land within the boundaries will be raised to the height of the terreplein; with the exception, however, of the berm, slopes, and the roadways, the whole will be planted: the superficial area of land which the canal will occupy on No. 1 project may be estimated as follows:—

Main Line.

—	Length.	Breadth.	Area.	Total.
	Feet.	Feet.		Acres.
On section No. 1	264,000 ×	600 =	158,400,000	
" 2	316,800 ×	400 =	126,720,000	
" 3	369,600 ×	300 =	110,880,000	
" 4	369,600 ×	250 =	92,400,000	
" 5	158,400 ×	200 =	31,680,000	
" 6	913,440 ×	150 =	137,016,000	
Total	...	...	... 657,096,000	
			Then $\frac{657,096,000}{43,560}$ =	15,084·84
Cawnpoor branch	229,680 ×	150 =	34,452,000	790·90
Futtigurh branch	844,800 ×	200 =	168,960,000	3,878·78
Bolundshuhur branch	369,600 ×	150 =	55,440,000	1,272·27
Etawa branch	908,160 ×	200 =	181,632,000	4,169·69
Total amount of land required for the main canal and its branches on project No. 1	...	...	... ...	25,196·48

13. In addition to the above, it is proposed to establish orchards of grafted mango-trees at every first-class choki, or at every 15 miles or thereabouts; each orchard to consist of 5 acres. These may hereafter be extended throughout the branch lines, but the main line only is now taken into consideration. It will also be necessary to take in a portion of ground at Roorkee for the workshops, timber-yard, brick-ground, and for general purposes. The additional space required under these heads may be estimated at 250 acres, viz.:—

34 orchards × 5 = ...	170
Roorkee ground	80
Total	250 acres.

The object in combining with the plan for plantations of forest trees, one for the grafted mango, is to take advantage of the means of protection and care offered by the canal establishment in introducing generally on the whole line of the Doab a fruit which in its natural state is highly prized by the native community, and which, when cultivated, will be still more acceptable. The orchards will be annually farmed out, and the proceeds set off against the expenses of original outlay and maintenance; each orchard will be the nucleus of distribution for grafts when the parent trees have arrived at maturity, and it may be inferred that, by the means proposed, a very superior fruit will be generally disseminated.

14. In the above calculations, the total area of land required for the purposes of the Ganges Canal and its branches will be equal to 25,196·48 acres, say 25,200 acres, which, at an average of 2 *rs.* 8 *a.* per acre, leads to an annual remission of 63,000 *rs.* It may appear at first sight that this sum, which is annually disbursed from the treasury as long as the present assessments last, and the equivalent of which in the land itself is struck out of the Jumma when the next settlements take place, is not only an annual and permanent loss to the Government, but a dead weight upon the canal returns. It must be recollected, however, that the consequence of introducing facilities for irrigation are, increased value of property, and a security to the realization of the Government revenue. I merely advert to the direct benefits to the State as exhibited in the treasury receipts, and that these benefits will far counterbalance the remission for land taken up originally for the canal purposes, appears to me to be evident.

15. Independently, however, of remission for land occupied by the canal, the items of remuneration for standing crops, trees, buildings, wells, &c., present themselves; it is hardly possible to determine the exact amount which may be carried to this account. It would be a necessary part of the superintendent's duty, however, to make such arrangements as might prevent, as much as possible, the removal of standing corn, sugar-cane, cotton, &c., by postponing the excavation of the canal at points where they existed, and giving warning to the cultivators not to sow within the limits of the canal boundaries, when such boundaries had been distinctly laid down. I am not, therefore, disposed to estimate the remuneration on this item at a high amount. Trees and masonry wells would have to be paid for when actually removed, but I would restrict this removal to that portion of the canal limits occupied by the banks, berms, and channel. On that portion within the boundary devoted to plantations, the trees standing might be allowed to remain, as the property of the owner, until he wished to remove them, and the wells might continue in use for irrigation, without in any way interfering with the interests of the canal. This might be laid down as a general rule, the exception being where removal was necessary, in which case remuneration would be given.

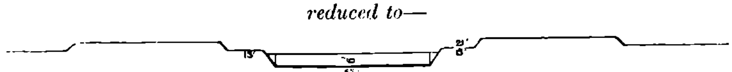
16. The remark, however, appended to paragraph 14 is equally applicable here: the original outlay on remission and remuneration, whether for land, crops, trees, or buildings, would meet with an ample return in the increased value of estates and property.

Ganges Canal Project No. 2.

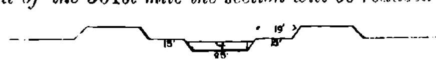
17. Up to the 280th mile, or to the departure of the Cawnpoor branch, there is no difference between this and the first project, and Nos. 1 to 5 of the Sections, with their calculated capacity for discharge, remain as before. In this project, however, the increased length of the Cawnpoor branch leads to a further removal of water from the main channel of 172 cubic feet per second, which (although, for reasons before explained, no additional waterway is required at the head of the branch) renders a reduction to the section of the main line after the departure of that branch convenient.

18. In continuation, therefore, from No. 5 section of Project No. 1, we have—

No. 6.—From the commencement of the 281st mile, or below the departure of the Cawnpoor branch, the section will be reduced to—



No. 7.—From the commencement of the 361st mile the section will be reduced to, and continue to, the terminus.



Section.	Value of R.	Value of $\frac{1}{b}$.	Sectional Area Square Feet.	V in Feet.	Discharge.	
					Theoretical.	Required.
Number 6	62·36	$\frac{1}{5280}$	426	2·710	1,154·5	1,194
„ 7	38·33	$\frac{1}{5280}$	116	2·117	245·6	250

——	Water demanded for Irrigation.		Discharge below Branch on the Main Canal.
	Main Line.	Branch.	
The expenditure on the main line to immediately south of the Cawnpoor head being	2,434 — 800 + 440 =		1,194
To Allahabad	1,194 — 944 + 0 =		250

1,194 cubic feet per second passes the 280th mile for the purposes of irrigation and navigation, the length of canal being 173 miles; for the first 80 of which an allowance is made for irrigation, agreeably to the second axiom of 8 cubic feet per mile, and to the latter from the reservoirs for lockage 3·26 cubic feet per mile—the disposal of the whole body being thus:—

For irrigation from the 280th to 360th mile	640	cubic feet.
„ „ 360th to 453rd „	304	„
For navigation	250	„
Total	1,194	„

Stop bridges will be placed on the canal, south of the Cawnpoor Head and south of the Deosur Escape, to regulate this supply, and protect the canal on its reduced section (commencing at the 360th mile) from being overloaded.

19. It will be observed that, on the above calculation, the quantity of water in the canal, on its reaching the diminished section, figure No. 7, is equal to 614 cubic feet, whereas the capacity of channel upon which the above section has been framed is only equal to carry 244·64 cubic feet per second. By referring, however, to the depths of excavation from the 360th mile downwards, *vide* Estimate, it will be seen that they far exceed 4 feet, which as the minimum depth was that to be admitted into the calculations; the capacity of this channel, therefore, is fully equal to the quantity of water it will receive. I have been more willing to give an excess of water on this line, from the circumstance of the immediate neighbourhood of the Ghatumpoor Purgunna, in the Cawnpoor District, a tract of land lying to the south-west of the town of Sarh and the Fort of Deosur, and greatly in want of irrigation. The purgunna in question lies on the right or opposite bank of the Rinde River, but a cut taken from the canal at some point between Suchindee and Etarra, *vide* Sheet of Protracted Levels, No. 9, would, by the interposition of an aqueduct built over the Rinde, provide this tract of land with ample means for irrigation.

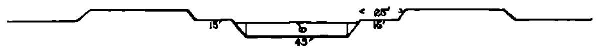
20. This project will add in a small degree to the amount required for remuneration on land, viz., that for an additional length of $16\frac{1}{2}$ miles to the Cawnpoor branch, thus—

Miles.	Feet.	Feet.	Square Feet.		Acres.
$16\frac{1}{2}$ or	87,120 ×	150 =	$\frac{13,068,000}{43,560}$ =	... ...	300
		Brought forward	... ...	...	25,196·48
		Total land required for No. 2 project	...	...	25,496·48

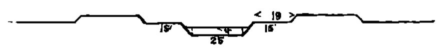
No. 3 Project.

21. Up to the departure of the Cawnpoor branch, at the 280th mile, the calculations remain the same as in the former projects; from the point of separation each branch, viz., that one towards Allahabad, and that to Cawnpoor, are projected as lines of navigation, the former being locked into the Jumna south of the Rinde River, and the latter into the Ganges at Cawnpoor. The sections are as follow :—

No. 6.—Allahabad Branch below regulator at the point of separation.



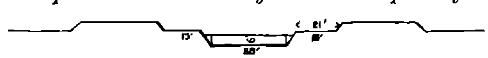
No. 7.—Allahabad Branch Terminus.



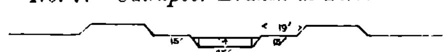
Section.	Value of R.	Value of $\frac{1}{b}$.	Sectional Area Square Feet.	V in Feet.	Discharge.	
					Theoretical.	Required.
Number 6	59·26	$\frac{1}{5280}$	306	2·641	808·1	967·72
,, 7	38·33	$\frac{1}{5280}$	116	2·117	245·6	250·00

	Water demanded for Irrigation.		Discharge below Branch on the Main Line.
	Main Line.	Branch.	
Expenditure on the main line immediately south of the Cawnpoor head being	2,434 — 800 + 425·25 + 250		= 967·72
To Allahabad	967·72 — 717·72 + 0		= 250

No. 6.—Cawnpoor Branch below regulator at the point of separation.



No. 7.—Cawnpoor Branch at Terminus.



Section.	Value of R.	Value of $\frac{1}{b}$.	Sectional Area Square Feet.	V in Feet.	Discharge.	
					Theoretical.	Required.
Number 6	56·81	$\frac{1}{5280}$	246	2·585	635·9	666·28
,, 7	38·33	$\frac{1}{5280}$	116	2·117	245·6	250·00

On the Allahabad branch, a reduction in width of one foot takes place on each 5 miles. On the Cawnpoor one, a similar reduction is made on every 6.

22. In this project, 1,634 cubic feet per second reaches the point where the Allahabad and Cawnpoor branches separate; out of which is reserved, for the purposes of navigation, 500 cubic feet per second, that

is, 250 for the terminus of each. The remainder, which is applicable to irrigation, is divided off as follows:—

		Cub. Ft. per Second.		Per Mile.
Allahabad branch,	100 miles, has	717·72	or	7·0871
Cawnpore ,,	63 — 5 = 58	416·28	or	7·8750

This proportion of water per second for the supply of each running mile is somewhat less than laid down in the second axiom of this Appendix.

23. The quantity of land occupied on this project will be as before, deducting 93 — 20 miles, or the difference between the length of canal from the 360th mile to Allahabad, and that from the 360th mile to the Jumna near the mouth of the Rinde River.

Therefore, as before	25,496·48 acres.
Deduct $385{,}440 \times 150 = \frac{57{,}816{,}000}{43{,}560} =$	1,327·27 ,,
Total quantity of land required for No. 3 project	24,169·21 ,,

(Signed) P. T. Cautley, *Captain*,
Director Ganges Canal Works.

APPENDIX G.

REPORT *on the* WATER *in the* HINDUN RIVER, *from the Point where the* BRIDGE *is building at* GHAZIOODEENNUGGER *to its Junction with the* JUMNA, *near the Village of* MOZABAD, *as taken on the 4th, 5th, 6th, and 7th of* APRIL, 1840.

Number of Station.	Distance.	Width.	Central Depth.		Remarks.	Number of Station.	Distance.	Width.	Central Depth.		Remarks.
	Feet.	Feet.	Ft.	Ins.			Feet.	Feet.	Ft.	Ins.	
1	1,000	108½	3	2	From No. 1 to 36, taken on the 4th April, 1840.	39	1,000	92	2	4	
2	1,000	180	3	10		40	1,000	89	3	2	
3	1,000	145	2	4		41	1,000	85	3	0	
4	1,000	112	2	2		42	1,000	93	3	10	
5	1,000	65	4	3		43	1,000	131	2	2	
6	1,000	148	2	4		44	1,000	111	3	4	
7	1,000	86	5	6		45	1,000	108	3	6	
8	1,000	123	3	0		46	1,000	75	8	2	
9	1,000	132	3	3		47	1,000	137	2	3	
10	1,000	140	2	4		48	1,000	101	2	4	
11	1,000	174	4	0		49	1,000	63	3	7	
12	1,000	76	4	4		50	1,000	55	5	2	
13	1,000	113	2	1		51	1,000	98	4	1	
14	1,000	111	2	11		52	1,000	99	3	2	
15	1,000	61	7	2		53	1,000	115	3	0	
16	1,000	100	3	5		54	1,000	94	5	6	
17	1,000	106	10	2		55	1,000	105	2	4	
18	1,000	97	3	3		56	1,000	63	3	5	
19	1,000	105	9	2		57	1,000	76	4	2	
20	1,000	92	4	2		58	1,000	71	4	1	
21	1,000	88	6	1		59	1,000	61	5	1	
22	1,000	110	3	9		60	1,000	89	2	6	
23	1,000	122	2	4		61	1,000	132	2	1	
24	1,000	110	2	1		62	1,000	75	3	1	
25	1,000	87	3	11		63	1,000	85	2	0	
26	1,000	102	2	10		64	1,000	78	2	3	
27	1,000	150	2	0		65	1,000	50	11	4	
28	1,000	84	3	4		66	1,000	191	3	8	
29	1,000	101	5	4		67	1,000	57	3	4	
30	1,000	86	6	2		68	1,000	60	4	10	
31	1,000	110	3	0		69	1,000	66	6	2	
32	1,000	88	3	1		70	1,000	79	2	11	
33	1,000	180	2	1		71	1,000	117	1	11	
34	1,000	110	2	9		72	1,000	57	5	8	
35	1,000	71	2	10		73	1,000	60	6	0	
36	1,000	62	4	6		74	1,000	71	6	9	
37	1,000	59	2	9	From No. 37 to 79, taken on the 5th April.	75	1,000	73	4	9	
38	1,000	65	2	2		76	1,000	62	4	2	

Number of Station.	Distance.	Width.	Central Depth.		Remarks.	Number of Station.	Distance.	Width.	Central Depth.		Remarks.
	Feet.	Feet.	Ft.	Ins.			Feet.	Feet.	Ft.	Ins.	
77	1,000	84	3	8		119	1,000	108	2	0	
78	1,000	65	9	1		120	1,000	68	8	8	
79	1,000	85	2	10		121	1,000	138	2	6	
80	1,000	113	2	8	From No. 80 to 124, taken on 6th April.	122	1,000	106	2	11	
81	1,000	73	3	1		123	1,000	58	5	11	
82	1,000	87	2	4		124	1,000	74	4	2	From No. 124 to 159, taken 7th April, 1840.
83	1,000	69	2	11		125	1,000	130	1	10	
84	1,000	78	2	8		126	1,000	103	2	10	
85	1,000	107	2	0		127	1,000	95	4	10	
86	1,000	80	4	2		128	1,000	128	1	11	
87	1,000	62	4	1		129	1,000	112	1	6	
88	1,000	100	2	1		130	1,000	69	8	2	
89	1,000	67	3	2		131	1,000	74	6	1	
90	1,000	106	2	2		132	1,000	112	3	2	
91	1,000	102	4	6		133	1,000	127	2	11	
92	1,000	79	4	10		134	1,000	91	3	0	
93	1,000	120	1	10		135	1,000	120	2	7	
94	1,000	80	4	1		136	1,000	96	2	8	
95	1,000	81	3	1		137	1,000	89	2	11	
96	1,000	89	2	8		138	1,000	54	7	1	
97	1,000	84	2	10		139	1,000	101	5	10	
98	1,000	86	4	8		140	1,000	120	2	2	
99	1,000	106	2	2		141	1,000	139	2	0	
100	1,000	85	3	1		142	1,000	97	2	1	
101	1,000	97	3	4		143	1,000	141	1	11	
102	1,000	96	2	3		144	1,000	67	3	6	
103	1,000	90	2	1		145	1,000	80	2	6	
104	1,000	74	6	9		146	1,000	80	2	7	
105	1,000	109	5	0		147	1,000	100	1	10	
106	1,000	76	4	1		148	1,000	64	2	4	
107	1,000	168	1	5	At points Nos. 107 and 108, where there is least water, is close to the village of Gojur.	149	1,000	82	3	0	
108	1,000	151	1	4		150	1,000	104	2	1	
109	1,000	89	2	2		151	1,000	137	2	1	
110	1,000	68	2	8		152	1,000	90	1	10	
111	1,000	114	2	11		153	1,000	68	2	10	
112	1,000	94	2	3		154	1,000	85	1	10	
113	1,000	95	6	1		155	1,000	89	1	11	
114	1,000	105	2	3		156	1,000	77	3	1	
115	1,000	82	10	7		157	1,000	73	2	0	
116	1,000	111	2	11		158	1,000	83	1	9	
117	1,000	83	2	4		159	1,000	94	2	8	
118	1,000	130	2	0							

9th April, 1840. (Signed) H. B. Brew, *Overseer*,
Eastern Jumna Canal.

APPENDIX H.

Circular Memorandum *to all* Executives *on the* Ganges Canal.

No. 82.

Dated 1*st January*, 1852.

Plan and section of canal, with reference to roadway, plantations, and ultimate annual clearance.

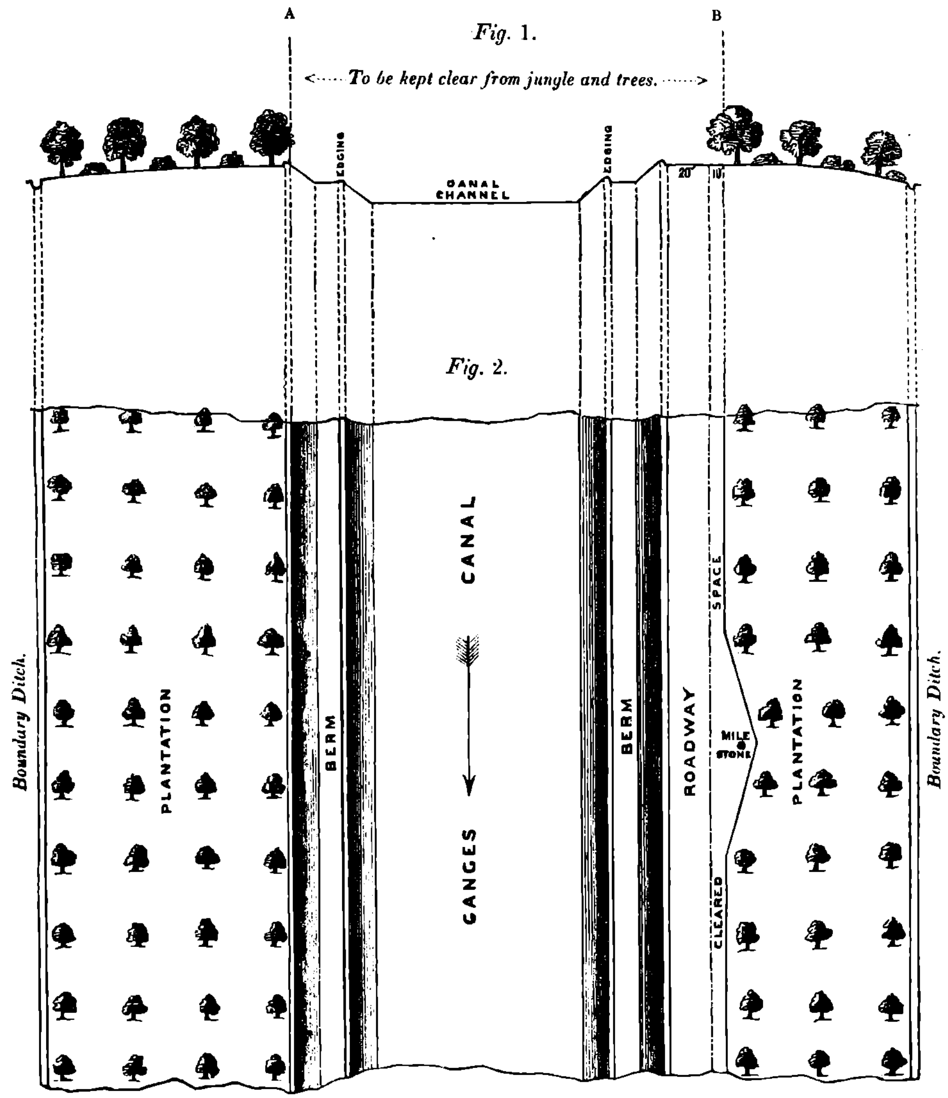


Fig. 3.

Fig. 1 shows a section of the canal, as it is supposed to be, when the plantations are established. These plantations will, on the right bank of the canal, be established from the boundary ditch to A, or to the crest of the interior slope of the embankment. On the left bank of the canal, the plantations will be confined to the ground situated between the letter B and the canal boundary on that side.

The intermediate space between A and B, including the interior slopes, berms, roadway, &c., and canal channel, will be kept perfectly free from plantation, as well as from jungle.

Fig. 2 shows a plan with a representation of the lining out of plantation and roadway at every mile-stone; the diagram speaks for itself; the esplanade for the mile-stone will have a chord of 150 feet and a versed line depending on the width of artificial esplanade existing. The mile-stones ought to be centrically situated.

Fig. 3 shows the section of the road on a larger scale, with dimensions of edging; it shows also the slope to be given to the 30 feet esplanade which I propose to leave for the roadway, and the cleared space parallel to it; this slope is directed upon the outside, so that the canal channel may not be interfered with (my only object in giving the slope is, that the drainage may pass off to the outer boundary; any slope, sufficient for this purpose, will answer, whether it is 3″ or ½ an inch). The roadway itself will be maintained clear from jungle or impediment of any sort; it will be kept well rolled on a breadth of 20 feet, as shown in the diagram; the 10 feet in the rear, which is intended to receive the dropping from the trees, and will relieve the roadway from the projecting branches, will be kept clear from jungle, and it will act, in case of necessity, for carts and hackeries.

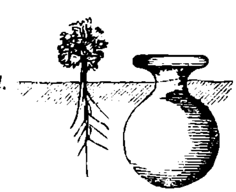
It is an object to keep the 20 feet of road free from Kunkur metalling; but in very sandy tracts, like those in the upper parts of the first and second divisions, either kunkur or clay must be laid down; I prefer the latter as more suitable for horses' feet, and more agreeable for walking on. When Doob grass is fairly established, the earthen road becomes very firm and good, as is shown in the road banks of the Jumna canals. A stratum of 1½ or 2 feet of good clay would answer every purpose, I imagine.

The embankment roadways are for domestic purposes only, they are not intended for traffic, or for general public use. Strings of carts or cattle, of any description, are prohibited from coming upon the roadway, excepting in the train of a member of the canal establishment; the establishment are specially called upon to use this line for patrol and inspection purposes.

The latter end of March and beginning of April is a favourable period for tree-planting. I take the opportunity, therefore, of pointing out that I am very desirous of establishing lines of mangoe-trees (not grafts) along the canal banks. Trees of this sort require great care and more looking after than others, and I wish to confine the mangoe-tree planting to two lines, one on the right, the other on the left bank. The position of the line on the left bank is to be 10 feet in the rear, or on the left of the 30 feet passage for roadway; that is to say, at a distance of 40 feet from the crest of the interior slope of the embankment. The position on the right bank is to be exactly similar, viz., 40 feet to the right of the interior slope of the embankment.

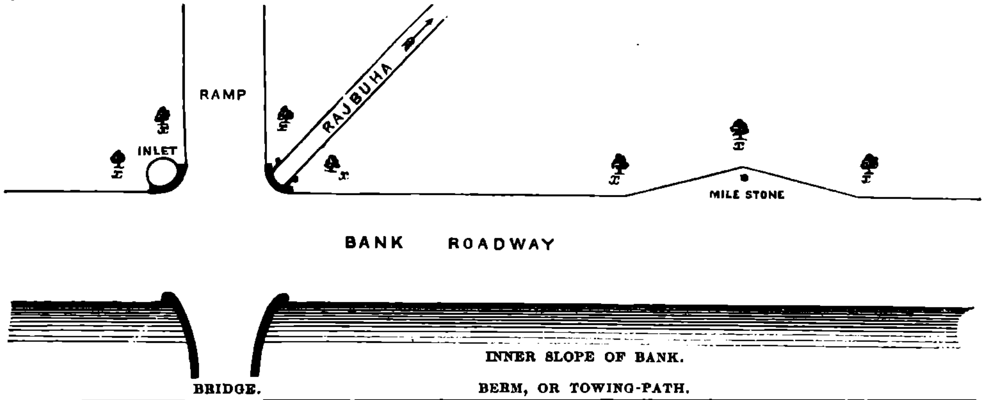
The trees are to be planted at a distance of 100 feet from each other, so that about 53 plants will be required per mile. At the foot of each plant, a ghurra, or kedgeree pot, in the bottom of which a very small hole is perforated, will be buried thus:—

Surface of ground.



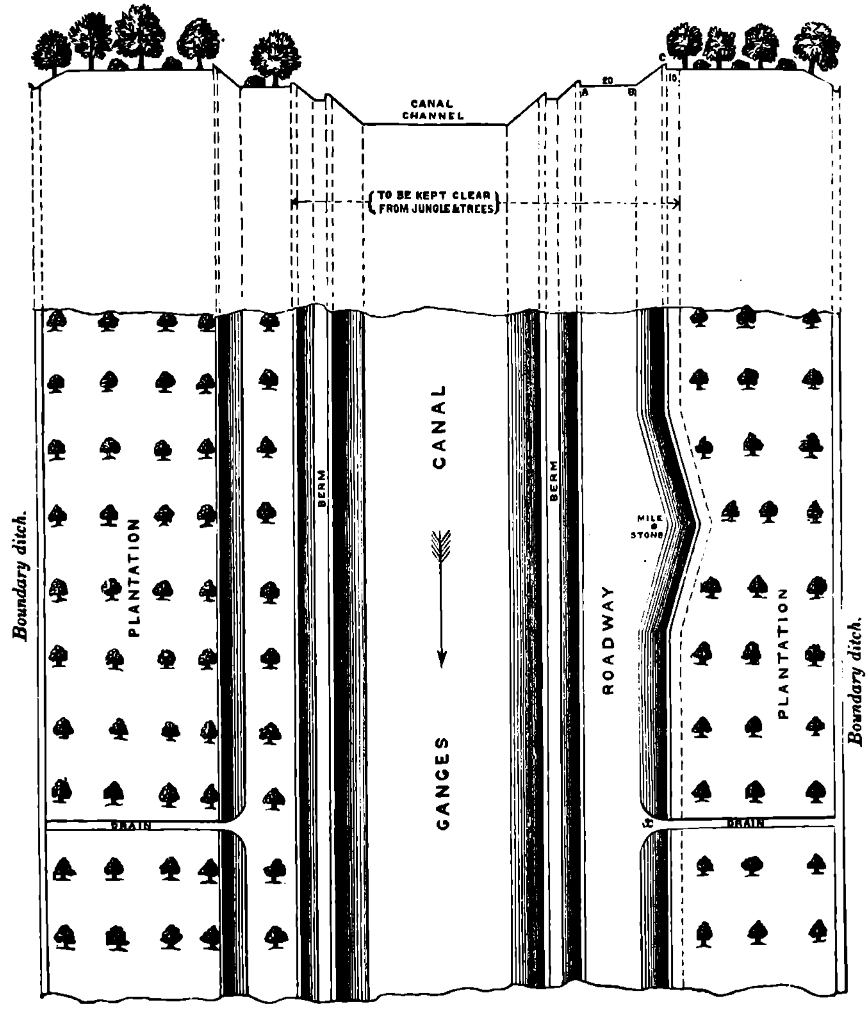
These ghurras will be filled with water periodically and as frequently as may be considered necessary with reference to the moisture required.

I have stated that the mangoe-trees should be planted at distances of 100 feet; I would not diminish this distance, but I would so arrange that at bridges and at mile-stone posts, trees might be thus situated, as at x, x, x, x :—

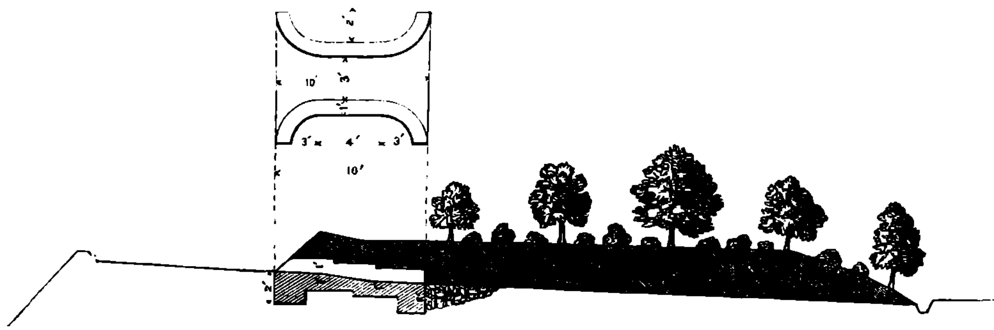


I shall be glad to hear of the arrangements above described being entered on in the ensuing season.

The following diagrams will show the lining-out which I propose for the roadway and plantations in those places where the section of the canal is thus :—



The roadway, which is to be 20 feet wide, is to have a slight slope externally from A to B, so that the drainage may be carried off at the foot of the slope B, C, to drains, as shown at x, which, being situated at about 1,000 feet apart, will deliver the water into the boundary ditches. I see no necessity for going to heavy expense in these escapes; where kunkur is at hand, they can be protected from injury by very simple arrangements, either by massive blocks or by concrete made with kunkur gravel; where there is no material but brick, the refuse from kilns, or broken brick which remains on hand after the completion of bridges, may be used with great economy. But in many cases, it is possible that no permanent structure may be required at all. Executive engineers, however, will understand that I have no desire to go to heavy expense in their construction. The drains will be open through the plantations, and not covered, and might be built of the following pattern.



(Signed) P. T. CAUTLEY, *Lieutenant-Colonel,*
Director Ganges Canal Works.

APPENDIX I.

COMPARATIVE STATEMENT of Details regarding

Name of Bridge.	CONSTRUCTION. Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks. Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.	Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	PRECAUTIONARY PREPARATORY TO How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
KUNKHUL.	From one centre.	Particular care taken.	Equable throughout.	From 3-16″ to 5-16″	1,050 cub. ft.	2,100 cub. ft.	None	99,000 L = 12·01″ B = 5·73″ D = 2·04″	10,306·67	One arch keyed in presence of Mr. W. Kay, and two under superintendence of a mistree. Key bricks carefully dressed, laid in fine mortar, and driven with wooden mallets.	Earthwork completed to a level 3½ feet below crown of arches; well watered and rammed.
JOWALLAPOOR.	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto	None	Ditto	Ditto	Two arches keyed in presence of Mr. W. Kay, and one in presence of a mistree only, with the same care as above detailed.	Earthwork completed to a level of 1 foot below crown of arches; well watered and rammed.
DHUNNOWREE.	Ditto	Ditto	Ditto	¼″	1,330 cub. ft.	2,660 cub. ft.	None	1,35,350 9¼″ × 4¼″ × 2⅛″	11,182·5	Keyed in presence of Mr. Login. The keying was done in the same manner as described in keying the Muhewur bridge arches.	Earth level with top of skewback at both abutments; watered, but not rammed.
PEERANKULLEEUR.	Ditto	Ditto	Ditto	¼″	1,925 cub. ft.	3,850 cub. ft.	None	1,48,000 12″ × 5¾″ × 2⅓″	14,265	Partly in presence of Mr. Parker, and partly in presence of Ukbar Khan, mistree, in the same way as the Muhewur bridge.	Up to within 1½ feet from surface of roadway. Earth well rammed and watered long before commencement of Centres.
MUHEWUR.	Ditto	Ditto	Ditto	11-32″	1,300 cub. ft.	2,600 cub. ft.	None	1,47,400 10″ × 5″ × 2⅝″	12,080	Partly keyed in presence of Capt. Goodwyn, and partly in presence of a mistree. Previously to keying the arches, the layers on each side of the key bricks were wedged back, the wedges being then taken out and the key-bricks tightly fitted in.	Earthwork completed to within 3 feet below crown of arches, and rammed.

APPENDIX I.

Construction of Arches of Bridges on the Ganges Canal.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
Earth filled in spandrils over haunches to level, 3½ feet below crown of arches?	3 feet below crown of arches.	12 hours	Centres lowered by equal graduation about ¼″ or ½″ at once.	2¼″	3″	2¼″	2·583″	No cracks	No crushing	None.
				Quoted from memory.						
Ditto, ditto, 1 foot below crown of arches.	Level of cornice.	2 days	Ditto	4″	5″	3½″	4·166″	Ditto	Ditto	Ditto.
				Quoted from memory.						
No weight on haunches when centres were being struck.	No spandril masonry; wing walls to level of crown of arches.	Began striking as soon as the last key-brick was fixed, but the striking not completed till next day.	Began lowering the centres a quarter of an inch, and afterwards half an inch at a time. This was continued till all the centres were clear of the arch.	·41′	·36′	·37′	·38′	There were cracks not exceeding ·32″ broad along all the arches, 5 feet above the spring; but had the spandrils been filled with either earth or masonry, they could not have been seen, as I could not see them along the face of the arches. The work being built and centres struck all within 16 days may account for arches sinking so much, the work being perfectly green.	Ditto	I did not think at the time that the abutments gave, but since then they appear to have done so. The cause, I think, is, that the block on which they rest has sunk.
No	No spandril walls. Wing walls finished to full height.	12 hours	Half an inch at a time; central parts first haunches afterwards.	·37′	·24′	·20′	·27′	No	No	No.
Yes, up to 3 feet below the crown of arches.	No spandril walls built. Wing walls built to 3 ft. below crown of arches.	After twelve hours haunches lowered. After 84 hours all the arches left clear of the centres. Brickwork very moist, through the heavy rain then falling.	Centres lowered one inch at a time, the haunches being lowered that amount first, and then the central parts the same.	·23′	·21′	·25′	·23′	No	No	No.

	Construction.										Precautionary preparatory to
Name of Bridge.	Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Roorkee.	From one centre.	Particular care taken.	Equable throughout.	0·28″, or ¼″ nearly.	1,076 cubic feet.	2,152 cubic feet.	None	7,262 about 15″ × 7½″ × 3″ 85,178 12·176″ × 5·86″ × 2·36″	13,069	Keying performed in presence of Mr. T. Login, officiating executive officer, with exception of portion of one arch, where greatest sinking subsequently occurred. Key bricks carefully dressed and laid — a pressure of about 1,000 lbs. obtained by use of a lever, in addition to hammering, and auxiliary to it being exerted.	Earthwork well watered and rammed, and completed to spring of extrados.
Munglour.	From five centres corresponding to curves of intrados.	Ditto	Equable generally, but may have been a little better in faces of arches.	Not ascertained.	1,648 cubic feet. Believed to be nearly correct.	3,296 cubic feet.	None	Side arches, 12″ × 6″ × 2″ Centre arches, 12″ × 6″ × 3″	13,734	Keyed in presence of Lieut. E. Fraser, executive engineer. Key bricks driven in with heavy sledge-hammers, a piece of wood being interposed to prevent the bricks splitting.	Earthwork completed to level, 4 feet below crowns of arches; well watered and rammed.
Liburheree.	From one centre.	But little dressing required.	Equable throughout.	¼″	1,316 cub. ft.	2,632 cub. ft.	None	12″ × 6″ × 3″	11,529·00	Keying performed in presence of Mr. Conductor Gair, and of Sergt. O'Farrell, and superintended by Lieut. Fraser at intervals. Method of keying, the same as at the Munglour Bridge.	Earth completed to level 4 feet below crowns of arches; well watered and rammed.
Dimat.	Ditto	Not	Good in faces, but bad in the interior.	·3703, or 6-16ths nearly.	1,325 cub. ft.	2,650 cub. ft.	None	12″ × 6″ × 2·887″	11,529·00	Keying of eastern arch performed by mistree; of centre and western arches in presence of Lieut. Sharpe. Method of keying the same as the foregoing.	Earthwork completed to top of wing walls prior to final lowering of centres of both eastern and western arches; but the eastern arch was lowered six inches when the earthen backing of the abutment had only attained the level of the springing line of the elliptical curve.
Toghulpoor.	Ditto	Particular care taken.	Perfectly so.	·02′	1,194 cub. ft.	2,388 cub. ft.	None	1·16′ × 504′ × 244′ =61,866 1′ × 5′ × 166 =26,964	11,529·00	In that of Lieut. Sharpe, and key bricks (well fitted) were driven home by sledge hammers.	Earth well watered and rammed to a height of 11 feet above spring of arches.
Belra.	Ditto	Much dressing not required.	Ditto	0·25′¼	4,030 cub. ft.	2,015 cub. ft.	None	12″ × 6″ × 3″	11,529·00	In that of Assistant Overseer Phillips, key bricks dressed and driven in with heavy sledge hammers, a wooden wedge being interposed to prevent the bricks from splitting. After keying, fine mortar filled in over key bricks.	Ditto, ditto to 4 feet below arches.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
No earth filled in spandrils.	Level with spring of extrados.	1 inch immediately	After first lowering to close joints a week elapsed before any further lowering took place. The centres were then lowered 2" at termination of each week till clear of arch, by gradations of ½ of an inch at a time.	Keyed by mistree. 6·6" Down stream side, Keyed by Mr. Login. 5½"	Keyed by Mr. Login. 5·52"	5·4"	5·755"	A slight crack along each of the haunches, but not sufficiently open to admit the point of a trowel.	No	No.
Earth filled in spandrils over haunches to level, 4 feet below crowns of arches.	4 feet below crowns of arches.	Lowered 1 inch immediately after keying.	Centres lowered a quarter of an inch at a time from sides towards centres of arches, after interval of one month after keying.	3·7"	3·7"	4·5"	3·96"	In the north face of the eastern arch a few bricks were cracked in the centre of arch and eastern haunch. The direction of the haunch crack being parallel to curve which arose, the executive engineer thinks, from the masonry in the face being slightly better than that in the interior.	No	No.
Ditto	Ditto	Ditto	Ditto	1·2"	2·08"	1·44"	1·57"	No crack.	No	No.
No superincumbent weight on haunches beyond that of the spandril walls themselves.	Wing walls level with point where crown of extrados meets imports of arches. Spandril walls 2 feet 8 inches higher.	Ditto	Ditto	13" Still resting on centres in the middle.	...	15"	...	Many cracks parallel to the curve, and perpendicular to it, both in faces and interior of arches in the middle; more particularly shown at the haunches.	Considerable crushing in the faces of arches about the centres and haunches.	None.
None.	Both built to 11 feet above spring of arches.	Immediately	They were lowered in the ordinary manner, from haunch to crown, ¼" at a time (6), six days after keying.	1·19"	2·23"	1½"	1·64"	No	No	No.
Several thousand dry bricks placed on spandrils.	4′ 6″ below crown of arches.	Lowered one inch immediately.	Same as at Liburheri.	3·21"	3·26"	5·17"	3·88"	A few slight cracks on the centre of eastern arch parallel to curve.	A slight crushing took place on north face of east arch, but not sufficiently to displace the face of bricks.	No.

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Bhopa.	From one centre.	Much dressing not required.	Perfectly so.	From 4-16″ to 5-16″	2,662 cub. ft.	1,331 cub. ft.	None	68,000 12″ × 6″ × 3″	10,773·00	In that of Assistant Overseer Phillips, key bricks dressed and driven in with heavy sledge hammers, a wooden wedge being interposed to prevent the arches' bricks from splitting. After keying, fine mortar filled in over key bricks.	Earth well watered and rammed to a height of 5 feet below arches.
Dukeree.	Ditto	Well dressed.	Ditto	·23″	4,400 cub. ft.	2,200 cub. ft.	None	6,000 12″ × 6″ × 3″ Number of native bricks not ascertained.	10,828·00	Ditto Ditto	Ditto ditto, 2 feet ditto ditto.
Jansut.	Ditto	Ditto	Ditto	·24″	5,612 cub. ft.	2,896 cub. ft.	None	Ditto	11,859·00	Ditto, ditto Assistant Overseer Dillon, ditto, ditto.	Ditto Ditto
Surai.	Ditto	3″ bricks dressed, native bricks not dressed.	Ditto	1-5″ nearly	3,906 cub. ft.	1,953 cub. ft.	None	3,035 12″ × 6″ × 3″ Number of native bricks not ascertained.	10,741½·00	Ditto, ditto, Assistant Overseer Mills, ditto.	Completed to level of 4 feet below crowns of arches and rammed.
Khutoulee.	From five centres corresponding to curves of Intrados.	But little dressing.	Generally so, but a little better in faces of arches.	1-4″	2,980 cub. ft.	1,786 cub. ft.	None	122,000 12″ × 6″ × 3″	15,715·84	Two arches keyed in presence of Mr. Read and Sergt. Mills, and one by Sergt. Mills. Key bricks driven in as before.	Well watered and rammed; completed to level below crowns of arches.
Sutheree.	From one centre.	3″ bricks dressed, native bricks not.	Equable throughout	1-5″ nearly	4,244 cub. ft.	2,122 cub. ft.	None	3,050 12″ × 6″ × 3″ Number of native bricks not ascertained.	10,741½·00	In presence of Sergt. Mills. Key bricks as before.	Earth rammed; completed to 4 feet below crowns of arches.
Aturna.	Ditto	Particular care taken.	Ditto	3-16″	5,176 cub. ft.	2,588 cub. ft.	None	3,400 12″ × 6″ × 3″ Native bricks, 9,000 cub. ft. 4″ × 3″ × 1″	10,828·00	In presence of Sergt. Dillon. Ditto, ditto.	Earthwork completed to crown of arch of passage.
Sirdhanna.	Ditto	Great care taken.	Of equal quality throughout rather better at faces of arches.	·175″	3,696 cub. ft.	1,848 cub. ft.	None	105,780 12″·4 × 6″ × 2″·76	15,939·00	In that of Lieut. Sharpe. Keyed as at Belra.	To within a foot of crown of arch, rammed and watered.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.									
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
Several thousand dry bricks placed to level 3 feet below crowns of arches.	4′ 6″ below crown of arches.	Lowered 1 inch immediately.	Same as at Liburheri.	$2\frac{3}{4}$″	$2\frac{1}{2}$″	3″	$2\frac{3}{4}$″	A few cracks on each arch, parallel to curve, and scarcely perceptible.	No	No.
No	4 feet ditto	1 month	Earthen centres. Removed a month after keying.	·06″	·04″	·03″	·04″	No	No	No.
No	Ditto	Ditto	Ditto	·03″	·05″	·07″	·05″	No	No	No.
No	Wing walls to level of inner crown of arches; no masonry in spandrils.	2 months and 6 days.	Ditto: clear of arches. 3 months and 26 days after keying.	...	...	...	...	Very slight opening at haunches.	No	No.
Earth filled in spandrils over arches to $2\frac{1}{2}$ feet below crowns of arches.	$2\frac{1}{2}$ feet below crowns of arches.	2 months	Ditto Ditto 2 months and 10 days.	$\frac{1}{2}$″	$\frac{3}{8}$″	$\frac{1}{4}$″	$\frac{3}{8}$″	No	No	No.
No	Wing walls to level of inner crown of arches.	2 months and 1 day.	Ditto Ditto 3 months and 26 days.	...	...	...	...	Very slight openings at haunches.	No	No.
No	Wing walls up to level of crown of arched passage.	6 months.	Ditto Earth removed equably throughout.	$2\frac{3}{4}$″	$2\frac{1}{2}$″	3″	$2\frac{3}{4}$″	A few cracks on each arch, parallel to curve, but scarcely perceptible.	No	No.
Spandril walls built up to $1\frac{3}{4}$′ below crown of arch. No earth.	Wing walls to 1′ below extrados, spandrils being $1\frac{3}{4}$′ below intrados.	25 days	The centres (earthen) were first perforated by three tunnels, one under crown 8′ wide, and at intervals of 7′, by one on either side 7′ wide; thus leaving 4 earthen piers supporting the arch. Four gangs of men were then set to work, two in the centre tunnel, standing back to back, and digging outwards (*i.e.*, towards the haunches), and the other two excavating the piers under haunches, likewise working outwards. As the piers lessened the arch came down gradually, crushing the earth, and settling equably to its bearings.	·18′	·18′	·18′	·18′	No	No	No

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Nanoon.	From one centre.	Great care taken.	Of equal quality throughout rather better at faces of arches.	·1517″	3,100 cub. ft.	1,550 cub. ft.	None	88,722 12·2″ × 6·12″ × 2·9″	13,373·00	In that of Lieut. Sharpe, keyed as at Belra.	To the level of top of skew backs or spring of extrados or arch; well watered and rammed.
Juttoora.	Ditto	Ditto	Equable throughout	3-16″ to 5-16″	2,042 cub. ft.	1,021 cub. ft.	None	65,208 2·64″ × 6·22″ × 12·52″	8,951·00	In that of Mr. Conductor Gair. Keying as before.	Three feet above spring of arches, and ditto ditto.
Pooth.	Ditto	Ditto	Ditto	1-4″	2,684 cub. ft.	1,342 cub. ft.	None	79,885 12½″×6¼″×2¾″	9,803·38	Ditto Ditto	Earthwork completed to level with crown of arches, principally sand, well rammed and watered.
Jannie Khoord.	Ditto	Ditto	Ditto	1-4″	2,598 cub. ft.	1,299 cub. ft.	None	76,985 12½″×6¼″×2¾″	9,803·38	In that of Mr. Conductor Gair and Keahuree Misturee at intervals. Detail as before.	Earthwork completed to level of cornice, well rammed and watered.
Nugla.	Ditto	Ditto	Ditto	1-8″ to 5-16″	3,087 cub. ft.	1,029 cub. ft.	None	79,580 12·4″ × 6·3″ × 2″ 5-7ths.	9,803·38	Ditto Ditto	To crowns of arches, ditto, ditto.
Nuwarree.	Ditto	But little care required.	Ditto	1-4″	2,349 cub. ft.	783 cub. ft.	None	73,800 12·4″ × 6·3″ × 2″ 5-7ths.	8,950·92	Ditto ditto Ramsook Misturee ditto ditto.	To 6 feet above springing arches, ditto ditto.
Soundha.	Ditto	Ditto	Ditto	1-8″ to 1-4″	2,930 cub. ft.	None	None	75,000 12″ × 6″ × 3″	9,355·50	In that of Corporal Rae. Detail as before.	To spring of extrados, well rammed and watered.
Aboopoor.	Ditto	Ditto	Ditto	1-8″ to 3-8″	3,400 cub. ft.	None	None	58,000 12″ × 6″ × 3″ 8,000 12″ × 6″ × 2″	9,355·50	Ditto Ditto	Ditto ditto
Morad-Nuggur.	Ditto	Ditto	Ditto	1-8″ to 1·4″	3,680 cub. ft.	None	None	88,600 12″ × 6″ × 3″	12,474·00	Ditto Ditto	Ditto ditto

Measures lowering Centres.	Lowering and Removal of Centres, and Results.									
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
None	Wing walls level with intrados of crown of arches. Spandrils, none.	1 day	*See* Sirdhanna, p. 163	·23′	·22′	·23′	·226′	A few bricks were found cracked in the face of the haunch of the last arch some days subsequent to final lowering of centres.	Slightly at crown of arch; attributed to unequal settling.	No.
Ditto	Wing walls 3″ above spring of arches. Spandril walls not commenced.	2 months and 6 days.	In the same manner as at Sirdhanna, but slight variation in width of tunnels.	1½″	1½″	1½″	1½″	No	No	No.
Ditto	Wing walls to level of cornice, as well as outside wall of passage. No spandril walls.	15 days. Arches were clear of centres in 10 days after.	Ditto	1½″	1¼″	1½″	1 5/12″	No	No	No.
Ditto	Ditto	2 days. Arches clear in 15 days after.	Ditto	1½″	1¾″	¾″	1⅓″	No	No	No.
Ditto	Wing walls to level of crowns of arches. No spandrils.	Immediately. Centres were clear in 26 days.	Ditto	1·2″	1″	1·2″	1·13″	No	No	No.
Ditto	Wing walls 6 feet above springing of arches. No spandrils.	Clear in 36 days after keying.	Ditto	1·48″	1·5″	1·65″	1·55″	No	No	No.
Ditto	Wing walls to spring of extrados.	1 month	Ditto	1·55″	1·5″	1·67″	1·54″	No	No	No.
Ditto	Ditto	20 days	Ditto	1·6″	1·54″	1·5″	1·54″	No	No	No.
Ditto	Ditto	2 months	Ditto	1·58″	1·53″	1·5″	1·52″	No	No	No.

Name of Bridge.	CONSTRUCTION. Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks. Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.	Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	PRECAUTIONARY PREPARATORY TO How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
NOORPOOR.											
PEPULHERA.											
RAOLEE.											
NIDHOULEE.	From one centre.	Yes	Yes	·16″ to ·3″	3,220 cub. ft.	None	None	58,403 12″×6″×3″	7,601	In that of Lieut. Merrick. Key bricks driven in with wooden mallets.	Abutments rested against natural soil to spring of arch.
JARCHA.	Ditto	Ditto	Ditto	·14″ to ·23″	2,072 cub. ft.	Ditto	Ditto	60,968 Ditto	Ditto	Ditto	Ditto.
GEESERPOOR.	Ditto	Ditto	Ditto	·063″ to ·22″	2,462 cub. ft.	Ditto	Ditto	Ditto Ditto	Ditto	Ditto	Ditto.
SUNNONTA.	Ditto	Ditto	Ditto	·12″ to ·28″	2,636 cub. ft.	Ditto	Ditto	61,988 Ditto	Ditto	Ditto	Ditto.
PUKHANA.	Ditto	Ditto	Ditto	3-16″ to 5-16″	2,370 cub. ft.	Ditto	Ditto	62,000 $\frac{3}{4}$ths 12″×6″×2½″ $\frac{1}{4}$th 12×6×3	7,623	In that of Assist.-Overseer Virgiro. Keyed as before.	Ditto within 2 feet of ditto.
DUMKOURA.	Ditto	Ditto	Ditto	Ditto	2,330 cub. ft.	Ditto	Ditto	57,500 12″×6″×3″	Ditto	Ditto	Ditto, ditto, on east side; on west side level with spring of arch.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
None	Not commenced.	17 hours	Centre portion removed at first time of striking; remaining portion several weeks after.	·17′	·17′	·17′	·17′	Slight cracks parallel to curve, about 2 feet from north face of arch, 20 feet long in left and centre arches, and 12 ft. in right arch.	No	No.
None	Ditto	Ditto	Ditto	·10′	·15′	·15′	·13′	No	No	No.
None	Ditto	Ditto	Ditto	·15′	·05′	·02′	·13′	No	No	No.
None	Ditto	Ditto	Ditto	·15′	·13′	·15′	·14′	No	No	No.
Kucha pukka masonry built in over haunches to 5 feet above spring of arch.	Wing walls south of bridge to 5′ above spring of arch. North wing walls not commenced, nor spandrils.	24 hours	Ditto	·17′	·02′	·02′	·19′	Slight cracks appeared in haunches before keying, but none after.	No	No.
Ditto	Ditto	Ditto	Ditto	·15′	·125′	·125′	·13′	Ditto	No	No.

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Unoulee.	From one centre	No	Yes	1-5″ to 1-3″	3,558 cub. ft.	None	None	86,500 12″ × 6″ × 3″	10,000	In that of the executive officer. Keyed as before.	Abutments rested against natural soil to 4 feet below spring of arch; remaining 4 feet filled up, and well rammed and watered.
Wullipoora.	One centre	No	Ditto	1-4″ to 1-3″	3,114 cub. ft.	None	None	87,525 12″ × 6″ × 3″	10,000	In that of Mistree. Keyed as before.	Natural soil to spring of arch.
Mamun.	Ditto	Yes	Ditto	·018′	1,400 mds.	None	None	60,560 12″ × 6″ × 3″	7,570	In that of Lieut. Home. Keyed as before.	Carried up to a height of 5 feet, and well rammed and watered.
Uchuhja.	Ditto	Ditto	Ditto	·014′	1,100 mds.	None	None	Ditto	Ditto	Ditto Ditto	Ditto Ditto
Moondakhera.	Ditto	Ditto	Ditto	·016′	1,250 mds.	None	None	Ditto	Ditto	Ditto Ditto	Ditto Ditto
Suhenda.	Ditto	Ditto	Ditto	Ditto	1,150 mds.	None	None	Ditto	Ditto	Ditto Ditto	Ditto Ditto
Daoopoor.	Ditto	Ditto	Ditto	·0125′	897 mds.	None	None	51,168 12″ × 6″ × 3″	63,96½	Ditto Ditto	To top of towing-path arches; well rammed and watered.
Birroulee.	Ditto	Ditto	Ditto	·013′	967 mds.	None	None	52,434 12″ × 6″ × 3″	Ditto	Ditto Ditto	Ditto Ditto

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
Kucha pukka masonry built in over haunches, to 5 feet above spring of arch.	Wings and spandrils not commenced.	24 hours	Centre portion removed at first time of striking; remaining portion several weeks after.	·12′	·18′	·15′	·15′	Owing to work being carried on in the rains, the work of two of the arches had to be taken down, the cracks were so considerable prior to keying. None appeared after keying of arches.	No	No.
No.	Not commenced	Ditto	Ditto	·21′	·17′	·12′	·16′	Same as at Pukhana	No	No.
Spandrils of arches filled in to a height of 2 feet with kucha pukka masonry.	Wing walls to 5 feet above spring of arch. Spandrils not commenced.	2 days	As at Jutpoora	·25′	·18′	·18′	·2′	Small cracks about a knife's edge in thickness usually appeared in third layer after arch had progressed 7 ft. from springing; always perpendicular to curve.	No	No.
Ditto	Ditto ditto on up-stream side on down-stream side to level of cornice. Spandrils not commenced.	Ditto	Ditto	·1′	·1′	·15′	·116′	Ditto	No	No.
Ditto	Same as at Mamun.	Ditto	Ditto	·25′	·25′	·25′	·25′	Ditto	No	No.
Ditto	Same as at Uchuja.	Ditto	Ditto	·1′	·1′	·14′	·113′	Ditto	No	No.
Earth from centres filled on haunches as centres were lowered.	Wing walls to top of towing path arch.	Next morning	Ditto	·16′	·16′	·25′	·19′	No	No	No.
Ditto	Ditto to spring of ditto ditto.	Ditto	Ditto	·16′	...	·08′	·08′	No	No	No.

Name of Bridge.	Construction.											Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Dubtulla.	From one centre.	Yes	Yes	·013′	1,046 mds.	None	None	54,518 12″ × 6″ × 3″	6,396½	In that of Lieut. Home. Keyed as before.	To top of towing-path arches, well rammed and watered.
Kassimpoor.	Ditto	Ditto	Ditto	·032′	1,476 mds.	Ditto	Ditto	44,000 12″ × 6″ × 3″ 800 maunds kunkur.	6,933	In that of Lieut. Merrick, Keyed as before.	Not commenced
Burota.	Ditto	When found requisite, Yes.	Ditto	Ditto	1,532 mds.	Ditto	Ditto	64,680 12″×6″×3″	8,223	As in the preceding bridge	Ditto.
Machora.	Ditto	Ditto	Ditto	Ditto	1,491 mds.	Ditto	Ditto	43,000 Ditto	6,933	Ditto	Ditto.
Chungeyree.	Ditto	Ditto	Ditto	Ditto	1,256 mds.	Ditto	Ditto	43,000 Ditto 800 maunds kunkur.	Ditto	Ditto	Ditto.
Shekha.	Ditto	Ditto	Ditto	Ditto	1,666 mds.	Ditto	Ditto	59,600 Ditto 800 maunds kunkur.	8,223	Ditto	Ditto.
Keylunpoor.	Ditto	No.	Ditto	7-16″	2,650 cub. ft.	Ditto	Ditto	47,000 11·6″ × 5·8″ × 2½″ 12″×6″×3″	5,545·125	Keyed by Mistree, without any superintendence. Key bricks driven in by mallets.	Level with crown of arch; not rammed nor watered.
Rudain.	Ditto	No.	Ditto	1-3″	2,060 cub. ft.	Ditto	Ditto	43,700 12″×6″×3″	5,068·125	Under Lieut. Dumbleton, ditto ditto.	Ditto.
Girnoulee.	Ditto	No.	In centre and left arches tolerably so. In right arch much finer from half way up to key.	Right 1-3″ centre and left 1-4″	2,050 cub. ft.	Ditto	Ditto	43,800 12″×6″×3″	5,068·125	Ditto	Ditto.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
Earth from centres filled on haunches as centres were lowered.	Wing walls to spring of towing path arch.	Next morning.	As at Jutpoora	·16′	·05′	·15′	·12′	No	No	No.
None	Not commenced.	14 hours	Peela brick arch removed on each side, and a hole dug through the centre of earth centreings.	·2′	·2′	·2′	·2′	No	No	No.
No	Ditto	Right arch, 38 hours. Centre, 14 do. Left, 22 do.	As in the preceding.	·1′	·1′	·2′	·133′	No	No	No.
No	Ditto	17 hours	Ditto	·35′	·25′	·2′	·2166′	No	No	No.
No	Ditto	14 hours	Ditto	·3′	·3′	·3′	·3′	No	No	No.
No	Ditto	Ditto	Ditto	·3′	·25′	·3′	·2833′	No	No	No.
A hearting of masonry built up 2 ft. above springing of extrados, and earth filled over this to crown of arches.	... ...	3 days	Centres being of earth were dug out; this operation lasted 4 days.	...	...	...	Not accurately known. Maximum 9″.	Slight cracks from 6th to 10th course up from springing; ditto, ditto, 24th to 26th courses up, where slightest tendency to open is traceable.	No	No.
Ditto	... ...	Ditto	Ditto	...	...	...	Ditto ¾″	Separation discernible here also, but can hardly be called cracks.	No	No.
Ditto	... ...	Ditto	Ditto	...	...	...	Ditto 9″	More decided here, but still very slight, and in some parts not traceable.	No	No.

Name of Bridge.	Construction.											Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?		How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.				
Bunamai.	From one centre.	No.	Not quite	Right 3-10″ centre and left 4-10″	2,350 cub. ft.	None	None	44,000 12″×6″×3″ with some few 12″×6″×2½″	5,545·145	Two arches in presence of Ex. Engineer and Lieut. Dumbleton, the third in presence of the latter. Key bricks as before.		Earth level with crown of arches, but not rammed nor watered.
Poordilnuggur.	Ditto	Dressed but not radiated.	Tolerably so.	1-3″	2,000 cub. ft.	...	...	46,000 12″ × 6″ × 3″ 12″ × 6″ × 2½″	5,545·125	Under the eye of Lieut. Dumbleton. Key bricks as before.		Ditto.
Jurrowlee.	Ditto	Ditto	Yes.	1-8″	1,580 cub. ft.	...	...	39,060 12″ × 6″ × 2¾″	5,092·03	In presence of Petumber Sing, Sub-Assist. Civil Engineer, blocks of kunkur carefully dressed and 8″ thick, being driven in with blocks of stone. Three arches keyed simultaneously.		None
Junsoi.	Ditto	Ditto	Tolerably so.	1-4″	2,250 cub. ft.	...	...	44,000 12″ × 6″ × 2⅞″	5,068·125	Under the eye of Lieut. Dumbleton. Key bricks driven in with mallets.		Earth level with crown of arches, not rammed nor watered.
Tuttarpoor.	Ditto	Ditto	Yes	1-8″	1,580 cub. ft.	...	...	43,818 12″ × 6″ × 2⅜″	5,375·10	Same as at Jurrowlee		None
Bundie.	Ditto	Ditto	Ditto	Ditto	1,336 cub. ft.	...	...	33,936 12″ × 6″ × 2¾″	4,245·75	Ditto		Ditto
Guddunpoor.	Ditto	Ditto	Ditto	Ditto	1,368 cub. ft.	...	...	34,032 12″ × 6″ × 2¾″	4,542·12	Ditto		Ditto

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
A hearting of masonry built above top of skewback, and earth filled over this to crown of arches.	... ...	3 days	Centres being of earth were dug out; this operation lasted 4 days.	...	...	...	Not accurately known. Maximum ¾″	None traceable in any joints, though there were in the haunches, prior to striking, cracks in the superincumbent masonry.	No	No.
As in the foregoing bridge.	... ...	Ditto	As in the foregoing bridge.	...	...	...	Ditto 1″	Slight separations visible at skewback, but at no other places.	No	No.
None	Wing walls built.	Ditto	Ditto	...	...	...	Ditto	No	No	No.
As at Keylumpoor, but no earth over.	... ...	Ditto	Ditto	...	...	...	Ditto	Separations at each skewback; at left end of left arch being considerable, joint being thick; other separations very slight.	No	No.
None	Wing walls built.	... ...	Ditto	...	...	...	Ditto	A slight separation at one end of springing of right arch, and one in the same near the crown.	No	No.
Ditto	Ditto partly built.	... ...	Ditto	·03′	·00′	·015′	·015′	A ditto, but distinct crack perceptible at springing on right side of centre arch; very slight hair cracks might perhaps be perceived in all the haunches, but they were doubtful.	No	No.
Ditto	Ditto	... ...	Ditto	·025′	·01′	·03′	·21′	Very slight hair cracks perceptible for a time in all the haunches; most marked one in right side of right arch—a sheet of paper might have been put in this, but no more.	No	No.

Name of Bridge.	CONSTRUCTION. Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks. Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.	Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	PRECAUTIONARY PREPARATORY TO How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
GOPALPOOR.	From one centre	Dressed, but not radiated.	Yes	1-8″	1,320 cub. ft.	...	...	32,592 12″ × 6″ × 2¾″	4,151·4	Same as at Jurrowlee	None
DHAROO.	Ditto	Ditto	Ditto	Ditto	1,280 cub. ft.	...	...	32,000 12″ × 6″ × 2¾″	4,035·37	Ditto	Ditto
KEYLAI.	Ditto	Ditto	Ditto	1-4″	1,566 cub. ft.	...	...	37,152 12″ × 6″ × 2⅞″	4,404·15	In presence of Ex. Engineer and Assistant Overseer. Keyed as before.	Ditto
KOREET.	Ditto	Yes	Ditto	1-4″	1,425 cub. ft.	...	...	3,876 cub. feet stone.	3,976	In presence of Assistant Overseer. Key bricks driven in as before.	Not stated
MOKUMPOOR.	Ditto	Ditto	Finer in the face; otherwise yes.	1-6″	1,675 cub. ft.	...	...	30,960 12″ × 6″ × 2⅞″ 85 cub. feet stone.	4,016¼	Ditto Ditto	Ditto
NUGUREEA.	Ditto	Ditto	Yes	1-4″	1,175 cub. ft.	...	...	30,004 12″ × 6″ × 2⅞″	3,868½	Ditto Ditto	Ditto
PUCHOUR.	Ditto	Ditto	Ditto	Ditto	1,700 cub. ft.	...	...	30,600 12″ × 6″ × 2⅝″	3,538·3	Ditto Ditto	Ditto
KOORAOLI.	Ditto	Ditto	Ditto	Ditto	1,432 cub. ft.	...	...	7,308 12″ × 6″ × 2⅞″ 40,368 9″ × 4½″ × 2¼″	3,605	Ditto Ditto	Ditto
DUNNAHAR.	Ditto	Ditto	Ditto	1-3″	2,297 cub. ft.	...	...	40,128 12″ × 6″ × 2¾″ 2,297 cub. feet stone.	4,796·85	Ditto Ditto	Ditto

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
None	Wing walls 4′ high.	... ...	As in the foregoing bridge.	·01′	·00′	·02′	·01′	None	No	No.
Ditto	Ditto	... ...	Ditto	·02′	·01′	·025′	·017′	No separations traceable in haunches, but slight cracks through parapets found above all the haunches.	No	No.
None	Wing walls built.	12 hours.	Ditto, cleared out in 4 days.	·02′	·03′	·04′	·03	Small cracks perceptible in haunches 2 and 3 feet above the springing; in the arches there are very minute ones; they extend up the face walls and parapets, where they are broad enough to insert a trowel.	No	No.
No	Ditto	Ditto	As in the preceding	·0′	·04′	·02′	·02′	Small cracks in haunches—in joints of masonry at first perceptible—do not appear in face walls and parapets.	No	No.
Ditto	Only a portion of wing walls built.	Immediately	Ditto 3 days	·02′	·0′	·0′	·01′	As before, but extend to face walls and parapets, where they are broad enough to admit a trowel.	No	No.
Ditto	Part in length of wing walls built to springing of passage arches.	Ditto	Ditto	·03′	·02′	·01′	·02′	Ditto	No	No.
Ditto	Ditto	Ditto	Ditto	·15′	·05′	·05′	·08′	Ditto	No	No.
Ditto	Wing walls built.	Ditto	Ditto 2 days	·03′	·02′	·002′	·023′	Minute separations in joints of all the haunches which have occasioned cracks in parapets.	No	No.
Ditto	Ditto	Ditto	Ditto 3 days	·02′	·02′	·025′	·02′	Minute separations, at first visible, but closed with superincumbent weight.	No	No.

Name of Bridge.	Construction. Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks. Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.	Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	Precautionary preparatory to … How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
Roostumpoor.	From one centre.	Yes	Yes	1·6″	1,830 cub. ft.	...	...	34,100 12″ × 6″ × 2¼″	3,947·85	In presence of Assistant Overseer. Key bricks driven in as before.	Not stated
Singhpoor.	Ditto	Ditto	Ditto	1·8″	1,300 cub. ft.	...	...	33,856 12″ × 6″ × 2⅞″	4,082·62	In presence of Executive Engineer. Key bricks driven in as before.	Ditto
Puttarhar.	Ditto	Ditto	Ditto	Ditto	1,824 cub. ft.	...	...	37,500 12″ × 6″ × 2⅝″	4,010·9	In presence of Assistant Overseer. Key bricks driven in as before.	Ditto
Bhawunt.	Ditto	Ditto	Ditto	Ditto	1,896 cub. ft.	...	...	12,807 12″ × 6″ × 2¾″ 27,486 12″ × 6″ × 2⅝″	4,338·3	Ditto Ditto	Ditto
Sogaon.	Same as before.	Ditto	Finer in the face; otherwise yes.	1·6″	1,422 cub. ft.	...	...	13,989 12″ × 6″ × 2¾″ 17,356 12″ × 6″ × 2⅜″	3,772	Same as last.	Ditto
Kussudh.	Ditto	Ditto	Ditto	1·8″	1,390 cub. ft.	...	...	27,786 12″ × 6″ × 2¾″	3,772	Ditto Ditto	Ditto
Rythaee.	Ditto	Ditto	Ditto	1·8′	1,444 cub. ft.	...	...	27,653 12″ × 6″ × 2⅜″ 4,789 9″ × 4½″ × 2⅝″	3,596½	Ditto Ditto	Ditto
Dhundos.	Ditto	Ditto	Ditto	1·4″	1,300 cub. ft.	...	...	26,030 12″ × 6″ × 2¾″	3,291½	In presence of Lieut. Lamb, as before.	Ditto
Tirreea.	Ditto	Ditto	Ditto	1·5″	1,200 cub. ft.	...	...	26,660 12″ × 6″ × 2⅞″	3,681	Ditto Ditto	Ditto

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
No	Wing walls built.	Immediately	Ditto 3 days	·03′	·03′	·02′	·026′	Minute separations, at first visible, but closed with superincumbent weight.	No	No.
Ditto	Ditto to springing of passage arches.	Ditto	Ditto	Not accurately ascertained.			½″	Ditto	No	No.
Ditto	Ditto	Ditto	Ditto 6 days	·06′	·04′	·04′	·04′	Ditto, but not closed	No	No.
Ditto	Ditto 2½ feet above ditto for a portion of their length.	36 hours	Ditto rapidly	Not ascertained.				A very slight one across arch at each haunch in joints, wide enough to admit a card.	No	No.
Ditto	Ditto	Ditto	Ditto	Not ascertained. Not perceptible with line and rule.				A slight crack in one haunch of right arch; ditto each ditto left ditto; and through joints 3 feet above the spring.	None	None.
Ditto	Wing walls not built.	24 hours	Ditto	Ditto	Ditto	Ditto	Ditto	One crack just perceptible 2 feet above spring at abutment end, extending half way across arch.	Ditto	Ditto.
Ditto	Wing walls to 2½ feet above springing of passage arches for a portion of their length.	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto	Slight separations in faces and extrados of arches in each haunch, 2½ to 2¾ feet from spring.	Ditto	Ditto.
Ditto	Ditto	12 hours	Ditto	Ditto	Ditto	Ditto	Ditto	Hair cracks in all haunches perpendicular to face; maximum depth 11″ from extrados.	Ditto	Ditto.
Ditto	Wing walls not built.	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto	Ditto, 13″ ditto	Ditto	Ditto.

	Construction.										Precautionary preparatory to
Name of Bridge.	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Futtehpoor.	Same as before.	Yes	Finer in the face; otherwise yes.	1-5″	1,100 cub. ft.	...	...	20,560 $12'' \times 6'' \times 2\frac{7}{8}''$	2,759	In presence of Lieut. Lamb, as before.	Not stated.
Mirzapoor.	Ditto	Ditto	Ditto	1-5″	1,100 cub. ft.	...	...	23,900 $12'' \times 6'' \times 2\frac{7}{8}''$	2,929½	Ditto Ditto	Ditto Ditto
Dingri.	Ditto	Ditto	Ditto	2-9″	1,000 cub. ft.	...	...	21,800 $12'' \times 6'' \times 2\frac{7}{8}''$	2,759	In presence of Assistant Overseer, as before	Ditto Ditto
Sureya.	Ditto	Ditto	Ditto	2-9″	1,150 cub. ft.	...	...	22,360 $12'' \times 6'' \times 2\frac{7}{8}''$ $10'' \times 5'' \times 2\frac{3}{8}''$	2,832	Ditto Ditto	Ditto Ditto
Kunsowa.	Ditto	Ditto	Ditto	¼″	880 cub. ft.	220 cub. ft. Buzree.		17,480 $12'' \times 6'' \times 3''$	2,730	Ditto Ditto	Ditto ditto
Husseyrun.											
Bahosi.											
Gonaha.											
Oomurda.											
Soorkee.											

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches. Right.	Centre.	Left.	Mean.	Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
No	Wing walls level to extrados of passage arches.	12 hours	As in last.	...	...	...	·03′	Ditto in three ditto, 6″ ditto.	None	None.
No	Ditto	Ditto	Ditto	...	...	...	·04′	Ditto two ditto	Ditto	Ditto.
No	Wing walls not built.	Ditto	Ditto	Did not exceed ¾″				Ditto three ditto	Ditto	Ditto.
No	Ditto	Ditto	Ditto	Did not exceed ½″				Ditto	Ditto	Ditto.
No	Wing walls partly built.	21 days	As before	Not ascertained				No	No	No.

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Khyrnuggur.											
Aima.											
Barrapoor.	From one centre.	No	Yes	5-16″	600 cub. ft.	...	...	14,056 12″×6″×2⅞″	2,008	In presence of Sub-Assistant Civil Engineer Madhoram. As before.	Not stated.
Bidhun.											
Ootha.											
Munowa.											
Kukwan.											
Mudoopoor.											
Koondhun.	From one centre.	No	Yes	5-16″	600 cub. ft.	...	...	14,050 12″ × 6″ × 2⅞″	2,008	As at Barapoor	Not stated.
Tuktaolee.											

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any crushing of abutments take place?
				Right.	Centre.	Left.	Mean.			
None	Wing walls built.	Immediately	Completed in a few days.	·09′	...	·05′	·07′	No	No	No.
No	As at Barapoor.	Immediately	Completed in a few days.	0·11′	...	0·08′	·095′	No	No	No.

	Construction.										Precautionary preparatory to
Name of Bridge.	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at times centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Bhosan.											
Juggutpoor.											
Runjeetpoor.											
Hoorkapoor.											
Koorsaolee.											
Bana.											
Muswanpoor.											
Kujoore.											
Duboulee.											

*** *These Returns not having been received on going to press, the blanks have been retained, so that copies of the Report*

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			

which fall into the hands of Members of the Irrigation Department, North-Western Provinces, may be filled in hereafter.

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks. Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.	Total Cubic Feet of Masonry.	Keying performed: in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at times centres were struck, and was this earth rammed and watered?
Cawnpore Course.	From one centre.	Yes	Finer in face; otherwise yes.	1·7″	650 cub. ft.	...	...	10,480 $12'' \times 6'' \times 2\frac{7}{8}''$	1,311	In presence of executive engineer and Lieutenant Willoughby. As before.	Not stated.
Chitraolee.											
Bujrungpoor.	Ditto	No	No	...	2,700 cub. ft.	...	...	$12'' \times 6'' \times 3''$ and $12'' \times 6'' \times 2\frac{1}{2}''$	...	Lieut. Brownlow and assist.-overseer. As before.	Up to springing line —well rammed and watered.
Beejeeguri.	Ditto	Yes	Ditto	...	...	...	...	$12'' \times 6'' \times 3''$	...	Ditto	Ditto
Jao.	Ditto	Ditto	Ditto	...	...	...	...	$12'' \times 6'' \times 3''$	...	Ditto	Ditto
Lodeepoor.	Ditto	Ditto	Finer in Faces.	...	...	...	...	$12'' \times 6'' \times 3''$	...	Lieut. Brownlow. Ditto, ditto.	None
Kutye.	Ditto	Yes	Ditto	...	...	...	...	$13'' \times 6'' \times 3''$			
Seetapoor.	Ditto	Ditto	Ditto	...	...	...	...	Ditto	...	As at Jao	None.
Pilkutra.	Ditto	Ditto	Ditto	...	...	...	...	Ditto	...	Lieut. Brownlow. As before.	None.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
No	As at Barapoor	As at Barapoor	As at Barapoor	About ½"				No	No	No.
No	Down stream wing walls to level of spring line; up ditto only 2 or 3 feet from passage-wall. No spandrils built.	Immediately	First cut 6′ wide through centre; then earth removed under haunches.	·06′	·06′	·07′	·063′	In right and centre arches 2 or 3 crow's feet cracks, 2′ long, perpendicular to curve, and 3 or 4 feet from crown of arch.	No	No.
No	Ditto	Ditto	Ditto		Rigid	Rigid	Rigid	No cracks	No	No.
No	Ditto	Ditto	Ditto	·03′	·04′	·06′	·043′	Ditto	No	No.
No	... ...	12 hours	Ditto 12 feet ditto	·03′	·04′	·06′	·043′	Ditto	No	No.
No	... ...	Two arches 12 hours after keying, and one immediately.	As at Lodepoor	...	...	...	2″			
No	... ...	12 hours	Ditto							

Name of Bridge.	Construction.										Precautionary preparatory to
	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at times centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
Nooh.	From one centre.										
Obeyree.	Ditto										
Guhrana.	Ditto	Yes	Finer in faces.	...	...	...	...	9″ × 4½″ × 2″ and 13″ × 6″ × 3″	...	Lieut. Brownlow, east and centre, and mistree west arch, as before.	Natural soil backing the abutments.
Sonaree.	Ditto	Ditto	Yes	·03′ to ·04′	...	...	...	13′ × 6′ × 3′	...	Assistant Overseer, as before	Level with skew-backs. Rammed, but not watered.
Soraon.	Ditto										
Kutana.	Ditto										
Jeyra.	Ditto	Ditto	Ditto	·02′ to ·03′	...	...	...	13″ × 6″ × 3″	...	As at Sonaree.	As at Sonaree
Peyahut.											
Kanakawa.											

MEASURES LOWERING CENTRES.		LOWERING AND REMOVAL OF CENTRES, AND RESULTS.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
No	...	As at Seetapoor	As at Lodeepoor.							
No	Down stream wing walls to 8 feet high. No Spandrils.	Immediately	Earthen centres lowered simultaneously and cleared out in 30 hours.	·05′	·06′	·05′	·053′	No	No	No.
No	As at Sonaree, but only 4 feet high.	Immediately	...	·08′	·03′	·06′	·056′	No	No	No.

	CONSTRUCTION.										PRECAUTIONARY PREPARATORY TO
Name of Bridge.	Voussoirs radiating from one Centre, or from several, corresponding to Centres of Curves of Intrados.	Particular care taken in dressing Bricks generally, or not.	Workmanship equable throughout, or not.	Mean Thickness of Joints.	Quantity of Materials in dry state expended, and Dimensions of Bricks.				Total Cubic Feet of Masonry.	Keying performed; in whose presence? Were key bricks fitted into their places as tightly as possible by ordinary means? Any extraordinary means used? and if so, of what description were they?	How far was earthwork in rear of abutments completed at time centres were struck, and was this earth rammed and watered?
					Lime.	Soorkee.	Sand.	Bricks, Number and Dimensions.			
PILKUTRA.											
BUNAGAON.											
KOOSYAREE.											
FUTTEH KHAN KA NUGLA.											
GIHROR.	One centre	No	Yes	$\frac{1}{4}''$	...	...	...	26,500 $13'' \times 6\frac{1}{2}'' \times 3\frac{1}{4}''$	$4{,}315\frac{1}{2}$	In presence of Executive Engineer and Assistant Overseer, and as before.	Natural soil up to $2\frac{1}{2}$ ft. below springing line.

Measures lowering Centres.		Lowering and Removal of Centres, and Results.								
Any earth or superincumbent weight on haunches of arches when the centres were struck?	State of progress of wing and spandril walls at time of lowering centres?	After what interval of time after keying were centres first lowered?	Detail of lowering Centres.	Ultimate Sinking of each of three Arches.				Did any cracks appear? If so, what were their position and dimensions, and was their direction parallel or perpendicular to curve of arch?	Did any crushing of bricks take place? and was this owing to inferior material or unequal pressure?	Did any yielding of abutments take place?
				Right.	Centre.	Left.	Mean.			
No	Wing walls 4′ high.	12 hours	As at Jao.	·1′	...	·1′	·1′	Very thin hair cracks from face to face at 10th or 12th brick, and only visible at back of arch. One do. do. in centre arch parallel to faces.	No	No.

APPENDIX J.

TABLE exhibiting certain Statistics connected with

1.	2.				3.				4.	5.	6.			
	Distance of the Work from the Myapoor Regulator.				Arches.					Measurement.	Materials Expended.			
											Bricks.			
Name of Work.	Miles.	Furls.	Yds.	Feet.	Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	Width of Roadway between Plinths of Parapets.	Content of Masonry.	12″ × 6″ × 3″	12″ × 6″ × 2½″	12″ × 6″ × 2″	9½″ × 4″ × 3″ Smaller and of various Sizes.
						Feet.	Feet.	Feet.		Cubic Feet.				
Head works at Myapoor, consisting of—														
Dam on the supply branch of the Ganges river	Above regulator ...				...	...	...	...	...					
Revetment connecting the dam with the regulating bridge	Ditto				...	...	...	...	...	520,101	...	3,64,821	5,35,744	2,700
Ghats, bytuks, &c.	Ditto				...	...	...	...	...					
Myapoor inlet	Ditto				1	20	4	1½	23					
„ road bridge ...	Ditto				1	20	4	1½	...					
„ regulating bridge	...	...	...	...	10	20	4	1½	37¾					
„ 1st class choki ...	...	...	73	2	...	...	...	...	...					
Lounda Leni Wala inlet ...	...	4	39	...	...	...	...	...	...	24,694	...	62,050	...	...
Kunkhul inlet and outlet ...	1	2	213	...	...	...	...	...	...	43,675	...	81,790	...	...
„ mills	Not yet commenced.													
„ bridge and ghats ...	1	6	129	...	3	55	12	3	18	1,21,683	...	3,20,877	2,15,829	...
Jowalapoor inlet	3	1	185	...	...	...	...	...	...	48,929	...	1,49,950	...	...
Jowalapoor bridge, "Dalhousie ghats" and navigable canal head.	3	4	194	...	3	55	12	3	18	1,78,961	...	7,34,519	49,873	...
Ranipoor 1st class choki ...	5	...	92	2	...	...	...	...	...	15,917	...	1,46,990	...	...
Ranipoor super-passage and works, viz. :—														
No. 1 fall on main canal superstructure to form super-passage over fall, and No. 1 lock, to pass navigable canal irrigation channel with entrance and exit works.	5	...	216	1	8 1 1	25 19 10	4 4 4	3 3 3	200	16,36,252	...	62,13,753	1,500	...
Bahadoorabad store-room No. 1	...	...	...	...	...	...	...	...	...	3,968	...	3,125	35,300	...
„ mills	Only just commenced.													
„ 1st class choki ...	6	7	63	2	...	...	...	...	...	11,749	...	...	1,19,330	...

. . . . APPENDIX J.

each Work constructed on the Ganges Canal.

6. Materials Expended.							7.	8.	9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.	Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS. A. P.	
3,35,000	...	98,690	...	...	96,991	...	These works are the permanent regulators at the head. A dam over the supply branch is connected by a revetment to the regulating bridge. On the west and up-stream of the regulator a massive revetment connects the Myapoor inlet with the main works; and above the inlet further revetments, with extensive ghats, have been built. Behind these works, and with the road esplanade between them, extensive lines of bytuks have been formed. The choki is of the standard plan, but centre room is only 18 feet square.	90,659 2 7	Lieut. Strachey, Lieut. Yule, Major Goodwyn.
25,020	...	4,655	...	...	4,565	...	This is a combination of ghat and passage of 50 feet for inlet water—a block of masonry having its upper portion stepped for access to the water, with side revetments to confine the drainage as it passes over the steps, the upper step being on a level with the high-water mark.	5,628 2 8	Major Goodwyn.
36,003	...	8,262	...	...	8,070	...	These differ from the Lounda Leni Wala work, in having arched passages; the inlet has a 30-ft. passage, the outlet 20 feet.	8,271 14 9	Lieut. Strachey, Major Goodwyn.
40,936	...	22,898	...	...	27,734	...	Arches are elliptical with niched pilasters. The foundations of this bridge are 8′ to 10′ deep. Ghats for approach of bathers to the water are placed on all the flanks.	25,853 6 3	Lieut. Yule, Major Goodwyn.
39,965	...	9,346	...	...	9,622	...	Same as Lounda Leni Walla, but having a 100-feet passage for drainage water.	8,399 12 11	Major Goodwyn.
79,883	...	33,276	...	...	35,953	...	Bridge same as Kunkhul foundations, being 8′ 6″ deep. Ghats directed to be built by the Marquis of Dalhousie, of 100 feet in length, are placed on all four flanks, and the head of the navigable channel passing by the Ranipoor works and Bahadoorabad Falls, is situated on the up-stream terminus of the left-hand up-stream ghat.	39,242 9 11	Lieut. Yule, Major Goodwyn.
...	...	795	...	...	780	...	Standard plan, the centre room being 20 feet square.	1,895 12 7	Major Goodwyn.
14,67,814	...	3,00,294	...	...	2,98,395	...	These works consist of a super-passage 200 feet in breadth between its parapets, for the passage of the Ranipoor torrent, the canal passing under, through eight arches of 25 feet span each. On the up-stream a fall of 9 feet is projected, to carry the canal to a lower level. On the left of the falls is a locked channel, passing boats under the super-passage. The head of this channel is situated at the Jowalapoor Bridge. On the left of the lock-channel is another channel for the supply of the Bahadoorabad mills. The channels of entrance and exit have their sides revetted with masonry on a considerable length.	3,52,088 2 8	Ditto.
...	...	186	...	...	89	...	Same as the centre room of a first-class choki.	511 13 7	Ditto.
...	...	490	...	...	261	...	Standard plan	1,780 3 7	Ditto.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator. Miles.	Furls.	Yds.	Feet.	3. Arches. Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks. 12" × 6" × 3"	12" × 6" × 2½"	12" × 6" × 2"	9½" × 4" × 3" Smaller and of various Sizes.
						Feet.	Feet.	Feet.		Cubic Feet.				
Bahadoorabad fall No. 2 ...	6	7	163	2	8	25	5·5	2	28	4,24,949	...	9,23,500	7,28,900	...
" lock No. 2 ...	6	7	163	2	...	...	...	...	...	83,396	...	7,11,043	...	...
" store-room No. 2	...	...	...	...	...	...	...	...	...	3,857	...	27,596	...	...
" fall No. 3 ...	7	3	182	1	8	25	5·5	2	18	4,28,291	...	14,31,220	...	...
" lock No. 3 ...	7	3	182	1	...	...	...	...	...	81,065	...	2,89,100	27,000	...
Sulempoor inlet	8	1	163	2	...	...	...	...	...	35,253	...	1,09,413	...	...
Puttri, 1st class choki	9	4	161	...	...	...	...	...	...	14,133	...	1,27,608	...	...
Puttri super-passage and works, viz.:— No. 4 fall on main canal; No. 4 lock on navigable canal; superstructure to form super-passage over fall and lock, with entrance works.	9	5	210	...	9	25	4	3	300	22,43,591	...	94,11,011	...	3,66,144
Badshahpoor inlet	11	6	71	...	...	...	...	...	...	23,763	...	75,974	...	...
Dhunouri, 1st class choki ...	12	6	6	1	...	...	...	...	...	10,190	...	1,01,400	...	...
Rutmoo works, consisting of—														
Roadway bridge	12	6	73	...	...	...	...	...	...	14,96,463	...	1,21,34,613	...	8,13,852
Inlet and outlet dams ...	12	7	23	1	...	...	...	...	...					
Regulating bridge with revetments connected the whole together.	13	...	109	1	...	...	...	...	...					
Peeran Kulleeur bridge ...	14	2	133	2	3	55	7·37	3	18	1,45,214	...	7,56,800	...	2,85,090
Solani aqueducts works, consisting of—														
Mahewur bridge	15	7	150	...	3	55	12	3	18	1,07,54,218	15,080	8,47,64,338	38,87,809	7,64,150
Aqueduct proper	18	...	134	2	15	50	8	5	...					
Roorkee bridge	18	5	169	1	3	55	12	3	18					
Earthen aqueduct with masonry revetted sides connecting the whole of the above works together; above the Mahewur bridge an ogee and cattle ghats with escapes; below the Roorkee bridge there are similar ogee and cattle ghats, with a revetment protecting the right bank on the whole length of the Roorkee curve.														
Roorkee workshops	...	...	...	...	...	...	...	...	...	5,71,329 not complete.	...	31,32,057	...	40,300

6. Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS.	A.	P.	
3,17,225	10,919 jhama	75,310	...	...	71,418	...	This fall is 9′ deep in perpendicular drop, and its waterway is 200 ft. in breadth at the bridge which is thrown over the head of the fall.	72,788	8	11	Major Goodwyn.
...	...	13,954	...	...	16,340	...	Has a drop of 9 ft. The work consists of a lock channel and a waste one, with all the usual appurtenances of works of this kind.	15,807	3	2	Ditto.
...	...	147	...	...	92	...	Same as No. 1	665	4	5	Ditto.
3,26,088	7,910 jhama	75,993	...	...	77,670	...	Same as No. 2 fall, but having its jetty walls curved to suit a change in the direction of the canal alignement.	67,613	10	3	Ditto.
17,380	...	15,302	...	...	14,391	...	Same as No. 2	14,701	5	2	Ditto.
40,459	...	6,836	...	...	7,148	...	Same as the Lounda Leni Wala, but having a passage for inlet drainage of 150 feet.	9,193	2	2	Ditto.
...	...	704	...	...	577	...	Standard plan, the foundations being built on a series of arches.	1,759	2	2	Ditto.
14,04,262	23,248 jhama.	2,85,757	...	...	4,08,945	80,479	Same as the Ranipoor works, but the superpassage has a waterway of 300 feet in width. At the tail end of this work, the navigable channel re-enters the main canal, all the falls having been passed.	4,37,321	12	1	Ditto.
26,707	...	3,928	...	...	3,967	2,686	Similar to the Lounda Leni Wala, but in consequence of the nature of the soil, having its foundations sunk by means of wells.	8,283	13	8	Ditto.
...	...	374	...	...	370	...	Standard plan	1,421	12	4	Ditto.
1,26,125	26,964 jhama.	2,08,981	...	...	3,97,906	6,058	On the approach to the site of these works there is a sudden curve in the canal alignement to bring it on a direct bearing with the Solani aqueduct works. This curve is revetted on either side with masonry until it meets the straight alignement, at which point a bridge for communication spans the canal. From this bridge further revetments line both sides of the canal, until a junction is formed with the inlet on the right and outlet on the left, both of which works have clear waterways of 800 feet for the passage of the torrent. Below and from these works additional revetments meet a regulating bridge, the down-stream of which is finished off with ghats for the accommodation of bathers.	5,22,231	2	1	Ditto.
...	...	17,242	...	...	34,892	...	This bridge differs from the foregoing ones in having its arches segmental instead of elliptical, and in the height of roadway being 36½ feet from the flooring of the bays instead of 24′. Passages for the towing-path are pierced in the abutments, their flanks being rusticated works to the mean height as the piers with which they correspond.	35,307	14	0	Ditto.
21,937	5,87,005 jhama and kunkur.	17,65,889	...	...	24,12,802	...	The commencement of these works are escapes on the right and left of the canal which, if required, can be used as safety valves; these escapes are followed by cattle ghats for the approach of cattle to the canal water. From these ghats the revetments of the earthen aqueduct commence; they meet the Mahewur Bridge in Ogee curves, and leave it similarly; they are then carried in a direct line till their approach to the aqueduct proper; the canal passes through the aqueduct proper in two chambers, and the torrent passes under the canal in fifteen arches of 50 feet span each. Below the aqueduct proper, and above and below the Roorkee Bridge, the revetments and works correspond in all respects with those on the Mahewur side, except that there are no escapes. The right bank of the canal below the aqueduct terminus is revetted on the whole length of the curve which the canal takes at this point.	32,86,812	10	9	Lieut. Strachey, Lieut. Yule, and Major Goodwyn.
...	24,597 jhama.	40,136	...	...	44,218	...	These buildings contain separate accommodation for smiths, carpenters, &c., and the commencement of a foundry with numerous store-rooms, engine-rooms, &c.	85,745	0	2	Lieut. Turnbull, Lieut. Yule, and Major Goodwyn.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator. Miles.	Furls.	Yds.	Feet.	3. Arches. Number of.	Span of. Feet.	Height of Versed Sine. Feet.	Thickness at Crown. Feet.	4. Width of Roadway between Plinths of Parapets.	5 Measurement. Content of Masonry. Cubic Feet.	6. Materials Expended. Bricks. 12″ × 6″ × 3″	12″ × 6″ × 2½″	12″ × 6″ × 2″	9½″ × 4″ × 3″ Smaller and of various Sizes.
Director's office	...	...	...	...	...	...	...	...	...	11,223	...	1,06,877	...	...
Government accommodation bungalow.	...	...	...	...	...	...	...	...	...	22,059·47	...	1,57,977	...	...
Hospital	...	...	...	...	...	...	...	...	...	...		Principally kutcha		
Mr. Parker's bungalow ...	...	...	...	...	...	...	...	...	...	...	...	20,000	...	...
Burial ground	...	...	...	...	...	...	...	...	...	5,645	...	48,480	...	...
Guneshpoor bridge	20	...	24	2	3	55	12	3	18	78,327 (not complete.)	...	1,12,600	...	3,44,800
Assofnuggur, 1st class choki ...	22	4	216	2	...	...	...	...	...	12,088	...	...	1,24,004	...
„ navigable channel head works and right rajbuhas head.	...	...	...	...	...	...	...	...	...	68,975	...	73,050	...	5,89,000
Assofnuggur falls	22	5	196	2	8	25	5·5	2	18	421,913	...	34,67,766	...	1,50,000
Assofnuggur locks, mills, and left rajbuha head.	22	5	196	2	3*	...	...	...	15	54,846 (not complete.)	...	4,30,967	...	...
Munglour 2nd class choki ...	24	5	194	...	...	...	...	...	...	4,577		34,327		
Munglour bridge and ghats, on both up and down stream.	24	6	94	2	3	55	12	3	18	1,26,096		9,45,720		
Liburheri 2nd class choki ...	26	1	80	...	...	...	...	...	...	2,576	19,320	...	...	...
„ bridge and ghats ...	26	1	189	1	3	55	12	3	18	1,39,954		10,49,655		
Mundowli bridge	28	5	124	...	3	55	not yet complete		21	59,542		4,46,565		
Mymoodpoor navigable channel head and right rajbuha head.	30	3	100	...	...	...	...	...	...	56,997		4,27,477		
Mymoodpoor 1st class choki ...	30	7	184	2	...	...	...	...	...	14,316		1,07,370		
„ locks, mills, and left rajbuha head.	31	...	97	1	3*	...	...	...	15	1,27,044		9,52,830		
Mymoodpoor falls	31	...	144	2	8	25	5·5	2	18	4,51,597		33,86,977		
Dimat bridge with ghats ...	33	5	93	1	3	55	12	3	18	1,35,719		10,17,892		
Toghulpoor 2nd class choki ...	38	...	57	...	...	...	...	...	...	2,488		13,215		
„ bridge	38	...	149	1	3	55	12	3	18	1,12,690	8,45,175	...	...	...
Bailra navigable channel head and right rajbuha.	41	6	138	2	1	10	5	2	...	57,164	4,28,730	...	...	...

* 2 of 10′ and 1 of 15′.

. . . . . 6. . . . . Materials Expended.							7.	8.	9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.	Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		Rs. A. P.	
...	...	2,133	...	...	1,827	...	A centre room 36′ × 20′ with a 10 feet veranda all round, the north and south ends being formed into rooms.	5,307 14 5	Major Goodwyn.
...	568 jhama.	1,356	...	...	550	...	Two rooms 20′ square each, surrounded by a veranda, the north and south ends of which are enclosed as sleeping rooms and baths; roof thatched.	3,441 7 10	Ditto.
...	...	...	...	...	...	...	A plain room with a veranda round it, and a thatched roof.	1,286 1 7	Lieut. Strachey.
...	...	120	...	...	120	...	... ...	1,008 10 6	Major Goodwyn.
...	...	582	...	...	692	...	Merely a plain wall	735 5 11	Ditto.
21,391	15,520 jhama.	10,489	...	...	21,744	1,884	Same as Kunkhul, but with a different form of ghat.	17,738 8 6	Major Goodwyn and Lt. Fraser.
...	...	663	...	...	884	...	Standard plan	2,351 10 4	Major Goodwyn.
...	13,625 jhama.	13,223	...	...	20,140	...	These consist of a block of masonry built into the bank of the canal at the point of departure of the channel, one side forming the left revetment on the main canal, the other the right of the navigable one; opposite these revetments are others lining the sides of the two canals, and the Rajbuha Head is in connection with the up-stream terminus of the main canal right revetment.	17,523 14 2	Major Goodwyn and Lt. Fraser.
8,236	6,250 jhama.	65,860	...	...	85,135	...	Similar to the No. 2 Bahadoorabad Falls, except in foundations, which are greatly increased to meet the altered soil that is here met with.	91,419 0 6	Major Goodwyn.
2,150	2,900 jhama.	6,800	...	...	10,362	504	Similar to those at Bahadoorabad, but has a mill-house and a rajbuha head appended.	Not complete	Major Goodwyn and Lt. Fraser.
...	...	763	...	...	1,525	...	A one-roomed house, 20′ × 20′, with a door to the front and rear, all pukka.	751 9 11	Mr. F. Read.
...	...	21,016	...	...	42,032	...	Foundations 12′ to 13′ 3″ below canal bed. Ghats of 25 feet length on each flank, the whole being protected by piling and box work. Towing-path rests on wooden frame-work.	24,131 3 0	Lieuts. Turnbull and Fraser, of the Engineers, and Mr. F. Read.
...	...	429	...	...	858	...	One room 18′ × 14′, kutcha-pukka	304 10 10	Lieut. Turnbull.
...	...	23,326	...	...	46,651	...	Foundations 11·67′ below Canal-bed; 25 feet ghats on down stream. Protected as at Munglour.	23,577 4 8½	Lieut. Fraser and Mr. F. Read.
...	...	9,924	...	...	19,847	...	Will be the same as the Munglour Bridge, but without ghats. Foundations 15 feet below canal bed.	12,897 11 11	Mr. Read.
...	...	9,500	...	...	19,098	...	Similar, and for the same objects, as the same kind of works at Assofnuggur.	10,996 15 1	Mr. Read.
...	...	2,386	...	...	4,772	...	Same as at Assofnuggur ...	2,422 14 6	Mr. Read.
...	...	21,174	...	...	42,348	...	Ditto	23,960 14 9	Mr. F. Read.
...	...	75,266	...	...	150,532	...	Ditto	80,496 5 8½	Lieut. E. Fraser, Mr. Read.
...	...	22,620	...	...	45,239	...	Same as at Liburheri. Foundations 15 feet deep.	25,715 7 10	Ditto.
...	...	294	...	...	587	...	Same as at Liburheri	276 11 2	Mr. F. Read.
...	...	18,782	...	...	37,563	...	Same as Munglour Bridge, but without ghats. Foundations from 10′ 3″ to 16′ deep.	22,710 8 5	Lieut. Turnbull, Lieut. Fraser, Mr. Read.
...	...	...	...	19,054	9,528	...	Same as at Mymoodpoor ...	10,601 13 10	Mr. F. Read.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator. Miles.	Furls.	Yds.	Feet.	3. Arches. Number of.	Span of. Feet.	Height of Versed Sine. Feet.	Thickness at Crown. Feet.	4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry. Cubic Feet.	6. Materials Expended. Bricks. 12 × 6 × 3	12 × 6 × 2½	12 × 6 × 2	9½ × 4 × 3 Smaller and of various Sizes.
Bailra 2nd class choki	42	3	80	1	...	...	...	...	...	3,068	23,010	...	...	...
Bailra locks, mills, and left rajbuha head.	42	3	138	...	3*	...	...	...	15	1,26,675	9,50,062	...	...	...
Bailra falls	42	3	185	1	8	25	5·5	2	18	3,96,370	...	29,72,775		
„ 1st class choki	44	...	153	...	...	...	...	...	...	10,225	76,687	...	...	...
„ bridge	44	1	41	1	3	55	12	3	18	112,931	8,46,982	...	...	...
Bhopah 2nd class choki ...	46	3	177	2	...	...	...	...	...	2,404	18,030	...	...	...
„ bridge	46	4	44	...	3	55	12	3	18	1,09,543	8,21,572	...	...	...
Jowli navigable channel head and right rajbuha.	47	4	204	...	1	10	5	2	...	45,575	3,41,812	...	...	...
Jowli falls	48	2	11	2	8	25	5·5	2	18	3,67,130	27,53,475	...	...	...
Jowli locks, mills, and left rajbuha head.	48	2	26	...	3*	...	...	...	15	1,31,506	9,86,295	...	...	...
Futtehgurh branch head regulating bridge.	50	2	205	2	4	20	6	1·05	18					
Ghats and platforms connecting above with.	50	3	48	...	...	...	...	...	...	1,36,046	10,20,345	...	...	...
Jowli main canal regulating bridge.	50	3	81	...	4	20	6	1·05	18					
Jowli 1st class choki	50	4	22	...	...	...	...	...	...	13,998	...	1,04,985	...	...
Dukheri 2nd class choki ...	53	2	102	2	...	...	...	...	...	2,928	...	21,960	...	...
„ bridge	53	3	16	...	3	55	10	2¾	18	91,199		6,83,992		
Jansut 2nd class choki	54	4	195	...	...	...	...	...	...	2,928	21,960	...	...	...
„ bridge and ghats ...	54	5	108	2	3	55	10	2¾	20	1,46,655		10,99,912		
Chitowra navigable channel head and right rajbuha head.	55	1	182	1	1	10	5	2	...	56,161		4,21,207		
Chitowra 1st class choki ...	55	6	134	2	...	...	...	...	...	15,547		1,16,602		
Chitowra locks, mills, and left rajbuha head.	55	6	182	...	3*	...	...	...	15	1,41,537		10,61,527		
Chitowra falls	55	7	9	1	8	25	5·5	2	18	3,16,995		23,77,472		
Serai 2nd class choki	58	4	177	2	...	...	...	...	...	2,928		21,960		
„ bridge	58	5	90	...	3	55	10	2·75	18	89,602		6,72,015		
Khutowli bridge and ghats ...	62	1	67	1	3	55	12	3	24	1,59,540		11,96,550		
„ escape	62	2	42	...	10	6	1·5	1·5	8½	57,849		4,33,867		
Sutheri 2nd class choki... ...	64	3	143	...	...	...	...	...	...	2,928		21,960		
„ bridge	64	4	61	2	3	55	10	2·75	18	1,23,114		9,23,355		
Sullawur navigable channel head and right rajbuha head.	66	5	141	2	1	10	5	2	...	45,658		3,42,434		
Sullawur 1st class choki ...	67	2	101	2	...	...	...	...	...	12,602		94,516		

* 2 of 10′, 1 of 15′.

6. Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS.	A.	P.	
...	...	...	...	1,023	511	...	Same as Liburheri	275	14	2	Lieut. Turnbull.
...	...	...	...	42,225	21,112	...	Same as Mymoodpoor	18,109	14	10	Mr. F. Read.
...	...	...	...	1,32,123	66,062	...	Same as at Mymoodpoor, except that tail jetties are curved outwards instead of inwards.	77,523	3	9	Lieut. Fraser, Mr. Read.
...	...	...	...	3,408	1,704	...	Standard plan	1,184	9	11	Lieut. Turnbull, Lieut. Fraser.
...	...	...	...	37,643	18,822	...	Same as Toghulpoor. Foundations 15½′ deep.	21,662	11	3	Lieut. Turnbull, Lieut. Fraser, Mr. Read.
...	...	...	...	802	401	...	Same as Liburheri	235	10	6	Lieut. Turnbull, Lieut. Fraser.
...	...	...	...	36,514	18,257	...	Same as Toghulpoor. Foundations 15′ deep.	21,760	12	3	Lieut. Fraser, Mr. Read.
...	...	...	...	15,191	7,695	...	Same as Mymoodpoor	8,964	3	3	Mr. F. Read.
...	...	...	...	1,22,377	61,188	...	Ditto	61,368	11	10½	Lieut. Fraser, Mr. Read.
...	...	...	...	43,835	21,918	...	Ditto	21,927	1	8	Mr. Read.
...	...	...	...	45,349	22,674	...	These works are situated at the point of departure of the Futtehgurh Branch Canal ...	29,770	14	3	Lieut. Fraser, Mr. Read.
...	...	...	...	4,666	2,333	...	Standard plan	1,328	13	1	Ditto.
...	...	...	...	976	488	...	Same as Liburheri	254	12	9	Ditto.
...	...	...	...	30,398	15,199	...	This bridge has a segmental arch with a versed sine of 10′. Its spandrils are perforated to secure lightness. Foundations 10·25′ deep.	16,366	8	7	Ditto.
...	...	...	...	976	488	...	Same as at Liburheri	264	13	5	Ditto.
...	...	...	...	48,885	24,442	...	Same as at Dukheri, but with ghats on down stream. Foundations 10′ deep.	25,843	12	3	Ditto.
...	...	...	...	18,720	9,360	...	Same as at Mymoodpoor ...	10,827	0	2	Mr. F. Read.
...	...	...	...	5,182	2,591	...	Ditto	2,749	15	4	Ditto.
...	...	...	...	47,178	23,589	...	Ditto	18,153	11	8	Ditto.
...	...	...	...	1,05,664	52,832	...	Ditto	55,132	13	5	Lieut. Fraser, Mr. Read.
...	...	...	...	976	488	...	Same as at Liburheri	276	12	6	Ditto.
...	...	...	...	29,868	14,933	...	Same as at Dukheri. Foundations, 10′ d[illegible].	16,527	2	0	Ditto.
...	...	...	...	53,180	26,590	...	Similar to M[illegible]lour bridge, except that it has longer ghats, and passages through the abutments for the towing-path. Foundations, 12′.	27,529	6	10	Ditto.
...	...	...	...	19,283	9,641	...	Situated on the right bank of the canal, and forms the head of an escape channel which empties itself into the river Hindun.	11,778	2	9	Ditto.
...	...	...	...	976	488	...	Same as at Liburheri	241	5	8	Ditto.
...	...	...	...	41,038	20,519	...	Same as at Dukheri. Foundations, 11·25′.	20,889	7	0	Ditto.
...	...	...	...	15,219	6,246	...	Same as Mymoodpoor	9,349	9	1	Mr. F. Read.
...	...	...	...	4,201	2,100	...	Standard plan	1,189	14	8	Lieut. Fraser, Mr. Read.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches.				4.	5. Measurement.	6. Materials Expended. Bricks.
					Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	Width of Roadway between Plinths of Parapets.	Content of Masonry.	" " " 12 × 6 × 3 / " " " 12 × 6 × 2½ / " " " 12 × 6 × 2 / 9½" × 4" × 3" Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.	
Sullawur locks, mills, and rajbuha head (left).	67	2	144	1	3*	...	...	...	15	1,16,233	8,71,747
Sullawur falls	67	2	191	2	6	25	5·5	2	18	3,25,368	24,40,260
Aboos Nulla escape	69	6	213	1	10	6	1·5	1·5	8½	56,752	4,25,640
Aternah 2nd class choki ...	71	2	93	...	...	...	...	...	...	2,761	20,707
„ bridge	71	3	6	2	3	55	10	2·75	18	74,142	5,56,065
Sirdhanna bridge and ghats ...	74	5	46	...	3	55	12	3	25	1,65,018	12,37,635
„ 1st class choki ...	74	6	199	1	...	...	...	...	...	12,602	94,515
Nanoo 2nd class choki	77	4	93	1	...	...	...	...	...	2,928	21,960
„ bridge	77	4	192	2	3	50	7	2¼	25	1,23,243	9,24,322
Jutpoora 2nd class choki ...	79	7	73	...	...	...	...	...	...	2,928	21,960
„ bridge	79	7	168	...	3	50	7	2¼	18	73,300	5,49,750
Pooth, 2nd class choki	82	2	161	1	...	...	...	...	...	3,394	25,455
„ bridge	82	3	38	...	3	50	7	2¼	20	85,418	6,40,635
Bhola navigable channel head and right Rajbuha head.	83	4	206	1	1	10	5	2	...	63,822	4,78,664
Bhola 1st class choki	84	1	183	2	...	...	...	...	...	12,602	94,515
Bhola locks, mills, and left Rajbuha head.	84	2	6	1	3*	...	...	...	15	1,47,444	11,05,830
Bhola falls	84	2	53	2	6	25	5·5	2	18	3,31,105	24,83,287
Janni escape	87	...	134	...	10	6	1·5	1·5	8½	69,468	5,21,010
„ 2nd class choki	87	...	153	2	...	...	...	...	...	3,033	22,747
„ bridge	87	2	71	...	3	50	7	2¼	20	78,061	5,85,457
Nugla, 2nd class choki	89	5	55	...	...	...	...	...	...	3,313	24,847
„ bridge	89	5	151	...	3	50	7	2¼	20	77,016	5,77,620
Newarri, 1st class choki ...	93	2	65	1	...	...	...	...	...	14,112	1,05,840
„ bridge	93	2	217	...	3	50	7	2¼	18	71,088	5,33,160
Soundha, 2nd class choki ...	96	1	41	1	...	...	...	...	...	3,200	24,000
„ bridge	96	1	151	1	3	50	7	2¼	18	71,215	5,34,112
Aboopoor, 2nd class choki ...	98	3	35	2	...	...	...	...	...	3,128	23,460
„ bridge	98	3	140	1	3	50	7	2¼	18	71,043	5,32,822
Moradnuggur, 2nd class choki	100	1	104	...	...	...	...	...	...	3,128	23,460
„ bridge and ghats	100	1	208	1	3	50	7	2¼	25	1,44,034	10,80,255
Noorpoor, 2nd class choki ...	102	7	203	1	...	...	...	...	...	3,173	23,797
„ Bridge	103	...	79	1	3	50	7	2¼	18	62,777	470,827
Dasnah Navigable Channel Head and Right Rajbuha Head.	104	7	125	...	1	10	5	2	...	45,382	340,364
Dasnah 1st class choki	105	4	105	...	...	...	...	...	...	12,602	94,515
Dasnah locks, mills, and left rajbuha head	105	4	114	2	3*	...	...	...	15	113,566	851,745
Dasnah falls	105	4	162	...	6	25	5·5	2	18	304,886	2,286,645

* 2 of 10′, 1 of 15′.

6. . . . . . Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS.	A.	P.	
...	...	...	...	38,744	19,372	...	Same as at Mymoodpoor... ...	13,443	6	2	Mr. F. Read.
...	...	...	...	1,08,456	54,228	...	Ditto, but water way contracted to 150′.	57,885	0	9	Lieut. Fraser, Mr. Read.
...	...	...	...	18,918	9,459	...	Similar to that at Kutowli, but without covered way.	10,487	11	7	Mr. F. Read.
...	...	...	...	920	460	...	Same as at Liburheri	281	7	11	Ditto.
...	...	...	...	24,714	12,357	...	Same as Dukheri. Foundations, 7½′.	16,711	13	1	Ditto.
...	...	...	...	55,006	27,503	...	Similar to Khutowli bridge. Foundations, 6¾′.	31,571	12	0	Lieut. Fraser, Mr. Read.
...	...	...	...	4,200	2,100	...	Standard plan	1,176	1	10	Ditto.
...	...	...	...	976	488	...	Ditto	274	6	6	Ditto.
...	...	...	...	41,080	20,540	...	Here the width of bridges is reduced to 150′ in three bays of 50′ each. The arch is a segment, with 7′ versed sine. The spandrils have a circular hole perforated through them. Ghats are provided on each flank. Foundations, 9′.	20,229	14	5	Ditto.
...	...	...	...	976	488	...	Standard plan	275	2	11	Ditto.
...	...	...	...	24,436	12,213	...	Same as at Nanoon, but without ghats. Foundations 13 feet.	11,954	6	8	Ditto.
...	...	...	...	1,132	566	...	Standard plan	322	0	7	Mr. F. Read.
...	...	...	...	28,473	14,236	...	Same as Jutpoorah. Foundations 15·75′.	14,926	5	5	Ditto.
...	...	...	...	21,273	9,264	...	Same as at Mymoodpoor, except that this head has a ghat 146 ft. long attached to it.	11,956	6	4	Ditto.
...	...	...	...	4,201	2,100	...	Standard plan	1,266	12	2	Lieut. Fraser and Mr. Read.
...	...	...	...	49,148	24,574	...	Same as at Sullawur	24,174	13	2	Mr. F. Read.
...	...	...	...	110,368	55,184	...	Ditto	65,520	6	8¾	Lieut. Fraser and Mr. Read.
...	...	...	...	23,156	11,578	...	Same as the Aboos Nulla ...	13,204	3	7	Mr. Read.
...	...	...	...	1,011	505	...	Standard plan	512	13	1	Ditto.
...	...	...	...	26,020	13,010	...	Same as Jutpoora. Foundations 11·25 feet.	14,231	3	7	Ditto.
...	...	...	1,656	...	...	...	Standard plan	513	1	4	Ditto.
...	...	...	38,508	...	...	...	Same as Jutpoora. Foundations 10·75 feet.	14,434	7	5	Ditto.
...	...	...	7,056	...	...	...	Standard plan	1,417	2	8	Ditto.
...	...	...	35,544	...	...	...	Same as Jutpoora. Foundations 10·75 feet.	14,528	10	6	Ditto.
...	...	...	1,600	...	...	...	Standard plan	371	14	1	Ditto.
...	...	...	35,607	...	...	...	Same as Jutpoora. Foundations 10 feet.	12,297	4	11	Ditto.
...	...	...	1,564	...	...	...	Standard plan	359	2	11	Ditto.
...	...	...	35,521	...	...	...	Same as Jutpoora. Foundations 11 feet.	12,749	6	1	Ditto.
...	...	...	1,564	...	...	...	Standard plan	376	4	8	Ditto.
...	...	...	72,017	...	...	...	Same as Jutpoora, but with ghats 160 feet long and similar to the Sirdhanna ones. Foundations 10 feet.	22,571	3	7	Ditto.
...	...	...	1,586	...	...	...	Standard plan	501	1	10	Ditto.
...	...	...	31,388	...	...	...	Same as at Jutpoora. Foundations 11 feet.	13,604	11	4	Mr. F. Read.
...	...	...	22,690	...	...	...	Same as Sullawar	9,355	11	6	Ditto.
...	...	...	6,301	...	...	...	Standard plan	1,544	10	3	Ditto.
...	...	...	56,783	...	...	...	Same as Sullawar	14,190	11	2	Ditto.
...	...	...	152,443	...	...	...	Ditto	54,639	12	8	Ditto.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches. Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks. 12 × 6 × 3	12 × 6 × 2½	12 × 6 × 2	9½ × 4 × 3 Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.				
Pepulheera bridge and ghats ...	106	6	84	2	3	45	6	2½	20	129,472	971,040			
Raoli bridge	108	5	84	...	3	45	6	2½	18	84,506	633,795			
Bolundshuhur branch headworks:														
Branch regulating bridge ...	110	2	96	...	3*	...	6	1½	18	102,817	282,204	...	...	...
Main canal „ ...	110	2	193	1	8	20	6	1½	18					
Duhera, 1st class choki ...	110	3	...	...	...	...	...	...	...	12,518	1,00,000	...	...	...
Nidhaoli bridge	113	6	...	...	3	45	6	2½	18	75,093	1,91,110	...	...	...
Nidhaoli, 2nd class choki ...	113	5	186	2	...	...	...	...	...	2,659	23,800	...	...	...
Jarcha, 2nd class choki ...	116	4	163	1	...	...	...	...	...	2,659	22,800	...	...	...
„ bridge	116	5	6	...	3	45	6	2½	18	72,137	2,50,111	...	...	...
Geesoopoor, 1st class choki ...	119	5	96	2	...	...	...	...	...	14,222½	1,05,460	...	...	...
Geesoopoor bridge	119	6	110	...	3	45	6	2½	18	74,390	2,19,122	...	...	...
Sunowta, 2nd class choki ...	122	4	153	1	...	...	...	...	...	2,737	22,800	...	...	...
„ bridge	122	5	44	1	3	45	6	2½	18	79,894	1,99,620	...	...	...
Pukkana, 2nd class choki ...	125	4	153	1	...	...	...	...	...	2,503	22,800	...	...	...
„ bridge	125	5	35	1	3	45	6	2½	18	78,211	1,23,900	...	...	...
Dumkoura 1st class choki ...	128	4	120	...	...	...	...	...	...	9,502	80,000	...	...	...
„ bridge	128	4	150	...	3	45	6	2½	18	64,018	1,41,350	...	...	...
Urrowli 2nd class choki ...	131	1	113	1	...	...	...	...	...	2,893	27,800	...	...	...
„ bridge	131	2	14	...	3	45	6	2½	25	1,03,226	1,99,722	...	...	...
Wullipoora bridge	133	6	108	1	3	45	6	2½	25	1,40,066	2,10,977	...	...	...
Wullipoora 2nd class choki ...	133	6	208	1	...	...	...	...	...	2,737	24,800	...	...	...
Mamun 2nd class choki ...	137	...	100	...	...	...	...	...	...	2,560	21,800	...	...	...
„ bridge	137	...	213	1	3	45	6	2½	18	78,375	1,45,414	...	...	...
Uchuhja bridge	139	5	189	1	3	45	6	2½	18	68,253	1,39,614	...	...	...
Uchuhja 2nd class choki ...	139	6	86	...	...	...	...	...	...	2,893	24,450	...	...	...
Moonda Khera 1st class choki...	140	...	83	1	...	...	...	...	...	13,881½	1,00,000	...	...	...
Moonda Khera escape ... ... connected by ghats with	140	...	...	...	10	6	1½	1	...	1,78,691	2,28,184	...	...	...
Moonda Khera bridge	140	...	116	2	3	4·5	6	2½	18					
Suhinda bridge	144	5	6	...	3	45	6	2½	18	80,147	1,13,968	...	...	...
Suhinda 2nd class choki ...	144	5	106	1	...	...	...	...	...	2,560	21,800	...	...	...
Pulra navigable channel, head, and right rajbuha.	148	...	133	...	...	...	...	...	...	30,653	36,477	...	...	...

* 2 of 15′, 1 of 20′.

6. Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS.	A.	P.	
...	...	...	64,736	...	...	...	The waterways of bridges are here reduced to 135′, and the design is altered by rusticated pilasters being dispensed with, and the spandrils being intact. Foundations 16·09.	19,046	12	6	Mr. F. Read.
...	...	...	42,253	...	...	...	Same as Peepulheera Bridge. Foundations 17·12.	15,372	2	6	Ditto.
...	1,10,132	191	28,621	...	...	...	These works are situated at the point of departure of the Bolundshuhur Branch, and are connected together by revetments, ghats, and platform. Foundations from 5 to 15 ft. deep.	18,757	10	4	Mr. P. Volk.
...	...	36	673	...	...	...	Standard plan. 7′ foundations ...	1,140	2	5	Ditto.
...	48,668	141	18,250	...	...	...	Same as Raoli, but with 100 feet ghats on up-stream, with rajbuha and inlet heads attached. Foundations 5½′ to 6¾′ deep.	9,871	14	11	Ditto.
...	...	7½	229	...	...	...	Standard plan. 6′ foundations ...	271	10	4	Ditto.
...	...	7½	158	...	...	...	Ditto ditto ...	233	3	5	Ditto.
...	34,590	130	14,553½	...	...	...	Like Nidhaoli. Foundations varying from 5¼ to 7 feet.	9,070	4	9	Ditto.
...	...	37	6,197	...	24	...	Standard plan—pukka throughout. Foundations 9½′.	1,713	4	11	Ditto.
...	46,128	135	16,576	...	...	...	Like Nidhaoli. Foundations from 5½ to 6¼ feet.	9,827	10	11	Ditto.
...	...	4	137	...	...	...	Standard plan. Foundations 6½′	251	3	10	Ditto.
...	25,593	87	11,329	...	...	...	Like Nidhaoli. Foundations from 8′ to 9′.	10,975	5	10	Ditto.
...	...	cont	ract.	...	...	...	Standard plan. Foundations 5′...	225	11	0	Ditto.
...	72,875	130	17,043	...	...	...	Like Nidhaoli. Foundations 5½ to 6 feet deep.	11,035	6	1	Ditto.
...	...	25	402½	...	...	...	Standard plan. 2½′ foundations	958	15	11	Ditto.
...	50,700	95	14,974½	...	...	...	Similar to Nidhaoli, but having no rajbuha or inlet heads, and the ghats are placed on down stream instead of up. Foundations 5¾′ to 6¼′.	8,604	7	2	Ditto.
...	...	7	230	...	...	...	Standard plan. 7½′ foundations	267	11	3	Ditto.
...	69,755	104	24,512	...	...	...	Differs from the Nidhaoli bridge only in shape of approach to ghat, and in the details of finish. Foundations 5¼′ to 8′.	13,967	6	0	Ditto.
...	1,03,447	168	34,353½	...	...	...	Like the Nidhaoli bridge, but has ghats 350′ long. Foundations 8′ to 8½′.	17,191	9	9	Ditto.
...	...	6¼	241	...	...	...	Standard plan. 6½′ foundations	254	4	0	Ditto.
...	...	2	58	...	...	...	Ditto. 5½′ foundations	229	6	8	Ditto.
...	70,300	77	19,101	...	...	...	Like the Nidhaoli bridge. Foundations 6′ to 6′ 2″.	10,383	3	3	Ditto.
...	56,600	56½	15,308	...	...	...	Same as Dumkoura bridge. Foundations 7′ 6″ to 8′ 6″.	9,017	2	7	Ditto.
...	...	4	146	...	...	...	Standard plan. 7½′ foundations	255	11	2	Ditto.
...	...	30	2,640	...	...	...	Ditto. 6′ foundations, pukka throughout.	...			Ditto.
...	1,28,206	420½	53,058	...	...	...	Escape and bridge, which is similar to Nidhaoli bridge, are connected together by a ghat 380′ long. Foundations 9′ 7″ to 10′ 1″.	22,976	2	4	Ditto.
...	67,300	134	19,268	...	...	...	Like Nidhaoli. Foundations 6′ 6″ to 6′ 8″.	10,182	7	10	Ditto.
...	...	5	150	...	...	...	Standard plan. 5½′ foundations	248	3	4	Ditto.
...	22,978	22	8,099	...	...	...	Same as at Mymoodpoor... ...	...			Ditto.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches.				4. Width of Roadway between Plinths of Parapets.	5. Measurement.	6. Materials Expended.			
											Bricks.			
					Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.		Content of Masonry.	" " " 12 × 6 × 3	" " " 12 × 6 × 2½	" " " 12 × 6 × 2	" " " 9¼ × 4 × 3 Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.				
Pulra 2nd class choki	148	4	212	2	...	...	...	...	...	2,513	14,312	...	...	...
„ falls	148	5	160	...	5	20	6	1½	18	1,74,375	2,21,141	...	...	...
„ locks, mills, and left rajbuha head.	148	5	160	...	...	...	...	...	...	69,827	83,094	...	...	...
Koel branch headworks :—														
Branch regulating bridge ...	151	7	123	...	3*	...	6	1½	18	87,149	1,52,445	...	...	...
Main canal ditto ...	151	7	145	...	6	20	6	1½	18					
Koel branch head 1st class choki	151	7	213	...	...	...	...	...	...	12,859·5	64,114	...	...	...
Daopoor 2nd class choki ...	155	3	114	...	...	...	...	...	...	2,671	14,312	...	...	...
„ bridge	155	4	11	...	3	40	5·4	2½	18	71,399	158,594	...	...	...
Birowli 2nd class choki ...	158	...	166	2	...	...	...	...	...	2,513	14,225	...	...	...
„ bridge	158	1	62	...	3	40	5·4	2½	18	70,702	1,56,201	...	...	...
Dubtulla 2nd class choki ...	161	1	46	2	...	...	...	...	...	2,513	13,751	...	...	...
„ bridge	161	1	152	...	3	40	5·4	2½	18	71,527	1,41,280	...	...	...
Simra navigable channel head and right rajbuha.	162	6	25	...	...	...	...	...	...	30,653	45,979	...	...	...
Simra 2nd class choki	163	2	82	...	...	...	...	...	...	2,394·5	14,432	...	...	...
„ falls	163	3	61	...	5	20	6	1½	22	1,86,063	2,76,304	...	...	...
„ locks, mills, and left rajbuha head.	163	3	61	...	...	...	...	...	...	74,790	1,12,185	...	...	...
Kasimpoor 1st class choki ...	166	3	100	...	...	...	...	...	...	14,392·5	22,163	...	...	...
„ escape, connected by ghats with	166	3	31	2	10	6	1½	1	...	1,65,707	2,67,957	...	...	...
Kasimpoor bridge	166	3	160	...	3	40	5·4	2½	18					
Burotha 2nd class choki ...	170	...	46	2	...	...	...	...	...	2,829	11,000	...	...	...
„ bridge	170	...	163	1	3	40	5·4	2½	22	76,564	1,52,749	...	...	...
Machooa 2nd class choki ...	172	7	186	...	...	...	...	...	...	2,829	13,632	...	...	...
„ bridge	173	...	83	...	3	40	5·4	2½	18	69,098	1,42,868	...	...	...
Chungeyri 2nd class choki ...	175	3	58	...	...	...	...	...	...	3,145	14,000	...	...	...
„ bridge	175	3	171	2	3	40	5·4	2½	18	59,809	1,31,500	...	...	...
Sheka 2nd class choki	177	6	95	...	...	...	...	...	...	2,987	16,000	...	...	...
„ bridge	177	6	212	...	3	40	5·4	2½	22	78,118	1,53,500	...	...	...
Nanoon headworks:—														
Cawnpoor branch regulating bridge.	180	7	52	...	5	20	6	1½	25	1,32,228	2,28,400	...	...	...
Etawah ditto	180	6	146	...	5	20	6	1½	25					
Nanoon 1st class choki	180	7	102	...	...	...	...	...	...	13,881·5	76,000	...	...	...
Etawah Terminal Line.														
Chitrowli 2nd class choki ...	2	5	12	2	...	...	...	...	...	4,160	14,400	...	...	...
„ bridge	2	5	112	2	3	33	4½	2¼	18	71,001·63	97,808	...	...	...
Bujrungpoor 2nd class choki ...	4	4	112	2	...	...	...	...	...	3,329	15,800	...	...	...
„ bridge	4	4	213	1	3	33	4½	2¼	18	71,627·232	99,200	...	...	...
Bijeegurh 2nd class choki ...	7	4	85	...	...	...	...	...	...	3,480	16,200	...	...	...
„ bridge	7	4	212	2	3	33	4½	2¼	18	69,207·582	91,488	...	...	...
Jao 1st class choki	10	4	163	1	...	...	...	...	...	16,064	70,000	...	...	...

* 2 of 15′, 1 of 20′.

6. Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		Rs.	A.	P.	
...	1,200	7	273	...	...	...	Standard plan. 5′ foundations ...	324	10	0	Mr. P. Volk.
...	1,28,802	117½	48,318	...	...	...	Same as at Sullawur, but waterway decreased to 100 feet ...	31,620	1	1	Ditto.
...	50,065	61	16,449	...	...	...	Same as at Sullawur				
...	93,100	236½	25,385	...	...	...	Same as at Bolundshuhur branch head. Foundations 5 feet.	16,752	14	9	Ditto.
...	6,300	20	1,752	...	...	...	Standard plan. 7½′ foundations	1,482	1	1	Ditto.
...	1,500	8	497	...	...	...	Ditto. 6′ foundations ...	371	13	5	Ditto.
...	62,005	84	21,833	...	...	...	Same as Nidhaoli, but waterway reduced to 120 feet. 6′ foundations.	10,125	3	7	Ditto.
...	1,200	9	497	...	...	...	Standard plan. 5′ foundations ...	334	8	11	Ditto.
...	57,043	74	21,485	...	...	...	Same as Daopoor. 5′ 11″ foundations.	9,316	3	10	Ditto.
...	1,200	9	382	...	...	...	Standard plan. 5′ foundations ...	347	3	7	Ditto.
...	42,250	88½	23,678	...	...	...	Same as Daopoor. 6′ 11″ foundations.	9,867	13	2	Ditto.
...	19,311	26½	9,140	...	...	...	Same as Pulra				
...	1,200	5	255	...	...	...	Standard plan. 4½′ foundations...	33,982	5	8	Ditto.
...	1,22,790	198	54,417	...	...	...	Same as Pulra	560	6	10	Ditto.
...	47,117	66	22,302	...	...	...	Ditto				
...	8,400	...	3,866	...	...	...	Standard plan. Pukka throughout. 9¾′ foundations.	1,720	14	9	Ditto.
...	94,553	9½	48,056	...	...	...	Same as at Moonda Khera. Foundations 7′ 11″.	20,415	9	0	Ditto.
...	1,300	...	236	...	...	...	Standard plan. 7′ foundations ...	344	11	11	Ditto.
...	57,912	56	23,953	...	...	...	Same as Daopoor. 7′ foundations	10,751	11	8	Ditto.
...	1,500	...	228	...	...	...	Standard plan. 7′ foundations ...	362	12	8	Ditto.
...	85,345	51	21,907	...	...	...	Same as Uchuhja, except width of waterway. 5 to 6 feet foundations.	10,424	11	1	Ditto.
...	1,500	...	455	...	...	...	Standard plan. 9′ foundations ...	344	12	6	Ditto.
...	58,705	49	19,436	...	...	...	Same as Machooa. 6′ 3″ foundations.	10,120	6	1	Ditto.
...	1,360	...	185	...	...	...	Standard plan. 8′ foundations ...	348	14	8	Ditto.
...	63,800	82	23,611	...	...	...	Same as Machooa. 5 to 6 feet foundations.	12,048	1	3	Ditto.
...	1,03,325	105	36,137	...	...	...	Same as Bolundshuhur. 6 feet foundations.	20,864	14	11	Ditto.
...	10,200	...	2,132	...	...	...	Standard plan. 9′ foundations ...	1,926	13	3	Ditto.
...	2,442	2	350	...	...	...	Standard plan. Block kunkur foundations.	468	11	6	Lieut. Whiting.
...	58,775	104	13,568	...	...	...	Design similar to foregoing bridges, but waterway reduced to 99 ft., and ghats only 60 feet long. Rajbuha and inlet heads attached; the former 10 feet wide, and floor 2′ above bed of canal. Foundations 6′.	10,046	14	1	Ditto.
...	1,443	2	300	...	...	100	Same as Chitrowli	388	12	8	Ditto.
...	59,235	264	15,491	...	...	464	Ditto	10,837	13	9	Ditto.
...	1,554	2½	340	...	...	...	Ditto	399	4	3	Ditto.
...	54,900	196	14,546	...	...	...	Ditto, except in shape of cornice and having piers pilastered, and face of arches with block kunkur.	10,293	1	4	Ditto.
...	8,000	20	2,576	...	...	170	Standard plan, except that roof over porches is built up level with centre room to form a staircase.	2,531	7	7½	Ditto.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches. Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks. 12 × 6 × 3	12 × 6 × 2½	12 × 6 × 2	9¼ × 4 × 3 Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.				
Jao bridge	10	5	17	1	3	30	4	2¼	18	68,601	85,119	...	...	...
Lodipoor 2nd class choki ...	...	...	...	...	...	...	...	...	...	2,778	14,600	...	...	...
„ bridge	13	1	152	...	3	30	4	2¼	18	59,687·49	92,728	...	...	...
Kutai 2nd class choki	15	2	187	1	...	...	...	...	...	3,643	2,000	...	...	...
„ bridge	15	3	110	1	3	30	4	2¼	18	64,812·12	86,791	...	...	...
Seetapoor 2nd class choki ...	17	7	158	1	...	...	...	...	...	3,284	14,600	...	...	...
„ bridge	18	...	92	...	3	30	4	2¼	18	59,687	85,666	...	...	...
Pilkutra 1st class choki ...	20	5	161	1	...	...	...	...	...	14,988	63,350	...	...	...
„ bridge	20	6	44	...	3	30	4	2¼	18	61,110·5	89,528	...	...	...
Noh 2nd class choki	23	2	31	2	...	...	...	...	...	3,580	15,500	...	...	...
„ bridge	23	2	219	...	3	30	4	2¼	18	68,350·9	94,287	...	...	...
Oreyree 2nd class choki ...	25	5	135	...	...	...	...	...	...	3,350	15,500	...	...	...
„ bridge	25	6	10	2	3	30	4	2¼	18	66,758	1,02,143	...	...	...
Guhrana bridge	28	2	89	...	3	30	4	2¼	18	39,693·8	37,600	...	...	80,000
Sonari 2nd class choki	31	1	180	...	...	...	...	...	...	3,805	1,600	...	...	...
„ bridge	31	2	57	...	3	26	3½	2¼	18	63,391·1	82,785	...	...	...
Soraoon 1st class choki ...	33	3	40	...	...	...	...	...	...	16,285	72,000	...	...	...
„ bridge	33	3	161	...	3	26	3½	2¼	18	63,907·4	98,654	...	...	...
Kutana 2nd class choki ...	35	6	48	2	...	...	...	...	...	3,327	16,000	...	...	...
„ bridge	35	6	134	...	3	26	3·5	2¼	18	63,907·4	1,02,204	...	...	...
Jeyra 2nd class choki	39	1	...	...	...	...	...	...	...	3,490	16,200	...	...	...
„ bridge	39	1	120	...	3	26	3½	2¼	18	64,501·5	70,850	...	...	...
Peydhut 2nd class choki ...	41	...	11	...	...	...	...	...	...	3,290·5	13,200	...	...	...
„ bridge	41	...	90	2	3	26	4	2	18	65,325·8	81,300	...	...	...
Kanakowa 2nd class choki ...	43	1	93	1	...	...	...	...	...	3,290	13,200	...	...	...
„ bridge	43	1	166	2	3	26	4	2	18	61,354·5	68,500	...	...	...
Puteeka 1st class choki ...	46	3	93	1	...	...	...	...	...	16,620	65,000	...	...	...
„ bridge	46	3	216	2	3	26	4	2	18	62,074·9	88,000	...	...	...
Burragaon 2nd class choki ...	49	3	126	2	...	...	...	...	...	3,290·5	13,200	...	...	...
„ bridge	49	4	11	2	3	26	4	2	18	59,167·4	1,00,000	...	...	...
Koosiarri 2nd class choki ...	52	3	36	2	...	...	...	...	...	3,171·5	13,200	...	...	...
„ bridge	52	3	136	2	3	26	4	2	18	58,767·5	2,00,000	...	...	...
Futtehkhan's 2nd class choki ...	54	7	40	...	...	...	...	...	...	3,171·5	13,200	...	...	...
„ bridge	54	7	140	1	3	26	4	2	18	56,954·5	1,38,000	...	...	...
Gihror 1st class choki	57	4	61	1	...	...	...	...	...	15,238	60,000	...	...	...
„ bridge, with connected escape, and extra bridge over escape channel.	57	4	158	...	2	33	4	2	25	1,34,699	1,80,000	...	...	...
CAWNPOOR TERMINAL LINE.														
Keylunpoor 2nd class choki ...	2	5	165	...	...	...	...	...	...	3,517	6,927	28,200	...	...
„ bridge	2	6	34	2	3	33	4¼	2¼	20	81,543	3,17,112	69,655	...	...
Rudain 2nd class choki ...	6	2	65	2	...	...	...	...	...	3,820	1,800	40,812	...	...
„ bridge	6	2	160	...	3	33	4¼	2¼	18	61,391	3,88,417	...	...	...

6. Materials Expended.							7.	8.			9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.			Name of the Executive Engineer or Officer under whom built. *
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet	Cub. Feet.	Cub. Feet.		RS.	A.	P.	
...	56,406	218	14,163	...	...	...	Same as Chitrowli, but waterway reduced to 90′.	10,889	8	1	Lieut. Whiting.
...	1,045	...	438	...	...	...	Same as Chitrowli; arches faced with block kunkur.	365	1	10½	Ditto.
...	48,113	234	13,187	...	...	...	Ditto	8,876	2	7	Ditto.
...	3,643	...	430	...	...	...	Ditto, but built entirely of block kunkur, except arches.	672	8	0	Ditto.
...	53,286	227	11,857	...	...	...	Same as Chitrowli; arches faced with kunkur.	9,698	7	10	Ditto.
...	1,552	...	330	...	...	120	Same as Chitrowli	432	12	4½	Ditto.
...	48,838	226	13,254	...	...	810	Ditto, arches faced with block kunkur.	9,679	2	1	Ditto.
...	72,505	14	1,900	...	...	...	Same as Jao	1,953	8	10	Ditto.
...	49,840	243	13,082	...	...	943	Same as Chitrowli	9,489	14	3	Ditto.
...	1,700	...	385	...	...	...	Ditto	442	0	8	Ditto.
...	56,568	120	12,916	...	...	410	Ditto	9,094	7	0	Ditto.
...	1,500	...	380	...	...	...	Ditto	415	2	2	Ditto.
...	53,980	145	14,504	...	...	...	Ditto	8,936	10	11	Ditto.
...	30,105	32	8,127	...	...	490	Ditto, but has no ghats, rajbuha heads, &c.	5,341	15	0	Ditto.
...	3,000	...	430	...	...	...	Block kunkur used throughout except in arches.	580	11	1	Capt. Whiting.
...	52,894	111	13,082	...	...	537	At this bridge the waterway is reduced to 78 feet, and the rajbuha heads are only 6 feet wide, with flooring 16 inches above bed.	8,521	1	7	Ditto.
...	7,777	4½	2,160	...	...	140	Same as at Jao	2,224	6	7	Ditto.
...	51,326	135	11,622	...	...	438	Arches faced with kunkur ...	8,353	0	4	Ditto.
...	1,443	3	270	...	...	106	Same as Chitrowli	409	8	6	Ditto.
...	50,680	126	12,000	...	...	1,080	Same as Sonari bridge	8,442	13	0	Ditto.
...	1,554	2½	280	...	...	112	Same as Chitrowli	413	4	10	Ditto.
...	55,940	93	12,006	...	...	550	Same as Sonari bridge	8,494	14	9	Ditto.
...	1,593	...	561	...	...	60	Same as Chitrowli	453	12	11	Ditto.
...	55,164	72	15,170	...	49	225	Same as Sonari, but ghats are 100 feet long.	9,073	11	4	Ditto.
...	1,593	...	300	...	...	115	Same as Chitrowli	415	2	7½	Ditto.
...	52,789	63	16,490	...	39	750	Same as Sonari	8,570	10	9	Ditto.
...	8,600	9	8,043	...	...	1,447	Same as at Jao, but pukka throughout.	2,544	14	0	Ditto.
...	51,067	38	18,150	...	...	...	Same as Sonari, but ghats are 75 feet long.	8,661	2	9	Ditto.
...	1,593	...	562	...	...	57	Same at Chitrowli	453	10	8	Ditto.
...	46,710	28	14,290	...	...	...	Same as Sonari	8,055	6	0	Ditto.
...	1,474	...	639	...	...	288	Same as Chitrowli, but pukka throughout.	472	2	11	Ditto.
...	33,180	14	14,905	...	...	...	Same as Sonari, except that canal embankment retaining wall is dispensed with.	8,869	12	6	Ditto.
...	1,474	...	236	...	...	200	Same as Chitrowli	410	13	5	Ditto.
...	39,697	60	14,122	...	...	...	Same as Koosiarri	8,392	15	0	Ditto.
...	7,725	17	2,398	...	156	868	Same as Jao	2,377	13	10	Ditto.
...	1,12,337	85	34,248	...	...	...	The design of these works is similar to those at Moonda Khera.	18,009	4	3	Ditto.
...	...	...	73	...	53½	...	Standard plan	382	3	9	Lieut. Hodgson.
...	29,787	...	25,668	...	...	4,310	Has ghats 60 feet long, road retaining revetments, inlet heads, and rajbuha heads 10 feet wide. Also a drop in floor of 2 feet.	11,742	11	7	Ditto.
...	...	...	86	...	17½	...	Standard plan	399	12	2	Ditto.
...	...	22,249	...	...	1,620	7,398	Same as at Keylunpoor, but without drop in floor.	10,192	14	10	Ditto.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches.				4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks.			
					Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.			" " " 12 × 6 × 3	" " " 12 × 6 × 2½	" " " 12 × 6 × 2	" " " 9½ × 4 × 3 Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.				
Ginnowli escape	9	2	4	...	3	6	1	1	...	14,231	85,200	...	...	...
„ 2nd class choki ...	9	2	62	...	...	...	...	...	...	3,460	7,500	23,500	...	...
„ bridge	9	2	113	1	3	33	4¼	2¼	18	61,421	3,68,480	...	...	...
Baramai bridge	11	2	186	2	3	33	4¼	2¼	20	47,860	3,47,585	...	...	70,000
Sikundra Rao 1st class choki ...	12	1	133	1	...	...	...	...	...	13,283	...	...	...	...
Poordilnugger bridge	12	7	215	...	3	33	4¼	2¼	20	63,057	1,92,338	2,19,394	...	13,000
Jirrowli 2nd class choki ...	15	7	29	1	...	...	...	...	...	2,723	26,738	...	...	...
„ bridge	15	7	116	2	3	33	4¼	2¼	18	61,832	1,36,252	2,00,004	...	...
Junsoi 2nd class choki	19	2	122	2	...	...	...	...	...	3,862	34,809	...	...	...
„ bridge	19	2	213	1	3	33	4¼	2¼	18	62,602	2,10,910	...	...	...
Tuttarpoor 1st class choki ...	22	5	66	2	...	...	...	...	...	14,882	...	1,18,510	...	...
„ bridge	22	6	5	...	3	32	4¼	2¼	18	65,779	...	1,61,750	...	...
Bundi 2nd class choki	26	6	50	...	...	...	...	...	...	3,470	7,479	13,080	...	...
„ bridge	26	6	166	2	3	31	4¼	2¼	18	54,808	1,75,441	66,030	...	...
Guddunpoor 2nd class choki ...	29	2	189	1	...	...	...	...	...	2,874	17,048	...	...	...
„ bridge ...	29	3	56	2	3	30	4	2	20	58,088	3,10,793	...	...	...
Gopalpoor 1st class choki ...	32	6	204	2	...	...	...	...	...	13,926	66,352	...	...	...
„ bridge	32	7	73	1	3	29	4	2	18	54,819	3,02,325	...	...	...
Dharoo 2nd class choki... ...	35	4	120	...	...	...	...	...	...	2,895	23,860	...	...	...
„ bridge	35	4	205	...	3	29	4	2	18	54,142	2,33,200	...	...	...
Keylai 2nd class choki	38	5	89	1	...	...	...	...	...	2,841	...	29,407	...	...
„ bridge	38	5	170	...	3	29	4	2	20	58,402	1,83,746	79,909	...	...
Khoreet 2nd class choki ...	41	4	199	2	...	...	...	...	...	2,777	19,110	...	...	...
„ bridge	41	5	76	2	3	28	4	2	18	54,233	1,05,192	...	...	...
Mokumpoor 1st class choki ...	44	7	4	...	...	...	...	...	...	14,270	96,538	21,513	...	...
„ bridge	44	7	126	2	3	28	4	2	20	55,414	2,32,064	27,942	...	...
Nuggureea escape	47	7	170	...	5	6	1	1	...	...	...	...	...	...
„ 2nd class choki ...	48	...	35	...	...	...	...	...	...	3,102	23,424	...	...	...
„ bridge	48	...	133	1	3	28	4	2	18	52,131	1,80,815	...	...	...
Puchowur 2nd class choki ...	50	4	216	1	...	...	...	...	...	2,339	21,588	...	...	...
„ bridge	50	5	83	1	3	27	4	2	20	53,538	1,25,435	...	...	...
Kuraoli 2nd class choki ...	54	...	123	...	...	...	...	...	...	3,122	26,532	...	...	...
„ bridge	54	...	205	1	3	27	4	2	18	52,480	2,12,863	...	...	80,835
Dunnahar 1st class choki ...	57	4	124	1	...	...	...	...	...	14,315	...	60,551	...	...
„ bridge	57	4	213	1	3	26	4	2	25	64,206	1,07,303	15,800	...	...
Roostumpoor 2nd class choki ...	60	7	110	...	...	...	...	...	...	2,997	22,576	...	...	...
„ bridge	60	7	215	1	3	26	4	2	20	53,800	99,818	...	...	...
Singhpoor 2nd class choki ...	64	5	203	1	...	...	...	...	...	2,881	11,850	10,693	...	...
„ bridge	64	6	63	1	3	26	4	2	20	53,602	1,19,841	...	...	...
Putturhar 2nd class choki ...	67	4	145	1	..	...	...	...	...	2,997	...	26,530	...	...
„ bridge	67	5	8	1	2	35	4½	2½	18	46,810	23,295	82,270	...	...
Bhawunt 1st class choki ...	70	3	131	2	...	...	...	...	...	13,985	52,206	...	...	...
„ bridge	70	3	210	...	2	35	4½	2½	20	56,951	1,33,520	15,193	...	...
Sogaon 2nd class choki... ...	74	1	138	...	...	...	...	...	...	2,859	13,867	...	...	...
„ bridge	74	2	2	1	2	33	4¼	2¼	18	49,117	1,25,413	5,700	...	...
Kussuah 2nd class choki ...	77	1	151	2	...	...	...	...	...	2,984	15,868	...	...	...
„ bridge	77	2	8	1	2	33	4¼	2¼	18	43,400	1,29,051	...	...	...
Ryharr 2nd class choki... ...	80	4	136	2	...	...	...	...	...	3,096	25,358	...	...	...
„ bridge	80	4	213	2	2	33	4¼	2¼	18	46,665	1,89,163	34,216	...	...
Dhundos 1st class choki ...	82	6	130	2	...	...	...	...	...	10,671	48,941	...	...	...
„ bridge	82	7	10	2	2	32	4¼	2¼	18	42,646	1,78,450	...	...	...
Tireea escape	87	...	185	1	5	6	1	1	...	17,437	38,608	3,625	...	...
„ 2nd class choki	87	1	31	2	...	...	...	...	...	2,728	9,467	10,300	...	...
„ bridge	87	1	87	1	2	32	4¼	2¼	20	48,047	1,55,497	9,670	...	...
Futtihpoor 2nd class choki ...	90	2	187	...	...	...	...	...	...	2,735	13,402	...	...	...

6. Materials Expended.							7.	8.	9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.	Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS. A. P.	
...	2,270	...	5,800	...	...	1,136	Is not connected with bridge ...	2,213 5 9	Lieut. Hodgson.
...	...	...	122	...	58	52½	Standard plan	404 12 0	Ditto.
...	9,853	...	24,073	...	501½	4,951	Same as Rudain	10,071 14 9	Ditto.
...	...	...	18,117	...	1,226	3,157	Same as Rudain, but has no rajbuhas attached, and ghats are on down-stream.	8,190 15 7	Ditto.
...	...	...	...	...	...	...	Standard plan	1,250 12 1	Ditto.
...	11,064	...	24,449	...	2,665	5,282	Same as Rudain	10,659 13 5	Ditto.
...	...	...	131	...	78½	...	Standard plan	310 4 8	Ditto.
...	23,352	...	18,631	...	2,084	5,339	Same as Rudain	9,930 7 6½	Ditto.
...	...	...	136	...	48	...	Standard plan	455 3 6	Ditto.
...	38,276	...	20,278	...	3,179	5,726	Same as Rudain	9,627 0 9	Ditto.
...	264	...	1,762	...	61	37	Standard plan	2,006 14 11	Ditto.
...	52,291	...	26,107	...	30	5,932	Same as Rudain, except in reduction of waterway.	10,935 1 5	Ditto.
...	1,200	...	199	...	...	16	Standard plan	402 2 2	Ditto.
...	32,492	...	16,826	...	236	5,190	Same as Rudain	9,390 13 0	Ditto.
...	...	...	144	...	...	96	Standard plan	393 14 8	Ditto.
...	17,224	...	15,779	...	1,102	5,534	Same as Rudain	9,854 6 1	Ditto.
...	6,000	...	1,434	...	...	326	Standard plan	1,884 12 2	Ditto.
...	20,852	...	14,140	...	628	5,296	Same as Rudain, with exception to rajbuha openings, which are reduced to 6 feet.	8,946 4 7	Ditto.
...	...	...	328	...	...	39	Standard plan	403 13 0	Ditto.
...	28,516	...	13,392	...	...	5,354	Same as Gopalpoor	8,551 5 6	Ditto.
...	...	...	159	...	...	25	Standard plan	351 7 11	Ditto.
...	22,477	...	15,763	...	1,546	7,417	Same as Gopalpoor	10,007 9 3	Ditto.
...	...	...	72	...	108	64	Standard plan	349 0 1	Ditto.
...	41,897	...	17,820	...	...	8,386	Same as Gopalpoor	9,402 15 7	Ditto.
...	...	...	555	...	203	99	Standard plan	1,506 2 10	Ditto.
...	22,797	...	17,105	...	190	6,529	Same as Gopalpoor	9,902 1 3½	Ditto.
...	...	...	...	...	...	...	... ...	3,340 5 11	Ditto.
...	...	...	172	...	...	8	Standard plan	347 1 3	Ditto.
...	28,534	...	16,431	...	...	8,138	Same as Gopalpoor	8,850 6 8	Ditto.
...	...	...	219	...	50	56	Standard plan	331 14 1	Ditto.
...	38,046	...	18,538	...	...	11,562	Same as Gopalpoor	8,865 3 9	Ditto.
...	...	...	175	...	58	16	Standard plan	390 5 3	Ditto.
...	18,436	...	18,449	...	1,077	5,409	Same as Gopalpoor, but no retaining revetments to bank.	8,699 4 6	Ditto.
...	6,912	...	2,382	...	...	356	Standard plan	2,133 13 11	Ditto.
...	48,815	...	20,301	...	...	10,606	Similar to Gopalpoor, but ghats 80 feet long, and no rajbuba heads.	12,419 1 4	Ditto.
...	...	...	348	...	...	...	Standard plan	393 15 1	Ditto.
...	40,478	...	20,871	...	...	11,787	Same as Gopalpoor	9,635 1 2	Ditto.
...	...	...	324	...	66	82	Standard plan	373 7 4	Ditto.
...	37,171	...	19,038	...	68	9,992	Same as Gopalpoor	9,895 7 4	Ditto.
...	...	...	262	...	11½	50	Standard plan	401 8 10	Ditto.
...	24,390	...	20,772	...	...	12,706	Same as Gopalpoor, but two bays instead of three.	8,625 0 6	Ditto.
...	4,547	...	1,678	...	...	472	Standard plan	1,857 13 3	Ditto.
...	34,812	...	17,049	...	1,908	10,260	Same as Puttuhar	9,403 14 4	Ditto.
...	1,326	...	180	...	...	62	Standard plan	435 15 11	Ditto.
...	30,849	...	15,596	...	2,024	10,464	Same as Puttuhar, but with reduced waterway.	8,649 2 9	Ditto.
...	1,372	...	244	...	10	106	Standard plan	407 13 4	Ditto.
...	28,926	...	13,100	...	1,260	9,040	Same as Sogaon	7,095 4 5	Ditto.
...	...	...	315	...	4	44	Standard plan	396 0 4	Ditto.
...	16,196	...	13,652	...	1,690	8,296	Same as Sogaon	7,617 1 1	Ditto.
...	4,313	...	264	...	...	68	Standard plan	(Not complete.)	Ditto.
...	20,161	...	15,699	...	...	6,370	Same as Sogaon, but with reduced waterway.	(Not complete.)	Ditto.
...	11,970	...	5,503	...	...	4,291	Same as Nuggureea	2,792 10 7	Ditto.
...	702	...	44	...	...	44	Standard plan	... ...	Ditto.
...	23,397	...	13,568	...	...	7,915	Same as Dhundos...	... ...	Ditto.
...	780	...	66	...	...	19	Standard plan	... ...	Ditto.

1. Name of Work.	2. Distance of the Work from the Mynpoor Regulator.				3. Arches.				4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks.			
	Miles.	Furls.	Yds.	Feet.	Number of.	Span of. Feet.	Height of Versed Sine. Feet.	Thickness at Crown. Feet.		Cubic Feet.	" " " 12 × 6 × 3	" " " 12 × 6 × 2½	" " " 12 × 6 × 2	" " " 9½ × 4 × 3 Smaller and of various Sizes.
Futtihpoor bridge	90	3	57	...	2	32	4¼	2¼	18	48,320	1,62,126	...	...	...
Mirzapoor 2nd class choki ...	93	...	205	...	...	...	...	...	...	2,687	15,394	...	...	...
„ bridge	93	1	70	2	2	30	4	2	20	45,001	2,64,717	...	...	...
Dinguree 1st class choki ...	96	4	86	1	...	...	...	...	...	Not begun.	...	...	...	...
„ bridge	96	3	178	2	2	30	4	2	18	49,170	1,17,513	...	...	31,093
Sureya 2nd class choki	98	4	32	...	...	...	...	...	...	2,687	15,510	...	...	...
„ bridge	98	4	115	1	2	30	4	2	20	44,457	1,32,437	...	...	3,500
Kunsowa 2nd class choki ...	102	2	14	...	...	...	...	...	...	2,580	22,200	...	...	...
„ bridge	102	2	78	2	2	30	4	2	18	47,255	60,842	...	...	...
Husseyrun 2nd class choki ...	104	5	143	...	...	...	...	...	...	2,580	19,388	...	...	...
„ bridge	104	6	29	1	2	30	4	2	20	66,949	16,210	...	...	...
Bahosi 1st class choki	108	5	59	1	...	...	...	...	...	9,260	76,403	...	...	...
„ bridge	108	5	132	...	2	30	4	2	18	50,893	19,225	...	...	...
Goonaha 2nd class choki ...	111	...	4	2	...	...	...	...	...	2,580	18,975	...	...	...
„ bridge	111	...	74	...	2	30	4	2	18	63,299	18,737	...	...	...
Oomurda 2nd class choki ...	113	6	117	...	...	...	...	...	...	2,580	19,932	...	...	...
„ bridge	113	7	16	2	2	30	4	2	18	45,917	22,364	...	...	...
Sookhi 2nd class choki	115	6	195	2	...	...	...	...	...	2,580	18,675	...	...	...
„ bridge	115	7	26	2	2	25	4	2	15	44,003	63,510	...	...	...
Khyrnugger 2nd class choki ...	118	7	209	...	...	...	...	...	...	2,580	18,110	...	...	...
„ bridge	119	...	66	2	2	25	4	2	15	52,508	53,301	...	...	...
Aima 1st class choki	122	...	166	2	...	...	...	...	...	12,365	97,345	...	...	...
„ bridge	122	...	200	...	2	25	4	2	15	45,487	49,202	...	...	...
Barrapoor bridge	124	6	166	2	2	25	4	2	15	31,846	61,390	...	...	...
Bidhun 2nd class choki	127	1	13	...	...	...	...	...	...	2,580	18,920	...	...	...
„ bridge	127	1	100	...	2	25	4	2	18	44,982	65,412	...	...	...
Ootha 2nd class choki	130	...	168	2	...	...	...	...	...	2,580	18,918	...	...	...
„ bridge	130	...	210	...	2	25	4	2	18	44,783	1,60,028	...	...	...
Munowa 2nd class choki ...	132	6	167	1	...	...	...	...	...	2,580	18,918	...	...	...
„ bridge	132	7	1	2	2	25	4	2	18	42,824	2,99,815	...	...	...
Kukwan escape	134	7	173	2	5	6	1	1	...	20,419	1,20,868	...	...	...
„ 1st class choki... ...	135	...	51	...	...	...	...	...	...	9,455	73,337	...	...	...
„ bridge	135	...	149	2	2	25	4	2	20	45,102	3,07,709	...	...	...
Mudoopoor 2nd class choki ...	138	...	115	1	...	...	...	...	...	2,580	19,018	...	...	...
„ bridge	138	...	160	...	2	25	4	2	18	49,609	1,12,298	...	...	...
Khoondun bridge	140	3	41	2	2	25	4	2	15	32,119	68,113	...	...	...
Tuktowli 2nd class choki ...	142	3	47	...	...	...	...	...	...	2,580	19,016	...	...	...
„ bridge	142	3	116	2	2	25	4	2	18	48,740	1,21,193	...	...	...
Bhosan 2nd class choki	145	1	114	2	...	...	...	...	...	2,580	17,538	...	...	...
„ bridge	145	1	158	1	1	30	4	2	20	43,835	2,05,938	...	...	...
Juggutpoor 1st class choki ...	147	...	111	2	...	...	...	...	...	16,012	92,929	...	...	...
„ bridge	147	...	208	1	1	30	4	2	18	44,266	31,988	...	...	...
Runjeetpoor 2nd class choki ...	150	1	148	2	...	...	...	...	...	2,580	18,918	...	...	...
„ bridge	150	2	3	1	1	30	4	2	18	36,093	1,90,883	...	...	...
Hoorkapoor 2nd class choki ...	153	2	57	...	...	...	...	...	...	2,580	20,877	...	...	...
„ bridge	153	2	165	...	1	30	4	2	...	35,645	2,46,793	...	...	...
Koorsouli 2nd class choki ...	156	...	136	2	...	...	...	...	...	2,580	19,436	...	...	...
„ bridge	156	...	210	...	1	30	4	2	18	41,652	2,75,254	...	...	...
Barra bridge	158	3	73	1	1	30	4	2	18	41,910	2,08,619	...	...	...
„ 1st class choki	158	5	3	1	...	...	...	...	...	...	58,010	...	...	...
Muswanpoor bridge	161	...	111	...	1	25	4	2	15	35,617	2,33,273	...	...	...
Khujoori 2nd class choki ...	...	...	...	...	...	...	...	...	...	2,580	14,341	...	...	...
„ bridge	162	4	76	2	1	25	4	2	20	57,439	3,75,940	...	...	..
Dubowli escape	164	4	126	1	...	...	...	...	...	48,426	3,18,913	...	...	37,532

6. Materials Expended.							7.	8.	9.
Boulders.	Block Kunkur.	Lime. Stone.	Lime. Kunkur.	Lime. Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.	Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS. A. P.	
...	22,317	...	12,531	...	...	8,058	Same as Dhundos...	... ...	Lieut. Hodgson.
...	534	...	52	...	...	52	Standard plan	327 14 7	Ditto.
...	9,699	...	11,680	...	...	7,736	Same as Dhundos, but with reduced waterway.	... ...	Ditto.
...	...	...	...	...	...	...	Not begun.		
...	12,448	...	8,230	...	...	5,374	Same as Mirzapoor	... ...	Ditto.
...	742	...	95	...	...	11	Standard plan	324 1 10	Ditto.
...	25,299	...	13,968	...	...	6,968	Same as Mirzapoor	... ...	Ditto.
...	...	...	145	...	...	85	Standard plan	310 2 6	Lt. Hutchinson and Lt. Hodgson.
...	41,164	...	11,243	...	2,615	6,649	Same as Mirzapoor	... ...	Ditto.
...	...	...	30	...	30	...	Standard plan	353 1 1	Ditto.
...	72,297	...	11,456½	...	9,440	730	Same as Mirzapoor	10,286 15 1	Ditto.
...	3,162	...	1,147	...	930	...	Standard plan	1,789 10 0	Ditto.
...	58,712	...	10,827	...	8,130	1,424	Same as Mirzapoor	8,651 2 0	Ditto.
...	...	...	195	...	60	...	Standard plan	308 9 0	Ditto.
...	66,052	...	13,836	...	11,025	...	Same as Husseyrun	10,561 9 4	Ditto.
...	...	...	45	...	...	5	Standard plan	380 13 3	Ditto.
...	58,063	...	10,300	...	8,620	...	Same as Husseyrun	8,853 15 7	Ditto.
...	...	...	171	...	105	...	Standard plan	360 9 2	Ditto.
...	37,003	...	8,143	...	7,248	...	Same as Husseyrun, but with waterway reduced.	6,287 1 5	Ditto.
...	...	...	100	...	60	...	Standard plan	351 13 3	Ditto.
...	53,084	...	12,143	...	10,491	...	Same as Sookhi	8,351 6 11	Ditto.
...	400	...	925	...	650	50	Standard plan	1,748 2 11	Ditto.
...	38,771	...	8,034	...	10,344	821	Same as Sookhi	6,842 5 5	Ditto.
...	23,710	...	9,939	...	...	5,455	Ditto, but with rajbuha heads and ghats.	4,999 14 1	Ditto.
...	...	...	95	...	185	...	Standard plan	373 13 1	Ditto.
...	37,445	...	9,017	...	6,143	1,825	Same as Sookhi	6,530 1 4	Ditto.
...	...	...	96	...	190	...	Standard plan	355 14 0	Ditto.
...	22,613	...	8,810	...	6,730	893	Same as Sookhi	6,765 3 2	Ditto.
...	...	...	241	...	375	...	Standard plan	389 14 4	Ditto.
...	...	...	9,849	...	6,203	1,479	Same as Sookhi	7,311 1 3	Ditto.
...	3,127	...	7,626	...	...	5,598	Same as Nuggureea	3,214 2 10	Ditto.
...	...	...	1,117	...	1,169	...	Standard plan	1,651 7 4	Ditto.
...	...	...	10,721	...	5,463	2,682	Same as Sookhi	7,334 2 7	Ditto.
...	...	...	166	...	221	...	Standard plan	393 8 0	Ditto.
...	37,129	...	10,071	...	7,703	870	Same as Sookhi	7,922 14 3	Ditto.
...	20,740	...	10,112	...	...	5,918	Same as Barrapoor	5,238 9 6	Ditto.
...	...	...	118	...	99½	...	Standard plan	355 9 7	Ditto.
...	38,224	...	8,698	...	4,347	827	Same as Sookhi	6,744 11 7	Ditto.
...	...	...	146	...	62½	...	Standard plan	349 9 4	Ditto.
...	14,054	...	10,936	...	2,510	3,791	Design similar to rest, but with only one waterway.	6,792 12 9	Ditto.
...	132	...	472½	...	810	...	Standard plan	1,685 9 7	Ditto.
...	38,812	...	8,978	...	3,445	4,855	Same as Bhosan	6,737 6 5	Ditto.
...	...	...	320½	...	210	...	Standard plan	353 8 10	Ditto.
...	11,384	...	8,389	...	4,356	2,474	Same as Bhosan	Not completed.	Ditto.
...	...	...	64	...	41	...	Standard plan	371 4 11	Ditto.
...	891	...	10,126	...	3,078	2,530	Same as Bhosan	Not completed.	Ditto.
...	...	...	53	...	52	...	Standard plan	344 2 9	Ditto.
...	...	...	10,562	...	4,606	2,921	Same as Bhosan	Not completed.	Ditto.
...	...	...	5,458	...	4,768	456	Ditto	5,606 0 2	Ditto.
...	...	...	623	...	316	252½	Standard plan	1,421 12 7	Ditto.
...	1,680	...	7,702	...	5,396	1,398	Same as Bhosan	Not completed.	Ditto.
...	...	...	80	...	39	37½	Standard plan	349 12 4	Ditto.
...	3,084	...	13,826	...	5,877	488	Same as Bhosan, but on a skew of an angle of 53°. Revetments, ghats, and rajbuha heads arranged so as to give squareness to the work.	9,341 10 6	Ditto.
...	...	...	17,854	...	605	775	An escape of 3 openings on each side of the canal, with an under passage of masonry for country drainage. Chokis on the flanks.	Not completed.	Lieut. Hodgson.

1. Name of Work.	2. Distance of the Work from the Myapoor Regulator.				3. Arches. Number of.	Span of.	Height of Versed Sine.	Thickness at Crown.	4. Width of Roadway between Plinths of Parapets.	5. Measurement. Content of Masonry.	6. Materials Expended. Bricks. 12" × 6" × 3"	12" × 6" × $2\frac{1}{2}$"	12" × 6" × 2"	$9\frac{1}{2}$" × 4" × 3" Smaller and of various Sizes.
	Miles.	Furls.	Yds.	Feet.		Feet.	Feet.	Feet.		Cubic Feet.				
Dubowli regulator	164	5	206	1	1	20	$2\frac{1}{4}$	$1\frac{3}{8}$	18	25,185	1,69,259	...	...	48,000
Duknapoor, or Grand Trunk Road bridge.	167	3	196	2	1	20	$2\frac{3}{8}$	2	25	27,785	76,284	1,08,541	...	16,589
Cawnpoor Works:—														
No. 1 Gunj bridge	168	1	185	1	1	20	$2\frac{7}{8}$	$1\frac{1}{2}$	20	13,879	63,956	...	...	63,496
2 ditto	168	2	166	...	1	20	$2\frac{7}{8}$	$1\frac{1}{2}$	20	12,103	64,986	...	...	65,696
3 ditto	168	3	165	...	1	20	$2\frac{7}{8}$	$1\frac{1}{2}$	20	12,328	60,906	...	...	23,920
4 ditto	168	4	151	...	1	20	$2\frac{2}{5}$	$1\frac{1}{2}$	20	11,654	67,602	...	...	13,780
5 Riddell's bridge ...	168	6	128	2	1	20	$2\frac{7}{8}$	$1\frac{1}{2}$	20	9,246	63,000	...	...	11,000
6 Course bridge	168	7	140	...	1	20	$2\frac{7}{8}$	$1\frac{1}{2}$	30	18,052	1,18,804	...	...	13,598
No. 1 Lock	169	...	183	1	...	...	...	...	...	78,311	2,72,781	15,950	...	26,21,682
Lower road bridge ...	169	3	57	2	1	20	$2\frac{3}{8}$	$1\frac{1}{2}$	30	12,185	71,500	...	...	15,000
No. 2 Lock	169	4	126	1	...	...	...	...	...	47,244	51,313	21,880	...	13,61,300
3 ditto	169	4	167	2										
4 ditto	169	5	151	2	Not commenced.									
5 ditto	169	5	192	2										
Terminal Works	169	6	13	2	...	...	...	...	...	...	1,54,185	...	...	4,07,750
Canal and esplanade, revetments, inlets, &c.	...		...	...	...	...	...	...	...	...	12,41,618	8,40,106	...	76,68,030

6. Materials Expended.							7.	8.	9.
		Lime.							
Boulders.	Block Kunkur.	Stone.	Kunkur.	Earth.	Soorkee.	Sand or Bujree.	Description of the Work.	Total Cost of the Work.	Name of the Executive Engineer or Officer under whom built.
Maunds.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.	Cub. Feet.		RS. A. P.	
...	...	...	9,705	...	306	205	Grooves are provided at this bridge for gates to shut off the canal. A rajbuha head of 10 feet opening for the country between the Pandoo and Ganges is also attached. Ghats on both sides, and an inlet on the left above bridge, form parts of this work.	Not completed.	Lieut. Hodgson.
...	3,925	...	6,486	...	291	2,229	This is the first of the Cawnpoor series of works. It has ghats on up-stream side, with inlets, but no rajbuha heads. Pilastered and rusticated piers.	Not completed.	Lieut. Hutchinson and Lt. Hodgson.
...	2,620	...	2,153	...	...	2,284			
...	2,760	...	2,323	...	...	2,268			
...	1,659	...	2,175	...	143	2,038			
...	...	...	1,957	...	1,957	...			
...	...	...	2,100	...	420	1,600			
...	...	...	4,988	...	225	3,247			
...	...	...	18,556	...	4,836	15,137	Not yet complete	1,96,614 1 11	Lt. Hutchinson, Lieut. Hodgson, and Lt. Price.
...	...	...	3,900	...	60	2,500			
...	...	...	10,403	...	3,224	6,327			
...	8,075	...	5,657	...	1,850	4,926			
...	...	...	73,051	...	24,935	73,636			

APPENDIX K.

Reports *on the* Dimat *and* Bhosan Bridges.

No. 194.

From Lieutenant A. G. Goodwyn, *Executive Engineer, Northern Division Ganges Canal, to* Lieut.-Colonel P. T. Cautley, *Director, Ganges Canal Works.*

Sir, *Mussoorie, 12th February*, 1850.

I have the honour of forwarding herewith the report in duplicate of the Committee which you in your letter No. 1,798, of 4th instant, ordered to assemble for the purpose of surveying the Dimat, Liberheri, and Munglour Bridges. This report is accompanied by a sketch, showing the general direction of the voussoirs of the eastern arch of the Dimat Bridge, illustrative of the remarks of the Committee on this point, and also by a letter, in original, from Lieutenant E. Sharpe, assistant executive officer of the Second Division Ganges Canal.

2. The letter of the Executive Engineer Second Division Ganges Canal, received under cover of your own, is herewith returned as directed.

I have the honour to be, &c.,

(Signed) A. G. Goodwyn, *Lieutenant,*
Executive Engineer, Northern Division Ganges Canal.

From Lieutenant Edmund Sharpe, *Acting Assistant Executive Engineer, Ganges Canal, to* Lieutenant E. Fraser, *Executive Engineer, Munglour Division Ganges Canal.*

Sir, *Dimat, 29th January*, 1850.

In reply to your letter dated the 26th instant, I have the honour to return the following replies to the queries contained in it:—

1st. The arching of the eastern arch was commenced on the 7th December, 1849, and was keyed on the 17th idem.

2nd. I made it a point to visit the bridge every day, except when any other important business should detain me; but from this, or any other cause, a greater lapse than that of one day never intervened between any two consecutive visits.

3rd. I obtained a supply of water for the bridge masonry from the village of Dimat, and two days' supply was always reserved in a tank built for the purpose, whence it was issued to the top of the bridge by bhishties in sufficient quantities; and whenever I saw the work going on, the bricks were invariably soaked before being given to the masons, as it seemed in a manner habitual to them, and I fully believe that they were always so wetted.

4th. Sergeant O'Farrell, Assistant Overseer, never missed one day in his attendance at the bridge, from the commencement of the arching to the 17th of December, 1849, when he was seized with an attack of illness which precluded his attendance. That he was also punctual in the time of arrival and departure, I myself ascertained by varying the hours of my own visits, sometimes arriving there by sunrise and sometimes at sunset.

I have the honour to be, &c.,

(Signed) EDMUND SHARPE, *Lieutenant*,

Acting Assistant Executive Engineer, Ganges Canal.

SECOND DIVISION GANGES CANAL.

REPORT of a COMMITTEE which assembled in accordance with orders contained in letter No. 1,798, dated 4th February, 1850, from the Director of the Ganges Canal Works to the President, to survey the Dimat Bridge over the Ganges Canal, and also those at Munglour and Liberheri.

President—Lieutenant A. G. GOODWYN, Executive Engineer, Northern Division, Ganges Canal.

Members { Lieutenant E. FRASER, Executive Engineer, Second Division, Ganges Canal.
Mr. THOMAS LOGIN, Assistant Executive Officer, Northern Division, Ganges Canal.

Subject on which a Report is called for by the Director.	Report and Remarks of Committee.
1. Quality of material, brick, and cement.	The cement is composed of one part stone lime to two parts soorkhee, and is of excellent quality. The dimensions of the bricks used are 12·225″ × 5·975″ × 2·8875″, and they are of the best description, thoroughly burnt.
2. Quality of workmanship in general, thickness of seams of arch especially.	The method taken by the Committee in arriving at the average thickness of seam has been to measure the original length of the arches over the extrados and under the intrados, taking the mean between these two measurements; then to count the number of courses on edge in this length. This number, multiplied by the average thickness of bricks, derived from a measurement of ten taken out of one of these arches, has then been subtracted from the mean length of arch, in inches, as obtained above, and the remainder being divided by the number of seams has given the following averages:—

In the east arch	·3857 inch.
In the centre arch	·3397 „
In the western arch	·3857 „

In the opinion of this Committee, although the materials used are good, the masonry, owing to bad workmanship, is entirely the contrary, except in the outer faces of the arches. The Committee are of opinion that it is owing to this difference in the quality of the work that the outer portions have suffered crushing on the striking of the centres. In that arch, the eastern, the middle of which is exposed, the Committee discovered a want of bedding of mortar for the bricks, which, they think, is of itself sufficient to account for the failure of the work. In a letter from Lieutenant E. Sharpe, the assistant in executive charge of the work, to the address of the executive engineer of the Second Division, that officer reports that the bricks were, when he visited the works, invariably soaked before they were given to the masons to lay, and he expresses his belief that they were always so wetted. In this belief the Committee cannot concur, should it be intended to be implied that the bricks were generally laid in a dripping state, or that sufficient water was used; and they remark that this being Lieutenant Sharpe's first masonry work, and he being practically unaware of what essential importance the free use of water in laying masonry in a dry climate is, is probably the cause of the

Subject on which a Report is called for by the Director.	Report and Remarks of Committee.
	discordance in their reports. The Committee also remark that the bricks were not dressed before being laid, and that the voussoirs in the interior of the eastern arch, the only one in which they have been able, by the removal of the masonry, to examine them, have not everywhere been constructed perpendicular to the curve of the extrados, as they were ordered to be, and should have been. Accompanying is a sketch showing this obliquity at various points along the interior masonry of the eastern arch. The Committee are aware that much of this obliquity is due to the sinking of the arch, but think that some also is owing to imperfect workmanship. The bond prescribed by the executive engineer, as described to the Committee by that officer, has not been carefully attended to; and the Committee observe an undue preponderance of headers (*i. e.* bricks set vertically, or nearly so).
3. State of advance of masonry in wings and spandrils at period when centerings were struck.	When the centres were struck, the wing walls were level with the point where the curve of the extrados meets the impost of the arches, and the spandril walls had been carried up 2 feet 8 inches higher.
4. State of induration of masonry of abutments, how long the abutment masonry had been allowed to stand before the arches were built, and how far earthwork was completed in their rear, at the time when the centerings were struck.	The abutment masonry had stood about seventy-five days before the arches were built. The induration of the cement is now very great, causing it to offer about the same resistance to an iron point as a good peela brick. The earthwork in rear of abutments was completed to the top of the wing walls prior to the final lowering of the centres of both eastern and western arches; but the eastern arch was lowered 6 inches when the earthen backing of the abutment had only attained the level of the springing line of the elliptical curve.
5. Action of thrust upon abutment, if any, to be described.	No appearance exists of any injurious action having occurred.
6. Whether to protect the works from contingencies arising from neglect or careless superintendence on part of the establishment on the work, either increased dimension to the abutment, or modification to the direction of the thrust of the arch, may be advantageously designed.	Four bridges having already been successfully built in the method designed for this one, the Committee consider the merits of the plan established, and recommend no modification of it. The causes of failure appear entirely independent of the plan.
7. The amount of supervision given by the assistant and overseer in charge of the particular work.	The Committee having in their answers to question 2 recorded their opinion of the causes of failure, beg to refer to the accompanying letter from Lieutenant E. Sharpe, regarding the amount of supervision bestowed on the work by himself and by Sergeant W. O'Farrell, late assistant-overseer of this division; and though not specifically ordered to report on this point, considers this supervision, as regards the number of visits of Lieutenant Sharpe, and the duration of the attendance of Sergeant O'Farrell, sufficient to warrant an expectation of good work. The Committee further remark, with reference to the centre arch, which, having been lowered only 1 inch, at present stands uninjured, that they are satisfied, after a careful examination, that should the centres be removed, failure here also will be

Subject on which a Report is called for by the Director.

Report and Remarks of Committee.

the result. They therefore recommend that it be immediately dismantled, without lowering the centres any further, or permitting further induration of the cement, as the former operation would, in their opinion, crush many bricks, and further setting of the mortar would increase the difficulty of removing the arch, without affording any fair prospect of advantage.

The Committee have inspected the Munglour and Liberheri bridges also, which they find to be sound and well built.

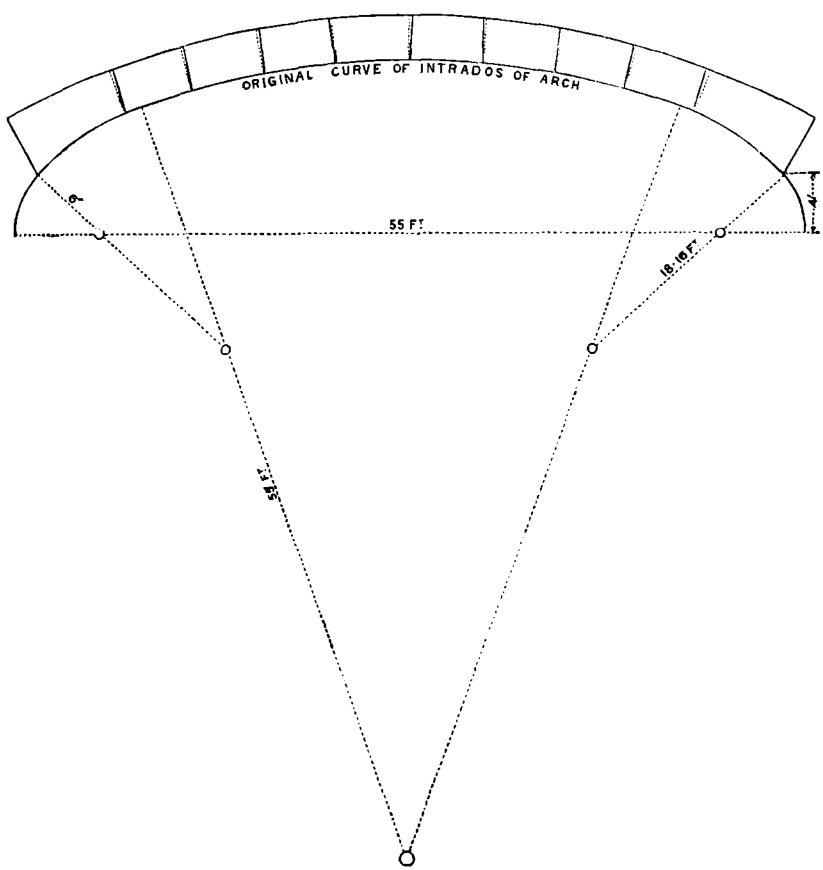
(Signed) A. G. Goodwyn, *Lieutenant, Executive Engineer, President.*
(Signed) E. Fraser, *Lieutenant, Executive Engineer, Member.*
(Signed) T. Login, *Assistant Executive Officer, Member.*

Dimat, 9*th February*, 1850.

Dimat Bridge, Eastern Arch.

Showing direction of Voussoirs at distances of 5 *feet, measured from the centre.*

(The dotted lines show what the direction of the Voussoirs should be.)



No. 209 of 1851-52.

From Lieutenant C. W. Hutchinson, *Executive Engineer, Sixth Division, Ganges Canal, to* Lieutenant-Colonel P. F. Cautley, *Director, Ganges Canal, &c.*

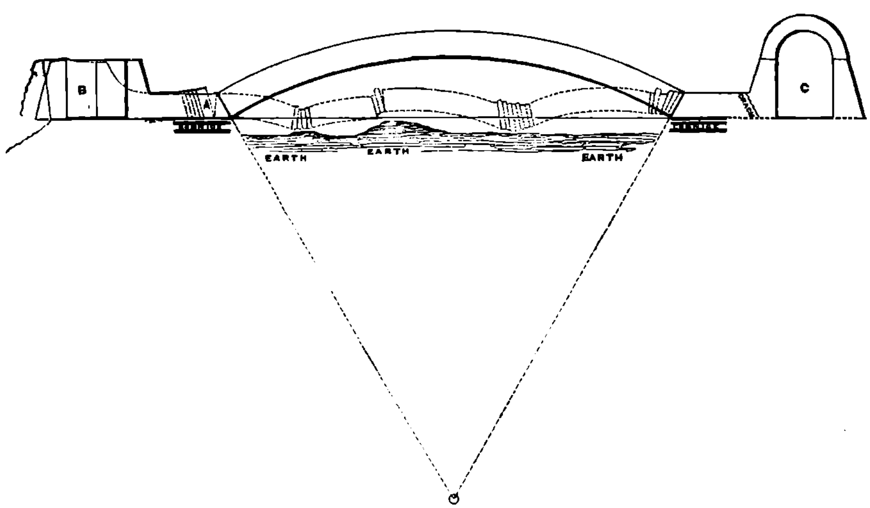
Sir, *Camp, Kukon, 28th February*, 1852.

I have the honour to report to you that a few days after the entire removal of the centering (an earthen one) of the Bhosan arch, it fell.

This arch (and one of the skewbacks) was built by contract by Mr. Hussey under the immediate supervision of Madhoram, Sub-Assistant Civil Engineer.

I attach a sketch of the state of progress in the adjoining side passages, &c., and a dotted line showing the position it assumed on falling.

Bhosan Bridge Arch.—February, 1852.



The cause, as it appeared to me, of this accident, and as Lieut. Hume (whom I sent for to meet me on the occasion of my visiting it after it fell) also thinks, was solely the very bad quality of the masonry in the backing to the arch (built by Mr. Hussey) and in the great quantity of mortar used, and in the very inferior quality of this mortar.

This skewback was the first masonry on the bridge that was built by Mr. Hussey. The abutment and the other skewback were built previously by Madhoram, and are much better built.

Madhoram states that he was absent on other works for the two or three days during which this was built, and was not aware it was so bad, although he was aware of the inferior quality of the mortar, as he saw it used on his return in other parts of the masonry, and at once insisted on its being properly prepared (it was not even ground or mixed in the mill at first), and saw that better lime was supplied to Mr. Hussey.

When I first visited the work, to see the quality of Mr. Hussey's masonry, I thought it so bad, in the portion of the side-passage walls that were built, that I had them pulled down, and particularly pointed out to Madhoram, that he was to allow no such masonry to pass. The skewback was covered over on the top, and I did not observe that it was so bad.

The arch itself was very well built, and the mortar used in it is very good, and the joints are fine.

The skewback has been, as shown in the sketch, thrust off the abutment almost; and on examining it, the centre of it appeared to have been stuffed with mortar, and this mortar had no hold of the bricks whatever. The mortar was all in powder. The arch, therefore, had nothing whatever to resist its thrust save a few bricks.

Mr. Hussey discontinued all masonry work in the middle of January last, not finding sufficient profit in the rates I allowed him.

Having allowed him to carry on the arch and other masonry work without having discovered the badness of the skewback built by him, I conceive that I cannot in any way now call upon him to rebuild any part of the fallen masonry, or even find fault with him.

The total loss by this accident is about 230 rupees, and this will not cause the estimate for this bridge to be exceeded; especially as so much masonry has been struck off by the omission of the ogee walls.

The skewbacks are now being rebuilt, and after they have had four months to indurate, the arch will be again turned.

I have, &c.,

(Signed) C. W. HUTCHINSON, *Lieutenant, Executive Engineer,*
Sixth Division, Ganges Canal.

APPENDIX L.

SYSTEM *of* ACCOUNT-KEEPING *introduced into the* ROORKEE WORKSHOPS *by* MR. HARRY MARTEN.

MEMORANDUM on an Improved System for conducting and keeping the Accounts of the Roorkee Workshops.

THE communications which have taken place between Colonel Cautley and myself, having ended by his deciding that the management and account-keeping of the Roorkee workshops, on their becoming independent of any particular work, shall be made to correspond as nearly as possible with what would be the system were the factory to be worked by a private company; and having been desired to draw up a memorandum on the plan which should be adopted for carrying out the object proposed, I beg leave to state that my general views regarding the Roorkee workshops are these:—

2. That they should be looked upon as, what they must ultimately become, a large factory and general furnishing warehouse, whose objects are to manufacture and retail out every description of article required for engineering purposes, whether undertaken by the Government or by private individuals; and that, in order to ensure these objects being gained, the institution should be conducted on the principles which guide similar concerns the property of private companies—the only difference being, that a private company would work its factory for pecuniary profit, the Roorkee workshops would be worked merely to cover their expenses.

3. The principal features involved in these views are:—1st. That the factory being conducted on the above principles, the director of the Ganges Canal Works should represent the interests of its proprietors (the Government of India), and be vested with powers, and act in every way, as if he were "Managing Director" (by which designation I shall hereafter refer to him) to a private company; 2ndly. That the factory be made to pay all the expenses incurred upon it—except for the cost of the original buildings and motive power, upon which (they being held as "dead stock," the property of the Government) it should pay the usual 5 per cent. interest only; 3rdly. That a commercial system of bookkeeping be introduced into the office of the factory; 4thly. That as the business of the factory will embrace sales to private individuals, and the supplying of Government officials, the system of payment should be the same in both cases.

4. On the first point, there is hardly any necessity for my remarking upon the duties of the managing director: he will of course watch with all possible vigilance the progress and growth of this promising factory, supply funds whenever necessary, inspect the works and examine the accounts, advise and control the superintendent in every possible way without harassing him with useless details, make reports to Government on what had been done and was doing, submit such periodical balance-sheets and progress-reports as would satisfy the Government as to the working of the concern, &c. &c.; but, in order that his interest in the welfare of the factory may not flag, he should be vested with some amount of discretionary power.

5. In elucidation of the second point, I would refer to the books of account appended to this paper, and to explanations of the same which will presently follow under the title of "Instructions to Superintendents."

It will be seen that all expenses on repairs of buildings, permanent or supervising establishment, wear and tear of tools, interest on dead stock, which is the extent of the contingent charges during the month fictitiously represented, are debited to "profit and loss." To meet this amount, a percentage (which in the course of a few months may be very approximately estimated) on all manufactured goods going out of the warehouse is charged, and the amount so realized credited to "profit and loss." Thus the factory not only exhibits itself as no expense to the Government, but returns 5 per cent. on the value of its dead stock; and, moreover, at once distributes its working expenses amongst those who have the best right to bear them, viz., the purchasers of manufactured articles, whether private individuals or Government departments.

6. On the third point, also, the best illustration of the advantages of a good system of bookkeeping that I can give, is the books themselves, and the explanations before adverted to; but to make this paper complete, I must, as briefly as possible, refer to them here. The particular system which I have illustrated in the appended forms is that known as "double entry," and is the one always adopted when large interests are at stake, and when a merchant is desirous of showing *good* books: it is accuracy itself, for no error can creep into the accounts without being detected when the balance-sheet is being made out. With a careful bookkeeper, the superintendent is relieved of all anxiety on the score of his accounts; every transaction being stamped in the day-book the moment it occurs, the rest follow in succession, and with this surety, the superintendent can devote the whole of his time to his legitimate duties. As explained in the instructions, the receipt or payment of money is confined entirely to the office; nobody has the handling of money but the cashier; and the subordinates of the factory who incur expense, either in labour or withdrawal of material from store, having each made up his portion of the daily abstract, are free of accounts. No delay, therefore, ought to occur in the books being kept up with regularity and expenditure, and a day's notice should be sufficient to produce a balance-sheet comprehensively showing the state of the affairs of the factory on any given date: in addition, the Government is assured as much as may be against fraud; for the foremen, overseers, and store-keepers, having nothing to do with payments, and the cashier being able to disburse money only on the indelible authority stamped on the daily abstracts, no collusion could possibly exist without being detected by a watchful manager. The "instructions" provide fully for the Government, and its offices of account being satisfactorily accounted to for what, in commercial phrase, may be styled the risk embarked in the factory, while, at the same time, from the comprehensiveness of the system of bookkeeping, the office work, not only in the factory, but in all the offices of control, is reduced to a minimum.

7. On the fourth point, my object is to secure the factory from the introduction of varying principles in the conduct of its account, which would inevitably create confusion, and suggest excuses for arrears. As the sales to private individuals must necessarily be cash transactions, I would make this the guiding principle, and demand similar cash payments from the various departments of Government that may purchase from the factory. Although this is a mere question of principle, it has many advantages over the present course; for the factory would be saved from submitting elaborately detailed bills twice over (one to Government and one to purchaser), and all the correspondence requisite for getting bills passed and their amounts debited to the various departments. And the department supplied with articles, having paid cash for them, is certain to bring the transaction on its books: not only, therefore, does that particular department become at once answerable for the cost of articles necessary to its operations, but the head offices of account are able to rapidly adjust the true value of the Government property in each of its departments—at least, as far as transactions with this factory are concerned. The money returns from these sources would often render the factory independent of advances from Government, and in this item also, save some measure of labour to its own and other offices of the State. The monthly account current which is to be submitted to the accountant shows how the factory would account for money so received.

8. In the accompanying forms of books and statements I have endeavoured to provide for the general wants of the factory; and in proceeding now to explain them, I shall enter upon other topics which will not only tend to make the proposed system understood, but be suggestive of the orders that may be necessary on the separation of the factory from the Ganges Canal Works, as "Instructions to the Superintendent."

9. The managing director has the general control of all the establishments attached to the Roorkee

factory; in him is vested authority for the appointment and dismissal of all permanent establishment, which comprises, in addition to the superintendent, deputy superintendent, practical engineers or foremen, overseers, misturees, warehouseman, storekeepers, bookkeeper, and clerks in the office, and no appointment or dismissal can be made in any of these ranks without his sanction.

10. The superintendent has the immediate and particular control of all the establishments, and of every department attached to the factory, and he has the arranging for, and disposing of, labour in such strength as the requirements of the work in progress, or about to be set in progress, may call for.

11. The superintendent's especial duties are, control, management, seeking, selecting, and purchasing material best adapted to the purposes of the factory, devising methods and ways for turning to the best use all the motive power, machinery, establishments, &c., that he has at his disposal, introducing improvements into existing designs, adapting simple machinery, calculated to come within the comprehension of the natives, to the purposes of more costly and intricate inventions, &c. &c.; and, in fact, while exercising a wholesome check upon everybody and everything placed under him, to endeavour by every means in his power to promote progress, and successfully work out the object of the founders of the institution.

12. The superintendent might place his office under the immediate charge of the deputy superintendent as one of his duties; and as all money is to be received into, and paid out of the office, he might constitute him "cashier"—he keeping the cash day-book (Form 1).

13. In the working of the factory, it will be found convenient to keep the manufactured goods distinct from all other stores, and of having a warehouseman (European assistant overseer) in charge of them, and for executing all orders that may be received. In the course of time, as the manufactured articles increase in extent and interest, a show-room might be erected, and the things so arranged, that visitors might at once see the quality and description of work the factory was able to turn out. The warehouseman should keep his account of stock in hand and issues, in a tabular form, similar to that (Form 2) appended for the storekeepers, so that the balance remaining in the warehouse, after each day's orders had been executed, might be seen at once, but the remaining account of the "receipts and issues" of each day should be kept in the Forms 2 *a* and 2 *b*.

14. The superintendent, being the receiver of all orders, would make any remarks upon them that he considered necessary, and send them to the office for entry into the order book (Form 3). This order book being sent to the warehouseman, he would execute them to the extent his stock admitted, and fill up the columns left in the book with information expected from him; with goods despatched he would always send a "list of stores despatched" (Form 4); and should the goods be going to a distance, which rendered an advance of cart hire necessary, he would note on this list the total amount of cart hire to be paid, the advance made by the factory, and the balance to be paid by the receiver of the goods. The presentation of this list by the chuprassy going in charge of the stores to the cashier, would be sufficient warrant for his paying the amount indicated. The invoice of such despatches would be made out from the order book and sent off by post, after its contents had been copied into the invoice book (Form 5). Every manufactured article sent out of the warehouse is to bear a percentage to cover the cost of the expenses of the factory; and this is added on in the office, the warehouseman's rates being those for the cost of material and labour only.

15. The office attached to the factory is to be formed and conducted on commercial principles; in it is to be comprehended every transaction connected with the working of the concern; nothing should go out of or come into the factory without passing through it; all money must be received into and paid from it; and with exception to muster-rolls (Form 8) and stock registers, no accounts whatever are to be kept away from it. The Daily Abstract Book will lie open in the office, and such subordinates as have to account for labour employed under them, stores issued or received, &c., will attend at the time that may be fixed upon for the purpose of entering into it the results of their day's operations. I deem it proper to leave to the superintendent, whose duty it especially is, the fixing of each subordinate's share in the filling up of this daily abstract; but my idea is, that a most excellent check might be established over this, the most important part of the factory, by the foremen and others having squads of workmen under them being made to keep a memorandum of the people employed, the materials received from stores, &c., in each of their sections; and when the general musterer was about to enter the details under each head of work, that they should compare

their memoranda with the return of the musterer—the same with the storekeepers—and attest the correctness of the entries by affixing each of their names to that portion which applied to their several sections. This daily abstract would form one of the most important of the auxiliary books required: the form already in use in the shops (Form No. 7) is probably as good a one as can be devised, and the only addition wanted is a general abstract, to be made up by the bookkeeper, in which he should extract the rate for each article manufactured and transferred to the warehouseman's books: generally, this would be made up at the end of every month for posting to the principal books; but if the article completed was to be sent away immediately, the abstract could at once be made out. The other auxiliary books are the Cash Day Book and the Stock Books, for which forms are given, and which require no explanation, their purposes being plainly stamped on their pages.

16. The principal books are the day-book, journal, and ledger; these are to be kept on the system known as "double entry," the grand objects being to secure to the factory a faithful record of its transactions with the least amount of labour, and to show that the factory pays the whole of its expenses, and returns to the Government 5 per cent. interest on its outlay in buildings and motive power. In drawing up the forms of these books, I have supposed that the superintendent has just received independent charge of the factory; that he has taken over from Lieut. Goodwyn the whole of the dead stock, machinery, tools, raw material, and manufactured goods, that exist on the date of the transfer; and that he, subsequently, receives an advance of money from the managing director. By the first account in the Ledger, "The Government of India," I prove that it gets the credit for these as well as for the interest on its dead stock, and by the last account, "The Balance Sheet," that the credit so given is the actual capital of the factory, and that the books are correct.

17. The Day Book and Journal are kept in one book; the former occupying the left page, the latter the right one; and much time and trouble are saved by this arrangement, besides the surety of accuracy; for if the entries in the Journal (which is the index to the Ledger) are correct, the totals of both its columns must agree, and also correspond with the total of the Day Book column. In the Day Book, we commence with an entry representing the value of the stock which we have to work upon, then follows the in-comings and out-goings as they occur; and on the last day of the month we bring forward in abstract the data afforded by the daily abstract in the expense that has been incurred in manufacturing; and the month's transactions are closed by the entries of all the contingent expenses of the month.

18. The Journal is deduced from the Day Book, and shows how the transactions are to be posted to the Ledger. Each Day Book entry calls for one Dr. and one Cr. in transferring it to the Journal, for the principle is that the Drs. must be equal to the Crs., and, therefore, the first item in the Day Book is transferred to the Journal as "stock Dr. to factory buildings, &c.," and "Cr. to the Government of India," whose property it is. The next entry in the Day Book is a draft, which it is not convenient to cash at once; it is consequently "Dr. to bills receivable," and "Cr. to the Government of India;" and when the cashing of the draft did take place, it is "Dr. to cash," and "Cr. to bills receivable;" the succeeding item "sales of manufactured goods," is "Dr. to Lieut. Goodwyn," the purchaser, and "Cr." partly to "manufactured goods," and partly to "profit and loss," the latter amount being the sum charged for factory percentage beyond the actual cost of the article, and which is a set-off to the contingent charges of supervising establishment, percentage for wear and tear of tools, and interest on dead stock, which are all "Dr. to profit and loss:" the folios of the Ledger to which the items are posted are also given.

19. The Ledger is the chief of all the books: a reference to it shows the exact state of each account, and also of the affairs of the concern for which it is kept; a balance-sheet drawn up from it, at any time that may be required, determining at once whether the factory is going on well or otherwise. In the book that I have prepared, the entries in the Journal before described are all posted to their separate accounts, and by following them out it will be easy to understand how the balance-sheet tests the correctness of all the accounts that have gone before it. I have only further to remark on this book that I have judged it proper that the profit and loss account of the Roorkee factory should admit on its debtor side only those contingent charges of its establishment, repairs of buildings, &c., which the purchasers of manufactured goods have

a right to pay, and on its credit side the sums realized by the percentage charged upon such goods; and that the value of the labour performed by steam-engines, after deducting the expense of working them, should, instead of going to the credit of profit and loss, form a fund either to decrease the amount value of dead stock, or to meet any unforeseen accident that may occur. This idea having been carried out in these accounts, we find that, after accounting to Government for all that is its due, there is a sum of 2,590 rupees still to be worked off by the charge of factory percentage on manufactured goods; the value of the stock of manufactured goods is 16,750 rupees: the 10 per cent., which has been assumed for the month illustrated, upon this sum is not enough therefore to cover the balance at debit of profit and loss, and during the subsequent month the factory percentage charge must be raised to 15 per cent.: accordingly, as each month's balance of profit and loss is exhibited with reference to the value of the stock of manufactured goods, so must the factory percentage be raised or decreased. As the charge for establishment, repairs, interest, &c., is nearly a constant quantity, the percentage fluctuates according to the work done, and the superintendent will therefore see that the more work he executes the lower will be the rate for factory percentage, and, consequently, the greater the credit due to his management. On the steam-engine working account, we see that there is a fund of 2,400 rupees to meet any accidents or for appropriation as may be decided upon.

20. The balances should be struck every month—the value of stock in hand being taken from the accounts. At the close of each year, it would be a safeguard that the balances of stock should be corrected by an inventory of everything being taken.

21. The book-keeper attached to the factory will understand that he is responsible for the correctness of the books, and for their being brought up with regularity. If, at the managing director's inspections, this is found not to be the case, the book-keeper alone will bear the censure.

22. Every manufactured article sent out of the factory is to be paid for by the purchaser, whether private individual or Government official, and the amount so realized carried to the Cr. of the factory by cash being made Dr. When other money is required for the purposes of the factory, application is to be made to the managing director.

23. The superintendent will submit to the managing director as soon as each month's accounts are closed:—1. Copy of the Ledger account with the Government of India; 2. Copy of the Ledger balance-sheet; 3. Account current (Form 6); 4. Copy of the Ledger cash account; 5. Copy of the abstract of the daily abstract; 6. Progress reports; 7. Acquittance rolls for salaries. Nos. 1, 2, 3, and 6, will be forwarded by the managing director to the military board for their and the Government's information. No. 3 will also be sent to the accountant, accompanied by the acquittance roll. Nos. 4 and 5 will be retained in the managing director's office, and will be his checks upon the factory.

24. The papers above indicated as having to be submitted to the Board will render every information to the Government that could possibly be desired. No. 3, from being in detail as regards the debits which are due to other departments for the purchase of manufactured goods, will place in the hands of the Board and accountant the means of checking the charges brought forward in those departments.

25. Changes in old-established customs, no matter how beneficial they may profess to be, are generally looked upon with suspicion; and, at first sight, it may be thought that in the proposals I have made there is an attempt to separate this particular institution from the connection and control which the Government now exercises over its several departments: I would, however, disclaim any such intention, and urge that the only object I have, and I trust that the preceding pages have proved it, is to introduce into this embryo factory and general furnishing warehouse sounder systems of account keeping, by which it shall have every encouragement to proceed on and arrive at that state of usefulness which is contemplated by its founders; and at the same time protect the interests of the Government immeasurably better than the present imperfect system admits of.

23*rd June*, 1852. (Signed) HARRY MARTEN, *Assistant.*

Form 1.—Form of Cash Day-Book.

Date.	Description.	Folio of Journal.	Expenditure.			Receipts.		
			RS.	A.	P.	RS.	A.	P.
1852. May 15	Received from the collector of Saharunpoor, cash in lieu of Director's draft No. 1 of 1852–53	1	...			10,000	0	0
„ 20	Paid to the Monkland Iron and Steel Company for iron	1	5,000	0	0	—		
„ 25	Received from Nychul for goods	1	...			110	0	0
„ 31	Paid labour for May, 1852	1	3,590	0	0	—		
	Paid permanent establishment for May, 1852	1	1,000	0	0	—		
	Total	...	9,590	0	0	10,110	0	0
„ 31	Cash balance in hand	...	520	0	0	—		
	Total	...	10,110	0	0	10,110	0	0
June 1	Cash in hand	...	...			520	0	0

Form 2.—Storekeeper's Account of Receipts and Issues of Iron.

Date.	From whom received, or to whom issued.	Bar rolled Iron 1½ inch.	Bar rolled Iron 1¾ inch.	Bar rolled Iron 3 inches.	Bolt Iron ⅞ inch.	Bolt Iron 1 inch.	Angle Iron 1 by ⅛.	Angle Iron 1½ by 3/16.	Rolled Iron 2 inches.
		MDS.	MDS.	MDS.	MDS.	MDS.	MDS.	MDS.	MDS.
1852. May 1	From Lieut. Goodwyn	100	100	100	200	500	500	400	—
„ 10	To Mr. ——, foreman	50	...	50	...	100	—	—	—
	May 10, balance	50	100	50	200	400	500	400	—
„ 20	From Monkland Company	500	...	...	...	...	...	...	500
	May 20, balance	550	100	50	200	400	500	400	500
„ 31	To Mr. ——, foreman	50	50	30	...	...	...	50	100
„ 31	To Mr. ——, foreman	50	25	10	100	300	—	—	—
		100	75	40	100	300	...	50	100
	May 31, balance	450	25	10	100	100	500	350	400

Form 2a.—Book of Receipts.

Date.	Description.	No.	Quantity.			Rate.	Amount.			Whence received.	Remarks.
			MDS.	S.	C.	RS.	RS.	A.	P.		
1853. Nov. 5	Tallow	...	20	0	0	8	160	0	0	Butcher.	
	Bel baskets	1,000	...			1 per 19	52	10	1	Bhanna contractor	
	Malla baskets	500	...			1 per 57	8	12	4	„ „	
	Iron flat bar, 4″ × 1″	...	50	0	0	...	...			Delhi magazine.	
	Old copper cuttings	...	0	10	8	...	...			Shops.	
	Old steel files	...	0	14	4	...	...			„	
	Bolts, first class	300	13	8	10	...	...			„	
	Brass borings and filings ...	...	0	4	14	...	...			„	
	Railway truck wheels	40	...			...	...			Ex. engineer.	
	Wrought-iron, first class ...	...	2	4	0	...	...			Forges.	
	„ „ second class ...	...	4	9	7	...	...			„	
	„ „ third class ...	...	15	4	9	...	...			„	
	Nails, second class	...	0	22	0	...	...			„	
	Lump iron	...	0	32	0	...	...			„	

FORM 2b.—BOOK OF ISSUES.

Date.	No. of Work.	Description.	No.	Quantity. MDS.	S.	C.	Remarks.
1853. Nov. 5	28	Phowrah blades	20	1	2	3	Making up.
	28	„ sockets	20	0	18	0	„
	28	Second-class nuts	...	0	1	4	„
	32	Leather buckets	20		...		Ex. engineer.
	32	Country twine	...	0	10	0	„
	Sold	Second class	...	0	2	0	Mr. Login.
	„	Putty	...	0	4	0	Dr. Burr.
	2	Old copper	...	0	4	0	Brass furnace.
	2	Zinc	...	0	1	0	„ „
	1	Old iron pieces	...	2	4	6	Forges.
	1	Iron, flat bar	...	4	17	3	„
	1	„ square	...	0	24	8	„
	1	„ rod	...	5	18	4	„
	1	„ Kheree	...	0	29	0	„
	1	Shear steel	...	0	1	8	„
	1	Cast steel	...	0	2	0	„

FORM 3.—FORM OF ORDER BOOK.

Folio of Sales Book.	Description of Articles, by whom required, and Date of Order.	Columns to be filled up by Warehouseman. Rate as standing on Warehouseman's Book. RS.	A.	P.	Date of Despatch.	Incidental Expenses.*	Rupees.	Date when Order was entirely completed.
	10th May, 1852. Lieut. A. G. Goodwyn, Executive Engineer Northern Division Ganges Canal, as per letter No. 5, of this date:—							
1	40 side tilt wagons, complete ... ... each	100	0	0	May 10			
	10 brick-making machines.							
	10 pile engines.							
	25th May, 1852. Nychul, carpenter, for ready money:—							
1	Carpenter's chest of tools ... ... each	100	0	0	May 25			1852. May 25th.
	31st May, 1852. Workshops:—							
1	1 carpenter's chest of tools ... ... each	100	0	0	May 31			1852. May 31st.
	1 smith's chest of tools ... ... each	50	0	0	May 31			

* The column for incidental expenses is intended to provide for the registration of expenses that may sometimes be incurred when goods are to be despatched to a distance. All advances to cartmen being made would appear here, and be duly included in the bill submitted to the purchaser. The attached form for warehouseman's "List of Stores despatched" will make this plain.

Form 4.—List of Stores despatched to Colonel Napier, Civil Engineer, Punjaub, in part of his Order, dated 1st July, 1852.

	RS.
Bholee Bux, Chuprassy in charge:—	
Jhams for block-sinking	50
Windlasses for ditto	50
Phourahs without handles	100
Brick-making machine	1
Conveyance :—	
Two four-bullock carts, engaged to deliver the above articles at Lahore for	30
Advanced by Roorkee workshops	5
Balance due, to be paid by Col. Napier	25

Roorkee Workshops, July 5th, 1852. A. B., *Warehouseman.*

Form 5.—Form of Invoice Book.

Date.	—	Rate. RS.	A.	P.	Amount. RS.	A.	P.	Total. RS.	A.	P.
May 10	Lieut. Goodwyn, Executive Engineer, Northern Division Ganges Canal :—									
	40 side tilt ballast wagons, complete with, &c. each	100	0	0	4,000	0	0			
	Add factory percentage, at 10 per cent.	...	...		400	0	0			
	Grand total	...	...		...	...		4,400	0	0
May 25	Nychul, carpenter, for cash :—									
	1 chest of carpenter's tools ... ... each	100	0	0	100	0	0			
	Add factory percentage, at 10 per cent.	...	...		10	0	0			
	Grand total	...	...		...	...		110	0	0
May 31	Factory :—									
	1 chest of carpenter's tools ... ... each	100	0	0	100	0	0			
	1 chest of smith's tools ... ... each	50	0	0	50	0	0			
								150	0	0

FORM 6.—*For the Month of May*, 1852.

The SUPERINTENDENT of the ROORKEE FACTORY in Account Current with the Honourable Company.

DR.

Date	Particulars	RS.	RS.	RS.
1852. May 1	To received from Lieut. Goodwyn, Executive Engineer, Northern Division Ganges Canal:—			
	Dead stock:—Factory buildings	50,000		
	Steam-engines	30,000	80,000	
	Current stock:—Machinery and tools ...	20,000		
	Iron	10,000		
	Timber	10,000		
	Manufactured goods ...	10,000	50,000	1,30,000
„ 15	To cash received in lieu of Managing Director's draft No. 1 of 1852–53		...	10,000
„ 30	To interest at 5 per cent. on dead stock		...	500
	Total		...	1,40,500

CR.

Date	Particulars	RS.	RS.
1852. May 31	By balance the property of Government carried to debit of the Roorkee factory	...	1,40,500
	Total	...	1,40,500

ROORKEE FACTORY.

DR.

Date	Particulars	RS.	RS.	RS.
1852. May 31	To balance due to Government of India		...	1,40,500
	To cash account:—			
	Received from Nychul for sales		110	
	To increased value of stock by purchase and manufacture during the month:—			
	Machinery and tools	150		
	Manufactured goods	11,000		
	Raw material	5,000	16,150	
	To profit and loss:—			
	Repairs of buildings	1,000		
	Permanent establishment	1,000		
	Percentage on tools	500		
	Interest on dead stock	500	3,000	
	To suspense account:—			
	Balance due from Lieut. Goodwyn		3,400	22,660
	Total		...	1,63,160

CR.

Date	Particulars	RS.	RS.
1852. May 31	By Department Public Works:—		
	Sales to Lieutenant Goodwyn, Executive Engineer, Northern Division Ganges Canal—40 side tilt wagons at 100 rupees each	4,000	
	Factory percentage	400	
	Total	4,400	
	Deduct amount of Lieutenant Goodwyn's bill for ordinary repairs to shops	1,000	3,400
	„ decrease of stock by issues to works and sales:—		
	Manufactured goods	4,250	
	Raw material	5,010	9,260
	„ cash account:—		
	Paid Monkland Company for iron	5,000	
	„ labour during the month	3,590	
	„ permanent establishment	1,000	9,590
	„ profit and loss:—		
	Factory percentage on sales	...	410
	„ balances:—		
	Dead stock	80,000	
	Machinery and tools	19,650	
	Raw material	19,990	
	Manufactured goods	16,750	
	Unrealized balances	3,400	
	Cash in hand	520	
	Balance against profit and loss account remaining to be worked off by factory percentage	2,590	
	Total	1,42,900	
	Deduct balance in favour of steam-engine account .	2,400	1,40,500
	Total	...	1,63,160

FORM 7.—DAILY ACCOUNT of Work done in the Roorkee Workshops during the Month of June, 1853.

Description.	Total of Labour or Materials.	Rate. RS. A. P.	Amount. RS. A. P.	Total. RS. A. P.
No. 1.—Wrought-iron Work.				
Smith's ...	14,507	½ as.	453 5 6	
Total of Labour				453 5 6
Iron, square	22 35 12	6 0 0	137 5 10	
„ rod ...	66 4 4	6 0 0	390 10 2	
„ flat ...	39 32 4	6 0 0	238 13 5	
„ sheet..	7 36 0	8 0 0	63 3 2	
„ country	10 18 0	4 4 0	44 6 7	
„ kheree	2 15 0	7 0 0	16 10 0	
„ 1st cl.	0 17 6	16 10 8	7 4 8	
„ square	0 26 0	5 8 0	3 9 2	
Steam Machinery —2nd class.	176	0 3 0	33 0 0	
Charcoal ...	1,610 0 0	0 6 0	603 12 0	
Total of Materials				1,544 11 0
Total				1,998 0 6
No. 2.—Casting Brass.				
Smith's ...	607	½ as.	18 5 6	
Total of Labour				18 5 6
Brass	0 7 0	0 8 0	3 10 0	
Zinc	0 21 0	0 5 3	6 14 3	
Copper......	2 21 0	54 0 0	136 5 7	
Solder	0 22 0	50 0 0	27 8 0	
Charcoal ...	23 0 0	0 6 0	8 10 0	
Total of Material				182 15 10
Total				201 15 4
No. 3.—Sundry Works for Capt. Goodwyn.				
Carpenters	193	½ as.	6 0 6	
Painters ...	60	½ as.	1 14 0	
Total of Labour				7 14 6
Turpentine	0 0 12	0 13 4	0 13 4	
Sâl Kurrie	16′	0 5 0	5 0 0	
Sâl Timber	12′	0 10 0	7 8 0	
Iron, 3rd cl.	1 10 0	10 0 0	12 8 0	
White paint	0 5 0	1 0 0	5 0 0	
Total of Material				30 13 4
Total				38 11 10

No. 1.—Wrought-iron Work.

June	Smith's	Iron, square MDS. S. C.	„ rod MDS. S. C.	„ flat MDS. S. C.	„ sheet MDS. S. C.	„ country MDS. S. C.	„ kheree MDS. S. C.	„ 1st cl. MDS. S. C.	„ square S.	Steam Machinery —2nd class.	Charcoal MDS.
1	816	1 22 0	1 14 0	1 14 0	0 25 0	1 18 0	0 12 0	...	...	...	70
2	823	1 39 0	3 7 0	0 14 0	1 0 0	1 5 0	0 7 8	...	...	...	70
3	...	...	...	...	...	...	...	...	...	...	...
4	746	...	0 7 0	0 5 8	1 2 0	...	...	0 2 8	...	...	70
5	774	4 9 0	10 0 0	4 22 0	...	1 35 0	0 10 0	...	...	...	...
6	822	1 33 0	2 26 8	4 27 0	0 38 0	1 18 0	0 7 0	0 2 0	...	...	100
7	828	...	...	...	...	...	...	...	...	...	...
8											
9											
10	...	...	...	...	...	...	...	...	...	...	200
11	834	3 13 0	4 26 0	6 31 0	1 33 0	1 8 0	0 18 0	...	26	...	...
12	691	2 13 12	14 8 0	1 26 0	0 21 0	...	0 8 0	...	...	...	...
13	802	1 6 0	3 17 0	0 35 0	0 26 0	0 30 0	0 8 0	...	...	...	400
14	777	0 39 0	2 9 0	3 2 8	0 26 0	0 8 0	...	...	...	...	...
15	731	0 31 0	0 4 0	0 27 8	0 6 0	0 36 0	0 7 8	...	...	...	...
16	583	0 22 0	2 3 0	6 22 0	0 14 0	...	0 10 0	...	...	...	...
17	...	0 38 0	...	...	...	...	...	...	...	...	...
18	564	0 27 0	2 27 0	0 27 0	...	1 2 0	...	...	...	...	200
19	550	...	0 31 0	0 11 0	...	0 3 0	...	0 2 0	...	...	...
20	590	...	0 4 8	...	...	...	...	...	...	...	...
21	296	0 32 0	...	...	...	...	...	...	...	...	...
22	564	...	1 12 0	5 28 0	...	0 9 0	...	...	...	...	...
23	30	...	...	...	...	...	...	0 3 0	...	...	200
24											
25	158	0 10 0	...	...	...	...	...	...	...	...	...
26	507	...	2 2 0	0 4 0	...	...	0 7 0	...	...	...	...
27	469	0 38 0	9 27 0	...	0 5 0	0 6 0	...	0 4 0	...	...	300
28	558	0 2 0	1 7 8	1 1 8	...	...	...	...	...	...	...
29	474	...	3 24 12	0 20 12	...	...	...	...	...	...	...
30	511	...	0 27 0	0 33 8	...	...	...	...	...	...	...

No. 2.—Casting Brass. No. 3.—Sundry Works for Capt. Goodwyn.

June	Smith's	Brass MDS. S. C.	Zinc MD. S. C.	Copper MDS. S. C.	Solder S.	Charcoal M.	Carpenters	Painters	Turpentine	Sâl Kurrie	Sâl Timber	Iron, 3rd cl. MDS. S. C.	White paint S.
1	28	0 0 12	...	...	...	23	21	...	...	...	...	1 10 0	
2	28	...	...	...	...	...	21						
3	...	0 0 8											
4	28	...	...	...	...	...	21						
5	28	...	0 6 0	0 22 0	...	...	21						
6	28	0 0 12	...	...	...	...	...	...	12				
7	28	...	...	...	...	...	15						
8													
9													
10	27												
11	27	0 1 8	0 12 0	1 0 0	22	...	...	10	...	...	...	...	5
12	21	...	...	...	...	...	...	10	...	16			
13	28	...	...	...	...	...	...	10					
14	28	...	...	...	...	...	...	10					
15	28	...	...	...	...	...	...	10					
16	...	...	...	...	...	...	...	10	...	...	12		
17	28												
18	28	...	...	...	...	...	21						
19	28	0 1 4	...	...	...	...	21						
20	28	...	...	0 7 0	...	...	21						
21	28	0 1 4	...	...	...	...	10						
22	...	...	...	...	...	...	21						
23													
24													
25	28												
26	28												
27	28	0 1 4											
28	28												
29	28	...	0 3 0	0 32 0									
30	28												

Day Book.

Date.	Description.	Rupees.	Amount. Rupees.
1852 May 1	Stock as received from Lieut. Goodwyn:—		
	Value of factory buildings, stock-book, page 1	50,000	
	" steam machinery " " 2	30,000	
	" machinery and tools " " 3	20,000	
	" iron in store " " 4	10,000	
	" timber in store " " 5	10,000	
	" manufactured warehouse goods, stock-book, page 6	10,000	
			1,30,000
" 5	Received from director of the works, draft on Saharunpoor:— Treasury, at sight, No. 1 of 1852–53 at 3rd current	..	10,000
" 10	Sold to Lieut. Goodwyn, Executive Engineer, Northern Division Ganges Canal:—		
	40 side tilt wagons complete, at 100 *rs.* each	4,000	
	Percentage of wear and tear, &c., at 10 *rs.* per cent.	400	
			4,400
" 15	Cashed the director's draft No. 1 of 1852–53	..	10,000
" 20	Bought from the Monkland Iron Company, for cash:— 1,000 maunds bar iron (various), stock-book, page 1, at 5 *rs.* per maund ..	..	5,000
" 25	Sold for cash, to Nychul, a carpenter's chest of tools	100	
	Percentage, at 10 *rs.* per cent.	10	
			110
" 31	Lieut. Goodwyn's bill to current repairs to buildings	..	1,000
	Received from the warehouse for the use of the shops:—		
	1 carpenter's chest of tools	100	
	1 smith's "	50	
			150
	Expended during the month, as per abstract-book:—		
	10 brick-making machines, completed and sent to warehouse:—		
	Iron	2,000	
	Timber	1,000	
	Manual labour..	3,000	
	Steam-engine labour	2,000	
			8,000
	10 pile engines, in progress:—		
	Iron	1,000	
	Timber	1,000	
	Manual labour..	500	
	Steam-engine labour	500	
			3,000
	Cost of repairs and working steam-engine:—		
	Labour..	90	
	Iron	10	
			100
	Cost of labour during May, 1852, as per pay-book	..	3,590
	Cost of permanent establishment for May, as per pay-book	..	1,000
	Percentage for wear and tear of tools	..	500
	Interest on value of dead stock, at 5 per cent.	..	500
			1,77,350

AND JOURNAL.

JOURNAL.

Folio of Ledger.	Dr.		Cr.		Folio of Ledger.
	Rupees.			Rupees.	
1	80,000	Dead stock.	Government of India	1,30,000	1
2	20,000	Machinery and tools.			
2	20,000	Raw materials.			
3	10,000	Manufactured goods.			
4	10,000	Bills receivable.	Government of India	10,000	1
4	4,400	Lieut. Goodwyn.	Manufactured goods..	4,000	3
			Profit and loss	400	5
4	10,000	Cash.	Bills receivable	10,000	4
2	5,000	Raw material.	Cash..	5,000	4
4	110	Cash.	Manufactured goods..	100	3
			Profit and loss	10	5
5	1,000	Profit and loss.	Lieut. Goodwyn	1,000	4
2	150	Machinery and tools.	Manufactured goods	150	3
3	8,000	Manufactured goods.	Raw material account	3,000	2
			Labour	3,000	6
			Steam-engine working	2,000	5
3	3,000	Manufactured goods.	Raw material account	2,000	2
			Labour	500	6
			Steam-engine working	500	5
5	100	Steam-engine working account.	Labour account	90	6
			Iron ,, ...	10	2
6	3,590	Labour account.	Cash	3,590	4
5	1,000	Profit and loss.	Cash	1,000	4
5	500	Profit and loss.	Machinery and tool account ..	500	2
5	500	Profit and loss.	Government of India	500	1
	1,77,350			1,77,350	

LEDGER.

Dr. The Government of India. Cr.

Date.	—	Folio.	Amount.	Date.	—	Folio.	Amount.
1852.			RS.	1852.			RS.
May 31	To balance	6	1,40,500	May 1	By stock	1	130,000
				„ 5	„ cash	1	10,000
				„ 31	„ interest on dead stock ...	1	500
					Total	...	1,40,500
	Total		1,40,500	June 1	By balance	...	1,40,500

Dr. Dead Stock. Cr.

1852.				1852.			
May 1	To value of	1	80,000	May 31	By balance	6	80,000
June 1	To balance		80,000				

Dr. Machinery and Tools. Cr.

1852.				1852.			
May 1	To value of	1	20,000	May 31	By profit and loss	1	500
	„	1	150		„ balance	6	19,650
	Total		20,150		Total	...	20,150
June 1	To balance		19,650				

Dr. Raw Material. Cr.

1852.				1852.			
May 1	To value of	1	20,000	May 31	By manufactured goods ...	1	3,000
	„ purchase Monkland Company	1	5,000		„ „ ...	1	2,000
					„ repairs steam-engine ...	1	10
					„ balance	6	19,990
	Total	...	25,000		Total	...	25,000
June 1	To balance	...	19,990				

Dr. Manufactured Goods. Cr.

1852.				1852.			
May 1	To value of	1	10,000	May 10	By sales Lieut. Goodwyn ...	1	4,000
	„ additions ...	1	8,000	„ 25	„ Nychul	1	100
	„ „ ...	1	3,000	„ 31	„ to shops	1	150
					By balance	6	16,750
	Total	...	21,000		Total	...	21,000
June 1	To balance	...	16,750				

DR. **BILLS RECEIVABLE.** CR.

Date.	—	Folio.	Amount.	Date.	—	Folio.	Amount.
			RS.				RS.
1852. May 5	To Director's draft	1	10,000	1852. May 15	By cash	1	10,000

DR. **LIEUT. GOODWYN, Executive Engineer, Northern Division Ganges Canal.** CR.

1852. May 10	To sundries	1	4,400	1852. May 31	By work performed	1	1,000
					,, balance	6	3,400
	Total	...	4,400				
June 1	To balance	...	3,400		Total	...	4,400

DR. **CASH.** CR.

1852. May 15	To cash for Director's draft ...	1	10,000	1852. May 20	By Monkland Company ...	1	5,000
,, 25	,, sales	1	110	,, 31	,, labour	1	3,590
					,, salaries	1	1,000
	Total	...	10,110		,, balance	6	520
June 1	,, balance	...	520		Total	...	10,110

DR. **PROFIT AND LOSS.** CR.

1852. May 31	To repairs buildings	1	1,000	1852. May 10	By manufactured goods ...	1	400
	,, permanent establishment ...	1	1,000		,, ,, ,, ...	1	10
	,, percentage on tools ...	1	500		,, balance	6	2,590
	,, interest on dead stock ...	1	500				
	Total	...	3,000				
June 1	,, balance	...	2,590		Total	...	3,000

DR. **STEAM-ENGINE (Working Account).** CR.

1852. May 31	To repairs, attendance, &c. ...	1	100	1852. May 31	By manufactured goods ...	1	2,000
	,, balance	...	2,400		,, ,, ,, ...	1	500
					Total	...	2,500
	Total	...	2,500	June 1	,, balance	...	2,400

N.B.—In actual practice it has been found better to carry the profit on this account to meet the charges for wear and tear of machinery.

DR. **LABOUR ACCOUNT.** CR.

Date.	—	Folio	Amount.	Date.	—	Folio.	Amount.
			RS.				RS.
1852. May 31	To cash	1	3,590	1852. May 31	By 10 brick machines ...	1	3,000
					„ 10 pile engines	1	500
					„ steam-engine	1	90
	Total	...	3,590		Total	...	3,590

DR. **BALANCE SHEET.** CR.

1852. May 31	To dead stock	1	80,000	1852. May 31	By profit on working steam-engine	5	2,400
	„ value of machinery and tools	2	19,650		„ balance, being next capital	1	1,40,500
	„ „ raw materials ...	2	19,990				
	„ „ manufactured goods...	3	16,750				
	„ due from Lieut. Goodwyn	4	3,400				
	„ cash in hand	4	520				
	„ profit and loss	5	2,590				
	Total	...	1,42,900		Total	...	1,42,900

FORM 8.

No. 26. ———, November, 1853.

Carpenters.	Rate.	Wheelbarrows for Lieutenant Dyas.																														Total.
			2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
Bahadur	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Bhola (1)	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Boodhie	9	..	9	..	9	9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	9	9	9	..	9	9	9	..	81
Chotoo	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Chundee (3)	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Deeheedeen (2)	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Deeal	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Goolah	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Jahana	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Mulka............	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Jeet...............	9	..	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	9	9	9	..	9	9	9	..	225
Noor Mahomed	9	..	9	9	9	9	..	9	9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	54
Total	...	..	108	99	108	108	..	99	99	90	90	90	90	..	90	90	90	90	90	90	..	90	90	90	99	99	99	..	99	99	99	..	2385

Dead Stock (the Property of the Government of India), Roorkee Factory.

Buildings.		Interest at the rate of 5 per cent. credited to Government.		Steam Engines.		Interest at the rate of 5 per cent. credited to Government.	
1st May, 1852. (To be detailed in such manner that the description of rooms, number, measurements, &c., may at any time be known)	RS. 50,000	31st May, 1852	RS. 300	1st May, 1852. (To be detailed in such manner that principal parts may be recognized)	RS. 30,000	31st May, 1852	RS. 200

*** It will be understood that the dates and amounts of interest are noted without regard to accuracy, and only to preserve the order of the Day Book. The form also may be improved upon, for this is only given as suggestive of what is required to fix the record of original dead stock.

Dr. Machinery and Tools employed and used in the Factory. Cr.

Date.	Description.	Amount.	Total.
1852.		RS.	RS.
May 1	Received from Lieut. A. G. Goodwyn, Executive Eng., Northern Division Ganges Canal:—		
	1 5-inch centre Holtzapfell's lathe, &c. &c.	2,000	
	2 „ „ „ at 2,000 *rs.*	4,000	
	Punching and shearing machine	1,000	
	50 anvils, at 20 *rs.*	1,000	
	50 carpenters' chests of tools, at 100 *rs.*	5,000	
	50 smiths' ditto at 50 *rs.*	2,500	
	50 forge bellows, at 10 *rs.*	500	
	500 forge hammers, at 2 *rs.*	1,000	
	100 dozen files, as below, at 5 *rs.*:—	500	
	25 dozen smooth round, 8-inch		
	25 „ bastard round, 8-inch		
	25 „ „ pottam, 5-inch		
	25 „ „ safe edge, 10-inch		
	500 smiths' beck irons, at 2 *rs.*	1,000	
	Screw augurs, as below:— RS.		
	2 dozen long screw, with eyes, ½-inch, at 20 *rs.* ... 40		
	2 „ „ ¾-inch, at 25 *rs.* ... 50		
	2 „ „ 1 -inch, at 30 *rs.* ... 60		
	5 „ „ 1⅛-inch, at 40 *rs.* ...200		
	4 „ „ 1½-inch, at 50 *rs.* ...200		
		550	
	50 hand vices, at 5 *rs.*	250	
	50 best Turkey stones, at 10 *rs.*	500	
	1 grindstone	200	
			20,000
May 31	Received from warehouse:—		
	1 carpenters' chest of tools	100	
	1 smiths' chest of tools	50	
			150
	Total	...	20,150
1852. June 1	To balance	...	19,650

Date.	Description.	Amount.	Total.
1852.		RS.	RS.
May 31	By percentage of wear and tear, charged to profit and loss	...	500
	By balance	...	19,650
	Total	...	20,150

N.B.—This account current is for the office. The storekeeper would keep his stock in a tabular form, enabling the authorized person to affix his initials to anything written off, that may have been condemned as unserviceable.

DR. **IRON ACCOUNT.** CR.

Date.	Description.	Amount.	Total.	Date.	Description.	Amount.	Total.
1852.		RS.	RS.	1852.		RS.	RS.
May 1	Received from Lieut. A. G. Goodwyn, Executive Eng. Northern Division Ganges Canal:—			May 31	Issued to works during the month, as per daily abstract, and as per storekeeper's account	...	3,010
	100 bars rolled iron 1½-in. ... 100 mds.				By balance	...	11,990
	100 „ „ 1¾-in. ... 100 „						
	100 „ „ 3 -in. ... 200 „						
	200 bolts „ 0⅞-in. ... 200 „						
	500 „ „ 1 -in. ... 500 „						
	500 bars angle iron 1×½-in. ... 500 „						
	400 „ „ 1½×3-16-in. ... 400 „						
	Total ... ... 2,000 at 5 *rs.* per md. ...	10,000	10,000				
May 20	Bought from the Monkland Iron and Steel Company, as per invoice of this date:—						
	500 bars rolled iron 1½-in.... 500 mds.						
	500 „ „ 2-in. .. 500 „						
	Total ... ... 1,000 at 5 *rs.* per md. ...	5,000	5,000				
	Total	...	15,000		Total	...	15,000
June 1	To balance ... ... (Detail of stock to be given with rates.)	...	RS. 11,990		Here, again, this account is merely for the office. The storekeeper must keep his in a tabular form, with all detail. Form for this is appended, and the same form will answer for all the storekeepers, if there are more than one.		

DR. **TIMBER ACCOUNT.** CR.

Date.	Description.	Amount.	Total.	Date.	Description.	Amount.	Total.
1852.			RS.	1852.			RS.
May 1	Received from Lieut. A. G. Goodwyn, Executive Eng. Northern Division Ganges Canal:—			May 31	Issued to works, as per daily abstract, and as per storekeeper's account	...	2,000
	(Detail articles, as in Iron Account)	...	10,000		By balance	...	8,000
	Total	...	10,000		Total	...	10,000
June 1	To balance ... ... Detail.	...	RS. 8,000		See remarks to Iron Account.		

DR. **MANUFACTURED GOODS ACCOUNT.** CR.

Date.	Description.	Amount.	Total.	Date.	Description.	Amount.	Total.
1852.		RS.	RS.	1852.		RS.	RS.
May 1	Received from Lieut. A. G. Goodwyn, Executive Eng. Northern Division Ganges Canal:—			May 10	By sales to Lieut. Goodwyn	4,000	
	(Detail articles as in Iron Account)	...	10,000		„ to Nychul, carpenter	100	
May 31	10 brick-making machines, at 800 *rs.*	8,000	—		By issues to workshops	150	4,250
	10 pile engines in progress	3,000	11,000		By balance	...	16,750
	Total	...	21,000		Total	...	21,000
1852. June 1	To balance	16,750			*** The warehouseman should also keep his own account in a tabular form, so that on the receipt of orders he can at once tell, by reference to it, whether he has the article in store or not.		

APPENDIX M.

LIST OF BOOKS *belonging to the* GANGES CANAL PROFESSIONAL LIBRARY *on the* 1*st of April*, 1854.

	Vols.
Acts and Orders, 1840–43, 4to	1
Adam's Astronomical Essays, 8vo	1
Adcock's Data, 8vo	1
Admiralty Manual of Scientific Inquiry, 8vo	1
Aide Mémoire to the Military Sciences, 8vo	3
Alban's High Pressure Steam Engine, 8vo	2
Algebraical Geometry (Library of Useful Knowledge), 8vo	½
American Machinery, Drawings of, fol.	1
Andrews' Agricultural Engineering, post 8vo	1
Annals and Magazine of Natural History, 8vo	6
Archer's Collodion Process, 8vo	1
Architecture, Building, and Carpentry (Encyclopædia Britannica), 4to	1
Armstrong on Boilers, 8vo	1
Babbage's Economy of Manufactures, post 8vo	1
Baker and Jones's Canal Reports, N. W. P., fcap	1
Barlow's Encyclopædia of Arts, Manufactures and Machinery, 4to	1
Barlow on Materials, 8vo	1
Bartholomew's Specifications for Architecture, 8vo	1
Beardmore's Hydraulic Tables, 8vo	1
Bell's Plates of the Brain, 4to	1
Bennett's Geometrical Illustrations, 4to	1
Bland on Arches, 8vo	1
Blair's Grammar of Philosophy, 12mo	1
Boileau's Lectures on Iron Suspension Bridges, 8vo	1
„ „ „ 8vo	1
Bossut et Viallet sur les Digues, 4to	1
Bossut's Hydrodynamique, 8vo	2
Bourne's Great Western Railway, imp.	1
„ London and Birmingham Railway, imp.	1
Bourne on the Screw Popeller, 4to	1
Brande's Dictionary of Science, Literature and Arts, 8vo	1
„ Manual of Chemistry, 8vo	2
Brandon's Parish Churches, 4to	2
Bree's Railway Practice, 4to	4
Brooks' Designs for Cottage and Villa Architecture, 4to	1
Brooks on the Improvement of River Navigation, 8vo	1
Buchanan's Mill Work, 8vo	1
„ and Examples of Modern Tools, 4to	1
„ „ „ atlas, imp.	1
„ on Tools and Machines, royal 8vo	1
Buchanan on Tools and Machines, plates, folio	1
Buffon's Cours d'Eau, 8vo	2
„ Traités d'Irrigation, 8vo	3
„ „ plates, demy 4to	1
Builder, 1843–1851, royal 4to	9
„ 1852, royal 4to	1
Burnett's Patent Process of Preserving Timber, &c., 8vo	1
Byrne's Practical Model Calculator, 8vo	1
Calcutta Journal of Natural History, 8vo	8
Cautley's Reports on Canals, N. W. P., fcap	1
Civil Engineers' and Architects' Journal, 1838–1851, roy 4to	14
„ „ 1843 and 1844, roy. 4to	2
„ „ „ 1852, royal 4to	1
„ Institution, Transactions of, 4to	3
Clarke's Britannia and Conway Bridges, demy	2
„ „ „ plates, imp.	1
Conversations on Chemistry, 8vo	2
Craig's Lectures on Drawing, 8vo	1
Cresy's Encyclopædia of Civil Engineering, 8vo	1
Dana's System of Mineralogy, 8vo	1
„ Manual of Mineralogy, post 8vo	1
Daniell's Elements of Meteorology, 8vo	2
Davy on Foundations, 8vo	1
De Cessart's Travaux Hydrauliques, 4to	2
Delabeche's Geological Observer, 8vo	1
De la Lande's Canaux de Navigation, royal	1
De la Rive on Electricity. Vol. I. 8vo	1
Della Condotta dell Acque (Romagnosi), 8vo	6
De Morgan's Calculus (Library of Useful Knowledge), 8vo	1
Dempsey's Iron and Brick Bridges, and Iron Roofing, 4to	1
„ „ „ plates, imp.	1
Directions to Collectors of Land Revenue, 1848, 8vo	1
Dixon's Mairwarra, 4to	1
Douglas on Naval Gunnery, 8vo	1
Downing's Architecture of Country Houses, 8vo	1
Drewry on Suspension Bridges, 8vo	1
Dubuat's Hydraulics, 4to	1
„ „ 4to	1
Everest's Measurement of the Meridional Arc of India, 4to	1
„ „ „ plates, 4to	1

	Vols.
Elliot's Practical Geometry (Oordoo), 8vo	1
Elmes' Metropolitan Improvements, 4to	1
Ewbank's Hydraulic Machinery, 8vo	1
Fau's Artistic Anatomy, 8vo	1
„ „ Atlas, 4to	1
Fergusson's Mechanics, 8vo	2
„ Lectures on Mechanics, 8vo	1
Fiumi Laghi e Canali di Milano, super-royal	1
Forget's Electricity and Animal Physiology, 8vo	1
Frome's Trigonometrical Surveying, 8vo	1
Fulton on Canal Navigation, 4to	1
Gauthey's Canaux de Navigation, medium	1
Geography of Architecture, 8vo	2
Goodwyn's Memoir on Cast Iron Roofing, 4to	1
Gothic Ornaments of Lavenham Church, 4to	1
Graham's Elements of Chemistry, 8vo	1
Grant's Outlines of Comparative Anatomy, 8vo	1
Greece, Antiquities of, 8vo	2
Gregory's Mathematics for Practical Men, 8vo	1
Gwilt on Arches, 8vo	1
„ Architectural Criticisms, 8vo	1
Hagean's Canal de Jonction de la Meuse au Rhin, 4to	1
„ „ „ plates, royal	1
Hamilton's East India Gazetteer, 8vo	2
„ „ 8vo	1
Hay on Form, 4to	1
Henslow's Botany, 8vo	1
Herschel's Outlines of Astronomy, 8vo	1
„ Natural Philosophy, fcp 8vo	1
Higgins on Cements, 8vo	1
Hodgkinson on Cast Iron, 8vo	1
Holtzapfell's Turning and Mechanical Manipulation, 8vo	3
Hughes on Road Making, 8vo	1
Hughes's Principles of Geography (Oordoo), 8vo	1
Humboldt's Cosmos, (vol. 1), 8vo	1
Hutton's Recreations, 8vo	4
Indian Register of Medical Science, 8vo	1
Inman's Report on Ventilation, 8vo	1
Institution of Civil Engineers, 1844–47, 1849–50, 8vo	5
Iron Roof of New Houses of Parliament, 4to	1
Jackson's Military Surveying, 8vo	1
Jebb's Report on the Pentonville Prison, 1844–46, fcap	1
Johnson's Physical Atlas, imp.	1
Jones on Annuities (Library of Useful Knowledge), 8vo	2
Journal of Asiatic Society of Bengal, 8vo	9
„ Agricultural Society of India, 8vo	3
Kater and Lardner's Mechanics, 8vo	1
Knapp's Chemical Technology, 8vo	3
Kraft's L'Art de la Charpente, imp.	1
Lander's Floods in Moray, 8vo	1
Lardner's Railway Economy, post 8vo	1
Leach's Inland Navigation, 8vo	1
Lecount on Railways, 8vo	1
Lectures (Faraday's) on the Non-Metallic Elements, fcp 8vo	1
Leroy's Traité de Géométrie Descriptive, 4to	1
Liebig's Letters on Chemistry, 8vo	1
„ Agricultural Chemistry, 8vo	1
Lindley's Botany, (Library of Useful Knowledge), 8vo	½
London and its Environs, Topographical and Geological, 1851, 8vo	1

	Vols.
Loudon's Encyclopædia of Gardening, 8vo	1
Lyell's Elementary Geology, 8vo	1
„ Principles of Geology, 8vo	1
MacCulloch's Commercial Dictionary, 8vo	2
„ Geographical Dictionary, 8vo	2
MacNeil's Earthwork Tables, 8vo	1
Mahan's Civil Engineering, 4to	1
Martin's Circle of Mechanical Arts, m. 4to	1
Mathematics (Library of Useful Knowledge), 8vo	2
Mechanic's Magazine, 8vo	10
Miller's Principles of Physics and Meteorology, 8vo	1
„ Science of War, 8vo	1
Millington's Mechanical Philosophy, 8vo	1
Mitchell's Patent Screw Piles and Moorings, 8vo	½
Moseley's Engineering and Architecture, 8vo	1
„ Illustrations of Mechanics, 8vo	1
„ Mechanics applied to the Arts, 8vo	1
Murray's Encyclopædia of Geography, 8vo	2
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Naturalist's Library (Animals), 8vo	13
„ „ (Birds), 8vo	4
Natural Philosophy (Library of Useful Knowledge), 8vo	4
„ „ „ 8vo	4
Nautical Almanack for 1836–38, and 1842–46, 8vo	6
Naval Dry Docks of the United States, royal 4to	1
Navier's Mémoires sur les Ponts Suspendus, 4to	1
„ „ „ plates, oblong	1
Nichol's Architecture of the Heavens, 8vo	1
Nicholson's Principles of Architecture, 8vo	3
„ Architectural Dictionary, 4to	2
Notes on Building and Road Making, 8vo	1
O'Shaughnessy's Bengal Pharmacopœia, 8vo	1
Overmann's Manufacture of Iron, 1850, 8vo	1
„ „ 1851, 8vo	1
„ „ Steel, 8vo	1
„ Mineralogy, fcap 8vo	1
„ Moulder's and Founder's Guide, fcap 8vo	1
Paley's Baptismal Fonts, 8vo	1
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Parnell's Treatise on Roads, 8vo	1
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„ on Lime and Cements, 8vo	1
„ on Measures, Weights, and Money, 8vo	1
„ Military Policy, 8vo	1
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Phillip's Inland Navigation, 8vo	1
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Pocock's Finishings, 4to	1
Practical Geometry (Library of Useful Knowledge), 8vo	1

	Vols.
Professional Papers of the Royal Engineers, royal 4to	2
Professional Survey of Old and New London Bridges, 8vo	½
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„ and Mackenzie's Specimens of Gothic Architecture at Oxford, 4to	1
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Quekett on the Microscope, 8vo	1
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Report on the Boundary between Guntoor and Masulipatam, 1850, 8vo	1
„ on the Harbours of Refuge to be constructed at Dover and Holyhead, fcap	1
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„ on Grand Trigonometrical Survey of India, fcap	1
„ of Nizamut Adalut, of 1842–43, 4to	1
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„ „ „ Lower Provinces, 1845–46—1850–51, 8vo	6
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Stuart and Revett's Athens, imp.	4
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Telford, Sir Thomas, Life of, 4to	1
„ „ Atlas, imp.	1
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„ „ „ Supplementary, 1851, 8vo	1
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Weale's Architectural Drawing Book, 8vo	1
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„ Ensamples of Railway-making, post 4to	1
„ Papers on Civil Engineering, 4to	5
„ Public Works of Great Britain, imp.	1
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„ „ „ plates, medium 4to	2
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Weisbach's Mechanics of Machinery, 8vo	2
Whewell's Astronomy and Physics, 8vo	1
„ History of the Inductive Sciences, 8vo	3
„ Mechanics, 8vo	1
„ Philosophy of Inductive Sciences, 8vo	2
Whitlaw and Stuart's Water Mill, 8vo	1
Weibeking's Traité sur la Construction des Ponts, 4to	1
„ „ „ 4to	1
„ „ „ plates, imp.	1
Wilmes's Hand-Book of Mapping, 4to	1
Wilson's Ariana Antiqua, 4to	1
Wishaw's Railways of Great Britain and Ireland, imp.	1
Wood's Principles of Mechanics, 8vo	1

LIST OF BOOKS *belonging to the* NON-PROFESSIONAL LIBRARY *of the* GANGES CANAL *on the* 1st *of April*, 1854.

	Vols.
Acts and Gospels in Oordoo, 8vo	1
Apocalypse Revealed, by Swedenborg, post 4to	2
Christian Philosopher, by Dick, 8vo	1
Evil, on the Origin of, by Archbishop King, 4to	1
Four Leading Doctrines of the New Church, 8vo	1
Heaven and Hell, by Swedenborg, post 4to	1
Introduction to the Bible, Horne's, 8vo	1
Natural Theology, by Paley, 12mo	2
,, ,, 8vo	2
New Jerusalem, by Swedenborg, post 4to	1
Physical Evidence of a Future Life, by Bakewell, post 4to	1

HISTORY AND BIOGRAPHY.

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Annual Biography and Obituary for 1817 and 1823, 8vo	2
Army in Spain under Sir John Moore, 8vo	1
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,, ,, Vaughan (Library of Useful Knowledge), 8vo	2
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,, ,, by Gifford, 4to	2
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George the Second, Memoirs of the Reign of, by Lord Hervey, 8vo	2
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Goldsmith, Oliver, Life of, by W. Irving, 8vo	1
,, ,, ,, 8vo	1
Grammont, Count, Memoirs of, 8vo	3
Greece, History of (Library of Useful Knowledge), 8vo	1
Gresham, Sir T., Life of, Macfarlane's, 12mo	½
Haydn's Dictionary of Dates, 8vo	1
Hindostan, History of, Dow's, 8vo	3
Historical Essays, by Lord Mahon, 8vo	1
,, Parallels, by A. Malkin, M.A., 12mo	1
Impey, Sir Elijah, Memoirs of, by his Son, 8vo	1
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Johnson, Doctor S., Life of, Boswell's, 8vo	4
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Lafarge, Madame, Memoirs of, 8vo	1
Literature of England, History of, 12mo	3
,, Greece, History of (Library of Useful Knowledge), 8vo	1
Lives of the Early Italian Painters, 12mo	1
,, Eminent Persons (Lib. of Useful Knowledge), 8vo	1
London, History of, Mackay's, 8vo	1
Louis Philippe, Life and Times of, Wright's, 8vo	1
,, XVIII., Life of, written by Himself, 8vo	2
,, XIV. and the Court of France, by Miss Pardoe, 8vo	3
Mahomet, Life of, by W. Irving, 8vo	1
Mammalia, History of the, 12mo	3
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Munro, Sir J., Life of, 8vo	1
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Narrative of the Insurrection at Benares, 4to	1
,, ,, ,, 4to	1
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Ney, Marshal, Memoirs of, 8vo	1
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Sale's Brigade in Affghanistan, by Gleig, 8vo	½
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Selections from the Records of the Government of India, Sir C. Napier's Resignation, 4to	1
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	Vols.
Spain and Portugal, History of (Library of Useful Knowledge), 8vo	1
Statesmen of the Time of George III., Brougham, 12mo	3
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Vienna, Two Sieges of, by the Turks, 8vo	½
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Wraxall's Posthumous Memoirs, 8vo	1

Novels and Romances.

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„ „ 8vo	3
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Love and Pride, 8vo	3
Master Humphrey's Clock, by Dickens, 8vo	1
Michael Armstrong, by Mrs. Trollope, 8vo	
Miser, by Carleton, 8vo	
Mysterious Marriage, 8vo	4
Northword, or the Friendship of a Jesuit, 8vo	1
Our Street, by Thackeray, 8vo	1
Pamela, Richardson's, demy 4to	1
Paris Sketch Book, Thackeray's, 8vo	2
Pelham, Bulwer's, 8vo	1
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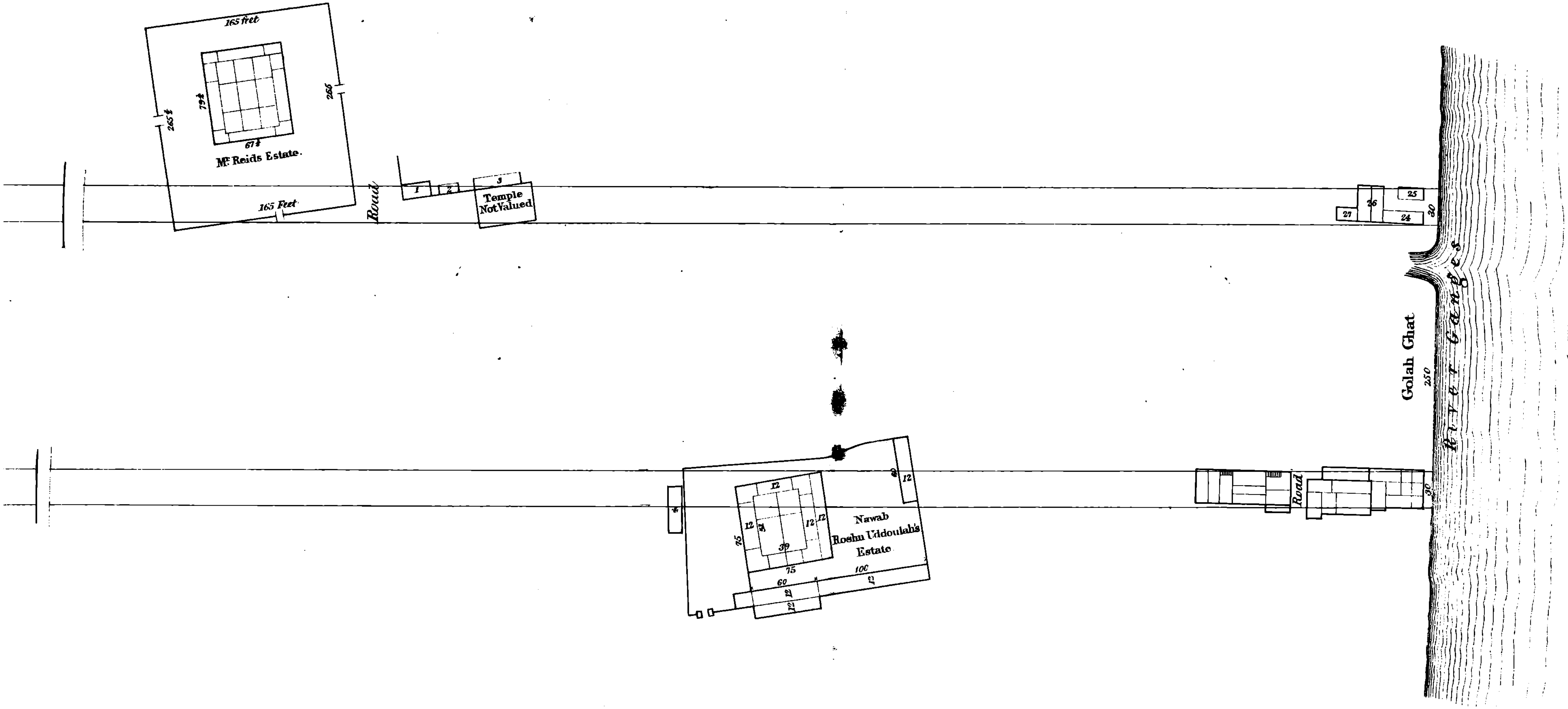

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APPENDIX N.

Valuation Statements *of* Property *at* Cawnpoor *falling within the* Canal Boundaries.

Survey Report of a Committee appointed by orders of the Brigadier Commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required by the Ganges Canal through the Suddur Bazar and Cantonment.—*Cawnpoor, 27th February*, 1851.

FIRST SECTION.

President—Major C. Troup.

Members—Captain G. R. Siddons, Captain T. Riddell, Lieutenant R. Wroughton, Syud Nasir Alli Khan, *Deputy Magistrate*.

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Ghoolameekhan ... (Valuation, 208 *rs.* 12 *a.* 9 *p.*)	15 rooms; average dimensions about 14½ by 8 feet; walls of 8 rooms of kutcha pukka masonry, remainder of mud; height of walls about 13 feet; roofs of 14 kutcha, and 1 of pukka, bad, and remainder in pretty good order.	Owner not present; 1,740 superficial feet, at 8 *rs.* per 100, equal to 139 *rs.* 3 *a.* 2 *p.*; cost for labour, at 3 *rs.* per 100 superficial feet, 52 *rs.* 3 *a.* 2 *p.*
2. Gungadeen ... ... (Valuation, 200 *rs.*)	7 rooms; average 11′ by 8′; 5 kutcha roofs on wall 10′ high, 2 tile roofs on walls 8½′ high; walls of mud, front wall on posts.	Owner present; 616 superficial feet, at 7 *rs.* per 100, part of house, &c., only to be taken for canal line, equal to 43 *rs.* 1 *a.* 11 *p.*; cost of labour, at 2 *rs.* 4 *a.* per 100, 13 *rs.* 13 *a.* 9 *p.*
3. Sewa Ram ... ... (Valuation, 200 *rs.*)	5 rooms; average 9½′ by 8′; 4 kutcha roofs on walls of mud 10′ high, 1 roof of tiles; front wall of kutcha pukka masonry, in good order.	Owner present; 380 superficial feet, at 10 *rs.* 8 *a.* per 100, equal to 40 *rs.*; labour, at 2 *rs.* 8 *a.* per 100, 9 *rs.* 8 *a.*
4. Muddun Mohun ... (Valuation, 550 *rs.*)	4 rooms; average 13½′ by 8¼′; 2 roofs kutcha on mud walls, and 2 tile roofs ditto; 2 tiled sheds in rear of rooms.	Owner present; 556 superficial feet, at 10 *rs.* per 100, and 3 for a well, equal in all to 58 *rs.*; labour, at 2 *rs.* 8 *a.* per 100, 12 *rs.* 14 *a.*
5. Deoke Nundun ... (Valuation, 1,200 *rs.*)	12 rooms; average 19½′ by 7′; 4 kutcha roofs on mud walls, 1 of thatch and the rest of tile.	Owner present; 1,638 superficial feet, at 10 *rs.* per 100, equal to 163 *rs.* 12 *a.* 9 *p.*; labour, at 2 *rs.* 8 *a.* per 100, 40 *rs.* 15 *a.* 2 *p.*
6. Santoo ... ... (Valuation, 136 *rs.*)	9 rooms; average 12½′ by 7′; 5 kutcha roofs, 4 tiled; walls of mud; 1 kutcha pukka well 3 feet diameter.	Owner present; 787½ superficial feet, at 6 *rs.* per 100, with a well at 5 *rs.*, equal to 52 *rs.* 4 *a.*; labour, at 2 *rs.* 8 *a.*, 19 *rs.* 10 *a.* 10 *p.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
7. Boodhoo ... ... (Valuation, 500 *rs.*)	16 rooms; average 14½′ by 7′; 9 roofs of thatch, and the rest of tiles, on mud walls, in tolerable order, about 9′ high.	Owner present; 1,624 superficial feet, at 7 *rs.* per 100, equal to 113 *rs.* 10 *a.* 10 *p.*; labour, at 2 *rs.* 4 *a.*, 36 *rs.* 8 *a.* 7 *p.*
8. Goolall ... ... (Valuation, 175 *rs.*)	10 rooms; average 19′ by 9′; 6 kutcha roofs, rest of tiles; mud walls in good order.	Owner present; 1,530 superficial feet, at 7 *rs.* per 100, equal to 107 *rs.* 1 *a.* 7 *p.*; labour, at 2 *rs.* 8 *a.*, 38 *rs.* 4 *a.*
9. Jemadoss ... ... (Valuation, 941 *rs.*)	46 rooms; average 15½′ by 7′; 34 kutcha roofs, and 12 of tiles; walls of mud.	Owner present; 4,991 superficial feet, at 6 *rs.* per 100, equal to 299 *rs.* 7 *a.* 3 *p.*; labour, at 2 *rs.*, 99 *rs.* 14 *a.* 9 *p.*
10. Sadoo ... ... (Valuation, 227 *rs.*)	7 rooms; about 12′ by 6½′; 6 roofs kutcha, 1 tiled; 2 rooms are 2 stories high, on mud walls.	Owner not present; 637 superficial feet, at 7 *rs.* 8 *a.* per 100, equal to 47 *rs.*, and a well and upper story at back, 13 *rs.*, equal to 60 *rs.*; labour, at 2 *rs.* 8 *a.*, 15 *rs.* 14 *a.*
11. Dunkee ... ... (Valuation, 2,000 *rs.*)	17 rooms; average 15¼′ by 6½′; 1 roof tiled, and rest mud, on mud walls.	Owner present; 1,712 superficial feet, at 12 *rs.* per 100, equal to 250 *rs.*; labour, at 3 *rs.*, 51 *rs.* 4 *a.*
12. Munsa Ram ... ... (Valuation, 300 *rs.*)	9 rooms; about 16′ by 7′; roofs all kutcha on mud walls.	1,008 superficial feet, at 7 *rs.* per 100, equal to 70 *rs.* 8 *a.*; labour, at 2 *rs.* 8 *a.*, 25 *rs.*
13. Bheeka ... ... (Valuation, 110 *rs.*)	3 rooms; about 12½′ by 6′; roofs kutcha, 1 fallen in; walls mud.	225 superficial feet, at 6 *rs.* per 100, equal to 13 *rs.* 8 *a.*; labour, at 2 *rs.*, 4 *rs.* 8 *a.*; a small portion of the house only taken.
14. Nunha... ... ... (Valuation, 50 *rs.*)	3 rooms; average 7′ by 5′; roofs mud on mud walls.	105 superficial feet, at 7 *rs.* per 100, equal to 7 *rs.* 5 *a.* 7 *p.*; labour, at 2 *rs.* 8 *a.*, 2 *rs.* 5 *a.*; very small portion only taken.
15. Sewa ... ... (Valuation, 180 *rs.*)	2 rooms; about 12′ by 6¼′; roofs mud, thatch; chopper attached; walls of mud, old.	225 superficial feet, at 8 *rs.* per 100, equal to 18 *rs.*; labour, at 2 *rs.* 8 *a.*, 5 *rs.* 10 *a.*; a small part of the house only taken.
16. Pursothom and Davedeen (Valuation, 800 *rs.*)	15 rooms; average 15½′ by 7′; 7 roofs kutcha, and 8 tiled walls of mud, not in good order.	1,627½ superficial feet, at 6 *rs.* 8 *a.* per 100, equal to 105 *rs.* 12 *a.*; labour, at 2 *rs.*, 32 *rs.* 8 *a.* 9 *p.*
17. Goolah... ... ... (Valuation, 50 *rs.*)	7 rooms; about 16½′ by 8½′; 4 roofs kutcha, 3 tiled; walls of mud, not in good order.	981¾ superficial feet, at 5 *rs.* 8 *a.* per 100, equal to 53 *rs.* 15 *a.*; labour, at 2 *rs.*, 19 *rs.* 10 *a.*
18. Jorawur ... ... (Valuation, 400 *rs.*)	13 rooms; about 12½′ by 6½′; 5 roofs kutcha, and rest tiled; walls mud, and not in good order.	1,056 superficial feet, at 5 *rs.* per 100, equal to 73 *rs.* 15 *a.*; labour, at 2 *rs.* 8 *a.*, 26 *rs.* 6 *a.*
19. Nuthoo ... ... (Valuation, 105 *rs.*)	3 rooms; about 4½′ by 7½′	326 superficial feet, at 6 *rs.* 8 *a.* per 100, equal to 21 *rs.* 3 *a.*; labour, at 2 *rs.* 8 *a.*, 8 *rs.* 2 *a.*
20. Byjoo ... ... (Valuation, 65 *rs.*)	5 rooms; about 11′ by 8′; roofs kutcha, and walls mud.	440 superficial feet, at 6 *rs.* per 100, equal to 26 *rs.* 6 *a.*; labour, at 2 *rs.* 8 *a.*, 11 *rs.*
21. Kulean ... ... (Valuation, 65 *rs.*)	4 rooms; average 22′ by 6¼′; 1 roof kutcha, 3 tiles; walls mud.	572 superficial feet, at 5 *rs.* per 100, equal to 28 *rs.* 9 *a.* 7 *p.*; labour, at 1 *r.* 8 *a.*, 8 *rs.* 8 *a.*
22. Kashee Doss ... ... (Valuation, .)	17 rooms; about 10′ by 7′; 15 roofs kutcha, and 2 tiled; walls of mud; foundations of 1 wall kutcha pukka, in tolerable order.	1,190 superficial feet, at 9 *rs.* per 100, equal to 107 *rs.* 1 *a.* 7 *p.*; labour, at 3 *rs.*, 35 *rs.* 11 *a.* 2 *p.*; owner absent.
23. Pertab... ... ... (Valuation, 135 *rs.*)	5 rooms; average 11½′ by 6½′; 3 roofs kutcha, and 2 tiled; walls of mud, not in good order.	373 superficial feet, at 5 *rs.* per 100, equal to 18 *rs.* 10 *a.* 6 *p.*; labour, at 1 *r.* 8 *a.*, 5 *rs.* 8 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
24. Chinta ... ... (Valuation, 150 *rs.*)	4 rooms; about 13′ by 8′; 2 rooms of 2 stories; 1 roof kutcha and 3 tiled; walls of mud.	520 superficial feet, at 5 *rs.* per 100, equal to 26 *rs.* 1 *a.*; labour, at 2 *rs.*, 10 *rs.* 6 *a.* 4 *p.*
25. Rambux ... ... (Valuation, 10 *rs.*)	1 room; 18′ by 7¾′; roof tiled; walls mud ...	139½ superficial feet, at 5 *rs.* per 100, equal to 6 *rs.* 15 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.*; owner absent.
26. Dullee ... ... (Valuation, 60 *rs.*)	3 rooms; 10¾′ by 6½′; 1 roof mud, and 2 of tiles; walls mud, not in good order.	209 superficial feet, at 5 *rs.* per 100, equal to 10 *rs.* 7 *a.* 2 *p.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 2 *a.*
27. Govind ... ... (Valuation, 60 *rs.*)	3 rooms; 10½′ by 5′; 2 roofs kutcha, and 1 tiled; also a tiled shed; walls mud.	630 superficial feet, at 5 *rs.* per 100, equal to 31 *rs.* 8 *a.*; labour, at 2 *rs.*, 12 *rs.* 9 *a.* 7 *p.*
28. Doorjun ... ... (Valuation, 60 *rs.*)	3 rooms; 13′ by 7′; 1 room 2 stories, 4 roofs tiled, and 1 mud, dilapidated; walls mud.	455 superficial feet, at 5 *rs.* per 100, equal to 22 *rs.* 12 *a.*; labour, at 2 *rs.*, 9 *rs.* 1 *a.* 7 *p.*
29. Khoodabux ... ... (Valuation, 80 *rs.*)	3 rooms; 14′ by 7½′; 2 mud roofs, and 1 tiled; mud walls, in bad order.	315 superficial feet, at 5 *rs.* per 100, equal to 15 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 4 *rs.* 12 *a.*
30. Deena ... ... (Valuation, 60 *rs.*)	2 rooms; 21½′ by 6½′; 1 kutcha and 1 tiled roof; mud walls, not in good order.	279½ superficial feet, at 6 *rs.* per 100, equal to 16 *rs.* 10 *a.* 9 *p.*; labour, at 2 *rs.*, 5 *rs.* 9 *a.*; a portion of house.
31. Subsook ... ... (Valuation, 50 *rs.*)	2 rooms; 10½′ by 6′; roofs kutcha; walls of mud.	126 superficial feet, at 7 *rs.* per 100, equal to 8 *rs.* 13 *a.*; labour, at 2 *rs.* 8 *a.*, ; portion of house.
32. Narain Doss ... ... (Valuation, 412 *rs.*)	3 rooms; 12′ by 7′; in bad order	Owner not present; 250 superficial feet, at 5 *rs.*, 12 *rs.* 8 *a.*; in ruins; part at rear occupied, sheds.

(Signed) C. W. HUTCHINSON, *Lieutenant, Executive Engineer, 6th Division, Ganges Canal.*

(Signed) T. ASHBURNHAM, *Brigadier, Commanding the Station.*

(Signed) C. TROUP, *Major, President.*

(Signed) T. RIDDELL, *Captain,*
(Signed) G. R. SIDDONS, *Captain,*
(Signed) R. WROUGHTON, *Lieut.,*
} *Members.*

Attending the Committee—

(Signed) JOHN ELIOT, *Lieutenant, Temporary Assistant, 6th Division, Ganges Canal.*
(Signed) GEO. SIM, *Lieutenant, Officiating Executive Engineer, 7th Division, Public Works.*
(Signed) NASIR ALLY KHAN.

SURVEY REPORT of a Committee assembled by order of the Brigadier Commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal through the Suddur Bazar and Cantonments.—*Cawnpoor, 4th March*, 1851.

SECOND SECTION.

President—Major C. TROUP.

Members—Captain G. R. SIDDONS, Captain T. RIDDELL, Lieutenant R. WROUGHTON, SYUD NASIR ALLI KHAN, *Deputy Magistrate.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Ummeersing ... ... (Valuation, 3,000 *rs.*)	43 rooms; average 10′ 3″ by 8½′; 33 rooms of kutcha roofs, the rest of tile, on walls 11½′ high; 1 wall of 13 rooms, and 2 of 2, of kutcha pukka masonry, and of the rest of mud, in fair order; 1 buttress on the side of the tank of kutcha pukka masonry, 5′ by 9′ by 55′.	1,105 superficial feet, at 12 *rs.* per 100, equal to 132 *rs.* 10 *a.*; 2,550, at 7 *rs.*, 178 *rs.* 8 *a.*; kutcha pukka revetment, 55′ by 9′ by 5′, at 6 *rs.*, 14 *rs.* 8 *a.*: total, 459 *rs.* 10 *a.*; labour, at 2 *rs.* 8 *a.*, 91 *rs.* 5 *a.*; part only required.
2. Dhunee ... ... (Valuation, 150 *rs.*)	8 rooms; average 15′ by 6½′; 5 roofs of kutcha, the rest of tile on mud; walls 9¼′ high, in fair order; 1 shed with tile roof.	780 superficial feet, at 5 *rs.* per 100, equal to 39 *rs.*; labour, at 1 *r.* 8 *a.*, 11 *rs.* 12 *a.*
3. Oodyt ... ... (Valuation, 75 *rs.*)	5 rooms; average 15′ by 7′; 3 roofs of kutcha (1 in ruins), and the rest tiles, on mud walls 10½′ high, in bad order.	525 superficial feet, at 4 *rs.* per 100, equal to 21 *rs.*; labour, at 1 *r.* 8 *a.*, 7 *rs.* 12 *a.*; in bad order.
4. Doorjun ... ... (Valuation, 50 *rs.*)	4 rooms; average 12′ by 7½′; 2 kutcha roofs, the rest tiled, on mud walls about 7′ high, in bad order; 2 small sheds, 1 tiled, the other thatched.	360 superficial feet, at 3 *rs.* per 100, equal to 10 *rs.*; labour, at 1 *r.* 8 *a.*, 5 *rs.* 4 *a.*; in bad order.
5. Doorga ... ... (Valuation, 90 *rs.*)	4 rooms; average 7¼′ by 4½′; 2 kutcha roofs and 2 tiled, the latter one of 2 stories; walls mud, about 12 feet high, in fair order.	130 superficial feet, at 5 *rs.* per 100, equal to 6 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 12 *a.*; in very bad order.
6. Purma ... ... (Valuation, 75 *rs.*)	5 rooms; average 13½′ by 7′; 2 kutcha roofs, the other tiled, on mud walls about 8′ high, in bad order.	472 superficial feet, at 3 *rs.* 8 *a.* per 100, equal to 16 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 7 *rs.*
7. Purtab ... ... (Valuation, 300 *rs.*)	9 rooms; average 16′ by 7½′; 4 kutcha roofs, the rest tiled, on mud walls about 9′ high, in fair order.	1,080 superficial feet, at 7 *rs.* per 100, equal to 75 *rs.* 8 *a.*; labour, at 2 *rs.* 8 *a.*, 27 *rs.*; in good order.
8. Bullooaha ... ... (Valuation, 67 *rs.*)	2 rooms; average 21′ by 8½′; 1 kutcha, the other tiled roof; mud walls about 10′ high, in fair order.	346 superficial feet, at 4 *rs.* per 100, equal to 13 *rs.* 4 *a.*; labour, at 1 *r.* 8 *a.*, 5 *rs.* 4 *a.*
9. Pershad ... ... (Valuation, 15 *rs.*)	1 room, 9¼′ by 6¾′, with tiled roof; mud walls 6½′ high, in bad order.	62 superficial feet, at 4 *rs.* per 100, equal to 2 *rs.* 3 *a.*; labour, at 1 *r.* 8 *a.*, 14 *a.*
10. Toola ... ... (Valuation, 80 *rs.*)	6 rooms; average 9¼′ by 17½′; 1 kutcha roof, the others tiled, on mud walls about 8′ high, in bad order.	971 superficial feet, at 4 *rs.* per 100, equal to 38 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 14 *rs.* 8 *a.*
11. Ghasee ... ... (Valuation, 132 *rs.*)	4 rooms; average 10¼′ by 5¾′; 1 roof kutcha, the others tiled; mud walls about 7′ high, in fair order; 2 rooms with 2 stories.	235 superficial feet, at 6 *rs.* per 100, equal to 15 *rs.* 4 *a.*; labour, at 2 *rs.*, 4 *rs.* 9 *a.*
12. Munniram ... ... (Valuation, 80 *rs.*)	3 rooms; average 6¼′ by 5½′; 2 of 2 stories, with tiled roofs, the other of kutcha; mud walls about 13½′ high, in fair order.	150 superficial feet, at 7 *rs.* per 100, equal to 10 *rs.* 8 *a.*; labour, at 5 *rs.*, 7 *rs.* 8 *a.*
13. Cheda ... ... (Valuation, 100 *rs.*)	4 rooms; average 10′ by 5¾′; kutcha roofs, walls of mud, about 10 feet high, in bad order; also 2 tiled roof sheds.	227 superficial feet, at 6 *rs.* 8 *a.* per 100, equal to 11 *rs.* 12 *a.*; labour, at 2 *rs.*, 4 *rs.* 8 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
14. Buddoollah ... ... (Valuation, 110 *rs.*)	6 rooms; average 14⅓′ by 6⅝′; 3 kutcha roofs, 2 tiled and 1 thatched; mud walls about 9⅝′ high, in bad order.	444 superficial feet, at 5 *rs.* per 100, equal to 22 *rs.* 2 *a.*; labour, at 1 *r.* 8 *a.*, 6 *rs.* 9 *a.*; in very bad order.
15. Doora ... ... (Valuation, 300 *rs.*)	5 rooms; average 12′ by 6′; 4 kutcha and 1 tiled roof; mud walls about 8′ high, in bad order.	360 superficial feet, at 5 *rs.* per 100, equal to 18 *rs.*; labour, at 1 *r.* 8 *a.*, 5 *rs.* 6 *a.*
16. Bheekha ... ... (Valuation, 32 *rs.*)	2 rooms; average 16¼′ by 16½′; kutcha roofs on mud walls about 8½′ high, in bad order; 1 roof nearly in ruins.	214 superficial feet, at 4 *rs.* 8 *a.* per 100, equal to 9 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 4 *a.*
17. Dhunowri ... ... (Valuation, 20 *rs.*)	5 rooms; 10½′ by 6′; 3 kutcha and 2 tiled roofs; mud walls 7′ high, in very bad order.	315 superficial feet, at 4 *rs.* per 100, equal to 12 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 4 *rs.* 12 *a.*
18. Munsa ... ... (Valuation, 98 *rs.*)	3 rooms; average 16½′ by 6⅓′; 2 kutcha and 3 tiled roofs; mud walls about 7′ high, in bad order.	300 superficial feet at 7 *rs.* per 100, equal to 21 *rs.*; labour, at 2 *rs.*, 6 *rs.*
19. Madar and Dhore ... (Valuation, 12 *rs.*)	1 room; 8½′ by 7¼′; tiled roof; walls mud, about 6′ high, in very bad order; 1 tiled shed.	61 superficial feet, at 4 *rs.* per 100, equal to 2 *rs.* 8 *a.*; labour, at 2 *rs.*, 1 *r.* 3 *a.*
20. Bullooa ... ... (Valuation, 30 *rs.*)	1 room; 23′ by 9⅝′; tiled roof, on mud walls, 7½′ high, in bad order.	224 superficial feet, at 4 *rs.* per 100, equal to 8 *rs.* 15 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 5 *a.*
21. Bissumber ... ... (Valuation, 40 *rs.*)	1 room; 15⅝′ by 6⅓′; ditto, ditto.	99 superficial feet, at 5 *rs.* per 100, equal to 4 *rs.* 15 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 8 *a.*; a portion only taken.
22. Ramzan ... ... (Valuation, 45 *rs.*)	2 rooms; 13¼′ by 8′; tile roofs; mud walls 10′ high, in bad order.	212 superficial feet, at 5 *rs.* per 100, equal to 10 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 12 *a.*; in bad order.
23. Polaz ... ... (Valuation, .)	Part of a side wall of the house; 6′ in height; mud; in fair order.	
24. Sadharee ... ... (Valuation, 200 *rs.*)	6 rooms; average 12⅓′ by 7⅓′; tile roofs; mud walls 7½′ high, in fair order.	540 superficial feet, at 6 *rs.* per 100, equal to 32 *rs.* 4 *a.*; labour, at 2 *rs.*, 10 *rs.* 12 *a.*
25. Nugnoo ... ... (Valuation, 80 *rs.*)	6 rooms; 15⅓′ by 7⅓′; tile roofs; mud walls, in fair order, 7½′ high.	651 superficial feet, at 4 *rs.* per 100, equal to 26 *rs.*; labour, at 1 *r.* 8 *a.*, 9 *r.* 12 *a.*; in bad order.
26. Chedah ... ... (Valuation, 25 *rs.*)	3 rooms; 19⅝′ by 6′; kutcha roofs; mud walls, 8½ feet high, in bad order.	355 superficial feet, at 5 *rs.* per 100, equal to 17 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 5 *rs.* 5 *a.*
27. Ramzan ... ... (Valuation, 50 *rs.*)	3 rooms; 17⅓′ by 8′; tile roofs on mud walls 10 feet high, in bad order.	408 superficial feet, at 4 *rs.* per 100, equal to 16 *rs.* 2 *a.*; labour, at 1 *r.* 8 *a.*, 6 *rs.* 1 *a.*; in bad order.
28. Dhunnee ... ... (Valuation, 150 *rs.*)	9 rooms; 12′ by 6¼′; 3 of kutcha, the rest tile roofs; on 2 stories; rooms mud walls, 9¼′ high, in bad order.	675 superficial feet, at 5 *rs.* per 100, equal to 33 *rs.* 12 *a.*; labour, at 2 *rs.*, 13 *rs.* 8 *a.*
29. Gunsamsing ... ... (Valuation, 105 *rs.*)	2 rooms; 22′ by 10′; tile roofs, mud walls, 11⅓′ high, in bad order; rooms 2 stories.	440 superficial feet, at 7 *rs.* per 100, equal to 30 *rs.* 12*a.*; labour, at 2 *rs.*, 8 *rs.* 13 *a.*
30. Esurie ... ... (Valuation, 95 *rs.*)	5 rooms; 15⅓′ by 5⅓′; one of 2 stories; mud walls, 9½′ high, in bad order, tile roofs.	426 superficial feet, at 4 *rs.* per 100, equal to 17 *rs.*; labour, at 1 *r.* 8 *a.*, 6 *rs.* 3 *a.*
31. Sahtawan ... ... (Valuation, 100 *rs.*)	6 rooms; 13⅝′ by 6′; 2 kutcha, the rest tiled roofs; mud walls, 7′ high, 1 with a kutcha pukka foundation, 19⅓′ by 6′.	492 superficial feet, at 4 *rs.* per 100, equal to 19 *rs.* 10 *a.*; labour, at 1 *r.* 8 *a.*, 7 *rs.* 1 *a.*
32. Sadhar ... ... (Valuation, 90 *rs.*)	4 rooms; 13½′ by 7½′; 1 kutcha, the rest tiled roofs; 1 room with 2 stories; mud walls, 6½′ high, in bad order.	405 superficial feet, at 5 *rs.* per 100, equal to 20 *rs.* 1 *a.*; labour, at 1 *r.* 8 *a.*, 6 *rs.*
33. Chand ... ... (Valuation, 300 *rs.*)	5 rooms; 19¼′ by 6¼′; 1 kutcha, the rest tiled roofs; 1 room 2 stories; mud walls, 10′ high, in fair order.	601 superficial feet, at 5 *rs.* per 100, equal to 30 *rs.*, × wall at 10 *rs.*, 40 *rs.*; labour, at 1 *r.* 8 *a.*, 9 *rs.* 6 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
34. Cheda ... ... (Valuation, 100 *rs.*)	7 rooms; $14\frac{1}{4}'$ by $6\frac{1}{4}'$; 1 kutcha, the rest tile roofs; mud walls, 6′ high, in bad order.	633 superficial feet, at 5 *rs.* per 100, equal to 31 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 9 *rs.* 8 *a.*
35. Goordial ... ... (Valuation, 40 *rs.*)	2 rooms; $15\frac{3}{4}'$ by $8\frac{1}{4}'$; tile roofs; mud walls, 6′ high, in bad order.	260 superficial feet, at 3 *rs.* per 100, equal to 7 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 14 *a.*
36. Fakeeraz ... ... (Valuation, 64 *rs.*)	4 rooms; $14\frac{1}{4}'$ by 6′; 2 kutcha and 2 tile roofs; mud walls, 9 feet high, in fair order; north-west walls, plinth, and foundations of kutcha pukka masonry 6 feet deep, and pukka plaster.	342 superficial feet, at 7 *rs.* per 100, equal to 23 *rs.* 13 *a.*; labour, at 2 *rs.*, 6 *rs.* 13 *a.*
37. Mukooa ... ... (Valuation, 31 *rs.*)	1 room; $8\frac{3}{4}'$ by $6\frac{1}{2}'$; kutcha roof; mud walls, 8′ high, in fair order.	56 superficial feet, at 4 *rs.* per 100, equal to 2 *rs.* 4 *a.*; labour, at 1 *r.* 8 *a.*, 13 *a.*
38. Cheda ... ... (Valuation, 36 *rs.*)	3 rooms; 13′ by $6\frac{3}{4}'$; 1 kutcha, the rest tiled roofs; mud walls, $7\frac{1}{2}$ feet high, in bad order.	263 superficial feet, at 4 *rs.* per 100, equal to 10 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 14 *a.*
39. Soobba ... ... (Valuation, 15 *rs.*)	2 rooms; $13\frac{1}{2}'$ by $6\frac{1}{4}'$; 1 kutcha, the others tile roofs; mud walls, 7′ high, in bad order.	172 superficial feet, at 3 *rs.* per 100, equal to 5 *rs.* 2 *a.*; labour, at 1 *r.*, 1 *r.* 11 *a.*

(Signed) C. W. HUTCHINSON, *Lieutenant*,
Executive Engineer,
6th Division, Ganges Canal.
(Signed) T. ASHBURNHAM, *Brigadier*,
Commanding the Station.

(Signed) C. TROUP, *Major*, *President*.
(Signed) G. R. SIDDONS, *Captain*,
(Signed) T. RIDDELL, *Captain*,
(Signed) R. WROUGHTON, S.A.C.G.,
(Signed) NASIR ALLI KHAN,
} *Members*.

Attending the Committee:—
(Signed) JOHN ELIOT, *Lieutenant*, *Temporary Assistant*, *6th Division*, *Ganges Canal.*
(Signed) GEO. SIM, *Lieutenant*, *Officiating Executive Engineer*, *7th Division*, *Public Works.*

SURVEY REPORT of a Committee appointed by order of the Brigadier Commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal through the Suddur Bazar and Cantonment.—*Cawnpoor, 8th March*, 1851.

THIRD SECTION.

President—Major C. TROUP.

Members—Captain G. R. SIDDONS, Captain T. RIDDELL, Lieutenant R. WROUGHTON.
SYUD NASIR ALLI KHAN, *Deputy Magistrate*.

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Ghunsam Sing ... (Valuation, 3,200 *rs.*)	44 rooms; average, 15′ by $6\frac{3}{4}'$; 10 of tile, and the rest of kutcha roofs but 3, which are of pukka; 4 rooms are 2 stories high; about 165 feet length of wall $11\frac{1}{4}$ feet high, and foundation is of kutcha pukka masonry and the rest of mud; 2 tile sheds, average 31′ by $8\frac{3}{4}'$, on mud pillars, in fair order.	The whole to be taken, equal to 1,000 *rs.*; labour, 200 *rs.*
2. Ramlall and Poorun ... (Valuation, 100 *rs.*)	3 rooms; average 8′ by $6\frac{1}{4}'$; of kutcha roof; walls mud, about 9 feet high, in bad order.	150 superficial feet, at 6 *rs.* per 100, equal to 9 *rs.*; labour, at 2 *rs.*, 3 *rs.*; only a portion taken.

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
3. Chand Khan ... ... (Valuation, 30 *rs.*)	2 rooms; average 11¾′ by 6½′; of kutcha roof; walls, mud, about 2 feet high, in bad order.	152 superficial feet, at 5 *rs.* per 100, equal to 7 *rs.* 9 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.* 4 *a.*; a small portion taken.
4. Gderaj ... ... (Valuation, 1,500 *rs.*)	4 rooms; average 13′ by 6½′; 3 of kutcha roof, and the fourth of pukka and 2 stories; walls of one room of pukka kutcha masonry, and the rest of mud, in fair order.	120 *rs.* This valuation has been assumed on account of superior materials and workmanship; and although part only is taken, it will destroy a greater part of the property not taken by canal officers.
5. Simboo ... ... (Valuation, 1,000 *rs.*)	6 rooms; average 9¾′ by 5½′; 3 of kutcha roof and 3 of pukka; 2 of the last are 2 stories; walls about 12 feet high, of kutcha pukka masonry, in fair order.	150 *rs.* Valuation adjudged by committee.
6. Heera Lall ... ... (Valuation, 210 *rs.*)	2 rooms; average 10½′ by 10½′; of kutcha roof; walls of mud, about 13 feet high, in fair order.	210 superficial feet, at 12 *rs.* per 100, equal to 25 *rs.* 3 *a.*; labour, 5 *rs.* 4 *a.*; only portion taken.
7. Dullee ... ... (Valuation, 225 *rs.*)	2 rooms; 11¼′ by 6¼′; of tile roof; 2 stories; walls, ditto, ditto.	A portion only to be taken; 281 superficial feet, at 8 *rs.* 8 *a.* per 100, equal to 28 *rs.* 13 *a.*; labour, at 2 *rs.* 8 *a.*, 7 *rs.* (well, 5 *rs.*)
8. Khialee ... ... (Valuation, 325 *rs.*)	5 rooms; average 9′ by 5¼′; 3 of kutcha roof and 2 of tile; 2 stories high; walls of mud, about 13 feet high, in fair order.	Front portion only taken, at 8 *rs.* per 100, equal to 22 *rs.* 10 *a.*; labour, 7 *rs.*; owner not present.
9. Gungapurshad ... (Valuation, 30 *rs.*)	1 room; 17¼′ by 8⅓′; of tile roof; walls, ditto, in bad order.	A portion only taken; 142 superficial feet, at 4 *rs.* 8 *a.* per 100, equal to 6 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.* 4 *a.*
10. Jowaher Lall ... ... (Valuation, 400 *rs.*)	3 rooms; average 11¾′ by 6′; of kutcha roof, one 2 stories high; walls of mud, about 11 feet high, in bad order.	423 superficial feet, at 7 *rs.* per 100, equal to 29 *rs.* 9 *a.*; labour, at 2 *rs.*, 8 *rs.* 7 *a.*
11. Choonnee ... ... (Valuation, 175 *rs.*)	4 rooms; average 14′ by 5′; 3 of kutcha roof, and 1 of tile; 2 stories high; walls, ditto.	420 superficial feet, at 7 *rs.* per 100, equal to 29 *rs.* 6 *a.*; labour, at 2 *rs.*, 8 *rs.* 7 *a.*
12. Bukhtawur ... ... (Valuation, 200 *rs.*)	4 rooms; average 6′ by 4′; 3 of kutcha roof, and 1 tile; 2 stories high; walls, ditto, ditto.	144 superficial feet, at 10 *rs.* per 100, equal to 14 *rs.* 7 *a.*; labour, at 2 *rs.* 8 *a.*, 3 *rs.* 7 *a.*
13. Luskurree ... ... (Valuation, 20 *rs.*)	3 rooms; average 8′ by 5⅔′; of kutcha roof; walls, ditto, ditto.	135 superficial feet, at 5 *rs.* per 100, equal to 6 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.* 1 *a.*
14. Gain Chund ... ... (Valuation, 46 *rs.*)	1 room; 16½′ by 7′; of tile roof; walls, ditto, ditto.	115 superficial feet, at 5 *rs.* per 100, equal to 5 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 12 *a.*
15. Mohunlall ... ... (Valuation, 250 *rs.*)	3 rooms; average 11′ by 5⅓′; of kutcha roof; walls, ditto, ditto.	A portion only taken; 176 superficial feet, at 6 *rs.* per 100, equal to 10 *rs.* 9 *a.*; labour, at 2 *rs.*, 3 *rs.* 8 *a.*
16. Rampersand ... ... (Valuation, 60 *rs.*)	1 room or grass shed; 19¼′ by 5½′; wall of mud, 9¼ feet high, in bad order.	A small portion taken; 105 superficial feet, at 5 *rs.* per 100, equal to 5 *rs.* 4 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 8 *a.*
17. Muddarbux ... ... (Valuation, 375 *rs.*)	2 rooms; average 10′ by 6′; of kutcha roof; 2 story; walls, ditto, 15 feet high, ditto.	A small portion taken; 240 superficial feet, at 8 *rs.* per 100, equal to 19 *rs.* 4 *a.*; labour, at 2 *rs.* 8 *a.*, 6 *rs.*
18. Rampersand ... ... (Valuation, 150 *rs.*)	4 rooms; average 10¼′ by 5¾′; 1 of kutcha and the rest of tile roof; walls, ditto, ditto.	A portion only taken; 210 superficial feet, at 6 *rs.* per 100, equal to 12 *rs.* 9 *a.*; labour, at 2 *rs.*, 4 *rs.* 3 *a.*
19. Onsuree ... ... (Valuation, 200 *rs.*)	4 rooms; average 13¾′ by 5½′; of kutcha roof; walls, ditto, ditto.	453 superficial feet, at 9 *rs.* per 100, equal to 40 *rs.* 14 *a.*; labour, 9 *rs.*
20. Chutooree ... ... (Valuation, 1,225 *rs.*)	7 rooms; average 17′ by 7¾′; 4 of tile, 1 of which is 2 story high roof, and the rest of kutcha; walls of 2 rooms of kutcha pukka masonry, and of the rest of mud; also foundations of pukka kutcha masonry, about 11 feet high, in fair order.	Merely compound and rear, valued, tiled; 527 superficial feet, at 4 *rs.* per 100, equal to 21 *rs.*; labour, at 1 *r.* 8 *a.*, 7 *rs.* 11 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
21. Rambux ... ... (Valuation, 700 *rs.*)	6 rooms; average $17\frac{1}{3}'$ by 8′; 3 of tile roof, and the rest of kutcha; walls of 3 rooms of kutcha pukka masonry, and the rest of mud, in fair order, about 8′ high.	828 superficial feet, at 11 *rs.* per 100, equal to 91 *rs.*; labour, at 2 *rs.* 8 *a.* per 100, 20 *rs.* 14 *a.*
22. Soobadar, surnamed Bundur-Walla. (Valuation, 250 *rs.*)	1 room (or his tomb); $9\frac{1}{4}'$ by $9\frac{1}{4}'$; of pukka roof; wall of pukka kutcha masonry, pukka plastered, about $11\frac{1}{2}$ feet high, in good order; 3 other tombs in bad order.	A tomb, &c.; 100 *rs.*
23. Kulloo Mul ... ... (Valuation, .)	6 rooms; average $13\frac{1}{3}'$ by $8\frac{2}{3}'$; two of kutcha, and the rest of tile roof; walls of mud, about 7 feet high; the 2 rooms of kutcha roof in good order, and the others in bad.	698 superficial feet, at 3 *rs.* per 100, equal to 34 *rs.* 15 *a.*; labour, at 2 *rs.*, 13 *rs.* 15 *a.*
24. Muneeram ... ... (Valuation, .)	4 rooms; average $8\frac{1}{4}'$ by 6′; 2 of kutcha roof, 1 of tile, and 1 of grass; walls of mud, 7 feet high, in bad order.	198 superficial feet, at 4 *rs.* per 100, equal to 7 *rs.* 14 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.* 14 *a.*
25. Mudarbur ... ... (Valuation, 50 *rs.*)	2 rooms; average 14′ by 7′; of tile roof; walls of mud, $7\frac{1}{2}$ feet high, in bad order.	196 superficial feet, at 4 *rs.* per 100, equal to 7 *rs.* 13 *a.*; labour, at 1 *r.* 8 *a.*, 2 *rs.* 14 *a.*
26. Shamut Khan ... (Valuation, 36 *rs.*)	5 rooms; average 12′ by $6\frac{1}{2}'$; 1 of grass roof, and the rest of kutcha; walls, ditto, ditto.	390 superficial feet, at 2 *rs.* per 100, equal to 7 *rs.* 15 *a.*; labour, at 1 *r.*, 3 *rs.* 15 *a.*
27. Ilaheebur ... ... (Valuation, 50 *rs.*)	3 rooms; average $16\frac{1}{3}'$ by $6\frac{1}{3}'$; 2 of kutcha and 1 of tile roof; walls, ditto, ditto.	304 superficial feet, at 4 *rs.* per 100, equal to 12 *rs.* 3 *a.*; labour, at 1 *r.* 8 *a.*, 4 *rs.* 9 *a.*
28. Juggurnauth ... ... (Valuation, 800 *rs.*)	9 rooms; average $13\frac{1}{3}'$ by $6\frac{1}{4}'$; 6 of tile roof and 2 stories high, and the rest of kutcha roof; walls of mud, about 11 feet high, in fair order.	1,080 superficial feet, at 30 *rs.* per 100, equal to 324 *rs.*; labour at 5 *rs.*, 54 *a.*
29. Sukhun ... ... (Valuation, .)	10 rooms; average $9\frac{1}{2}'$ by 6′; 3 of tile roof, 2 stories high, and the rest of kutcha; walls, of mud, ditto, ditto.	570 superficial feet at 12 *rs.* per 100, equal to 68 *rs.* 8 *a.*; labour, at 4 *rs.*, 22 *rs.* 12 *a.*
30. Gujjoo ... ... (Valuation, .)	2 rooms; average $15\frac{1}{2}'$ by $6\frac{1}{2}'$; 1 of kutcha roof and the other of tile; walls of mud, in bad order; height of walls about 9′ feet.	In very bad order; 4 *rs.*
31. Laoo ... ... (Valuation, 275 *rs.*)	7 rooms; average 15′ by 6′; 5 of kutcha roof and 2 of tile, 1 of which is 2 stories high; walls of mud, ditto, ditto.	630 superficial feet, at 8 *rs.* per 100, equal to 50 *rs.* 5 *a.*; labour, at 3 *rs.*, 18 *rs.* 15 *a.*
32. Bhola ... ... (Valuation, 45 *rs.*)	1 room; $15\frac{1}{2}'$ by 6′; of tile roof, 2 stories; walls of mud, 13 feet high, in fair order.	186 superficial feet, at 7 *rs.* per 100, equal to 13 *rs.*; labour, at 2 *rs.*, 3 *rs.* 12 *a.*
33. Sirdharee ... ... (Valuation, 150 *rs.*)	6 rooms; average $11\frac{3}{4}'$ by $6\frac{1}{2}'$; 2 of tile roof, and the rest of kutcha; walls of mud, 10 feet high, in bad order. One tile shed, 11′ by $5\frac{3}{4}'$.	454 superficial feet, at 5 *rs.* per 100, equal to 22 *rs.* 15 *a.*; labour, at 2 *rs.*, 9 *rs.* 1 *a.*
34. Bhageerut ... ... (Valuation, 335 *rs.*)	8 rooms; average 10′ by $5\frac{1}{2}'$; 4 of tile, and 1 of grass, 2 stories, the rest of kutcha roof; walls of mud, in bad order, high, about 10 feet.	660 superficial feet, at 10 *rs.* per 100, equal to 66 *rs.*; labour, at 2 *rs.*, 13 *rs.* 3 *a.*
35. Lodhee ... ... (Valuation, 276 *rs.*)	4 rooms; average $10\frac{1}{4}'$ by $7\frac{1}{4}'$; 2 of tile roof, 2 stories high, and the rest of kutcha roof; walls of mud, 10 feet high, in good order.	445 superficial feet, at 16 *rs.* per 100, equal to 71 *rs.*; labour, at 3 *rs.*, 13 *rs.* 5 *a.*
36. Gaiadeen ... ... (Valuation, 800 *rs.*)	9 rooms; average 7′ by 6′; of kutcha roof; walls of mud, 11 feet high, in good order.	378 superficial feet, at 30 *rs.* per 100, equal to 113 *rs.* 6 *a.*; labour, at 4 *rs.*, 13 *rs.* 5 *a.*, woodwork much.
37. Goobroy ... ... (Valuation, 200 *rs.*)	8 rooms; average $9\frac{1}{2}'$ by 6′; of tile roof, one 2 story tile; walls $9\frac{1}{2}'$ feet high, in good order.	513 superficial feet, at 6 *rs.* per 100, equal to 30 *rs.* 12 *a.*; labour, at 1 *rs.* 8 *a.*, 7 *rs.* 9 *a.*
38. Persand ... ... (Valuation, 380 *rs.*)	18 rooms; average $13\frac{1}{4}'$ by 8′; 4 of kutcha roof, and the rest of tile; walls of mud, 7 feet high, in bad order. Three tile sheds, 26′ by $6\frac{3}{4}'$.	1,908 superficial feet, at 6 *rs.* per 100, equal to 114 *rs.* 8 *a.*; labour, at 2 *rs.*, 38 *rs.* 2 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
39. Kooelee ... ... (Valuation, 250 *rs.*)	6 rooms; average 13′ by $\frac{2}{3}$′; 2 tile roof, and the rest of kutcha; walls, ditto, ditto, in bad order, one 2 stories.	450 superficial feet, at 8 *rs.* per 100, equal to 36 *rs.*; labour, at 2 *rs.*, 9 *rs.*
40. Munherdoss ... ... (Valuation, 400 *rs.*)	3 rooms; average $8\frac{1}{3}$′ by $6\frac{1}{3}$′; 1 of kutcha roof, and the rest of tile; walls of one room of pukka kutcha masonry, the rest of mud, 6′ high; also foundations of pukka kutcha masonry, in fair order.	150 superficial feet, at 20 *rs.* per 100, equal to 30 *rs.*; labour, at 2 *rs.* 8 *a.*, 3 *rs.* 12 *a.*, a very small portion only taken.
41. Tilokee ... ... (Valuation, 160 *rs.*)	9 rooms; average $13\frac{1}{2}$′ by $4\frac{1}{2}$′; 4 of tile roof, 1 of which is 2 stories, and the rest of kutcha roof; walls of mud, 8 feet high, in bad order.	668 superficial feet, at 8 *rs.* per 100, equal to 53 *rs.* 6 *a.*; labour, at 2 *rs.*, 13 *rs.* 4 *a.*
42. Laoo ... ... (Valuation, 200 *rs.*)	5 rooms; average $19\frac{1}{4}$′ by $6\frac{1}{3}$′; of kutcha roof; also 2 grass sheds supported on pillars of mud; walls of mud, $8\frac{1}{4}$′ high, in bad order.	670 superficial feet, at 6 *rs.* per 100, equal to 40 *rs.* 4 *a.*; labour at 1 *rs.* 8 *a.*, 10 *rs.*
43. Goordeen ... ... (Valuation, 350 *rs.*)	10 rooms; average $16\frac{1}{4}$′ by $5\frac{3}{4}$′; 4 of tile roof, and the rest of kutcha; walls of mud, ditto, ditto.	934 superficial feet, at 8 *rs.* per 100, equal to 75 *rs.* 12 *a.*; labour, at 2 *rs.*, 18 *rs.* 8 *a.*
44. Byjnauth ... ... (Valuation, 4,000 *rs.*)	11 rooms; average $12\frac{1}{4}$′ by 5′; 2 of tile, 1 of pukka roof, 2 stories high, and the rest of kutcha roof; walls 285 feet long, and about 15 feet high, of kutcha pukka masonry, as also the foundations, the rest walls of mud, in good order; part of the courtyard $24\frac{1}{4}$′ by 8, pukka plastered.	For all 1,000 *rs.*; labour, 200 *rs.*
45. Goolaba ... ... (Valuation, 157 *rs.*)	6 rooms; average $10\frac{1}{2}$′ by 8′; 1 of kutcha roof, and the rest of tile, of which 3 are 2 stories high; walls of mud, about 8 feet high, in very bad order.	756 superficial feet, at 6 *rs.* per 100, equal to 45 *rs.* 4 *a.*; labour, at 1 *rs.* 8 *a.*, 11 *rs.* 5 *a.*
46. Bhowaneedeen ... (Valuation, 700 *rs.*)	11 rooms; average 18′ by $6\frac{1}{2}$′; 2 of tile roof, and the rest of kutcha; walls of mud, $8\frac{1}{2}$′ feet high, foundations of a wall 51 feet long of pukka kutcha masonry, in fair order.	1,287 superficial feet, at 8 *rs.* per 100, equal to 103 *rs.*; labour, at 2 *rs.*, 25 *rs.* 12 *a.*
47. Goolab Khan Kotwal ... (Valuation, 800 *rs.*)	8 rooms; average $16\frac{1}{4}$′ by $7\frac{1}{4}$′; 3 of kutcha roof, and the rest of tile; walls of mud, $11\frac{1}{2}$ feet high, in bad order.	942 superficial feet, at 6 *rs.* per 100, equal to 56 *rs.* 8 *a.*; labour, at 2 *rs.*, 18 *rs.* 12 *a.*
48. Jhooma ... ... (Valuation, 600 *rs.*)	9 rooms; average $9\frac{3}{4}$′ by 7; 6 of tile roof, 2 of which are 2 stories, and the rest kutcha; foundations of kutcha pukka masonry; walls of mud, about 10 feet high, in bad order.	748 superficial feet, at 7 *rs.* per 100, equal to 52 *rs.* 4 *a.*; labour, at 2 *rs.*, 15 *rs.*
49. Buldeo ... ... (Valuation, 500 *rs.*)	5 rooms; average 15′ by 7′; 2 of tile roof, one of which is 2 stories, and the rest of kutcha; walls of mud, 11 feet high, in bad order.	630 superficial feet, at 7 *rs.* per 100, equal to 44 *rs.* 2 *a.*; labour, at 2 *rs.*, 12 *rs.* 8 *a.*
50. Roshun Lall ... ... (Valuation, 650 *rs.*)	7 rooms; average 11′ by 5′; of kutcha roof, half of which is 2 stories; walls about 56 feet long, and foundations of pukka kutcha masonry, the rest of mud, in fair order.	— —
51. Herdoss ... ... (Valuation, 3,500 *rs.*)	19 rooms; average $10\frac{1}{2}$′ by $6\frac{1}{2}$′; 7 of tile roof, and 2 of pukka, 2 stories, and the rest of kutcha; walls about 360 feet long, $10\frac{1}{2}$ feet high, of pukka kutcha masonry, and the rest of kutcha, in fair order.	For the whole 1,200 *rs.*; labour, 250 *rs.*
52. Kamall ... ... (Valuation, 3,000 *rs.*)	6 rooms; average 12′ by $6\frac{1}{3}$′; 1 tile roof, 1 pukka, and the rest kutcha; walls of 4 rooms and front one of pukka kutcha masonry, as also the foundations; the rest mud wall, about $10\frac{3}{4}$ feet high, in fair order.	532 superficial feet, at 60 *rs.* per 100, equal to 319 *rs.*; labour, at 82 *rs.*
53. Rampersand ... ... (Valuation,)	All in ruins, but one wall of pukka kutcha masonry $24\frac{1}{2}$ feet long and $6\frac{3}{4}$ feet high.	One piece of wall and some bricks; only in an open plot, equal to 5 *rs.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
54. Chatooree ... ... (Valuation, 1,050 *rs.*)	3 rooms; average $21\frac{3}{4}'$ by $8\frac{1}{2}'$; one of tile and the rest of kutcha roof; walls of 2 rooms of kutcha pukka masonry, and of the other of mud, and in bad order, height about 12 feet; one grass shed, $21\frac{1}{4}'$ by $13\frac{3}{4}'$.	Value, equal to 170 *rs.*; labour, 40 *rs.*
55. Ujooddeea Persand ... (Valuation, 20 *rs.*)	2 rooms; average 16′ by $7\frac{3}{4}'$; one of kutcha roof, and the other of the walls of mud 6 feet high, in bad order.	240 superficial feet, at 3 *rs.* per 100, equal to 7 *rs.* 4 *a.*; labour, at 1 *rs.* 8 *a.*, 3 *rs.* 6 *a.*
56. Persram ... ... (Valuation, 1,000 *rs.*)	5 rooms; average $9\frac{3}{4}'$ by $6\frac{3}{4}'$; of kutcha roof; walls of kutcha pukka masonry, in good order.	Value, equal to 350 *rs.*; labour, 80 *rs.*
57. Toonkeeram ... ... (Valuation, 1,100 *rs.*)	7 rooms; average $11\frac{1}{4}'$ by $8\frac{1}{4}'$; one of tile roof and the rest of kutcha; walls, ditto, ditto.	Value, equal to 600 *rs.*; labour, 80 *rs.*
58. Herdoss ... ... (Valuation, 800 *rs.*)	5 rooms; average $21\frac{1}{2}'$ by $9\frac{1}{2}'$; of pukka roof; walls of kutcha pukka masonry $13\frac{1}{2}$ feet high; one outer wall 57 feet long, pukka plastered, in good order.	Value, equal to 1,000 *rs.*; labour, 200 *rs.*
59. Moonjeeram ... ... (Valuation, 10,000 *rs.*)	15 rooms; average $14\frac{1}{2}'$ by 8′; 14 of pukka roof, 3 of tile; 7 are 2 stories high; walls of pukka kutcha masonry about 12 feet high, in fair order; two tile sheds $27\frac{1}{2}'$ by $8\frac{1}{2}'$; 1 pukka shed $12\frac{1}{2}'$ by $6\frac{1}{2}'$.	Value, equal to 3,000 *rs.*; labour, 1,000 *rs.*
60. Buldeo and Bukhtawur (Valuation, 10,000 *rs.*)	11 rooms; average 13′ by $8\frac{1}{4}'$; of kutcha roof; 5 rooms; 2 stories; walls of pukka kutcha masonry about 15 feet high, in good order.	Value, equal to 2,000 *rs.*; labour, 680 *rs.*
61. Chubbasing ... ... (Valuation, 138 *rs.*)	5 rooms; average 13′ by $5\frac{1}{2}'$; one of kutcha roof, and the rest of tile, 2 of which are 2 stories high; walls of mud about 9′ high, in fair order.	500 superficial feet, at 10 *rs.* per 100, equal to 50 *rs.*; labour, at 4 *rs.*, 20 *rs.*
62. Jeewun ... ... (Valuation, 50 *rs.*)	3 rooms; average $11\frac{3}{4}'$ by $5\frac{3}{4}'$; one of tile, and the rest of kutcha; walls of mud about 9′ high, in bad order.	180 superficial feet, at 7 *rs.* per 100, equal to 10 *rs.* 12 *a.*; labour, at 2 *rs.*, 3 *rs.* 9 *a.*
63. Buldeo ... ... (Valuation, 300 *rs.*)	5 rooms; average $14\frac{1}{2}'$ by $6\frac{1}{4}'$; of kutcha roof but one, which is of tile roof, and 2 stories high; walls of mud about $8\frac{1}{2}$ feet high, in bad order.	— —

(Signed) C. W. Hutchinson, *Lieutenant.*
Executive Engineer,
6th Division, Ganges Canal.

(Signed) T. Ashburnham, *Brigadier,*
Commanding the Station.

(Signed) C. Troup, *Major, President.*
(Signed) G. R. Siddons, *Captain,*
(Signed) T. Riddell, *Captain,*
(Signed) R. Wroughton, *Lieut.,*
} *Members.*

Attending the Committee,

(Signed) John Eliot, Lieut., *Temporary Assistant, Ganges Canal.*

(Signed) Geo. Sim, Lieut., *Officiating Executive Engineer, 7th Division, Public Works.*

SURVEY REPORT of a Committee appointed by order of the Brigadier commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal through the Suddur Bazar and Cantonment.—*Cawnpoor, 18th March,* 1851.

FOURTH SECTION.

President—Major C. TROUP.

Members—Captain G. R. SIDDONS, Captain T. RIDDELL, Lieutenant R. WROUGHTON, SYUD NASIR ALLY KHAN, *Deputy Magistrate.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Baneeram and Gungadeen. (Absent.)	2 rooms; average 18′ by $8\frac{3}{4}$′; 1 of tile and the other of kutcha roof; walls of kutcha pukka masonry, about 9 feet high, in fair order.	Owner not present; 311 superficial feet, at 10 *rs.* per 100, equal to 31 *rs.* 2 *a.*; labour, at 2 *rs.*, 7 *rs.* 12 *a.*
2. Nungoo ... ... (Valuation, 1,200 *rs.*)	14 rooms; average $10\frac{1}{2}$′ by 7′; of kutcha roof; 6 of these are 2 stories, 3 of kutcha pukka masonry, and the rest of mud, about $9\frac{1}{2}$ feet high, in very bad order; also 2 tile sheds, $11\frac{1}{2}$′ by $7\frac{1}{3}$′.	1,470 superficial feet, at 5 *rs.* per 100, equal to 73 *rs.* 8 *a.*; labour, at 2 *rs.*, 29 *rs.* 6 *a.*
3. Monjee Ram ... ... (Absent.)	4 rooms; average 15′ by $9\frac{1}{2}$′; 2 of pukka roof, 2 stories high, and the rest of kutcha; walls, kutcha pukka masonry, $11\frac{1}{4}$ feet high, in fair order; also 1 tile shed, 23′ by $7\frac{1}{3}$′.	855 superficial feet, equal to 400 *rs.*; labour, 100 *rs.*
4. Thakoordoss ... ... (Valuation, 500 *rs.*)	7 rooms; average $17\frac{1}{4}$′ by $6\frac{1}{2}$′; of kutcha roof; walls of mud, $10\frac{1}{2}$ feet high, in bad order.	739 superficial feet, at 8 *rs.* per 100, equal to 61 *rs.* 5 *a.*; labour, at 2 *rs.* 8 *a.*, 18 *rs.* 7 *a.* 6 *p.*
5. Deena ... ... (Valuation, 2,000 *rs.*)	9 rooms; average $9\frac{1}{3}$′ by $6\frac{2}{3}$′; 3 of tile roof, and the rest of pukka; walls of 3 rooms of pukka kutcha masonry, and the rest of mud, $10\frac{1}{4}$ feet high, in fair order; 1 tile shed, $20\frac{1}{2}$′ by $7\frac{1}{4}$′.	Value, equal to 250 *rs.*; labour, 80 *rs.*
6. Khemanund and Gunga-Bishun (Valuation, 4,000 *rs.*)	4 rooms; average $17\frac{1}{2}$′ by $7\frac{1}{2}$′; 2 of tile roof and 2 stories, and the rest of pukka roof; walls of kutcha pukka masonry, 11 5-4ths feet high, in fair order; 1 tile shed, $20\frac{1}{2}$′ by $7\frac{1}{2}$′.	Value, equal to 500 *rs.*; labour, 130 *rs.*
7. Ramdial ... ... (Valuation, 400 *rs.*)	15 rooms; average $16\frac{1}{4}$′ by $6\frac{1}{2}$′; 2 of tile roofs 2 stories high, and the rest of pukka and kutcha roofs; wall about 151 feet long and $10\frac{1}{4}$ feet high, of kutcha pukka masonry, the rest of mud, in good order.	Value, equal to 520 *rs.*; labour, 100 *rs.*
8. Humout Ram ... ... (Valuation, 7,000 *rs.*)	10 rooms; average $16\frac{1}{4}$′ by $8\frac{1}{2}$′; 6 of pukka roofs, 2 stories high; walls of kutcha pukka masonry, 1 side pukka plastered and 19 feet high, 2 of tile roofs, and the rest of kutcha pukka; walls of 4 rooms of mud, 10 feet high, in very good order.	Value, equal to 2,300 *rs.*; labour, 766 *rs.*
9. Poottoo ... ... (Valuation, 2,000 *rs.*)	9 rooms; average $10\frac{1}{2}$′ by $6\frac{1}{4}$′; 7 roofs kutcha and 2 tiled; walls of kutcha pukka masonry, $10\frac{3}{4}$ feet high, in good order.	Value, equal to 118 *rs.*; labour, 17 *rs.* 13 *a.*
10. Rampersaud ... ... (Valuation, 600 *rs.*)	17 rooms; average $13\frac{3}{4}$′ by $5\frac{1}{3}$′; of kutcha roofs; walls of 1 room of kutcha pukka masonry and the rest of mud, 9 feet high, in bad order; 1 tile shed, $10\frac{3}{4}$′ by $7\frac{1}{2}$′; 2 of kutcha roofs, in ruins.	1,238 superficial feet, at 16 *rs.* per 100, equal to 207 *rs.*; labour, at 4 *rs.*, 49 *rs.* 8 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
11. Bholanauth ... ... (Valuation, 3,000 *rs.*)	19 rooms; average 9¾′ by 6¾′; 1 of tile and the rest of kutcha roof; walls of 5 rooms of kutcha pukka masonry and of the rest of mud, 11 feet high, in bad order; 1 tile shed, 37′ by 7¾′.	1,280 superficial feet, at 25 *rs.* per 100, equal to 300 *rs.*; labour, at 4 *rs.*, 80 *rs.*
12. Motee ... ... (Valuation, 413 *rs.*)	11 rooms; average 12′ by 6¾′; 6 of tile and the rest of kutcha roof; walls of mud, 9 feet high, in bad order.	891 superficial feet, at 7 *rs.* per 100, equal to 62 *rs.* 11 *a.*; labour, at 2 *rs.*, 17 *rs.* 14 *a.*
13. Moona Lall ... ... (Valuation, 151 *rs.*)	2 rooms; average 16¾′ by 5¼′; roofs kutcha; walls of mud, 10′ high, in bad order.	175 superficial feet, at 10 *rs.* per 100, equal to 17 *rs.* 8 *a.*; labour, at 2 *rs.* 8 *a.*, 4 *rs.* 5 *a.*
14. Russool ... ... (Valuation, 50 *rs.*)	1 room; 20¾′ by 10′; of tile roof; wall of mud, 7 feet high, in bad order.	207 superficial feet, at 5 *rs.* per 100, equal to 10 *rs.*; labour, at 1 *r.* 8 *a.*, 3 *rs.*
15. Gungaram ... ... (Absent.)	6 rooms; average 18½′ by 7½′; 2 of tile roof and 2 stories high, and the rest kutcha; walls mud, 11 feet high, in fair order; 1 tile shed, 15¼′ by 6½′.	832 superficial feet, at 6 *rs.* per 100, equal to 49 *rs.* 15 *a.*; labour, at 2 *rs.*, 16 *rs.* 9 *a.*
16. Khemchund ... ... (Valuation, 800 *rs.*)	8 rooms; average 13′ by 5⅓′; 2 rooms pukka, rest kutcha; wall about 62 feet long and 8⅔ feet high, of kutcha pukka masonry, rest of mud, in fair order.	554 superficial feet, at 30 *rs.* per 100, equal to 166 *rs.* 2 *a.*; labour, at 4 *rs.*, 22 *rs.* 4 *a.*
17. Bullee ... ... (Valuation, 2,000 *rs.*)	5 rooms; 19′ by 4¾′; 2 of pukka roofs 2 stories high, and rest kutcha; wall 35 feet long and 10 feet high, of mud, rest of kutcha pukka masonry, in good order.	Value, equal to 350 *rs.*; labour, 116 *rs.*
18. Thundeeram and Sokemun. (Valuation, 400 *rs.*)	7 rooms; average 10¼′ by 5½′; two of tile roofs 2 stories high, 2 of kutcha pukka, and rest kutcha roofs; walls of mud 10 feet high, in bad order.	507 superficial feet, at 20 *rs.* per 100, equal to 101 *rs.* 7 *a.*; labour, at 2 *rs.* 8 *a.*, 12 *rs.* 10 *a.*
19 Toukee ... ... (Valuation, 400 *rs.*)	10 rooms; average 18½′ by 6′; roofs kutcha; walls mud, about 10 feet high, in bad order.	1,110 superficial feet, at 10 *rs.* per 100, equal to 111 *rs.*; labour, at 2 *rs.* 8 *a.*, 27 *rs.* 12 *a.*
20. Nund Kishore ... (Valuation, 200 *rs.*)	4 rooms; average 14¼′ by 6¼′; 3 roofs tiled 2 stories high, and 1 kutcha; walls mud, in fair order.	534 superficial feet, at 8 *rs.* per 100, equal to 42 *rs.* 10 *a.*; labour, at 2 *rs.* 8 *a.*, 13 *rs.* 3 *a.* 6 *p.*
21. Khoosal ... ... (Valuation, 800 *rs.*)	4 rooms; average 15½′ by 5¼′; roofs kutcha, 3 two-storied; walls mud, 15 feet high, in good order; walls of front room of kutcha pukka masonry.	Value, equal to 400 *rs.*; labour, 100 *rs.*
22. Sumber ... ... (Valuation, 150 *rs.*)	3 rooms; average 15¾′ by 6½′; roofs kutcha; walls of mud, 12 feet high, in bad order.	304 superficial feet, at 5 *rs.* per 100, 15 *rs.* 4 *a.*; labour, at 1 *r.* 8 *a.*, 4 *rs.* 8 *a.*
23. Rickhee ... ... (Valuation, 150 *rs.*)	1 room; 22¼′ by 5¾′; roof tiled; walls mud, in very bad order.	130 superficial feet, at 5 *rs.* per 100, equal to 6 *rs.* 8 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 15 *a.*
24. Oody Raj ... ... (Valuation, 500 *rs.*)	6 rooms; average 19⅓′ by 8′; 1 roof tile, rest kutcha; walls of mud, 10 feet high, in bad order; 1 tile shed, 21½′ by 7′.	1,078 superficial feet, at 15 *rs.* per 100, equal to 161 *rs.* 11 *a.*; labour, at 3 *rs.*, 32 *rs.* 5 *a.*
25. Doorgapersaud ... (Valuation, 500 *rs.*)	6 rooms; average 17¾′ by 8¼′; 1 roof kutcha, rest tile; walls mud, in bad order.	866 superficial feet, at 10 *rs.* per 100, equal to 86 *rs.* 10 *a.*; labour, at 2 *rs.* 8 *a.*, 21 *rs.* 11 *a.*
26. Gain Chund ... ... (Valuation, 200 *rs.*)	7 rooms; average 16¾′ by 7½′; 2 kutcha roofs, rest tiles; walls mud.	879 superficial feet, at 7 *rs.* per 100, equal to 61 *rs.* 8 *a.*; labour, at 2 *rs.*, 17 *rs.* 8 *a.*
27. Munsaram ... ... (Valuation, 250 *rs.*)	4 rooms; average 17′ by 7¾′; 2 kutcha roofs, rest tiles; walls mud.	527 superficial feet, at 9 *rs.* per 100, equal to 47 *rs.* 7 *a.*; labour, at 2 *rs.* 8 *a.*, 13 *rs.* 2 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
28. Gungadeen ... ... (Valuation, 155 *rs.*)	6 rooms; average 17½′ by 7¼′; 2 tile roofs, 4 kutcha; walls mud.	761 superficial feet, at 5 *rs.* per 100, equal to 35 *rs.*; labour, at 2 *rs.*, 15 *rs.*
29. Goordial ... ... (Valuation, 500 *rs.*)	3 rooms; average 20¾′ by 8′; 1 tile roof, and 4 kutcha; wall 63 feet long, kutcha pukka, 8½ feet high, rest mud, in bad order; 1 tile shed, 20½′ by 7′.	660 superficial feet, at 20 *rs.* per 100, equal to 132 *rs.*; labour, at 3 *rs.*, 19 *rs.* 13 *a.*
30. Junglee Soobadar ... (Valuation, 260 *rs.*)	12 rooms; average 12′ by 7′; 2 roofs kutcha, and the rest of mud, in bad order; 1 tile shed, 28½′ by 7′.	1,008 superficial feet, at 8 *rs.* per 100, equal to 80 *rs.*; labour, at 2 *rs.*, 20 *rs.*
31. Seetul ... ... (Valuation, 500 *rs.*)	6 rooms; average 15′ by 7½′; 2 roofs tiled, and 4 kutcha; 2 sheds, 25′ by 6¾′; walls mud, 11 feet high, in bad order.	652 superficial feet, at 12 *rs.* per 100, equal to 78 *rs.* 9 *a.*; labour, at 2 *rs.*, 13 *rs.*
32. Sheopersaud and Dabeedeen. (Valuation, 500 *rs.*)	7 rooms; average 17′ by 8′; 4 kutcha and 3 tile roofs; also 1 tile shed, 17½′ by 6¾′; walls mud, 11 feet high, in bad order.	952 superficial feet, at 15 *rs.* per 100, equal to 142 *rs.* 12 *a.*; labour, at 3 *rs.*, 28 *rs.* 8 *a.*
33. Goordial ... ... (Valuation, .)	8 rooms; average 10½′ by 7′; 4 kutcha and 4 tile roofs; walls as in preceding.	588 superficial feet, at 10 *rs.* per 100, equal to 58 *rs.* 12 *a.*; labour, at 2 *rs.*, 11 *rs.* 11 *a.*
34. Gungolee ... ... (Absent.)	1 room; 17′ by 9½′; roof kutcha, and 1 tile shed, 17′ by 6¼′; ditto.	429 superficial feet, at 10 *rs.* per 100, equal to 42 *rs.* 14 *a.*; labour, at 2 *rs.* 8 *a.*, 10 *rs.* 11 *a.*

(Signed) C. W. HUTCHINSON, *Lieutenant, Executive Engineer, 6th Division, Ganges Canal.*
(Signed) T. ASHBURNHAM, *Brigadier, Commanding the Station.*

(Signed) C. TROUP, *Major, President.*
(Signed) T. RIDDELL, *Captain,*
(Signed) G. SIDDONS, *Captain,*
(Signed) R. WROUGHTON, *Lieut.,*
(Signed) NASIR ALLY KHAN,
} *Members.*

Attending the Committee—
(Signed) JOHN ELIOT, *Lieutenant, Temporary Assistant, Ganges Canal.*
(Signed) GEO. SIM, *Lieutenant, Officiating Executive Engineer, Public Works, Cawnpoor.*

SURVEY REPORT of a Committee appointed by order of the Brigadier Commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal, through the Suddur Bazar and Cantonment.—*Cawnpoor, 19th March,* 1851.

FIFTH SECTION.

President—Major C. TROUP.

Members—Captain G. R. SIDDONS, Captain T. RIDDELL, Lieutenant R. WROUGHTON, SYUD NASIR ALLI KHAN, *Deputy Magistrate.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Bukhtu ... ... (Valuation, 100 *rs.*)	3 rooms; average 12′ by 6½′; 2 of tile, and 1 of kutcha roof; mud walls, about 9′ high, in fair order; also a tile shed, 34½′ by 5½.′	312 superficial feet, at 6 *rs.* per 100, equal to 18 *rs.* 12 *a.*; labour, at 1 *r.* 8 *a.*, 4 *rs.* 9 *a.*
2. Baday and Bhowanee... (Valuation, 400 *rs.*)	7 rooms; average 10¼′ by 7′; 6 of tiled roofs, 3 of which are two-storied, the rest kutcha; walls 11 feet high, in fair order; a shed tiled roof, 18′ by 3¾′.	717 superficial feet, at 12 *rs.* per 100, equal to 86 *rs.*; labour, at 3 *rs.*, 21 *rs.* 8 *a.*
3. Jumna Dass and Motee Ram. (Valuation, 1,400 *rs.*)	3 rooms; average 10¾′ by 10½′; kutcha roofs; walls 10 feet high, of kutcha pukka, in good order.	Value, equal to 750 *rs.*; labour, 250 *rs.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
4. Muchul ... ... (Valuation, 400 *rs.*)	8 rooms; average 13⅓′ by 6¼′; 4 of tiled roofs, of which 2 are two-storied, and 4 of kutcha roof (one in ruins); mud walls 9 feet high, in bad order; a shed, tile roof, 20½′ by 6′.	843 superficial feet, at 10 *rs.* per 100, equal to 84 *rs.* 4 *a.*; labour, at 3 *rs.*, 25 *rs.* 5 *a.*
5. Dhersing ... ... (Valuation,)	House in ruins	No property, only ground.
6. Sheropersad ... ... (Valuation, 700 *rs.*)	8 rooms; average 16¼′ by 6¾′; 4 of which tiled, 2 of 2 stories, and 4 kutcha roofs (one in ruins); mud walls 9 feet high; also a tile shed, 16¾′ by 5⅓′.	1,096 superficial feet, at 8 *rs.* per 100, equal to 87 *rs.* 10 *a.*; labour, at 2 *rs.* 8 *a.*, 27 *rs.* 5 *a.*
7. Gareel Doss ... ... (Valuation, 900 *rs.*)	7 rooms; average 18⅓′ by 7½′; 3 of tiled, and 1 of kutcha roofs; mud walls, 10 feet high; a tile shed, 29¾′ by 5¾′.	1,387 superficial feet, at 12 *rs.* per 100, equal to 166 *rs.*; labour, at 3 *rs.*, 41 *rs.* 9 *a.*
8. Chainsookh ... ... (Valuation, 700 *rs.*)	12 rooms; 13¼′ by 7⅓′; 5 of tiled roofs, 3 of which 2 storied, and 7 of kutcha; mud walls 10 feet high, in good order; a tile shed, 28′ by 5¾′.	1,643 superficial feet, at 16 *rs.* per 100, equal to 262 *rs.* 14 *a.*; labour, at 4 *rs.*, 65 *rs.* 11 *a.*
9. Bisram ... ... (Valuation, 250 *rs.*)	4 rooms; 12′ by 7¾′; 2 of tiles, and 2 of kutcha roofs; mud walls 9 feet high, in bad order; a tile shed, 12′ by 6′.	465 superficial feet, at 10 *rs.* per 100, equal to 46 *rs.* 8 *a.*; labour, at 2 *rs.*, 9 *rs.* 5 *a.*
10. Bindaram ... ... (Valuation, 200 *rs.*)	4 rooms; 11′ by 8¼′; 2 of tile and 2 of kutcha roofs; mud walls 9 feet high, in bad order; a tile shed, 13½′ by 6′.	453¾ superficial feet, at 10 *rs.* per 100, equal to 45 *rs.* 5 *a.*; labour, at 2 *rs.*, 9 *rs.*
11. Sulsookh ... ... (Valuation, 425 *rs.*)	10 rooms; average 10⅓′ by 5⅓′; 4 of tiles, 1 of which has 2 stories, and 6 of kutcha roofs, 1 of which also has 2 stories; mud walls, 12 feet high, in fair order; and shed, 17¾′ by 6′.	750 superficial feet, at 15 *rs.* per 100, equal to 112 *rs.* 8 *a.*; labour at 4 *rs.*, 30 *rs.*
12. Goordial ... ... (Valuation, 600 *rs.*)	7 rooms; average 11⅓′ by 7′; 3 of tiles and 4 of kutcha roofs; mud walls, 9′ high, in fair order; a tile shed, 23¼′ by 6′.	805 superficial feet, at 10 *rs.* per 100, equal to 80 *rs.* 8 *a.*; labour, at 3 *rs.*, 24 *rs.*
13. Shew Lall ... ... (Valuation, 300 *rs.*)	5 rooms; 17½′ by 7½′; 1 of kutcha, 4 tiled roofs; mud walls, 9 feet high, in fair order; 1 tile shed, 23′ by 6′.	787 superficial feet, at 7 *rs.* per 100, equal to 55 *rs.*; labour, at 2 *rs.*, 15 *rs.* 12 *a.*
14. Kunhee ... ... (Valuation, 350 *rs.*)	10 rooms; 16¾′ by 7′; 4 of tiled, and 6 of kutcha roofs; mud walls, about 10′ high, in fair order; front pillars of kutcha pukka; a tiled shed, 29½′ by 6′.	1,289 superficial feet, at 12 *rs.* per 100, equal to 154 *rs.* 10 *a.*; labour, at 3 *rs.*, 38 *rs.* 10 *a.*
15. Shewpersaud ... ... (Valuation, 30 *rs.*)	1 room; 14¼′ by 5¾′; kutcha roof; mud walls, 9½ feet high, in bad order.	82 superficial feet, at 15 *rs.* per 100, equal to 12 *rs.* 4 *a.*; labour, at 2 *rs.*, 1 *r.* 10 *a.*
16. Sollah ... ... (Valuation, 50 *rs.*)	6 rooms; average 12¾′ by 6′; 2 of tile and 4 of kutcha roofs; also 2 sheds, kutcha roofs, supported on wooden posts, 15′ by 15′, and a grass shed, 20′ by 6′; mud walls, 9 feet high, in bad order.	535 superficial feet, at 6 *rs.* per 100, equal to 32 *rs.* 2 *a.*; labour, at 1 *r.* 8 *a.*, 8 *rs.*
17. Koosall ... ... (Valuation, 100 *rs.*)	15 rooms; average 11⅓′ by 6⅓′; 4 of kutcha and 11 of tile roofs; mud walls, 7′ high, in bad order.	1,121 superficial feet, at 7 *rs.* per 100, equal to 78 *rs.* 7 *a.*; labour, at 2 *rs.*, 22 *rs.* 6 *a.*
18. Mookeembeg ... ... (Valuation, 227 *rs.*)	1 room; 12′ by 5¾′; kutcha roof; 2 tile sheds, 15′ by 11¾′; mud walls; one wall (14′ by 10′ by 1½′) kutcha pukka, in bad order.	Valuation, 150 *rs.*; labour, 50 *rs.*
19. Piarree ... ... (Valuation, 40 *rs.*)	7 rooms; average 9¾′ by 6′; 1 of tiled, 6 of kutcha roofs; mud walls, 7′ high, in bad order.	409 superficial feet, at 7 *rs.* per 100, equal to 28 *rs.* 10 *a.*; labour, at 2 *rs.*, 8 *rs.*
20. Boodhoo Khan ... (Valuation, 350 *rs.*)	3 rooms; average 21¾′ by 7¾′; 1 of kutcha, 2 tile roofs; mud walls, 8′ high, in bad order.	498 superficial feet, at 12 *rs.* per 100, equal to 59 *rs.*; labour, at 3 *rs.*, 14 *rs.* 15 *a.*
21. Buldeo and Niwazee ... (Valuation, 175 *rs.*)	2 rooms; 11′ by 6¼′; kutcha roofs; a tiled shed, 16¾′ by 6¼′; mud walls, 9′ high, in bad order.	175 superficial feet, at 15 *rs.* per 100, equal to 26 *rs.* 4 *a.*; labour, at 2 *rs.*, 3 *rs.* 8 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
22. Gungoo ... ... (Valuation, 100 *rs.*)	1 room; 13½′ by 8¼′; kutcha roof; a tile shed 15′ by 12¾′; mud walls, 9′ high, in bad order.	229 superficial feet, at 15 *rs.* per 100, equal to 34 *rs.* 5 *a.*; labour, at 2 *r.*, 4 *rs.* 3 *a.*
23. Bukha... ... ... (Valuation, 200 *rs.*)	7 rooms; average 14½′ by 6¼′; 1 tiled, and the rest kutcha roof; one 2 storied; mud walls, 10′ high, in bad order.	725 superficial feet, at 7 *rs.* per 100, equal to 50 *rs.* 12 *a.*; labour, at 2 *rs.*, 14 *rs.* 8 *a.*
24. Joogrol ... ... (Valuation, 100 *rs.*)	7 rooms; average 16¼′ by 7½′; 3 of tiled and 4 of kutcha roofs; mud walls, 9′ high, in bad order.	853 superficial feet, at 5 *rs.* per 100, equal to 42 *rs.* 9 *a.*; labour, at 2 *r.*, 17 *rs.*
25. Puchkowree ... ... (Valuation, 40 *rs.*)	3 rooms; 10′ by 6⅔′; 1 of grass 2 storied, and 2 of tiles; also a shed 5′ by 4¾′; mud walls, 9′ high, in bad order.	264 superficial feet, at 7 *rs.* per 100, equal to 18 *rs.* 7 *a.*; labour, at 2 *rs.*, 5 *rs.* 2 *a.*
26. Jemadar Fakeera ... (Valuation, 65 *rs.*)	2 rooms; 15¼′ by 8′; kutcha roofs, and a grass shed; mud walls, 9′ high, in bad order.	366 superficial feet, at 7 *rs.* per 100, equal to 25 *rs.* 9 *a.*; labour, at 2 *rs.*, 7 *rs.* 5 *a.*
27. Heera ... ... (Valuation, 40 *rs.*)	2 rooms; 18¼′ by 7½′; tiled roofs; mud walls, 8′ high, in fair order.	273 superficial feet, at 7 *rs.* per 100, equal to 19 *rs.* 1 *a.*; labour, at 2 *rs.*, 5 *rs.* 7 *a.*
28. Ramdial ... ... (Valuation, 60 *rs.*)	3 rooms; average 18½′ by 7⅔′; ditto, ditto ...	566 superficial feet, at 7 *rs.* per 100, equal to 39 *rs.* 9 *a.*; labour, at 2 *rs.*, 11 *rs.* 5 *a.*; 4 rooms.
29. Bhowanee	2 rooms; 10¾′ by 8¼′; thatched roofs; mud walls, 5′ high.	Value, 8 *rs.*; labour, 2 *rs.*
30. Rutnee	1 room; 14½′ by 7′; thatched roofs; mud walls, 5′ high; 2 sides grass on other 2, in bad order.	Value, 4 *rs.*; labour, 2 *rs.*
31. Ubdoo Raheem ... (Valuation, 16 *rs.*)	4 rooms; average 13¾′ by 6¼′; 3 tiled roofs, one 2 storied and 1 kutcha roof; also 2 sheds 14¼′ by 7½′; mud walls, 10′ high, in bad order.	556 superficial feet, at 8 *rs.* per 100, equal to 44 *rs.* 8 *a.*; labour, at 2 *r.* 8 *a.*, 13 *rs.* 14 *a.*
32. Ullebux ... ... (Valuation, 300 *rs.*)	4 rooms; 9¾′ by 6′; 2 of 2 stories, tiled roofs, and 2 of kutcha; a small room 4¾′ by 5′, with tiled roof; mud walls, 12′ high, in good order; also a shed 14½′ by 7′.	468 superficial feet, at 15 *rs.* per 100, equal to 70 *rs.* 3 *a.*; labour, at 3 *r.*, 14 *rs.* (upper stories).
33. Uzmut Khan ... ... (Valuation, 200 *rs.*)	4 rooms; average 10¾′ by 7¾′; 2 of kutcha, and 2 of tile roofs; mud walls, 8 feet high, in fair order.	426 superficial feet at 15 *rs.* per 100, equal to 63 *rs.* 14 *a.*; labour, at 3 *rs.*, 12 *rs.* (upper stories).
34. Chadee and Gungadeen (Valuation, 120 *rs.*)	4 rooms; average 9¾′ by 6¾′; 2 of kutcha and 2 of tiled roofs; 2 stories high; mud walls, 12′ high, in bad order.	384 superficial feet, at 10 *rs.* per 100, equal to 38 *rs.* 6 *a.*; labour, at 2 *rs.* 8 *a.*, 9 *rs.* 9 *a.*
35. Mukha ... ... (Valuation, 60 *rs.*)	4 rooms; average 11′ by 7′; kutcha roofs; mud walls, 9 feet high, in fair order.	350 superficial feet, at 8 *rs.* per 100, equal to 28 *rs.*; labour, at 2 *rs.*, 7 *rs.*
36. Kurreem ... ... (Absent.)	1 room; 15¾′ by 7¼′; tiled roof; a tiled shed, 12′ by 6′; mud walls, 8′ high, in bad order.	114 superficial feet, at 8 *rs.* per 100, equal to 9 *rs.* 1 *a.*; labour, at 1 *r.* 8 *a.*, 1 *r.* 11 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
37. Bhowaneedeen ... (Valuation, 200 *rs.*)	6 rooms; average 10′ by 5¾′; kutcha roofs; mud walls, 9′ high, in fair order.	345 superficial feet, at 30 *rs.* per 100, equal to 103 *rs.* 8 *a.*; labour, at 5 *rs.*, 17 *rs.* 4 *a.*
38. Lall Mahomed ... (Valuation, 150 *rs.*)	7 rooms; 8½′ by 6½′; kutcha roofs; mud walls, 9′ high, ditto.	386 superficial feet, at 20 *rs.* per 100, equal to 77 *rs.* 3 *a.*; labour, at 4 *rs.*, 15 *rs.* 7 *a.*
39. Kurreemun ... ... (Valuation, 60 *rs.*)	1 room; 15½′ by 7¼′; kutcha roof; 2 tile sheds, 16¼′ by 6½; mud walls, 9′ high, ditto.	336 superficial feet, at 8 *rs.* per 100, equal to 26 *rs.* 14 *a.*; labour, at 2 *rs.*, 6 *rs.* 11 *a.*
40. Hoolassie ... ... (Valuation, 80 *rs.*)	2 rooms; 15¼′ by 10′; 1 of tile, the other of kutcha roof, and mud walls; ditto, ditto.	305 superficial feet, at 8 *rs.* per 100, equal to 24 *rs.* 6 *a.*; labour, at 2 *rs.*, 6 *rs.* 1 *a.*
41. Ubdoolla ... ... (Valuation, 500 *rs.*)	12 rooms; average 12½′ by 7⅓′; 4 of tile, 8 of kutcha roofs; mud walls, 12′ high, in fair order.	1,099 superficial feet, at 20 *rs.* per 100, equal to 219 *rs.* 12 *a.*; labour, at 5 *rs.*, 54 *rs.* 15 *a.*
42. Thundee Mul ... ... (Absent.)	2 rooms; 17′ by 7¾′; 1 tiled and the other thatched; mud walls, 6′ high, in bad order.	263 superficial feet, at 5 *rs.* per 100, equal to 13 *rs.* 2 *a.*; labour, at 1 *r.* 8 *a.*, 3 *rs.* 15 *a.* Gardener's house only.
43. Lallah ... ... (Valuation, 25 *rs.*)	1 room; 12¾′ by 10½′; kutcha roof; mud walls, about 6′ high, in bad order.	133 superficial feet, at 10 *rs.* per 100, equal to 13 *rs.* 5 *a.*; labour, at 2 *rs.* 8 *a.*, 3 *rs.* 5 *a.*

(Signed) C. W. HUTCHINSON, *Lieutenant,*
Executive Engineer,
6th Division, Ganges Canal.

(Signed) T. ASHBURNHAM, *Brigadier,*
Commanding the Station.

(Signed) C. TROUP, *Major, President.*
(Signed) T. RIDDELL, *Captain,*
(Signed) G. R. SIDDONS, *Captain,*
(Signed) R. WROUGHTON, *Lieut.,*
(Signed) NASIR ALLY,
} *Members.*

Attending the Committee—
(Signed) JOHN ELIOT, *Lieutenant, Temporary Assistant, Ganges Canal.*
(Signed) GEO. SIM, *Lieutenant, Officiating Executive Engineer, 7th Division Public Works.*

SURVEY REPORT of a Committee appointed by order of the Brigadier commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal through the Suddur Bazar and Cantonment.—*Cawnpoor, 24th March,* 1851.

SIXTH SECTION.

President—Major C. TROUP.

Members—Captain G. R. SIDDONS, Captain T. RIDDELL, Lieutenant R. WROUGHTON, SYUD NASIR ALLY KHAN, *Deputy Magistrate.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Government	1 dawk bungalow, containing 6 rooms and 3 side verandahs; thatched out-offices; 2 rooms, average 15¾′ by 12¼′; and 5 rooms, average 12′ by 6′; tiled; walls of first two kutcha pukka and last five rooms of mud.	This bungalow is in good repair, only requiring a coat of grass to the roof; it appears, by the books of the Executive Engineer, that it originally cost 1,808 *rs.* 8 *a.* 4 *p.*, including out-offices; and when put in repair, the Committee consider the bungalow to be well worth the price; labour, 600 *rs.*
2. Uhmud Khan	1 room, 19½′ by 9′, tiled; mud walls, 6½′ high, in bad order.	1 outhouse; taken value, 10 *rs.*; compound wall not valued.
3. Nunhai Nawab	4 rooms; average 13¾′ by 11½′; 1 of grass, 1 of tile, and 2 of pukka roofs; walls of the first two mud, 8′ high; and the last two pukka masonry, pukka plastered, 11¼ feet high, in fair order; also a grass shed, 10¾′ by 8′.	Value—gate pillars 25 *rs.*; pukka godown, 237 *rs.*; kutcha out-offices, 19 *rs.*; woodwork gates, 2 *rs.*—equal to 301 *rs.*; labour, 86 *rs.*; walls not included in it, and when destroyed it is to be paid for by the canal executive officers, at the usual cantonment rate.
4. Mohomed Bukhsh ...	2 rooms; average 25½′ by 8½′; tiled roofs; mud walls, 8′ high, in very bad order.	House, 59 *rs.* 8 *a.*, and 35 *rs.* for compound walls, equal to 94 *rs.* 8 *a.*
5. Ditto	22 rooms; average 16′ by 7¼′; 3 thatched, the rest tiled; 4 grass sheds; average 17½′ by 6½′, mud walls, about 6′ high, in very bad order.	3,016 superficial feet of houses of sorts, and including compound walls, 250 *rs.* considered ample; labour, 50 *rs.*
6. Bukhut	15 rooms; average 13¾′ by 8½′; of tiled roofs, 2 storied, the rest of grass; mud walls, 8′ high, in bad order.	Value, equal to 150 *rs.*, compound wall included; labour, 50 *rs.*
7. Meer Auladally ...	18 rooms; average 20′ by 13′; of tiled roofs; mud walls, 10¾′ high, in fair order; 10 pukka pillars, 10′ high.	Valued, equal to 900 *rs.*; labour, 200 *rs.*
8. Mr. Reid	5 rooms; average 10′ by 10′; tiled roofs; mud walls, 6′ high, in fair order; 1 pukka well and gateway.	Gateway, well, and 5 rooms, out-offices, taken; value, 250 *rs.*

(Signed) C. W. HUTCHINSON, *Lieutenant, Executive Engineer, 6th Division, Ganges Canal.*
(Signed) T. ASHBURNHAM, *Brigadier, Commanding the Station.*

(Signed) C. TROUP, *Major, President.*
(Signed) G. R. SIDDONS, *Captain,* } *Members.*
(Signed) NASIR ALLY, }

Attending the Committee—

(Signed) JOHN ELIOT, *Lieut., Temporary Assistant, Ganges Canal.*
(Signed) GEO. SIM, *Lieut., Officiating Executive Engineer, 7th Division, Public Works.*

PROCEEDINGS of a Board of Valuation of Buildings and Property taken in the Thirty Feet Increase of Width of the Esplanades, Ganges Canal.

Cawnpoor, 24*th May*, 1853.

Name of Owners.	Owners' Valuation.	Board's Valuation.		Nature and Extent of Buildings.	Nature of Roof, &c.	Rate per 100 Superficial Feet.	
	RS.	RS.	A.	Superficial Feet.		RS.	A.
1. Lallmeerkhan ...	800	65	0	320 kutcha pukka	Flat mud on kurries	20	0
2. Ditto		25	10	320 kutcha; two rooms.	Tiled on kurries	8	0
3. Gungadeen ...	200	41	10	520 kutcha ...	Flat mud and leanto tile on kurries ...	8	0
4. Muddun Mohun ..	500	40	0	500 „ ...	Flat mud on kurries	8	0
5. Deokanundun ...	25	22	8	450 „ ...	Flat; bad repair	5	0
6.	..	...		Chupper to be removed.			
7. Khurnani ...	..	30	0	600 kutcha ...	Flat, and leanto tile; woodwork of inferior description.	5	0
8. Mudari	..	22	0	440 „ ...	Ditto, ditto	5	0
9. Jumna Doss ...	..	40	10	580 „ ...	Ditto, ditto, on kurries; good repair	7	0
10. Mahomed Khan ...	..	46	3	660 „ ...	Flat and chupper, dttto, ditto ...	7	0
11. Nunna	..	12	4	204 „ ...	Flat, mud on kurries	6	0
12. Sewa	..	25	0	250 „ ...	Thatched; 2 stories	10	0
13. Ditto	..	3	0	A well kutcha	3 feet at top, pukka		
14. Kushyal Teli ...	..	67	14	968 kutcha ...	Flat and leanto tile, on kurries ...	7	0
15. Merya	..	31	0	620 „ ...	Flat, mud, with tile and thatch leanto ditto, woodwork inferior description.	5	0
16. Nuthoo	125	68	0	850 „ ...	Flat, and leanto tile, on kurries; good repair.	8	0
17. Bhawani ...	150	94	0	1,280 „ ...	Tiled, on kurries ... ... { 1,000 / 280	8 / 5	0 / 0
18. Doorjun	..	4	8	150 „ ...	Thatched; bad repair	3	0
19. Subsookh ...	..	45	0	750 „ ...	Flat, mud, and leanto tile	6	0
20. Deena	..	36	0	600 „ ...	Tiled	6	0
21. Khodabux ...	..	27	8	500 „ ...	Tiled; inferior woodwork	5	8
22. Baddula	..	19	0	380 „ ...	Flat, mud, and leanto tile; ditto, ditto .	5	0
23. Poorun	..	60	0	750 „ ...	Flat, mud, and leanto tile, on kurries...	8	0
24. Subsookh ...	..	70	0	1,000 „ ...	Ditto, ditto	7	0
25. Pulloo	..	36	0	450 „ ...	Flat, on kurries	8	0
26. Moolla	..	12	0	300 „ ...	Chupper and tiled; out of repair ...	4	0
27. Narain	..	30	0	250 „ ...	Flat, on kurries; roof and building generally well constructed.	12	0
28. Bissumber ...	..	68	0	700 „ ...	Flat and leanto tile; good repair; pukka brick floor and plinth at doorway. } 300 at / 400 at	16 / 5	0 / 0
29. Subsukh ...	..	18	9	310 „ ...	Flat and leanto, thatched; inferior woodwork.	6	0
30. Karee Aheer ...	..	24	12	310 „ ...	Flat, on kurries; in good repair ...	8	0
31. Subba Aheer ...	..	19	9	280 „ ...	Flat, and leanto tile	7	0
32. Cheda	..	17	8	250 „ ...	Ditto, ditto	7	0
33. Mukha	..	35	0	500 „ ...	Ditto, ditto	7	0
34. Luchee Buniah ...	..	21	0	300 „ ...	Ditto, ditto	7	0
35. Chedi Boorja ...	...	76	0	950 „ ...	Flat, and leanto tile; on kurries ...	8	0
36. Cheda Sunar ...	..	150	0	600 „ ...	2 stories, with tiled open court in centre; in good repair, and well-built veranda next road.	25	0
37. Khoosial Boosawala	..	135	0	850 „ ...	Partly 2 stories, tiled; a boossa shed; sunken floor, pukka lined; pukka drains on house.	15	0
Carried forward	..	1,540	1				

Name of Owners.	Owners' Valuation.	Board's Valuation.		Nature and Extent of Buildings.	Nature of Roof, &c.	Rate per 100 Superficial Feet.	
	RS.	RS.	A.	Superficial Feet.		RS.	A.
Brought forward	..	1,540	1				
38. Kulla	..	..	..	Not valued, &c.			
39. Munneeram ...	..	6	12	444 kutcha ...	Sheds in bad repair	1	8
40. Mumbhur ...	..	250	0	1,016 part kutcha, part pukka.	With court in centre, well built, flat, mud, and leanto tile, with staircase.	25	0
41. Kanjee Mull ...	..	500	0	1,050 kutcha pukka	2 stories, flat; court in centre; double staircase; well built, and in repair.	48	0
42. Punchum Dirgee...	..	17	9	220 kutcha ...	Flat; repair good	8	0
43. Deena	..	126	0	1,400 „ ...	Flat, mud, and leanto tile, and thatched partly; doubled storied.	9	0
44. Salispam	..	21	0	300 „ ...	Tiled	7	0
45. Chuttri	12,000	3,000	0	2,000 pukka ...	2 stories, with inclosed court, also veranda; whole very well built, good repair; flat pukka.	150	0
46. Motee	..	105	0	1,500 kutcha ...	Flat, mud, and leanto tile	7	0
47. Lalla Bunniya ...	..	38	6	320 „ ...	2 stories, and flat and leanto tile, well built.	12	0
48. Buldee Dhobee ...	..	19	13	330 „ ...	Flat	6	0
49. Soumbur... ...	..	10	0	200 „ ...	Tiled, inferior woodwork	5	0
50. Kukhee	..	12	8	250 „ ...	Flat, and shed, ditto, ditto	5	0
51. Narain	..	30	0	500 „ ...	Flat and leanto tile	6	0
52. Ditto	..	16	8	165 „ ...	Tiled; 2 stories	10	0
53. Gungolie... ...	..	24	0	400 „ ...	Flat and leanto tile	6	0
54. Ajoodia	..	58	13	840 „ ...	„ „ good repair ...	7	0
55. Bahooram ...	..	66	0	330 „ ...	Part 2 stories, flat, good repair ...	20	0
56. Dhoondi	..	214	0	1,070 kutcha, one wall kutcha pukka.	Part 2 stories, flat, centre court and staircase good.	20	0
57. Seopershad ...	..	70	3	1,170 kutcha ...	Tiled	6	0
58. Khoori	..	18	0	300 „ ...	Tiled	6	0
59. Nuthun	..	42	0	350 „ ...	Part 2 stories, flat and leanto tile ...	12	0
60. Lalla	..	35	0	500 „ ...	Flat	7	0
61. Bhowanee ...	..	28	0	400 „ ...	Flat	7	0
62. Bhoop	..	28	0	400 „ ...	Flat and leanto tile	7	0
63. Heesa	..	27	8	550 „ ...	Low tiled	5	0
64. Ramdial	..	45	0	300 „ ...	2 stories, flat and leanto tile	15	0
65. Bawani Kunjori ...	..	15	0	250 „ ...	Tiled	6	0
66. Ruthnee	..	6	0	100 „ ...	Tiled	6	0
67. Bhola	..	24	0	300 „ ...	Tiled over flat	8	0
68. Thakooda ...	..	54	0	600 „ ...	Flat, and steps good	9	0
69. Poorun	..	52	8	750 „ ...	Flat and thatched	7	0
70. Baynee	..	72	0	600 „ ...	Flat, and yard good repair	12	0
71. Sewdeen	..	69	0	1,150 „ ...	Flat and tiled	6	0
72. Ramdeen ...	500	160	0	1,000 „ ...	Flat and tiled, 2 stories, good ...	16	0
73. Hoolassi	..	40	0	400 „ ...	Flat, 2 stories	10	0
Total	...	6,842	9				
LEFT BANK.							
Brought forward	..	6,842	9				
74. Gungoo	..	70	0	700 „ ...	Flat, and leanto tile, good woodwork ...	10	0
75. Buldoo Newazee	..	60	0	600 „ ...	Ditto ditto	10	0
76. Budhoo Khan ...	..	92	0	1,200 „ ...	Tiled ... ... { 700 500	6 10	0 0
77. Jumna Doss ..	..	1,000	0	2,250 kutcha pukka	2 stories, with centre court, flat, mud; with staircase, in good repair.	—	
Carried forward	..	8,064	9				

Name of Owners.	Owners' Valuation.		Board's Valuation.		Nature and Extent of Buildings.		Nature of Roof, &c.	Rate per 100 Superficial Feet.	
	RS.	A.	RS.	A.	Superficial Feet.			RS.	A.
Brought forward	..		8,064	9					
78. Valued and taken by former committee.									
79. Bukhtee ...	..		48	0	600	kutcha ...	Flat, and leanto tile, on good woodwork, with steps.	8	0
80. Russool ...	..		70	0	1,000	" ...	Tiled and flat, on ditto, ditto	7	0
81. Gunga Ram ...	..		76	8	850	" ...	Flat	9	0
82. Meeroo	..		36	0	450	" ...	Flat, and leanto tile, good woodwork ...	8	0
83. Moona Lall ...	..		63	0	700	" ...	Flat, mud, with centre yard and steps	9	0
84. Rambuksh ...	3,000		500	0	{ 400 750	" ... pukka ... }	Flat, pukka, and leanto tile, well built {	12 60	8 0
85. Thakoordass ...	..		200	0	500	kutcha pukka	Flat, and leanto tile	40	0
86. Ditto ...	..		15	0	120	kutcha ...	Tiled	12	8
87. Chuttri ...	..		600	0	750	kutcha pukka	2 stories, flat, and leanto tile, with steps, well built, and in good repair, with brick paved flooring.	80	0
88. Roshun Lall ...	..		180	0	400	"	2 stories, flat and tiled, with ditto flooring	45	0
89. Lall Mun ...	..		161	8	950	part kutcha, part pukka.	Flat, well built	17	0
90. Ramdeen ...	1,000		35	0	350	kutcha bricks	Flat, on kurries	10	0
91. Buldeo ...	5,000		600	0	750	kutcha pukka	Flat, mud warehouses, with brick paved floors, whole very well built, and nearly new.	80	0
92. Rampershad ...	..		21	0	300	kutcha ...	Flat, and leanto tile	7	0
93. Sheikh Madarbux	..		16	0	400	" ...	Walls alone standing	4	0
94. Rampershad ...	..		50	0	500	outer pukka, inner kutcha.	Flat	10	0
95. Mihee Lall ...	..		27	0	450	kutcha ...	Flat and tiled	6	0
96. Lalla Mull ...	..		126	0	1,050	outer pukka, inner kutcha.	Flat and tiled, with steps	12	0
97. Degram Lohar ...	..		24	0	400	kutcha ...	Flat and tiled	6	0
98. Kassiram ...	..		14	0	200	" ...	Ditto steps	7	0
99. Mungul Seri ...	..		20	0	250	" ...	Flat	8	0
100. Thatched sheds not valued.									
101. Gungapershad ...	..		40	0	400	" ...	2 stories, tiled	10	0
102. Dulla	..		54	0	450	" ...	Flat, well built	12	0
103. Gungapershad ...	..		66	0	550	" ...	2 stories, tiled	12	0
104. Sumbhoo ...	..		25	0	250	" ...	2 stories, tiled	10	0
105. Bodha	..		120	0	400	part kutcha, part pukka.	Flat, and steps, good repair	30	0
106. Hiyat Khan ...	..		43	6	620	kutcha ...	Tiled	7	0
107. Rokhmun ...	..		52	0	650	" ...	Part 2 stories, tiled	8	0
108. Rampershad ...	..		12	10	180	" ...	Tiled	7	0
109. Chundun ...	..		66	0	550	" ...	2 stories, tiled	12	0
110. Bhujja	..		38	8	550	" ...	2 stories, tiled, old	7	0
111. Ossaree	..		58	8	650	" ...	2 stories, tiled	9	0
112. Mahasook ...	..		125	0	1,250	" ...	Tiled	10	0
113. Ummun Sing ...	..		18	0	300	" ...	Tiled sheds	6	0
114. Ditto ...	..		24	0	400	" ...	Tiled sheds	6	0
115. Ditto ...	..		958	0	3,360	outer pukka, inner kutcha.	Flat mud roof, leanto tiled ditto below, 26 rooms forming range of 7 shops, pukka parapets, whole well built.	28	8
Total ...	..		12,648	9	Total valuation of buildings required in General Gunj.				
Carried forward	..		12,648	9					

Name of Owners.	Owners' Valuation.	Board's Valuation.		Nature and Extent of Buildings.	Nature of Roof, &c.	Rate per 100 Superficial Feet.	
	RS.	RS.	A.			RS.	A.
Brought forward	..	12,648	9				
116. Muss. Umeerun's Estate.	1,000	500	0	A flat-roofed house, containing 2 rooms with tiled verandah; walls kutcha; area of building 56′ by 40′; in bad repair.			
117. Nunna Nowah's estate.	Not present	600	0	A tiled building, 1 large and 7 small rooms, 64′ by 56′; roof of single tiles, with light woodwork, and not in good order; doors ditto.			
118. Ditto, ditto ...	Not present	1,400	0	A thatched building, 2 large and 8 small rooms, with verandah all round; area 68′ by 65′; with tiled out-office attached; 78 feet long by 12 broad; the whole in good repair.			
119. Mr. Reid's estate.	3,000	2,500	0	A tiled bungalow, 9 rooms, with verandah all round; area of building 80′ by 68′; in good repair, and well fitted in the interior range of stabling, and out-offices in the compound.			
120. Nawab Roshun and Udowlah's Estate.	Not present	2,500	0	A terrace-roofed building, 4 rooms, with inclosed verandah, and on one side an open one beyond this; area of whole building 75′ by 63′; walls of peela brick, with pukka plaster, much injured by weather in parts; venetians to 18 outside doors; all rooms in bad repair; range of mud roofed outhouses; walls, peela bricks in mud, 100′ by 12′; 2 ranges of tiled ditto: total length, 180 feet by 12 feet broad.			
GOLAH GHAT.				Superficial Feet.			
121. Kurreem Bux ...	..	56	0	800 kutcha ...	Flat, and leanto, thatched	7	0
122. Gunga Bysun ...	7,000	2,000	0	2,440 pukka ...	2 stories, with centre court flat pukka; whole, well built, and in good repair.		
123. Buddripershad Bepari.	5,000	400	0	940 kutcha pukka	Pukka, flat, with leanto tile ditto, woodwork of roof kurries, old, and suggest masonry of walls rough and without finish, the building being only timber; stores and workshops.		
124. Buleo	..	40	0	400 kutcha pukka	Leanto tile against wall of last building	10	0
125. Chundee ...	..	24	0	400 kutcha ...	Flat, leanto tile, and thatched ...		
126. Ghasee	..	50	0	1,000 " ...	Flat, leanto tile on bad woodwork ...	5	0
127. Moona Ghaseta ...	500	180	0	800 kutcha pukka 22 rg. ft. pukka	Flat, and leanto tile. Retaining walls 3 feet thick, and steps on river edge.	16 2 per rg. ft.	0
Grand total ...	..	22,898	9				

Attending the Board—

(Signed) CHARLES J. HODGSON, *Lieut.*,
Executive Engineer,
4th Division, Ganges Canal.

(Signed) GEO. SIM, *Lieut.*,
Officiating Executive Engineer,
7th Division, Public Works.

(Signed) T. J. BRADFORD, *Lieut.-Col., C.B., President.*

(Signed) T. RIDDELL, *Captain,*
(Signed) G. G. BOWRING, *Captain,*
(Signed) STEWART GRAHAM, *Lieut.,*
(Signed) NASIR ALLY,
} *Members.*

(Signed) T. PALMER, *Brigadier-General,*
Commanding the Division.

SURVEY REPORT of a Committee appointed by order of the Brigadier commanding the Station of Cawnpoor to Survey and Value certain Buildings and Property which come in the line required for the Ganges Canal through the Suddur Bazar and Cantonment.—*Cawnpoor, 26th March,* 1851.

SEVENTH SECTION.

President—Major C. TROUP.

Members—Captain C. BOULTON, Lieutenant R. WROUGHTON, Lieutenant C. WARDE, SYUD NASIR ALLI KHAN, *Deputy Magistrate.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
1. Ramdeen ... ... (Valuation, 25,000 *rs.*)	12 rooms; average 19¾′ by 10¾′; 3 of kutcha roof and the rest of tile; walls of mud, about 10½ feet high, and 3 sheds 14′ by 8¼′; 2 of grass and 1 of tile, in bad order; also a temple containing 2 rooms; average 16¾′ by 9½′; and a verandah, 45½′ by 7¾′; of pukka masonry, pukka plastered on both sides, and 2 stories high, total height 25 feet; roof pukka, and in very good order; also a pukka kutcha well, diameter 3½ feet.	Temple at 7,400 *rs.*; labour, at 2,400 *rs.*; 2,909 superficial feet, out-offices, at 10 *rs.* per 100, equal to 290 *rs.*; labour, at 70 *rs.*
2. Nabab Roshunoordowleh (Valuation,)	24 rooms; average 16¾′ by 9¾′; 11 of tile roof, and 10 of grass, and 3 with a frame of bamboos with no grass, &c., on them; walls of mud, with the exception of 22 pillars, 2½′ by 2½′, which are of pukka masonry, about 10 feet high; also 6 sheds, average 22′ by 10′; 3 of tile, and 3 of grass, whole in bad order.	Stables, equal to 1,200 *rs.*; out-offices, huts, &c., 342 *rs.*; gateway, 125 *rs.*—equal to 1,667 *rs.*; labour, at 400 *rs.*
3. Ghoolamrussool and Shubratally (Valuation, 140 *rs.*)	1 room; 18¾′ by 7¼′; of kutcha roof; walls of mud, about 8 feet high, in bad order.	135 square feet, at 8 *rs.* per 100, equal to 10 *rs.* 12 *a.*; labour, at 2 *rs.*, 4 *rs.* 12 *a.*
4. Ukburally ... ... (Valuation, 200 *rs.*)	2 rooms; average 12½′ by 9½′; of tile roof; walls of mud, about 6½ feet high, in bad order.	237 square feet, at 7 *rs.* per 100, equal to 16 *rs.* 9 *a.*; labour, at 2 *rs.*, 4 *rs.* 12 *a.*
5. Uzmutally ... ... (Valuation, 150 *rs.*)	2 rooms; average 12′ by 7½′; 1 of tile roof, 2 stories high, and the other of tile roof.	270 square feet, at 10 *rs.* per 100, equal to 27 *rs.*; labour, at 2 *rs.* 8 *a.*, 6 *rs.* 12 *a.*
6. Badoollah ... ... (Valuation, 175 *rs.*)	4 rooms; average 8½′ by 7¾′; 1 of kutcha roof, and 3 of tile, 2 stories high, walls of pukka kutcha masonry, 10 feet high, in good order.	460 square feet, at 14 *rs.* per 100, equal to 64 *rs.* 6 *a.*; labour, at 3 *rs.*, 13 *rs.* 12 *a.*
7. Junglee and Budloo ... (Valuation, 35 *rs.*)	3 rooms; average 12′ by 6′; 1 of kutcha roof, 2 of tile; walls of mud, about 7 feet high, in bad order; foundations, 2 walls 12 feet, 12 feet long, of kutcha pukka masonry.	216 square feet, at 8 *rs.* per 100, equal to 17 *rs.* 4 *a.*; labour, at 2 *rs.*, 4 *rs.* 5 *a.*
8. Makhun ... ... (Valuation, 50 *rs.*)	1 room; 16½′ by 7¾′; of tile roof; walls of mud, 4 feet high, in bad order.	130 square feet, at 8 *rs.* per 100, equal to 10 *rs.* 6 *a.*; labour, at 2 *rs.*, 2 *rs.* 4 *a.*
9. Bhujjoo ... ... (Valuation, 100 *rs.*)	2 rooms; average 21½′; of tiled roof; walls of mud, 4 feet high, in bad order.	279 square feet, at 8 *rs.* per 100, equal to 22 *rs.* 5 *a.*; labour, at 2 *rs.*, 5 *rs.* 8 *a.*
10. Rumow ... ... (Valuation, 50 *rs.*)	1 room; 19½′ by 7¼′; of kutcha roof; and a tile shed, 10′ by 6′; walls, ditto, ditto.	201 square feet, at 8 *rs.* per 100, equal to 16 *rs.*; labour, at 2 *rs.*, 4 *rs.*
11. Dabee ... ... (Valuation, 50 *rs.*)	1 room; 19′ by 7¼′; of tile roof; and a tile shed, 5′ by 4′; walls, ditto, ditto.	137 square feet, at 8 *rs.* per 100, equal to 11 *rs.*; labour, at 2 *rs.*, 2 *rs.* 12 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
12. Bheekha ... ... (Valuation, 250 *rs.*)	3 rooms; average $8\frac{3}{4}'$ by $8'$; 1 of kutcha roof, and the rest of 2 stories high; foundations of kutcha pukka masonry; and walls of mud, in good order.	277 square feet, at 18 *rs.* per 100, equal to 49 *rs.* 13 *a.*; labour, at 3 *rs.*, 8 *rs.* 4 *a.*
13. Moonnah and Ghusseetah (Valuation, 250 *rs.*)	2 rooms; average $12'$ by $10'$; 1 of kutcha roof, and the other of tile; also a tile shed, $11\frac{1}{4}'$ by $7\frac{1}{3}'$; walls of mud, about 8 feet high, in good order.	321 square feet, at 8 *rs.* per 100, equal to 25 *rs.* 10 *a.*; labour, at 2 *rs.* 8 *a.*, 8 *rs.*
14. Piaree ... ... (Valuation,)	2 rooms; average $6\frac{3}{4}'$ by $6\frac{1}{2}'$; of tile roof; walls of mud, about 9 feet high, in fair order.	175 square feet, at 12 *rs.* per 100, equal to 21 *rs.*; labour at 2 *rs.* 8 *a.*, 4 *rs.* 6 *a.*
15. Mohun ... ... (Valuation, 300 *rs.*)	3 rooms; average $7\frac{1}{3}'$ by $5\frac{1}{2}'$; 2 of tile roof, 2 stories high, and 1 of kutcha roof; a tile shed, $5\frac{3}{4}'$ by $5\frac{1}{4}'$; walls of kutcha pukka masonry, 10 feet high, in bad order.	200 square feet, at 30 *rs.* per 100, equal to 60 *rs.*; labour, at 10 *rs.*, 20 *rs.*
16. Buldeo Sohoy ... ... (Valuation, 3,500 *rs.*)	1 room; $25\frac{1}{2}'$ by $24\frac{1}{2}'$; of pukka roof; walls, kutcha pukka masonry, 14 feet high, in good order; base pukka.	Value, 2,000 *rs.*; labour, 666 *rs.*
17. Hoosainee ... ... (Valuation, 60 *rs.*)	4 rooms; average $13\frac{1}{2}'$ by $6\frac{1}{4}'$; 3 of kutcha roof, 1 of tile; and a shed of grass, $8'$ by $11'$; walls of mud, 9 feet high, in bad order.	337 square feet, at 8 *rs.* per 100, equal to 26 *rs.* 15 *a.*; labour, at 2 *rs.*, 6 *rs.* 12 *a.*
18. Heengun ... ... (Valuation, 50 *rs.*)	2 rooms; average $8\frac{1}{2}'$ by $8\frac{1}{4}'$; of kutcha roof; walls of mud, 9 feet high, in bad order.	140 square feet, at 10 *rs.* per 100, equal to 14 *rs.* 6 *a.*; labour, at 2 *rs.*, 2 *rs.* 12 *a.*
19. Bhudee ... ... (Valuation, 3,000 *rs.*)	4 rooms; average $21'$ by $10\frac{1}{4}'$; 3 of kutcha roof, 1 of tile, 2 stories high; walls of kutcha pukka masonry, $12\frac{1}{3}$ feet high, in good order.	Valuation, 1,560 *rs.*; labour, 500 *rs.*
20. Dumodur Doss ... (Valuation,)	5 rooms; average $17'$ by $11\frac{3}{4}'$; 1 of pukka roof, and the rest of tile; 4 walls of one room and 2 of another are of pukka kutcha masonry, the rest of mud, 11 feet high; a second story of pukka roof, walls pukka kutcha 11 feet high, in half a room, all in fair order.	Valuation, 2,100 *rs.*; labour, 710 *rs.*
21. Moonna and Ghusseeta (Valuation, 4,000 *rs.*)	2 rooms; average $21'$ by $18\frac{1}{2}'$; of kutcha roof; walls of pukka kutcha masonry, $14\frac{1}{3}$ feet high, in good order.	Valuation, 1,443 *rs.*; labour, 480 *rs.*
22. Gungadeen and Budloo (Valuation, 1,000 *rs.*)	5 rooms; average $13'$ by $8'$; 4 of kutcha and 1 of tile roof, in bad order; walls of pukka kutcha masonry, but 1 ($30'$ by $5'$) which is of mud; a tile shed, $30\frac{3}{4}'$ by $9\frac{3}{4}'$; height of the rest walls about 18 feet.	Valuation, 260 *rs.*; labour, 70 *rs.*
23. Kishun Sohoy and Saligram. (Valuation, 3,000 *rs.*)	1 room; $35\frac{1}{4}'$ by $19\frac{1}{4}'$; of pukka roof; walls of pukka kutcha masonry, $14\frac{1}{3}$ feet high, in good order.	Value, equal to 1,960 *rs.*; labour, 650 *rs.*
24. Mujlis Roy ... ... (Valuation, 700 *rs.*)	1 room; $35\frac{3}{4}'$ by $21\frac{1}{4}'$; one-third of grass, one-third of pukka roof, 2 stories high, and one-third pukka roof only 1 story high; walls of kutcha pukka masonry, 15 feet high, in good order.	Value, equal to 2,553 *rs.*; labour, 850 *rs.*
25. Suboochurn ... ... (Valuation, 1,000 *rs.*)	6 rooms; average $13'$ by $9'$; 4 of kutcha roof and 2 of tile; a wall, $23'$ by $8\frac{1}{2}'$, of pukka kutcha masonry, the rest of mud, in bad order.	700 square feet, at 40 *rs.* per 100, equal to 280 *rs.*; labour, 75 *rs.*
26. Seeta Ram ... ... (Valuation, 3,400 *rs.*)	5 rooms; average $15\frac{3}{4}'$ by $7\frac{3}{4}'$; 2 of tile roof, 2 stories high, and the rest of kutcha roof; walls of pukka kutcha masonry, 11 feet high, in good order; a grass shed, $20\frac{1}{4}'$ by $5'$.	Value, equal to 1,400 *rs.*; labour, 400 *rs.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
27. Manjie Ram ... ... (Valuation, 9,000 *rs.*)	2 rooms; average 28′ by 16′; of pukka roof; a second story, 28′ by 11′, of pukka roof, 11 feet high; walls of kutcha pukka masonry, 11 feet high, base of stone slabs, in good order.	Value, equal to 2,600 *rs.*; labour, 800 *rs.*
28. Mujlis Roy ... ... (Valuation, 9,500 *rs.*)	3 rooms; average 24½′ by 10′; 1 of pukka and 1 of grass roof; 2 stories high; the third of pukka roof (1 story); walls of kutcha pukka masonry, 12 feet high; base of stone slabs.	Value, equal to 3,000 *rs.*; labour, 1,000 *rs.*
29. Chainsookh and Bukhsheeram.	3 rooms; average 20½′ by 11¼′; of pukka roof; walls of pukka kutcha masonry, in good order; a grass shed, 28¼′ by 9¾′; height 15 feet; from the side of the nullah the height is 26½ feet.	Value, equal to 3,080 *rs.*; labour, 900 *rs.*
30. Gian Chund and Piran Sookh. (Valuation, 15,000 *rs.*)	15 rooms; average 20′ by 10¾′; of pukka roof, but 1, which is of tile; walls of kutcha pukka masonry, about 11 feet high; a grass shed 47¾′ by 8′, all in good order.	Value, equal to 4,800 *rs.*; labour, 1,600 *rs.*; owners state that they paid 6,000 *rs.* for the ground alone, and 9,000 *rs.* for their buildings.
31. Khemanund and Doongur Mul. (Valuation, 1,000 *rs.*)	1 tile shed, 73½′ by 14¼′, supported on one side on mud walls 11¾ feet high, and on the other (8′) pukka kutcha pillars 5½ feet high, in fair order.	Value, equal to 250 *rs.*; labour, 80 *rs.*
32. Jonahur Mul ... ... (Valuation, 13,000 *rs.*)	8 rooms; average 20½′ by 12′; 5 of tile roof, 3 of which are 2 stories high, and the rest of pukka roof; 3 walls of one and 2 of another room are of mud, and the rest of pukka kutcha masonry; height, about 13½ feet; a tile shed 50¼′ by 18′, all in bad order.	Value, equal to 3,000 *rs.*; labour, 980 *rs.*
33. Hursooskhroy and Ramkurrun. (Valuation, 3,000 *rs.*)	2 rooms; average 28½′ by 18½′; 1 of pukka roof, and the other of tile; wall of a room of mud, the rest of pukka kutcha masonry, about 13½ feet high, in fair order.	Value, equal to 1,200 *rs.*; labour, 400 *rs.*
34. Dyakishun ... ... (Valuation, 4,000 *rs.*)	3 rooms; average 24′ by 12′; 2 of kutcha roof, and the third of tile, but in very bad order; walls of kutcha pukka masonry, but 1 as in No. 33, the rest in good order.	Value, equal to 800 *rs.*; labour, 225 *rs.*
35. Bunseedhur ... ... (Valuation, .)	8 rooms; average 14′ by 7¼′; 1 of pukka, and the rest of kutcha roof; walls of kutcha pukka masonry, about 12 feet high, in bad order; 1 small dome, 4′ by 4′, on the outside, and 12¼ feet high of pukka kutcha masonry, and pukka plastered; also a grass shed, 15¾′ by 5′.	Value, equal to 800 *rs.*; labour, 225 *rs.*
36. Seetaram ... ... (Valuation, 2,000 *rs.*)	3 rooms; average 21′ by 9½′; of pukka roof; one 2 stories high; walls of pukka kutcha masonry, about 15 feet high, in good order.	Value, equal to 1,500 *rs.*; labour, 500 *rs.*
37. Moonna and Ghusseeta (Valuation, 2,500 *rs.*)	9 rooms; average 15½′ by 8½′; 2 of tile roof, and 1 of which is 2 stories high, and the rest of kutcha roof; walls of mud, 10 feet high, but the foundations, which are of pukka masonry, as also the back wall of the house, 34′ by 9½′, of kutcha pukka masonry, whole in bad order.	1,449 square feet, at 50 *rs.* per 100, equal to 724 *rs.* 8 *a.*; labour, 274 *rs.*
38. Chamsookh and Bukhshyram. (Valuation, .)	7 sheds; average 25¼′ by 11½′; 1 of tile and 6 of grass (in bad order); 5 supported on one side on mud walls 8 feet high, and on the other on bullies; and 2 on bullies only.	2,030 square feet, at 5 *rs.* per 100, equal to 101 *rs.* 8 *a.*; labour, 24 *rs.* 8 *a.*

Names of and Valuation by Owners.	Description.	Remarks by the Committee.
39. Seetulpersaud and Ubdoolkurreen. (Valuation, .)	2 rooms; average 15′ by 8½′; 1 of tile, and 1 of grass roof; walls of mud, 5 feet high, and a grass shed, 17′ by 10½′, in bad order; part of wall at the gate, about 12½′ by 7′, and the foundations of that wall, of kutcha pukka masonry.	382 square feet, at 6 *rs.* per 100, equal to 22 *rs.* 14 *a.*; 234 cubic feet kutcha pukka masonry, at 4 *rs.* 8 *a.* per 100, 10 *rs.* 8 *a.*; and 1 gateway, 15 *rs.*; labour, 13 rs.
40. Jurakhun ... ... (Valuation, 500 *rs.*)	1 wall of mud, 31 feet long, about 6 feet high, in bad order.	Wall and grass shed, 5 *rs.*
41. Kurreembuksh ...	1 tile shed, 10′ by 10½′; on one side one mud wall, and on the other of posts.	Value, equal to 5 *rs.*; labour, 1 *r.*
42. Byjnauth	1 tile shed, and 1 room, with kutcha pukka walls, 20′ by 10¾′.	Value, equal to 200 *rs.*; labour, 60 *rs.* House close to Gyanchund's, and was first included in the valuation, 5,000 *rs.*, agreed on for that house; but as it is a separate property, 200 *rs.* have been decided to be given to Byjnauth, and only 4,800 *rs.* to Gyanchund.

(Signed) C. W. HUTCHINSON, *Lieutenant, Executive Engineer, 6th Division, Ganges Canal.*
(Signed) T. ASHBURNHAM, *Brigadier, Commanding the Station.*

(Signed) C. TROUP, *Major, President.*
(Signed) C. BOULTON, *Captain,*
(Signed) NASIR ALLY,
(Signed) C. WARDE, *Lieut.,*
(Signed) R. WROUGHTON, *Lieut.,*
Members.

Attending the Committee—

(Signed) J. ELIOT, *Lieutenant, Temporary Assistant, Ganges Canal.*
(Signed) GEO. SIM, *Lieutenant, Officiating Executive Engineer, 7th Division Public Works.*

APPENDIX O.

GANGES CANAL WORKS.—NORTHERN DIVISION; *by* CAPTAIN A. G. GOODWYN, *Executive Engineer.*

ON BLOCK-SINKING.

THE object of this paper, and of the tabular statement which accompanies it, is, the discovery of the law which regulates the expense of block-sinking for foundations, as far as the operations in the bed of the Solani teach.

2. The statement embraces a period of two years and four months, or from 1st April, 1848, to 31st July, 1850, and shows the result of block-sinking operations since my connection with the Northern Division Ganges Canal, as far as relates to the aqueduct proper, with the exception of sinking sixteen wells for the support of the steps at the flanks of the abutments of that work.

3. To render this statement complete, however, similar detail is required regarding the under-sinking of the blocks for the support of the curved revetments connecting the work in the bed of the river with that on the banks; and, as these blocks are of uniform size and shape, and both are such as are likely to be more generally adopted in this country than those of many of the very large blocks supporting the heavy weight of the piers and abutments of the Solani Aqueduct, it is much to be desired that a similar record should, hereafter, include them.

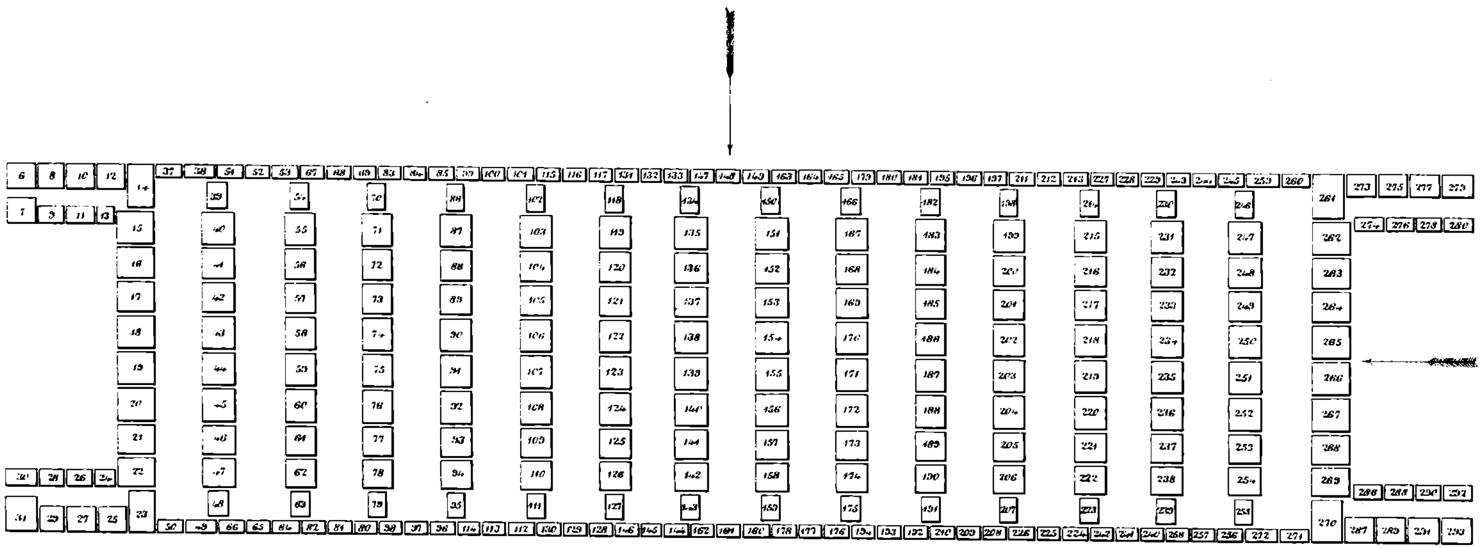
4. Again, this statement should embrace the whole of the block-sinking operations in the bed of the Solani; but in it I have not noticed the labours of my predecessor, Lieutenant H. Yule, of Engineers, on account of the monthly progress reports of block-sinking, prior to my receiving charge, showing merely the depth of sinking remaining to be executed for each block. It is true that materials exist for supplying every information that can be desired on this point, Lieutenant Yule's records being most complete and lucid; but as the depths to which blocks were sunk varied greatly, and moreover the sinking of the same blocks was not continuous, the labour of compiling from these records a list which should show each month the progress on each block, with the mean depth at which that progress took place, involves the formation of an entirely new set of progress reports, and is a work greater than I am at present equal to.

5. One great difficulty in framing this statement has been to arrive at the true mean depths at which sinking was performed. This difficulty has beset me at the outset, and has not been overcome. As an exemplification of it, suppose, on the first of a month, a block was down 14 feet, and on the last day of the month 20 feet, and that the cost of sinking during the month was 132 rs. Now, in this case, the rate per running foot would be 22 rs., the progress being 6 feet; also the mean depth at which sinking was performed was 17 feet. In making my calculations I have used data similarly obtained. But it must not be supposed

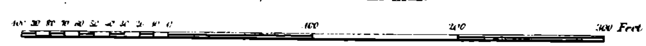
FOUNDATION BLOCKS

of the

SOLANI AQUEDUCT.



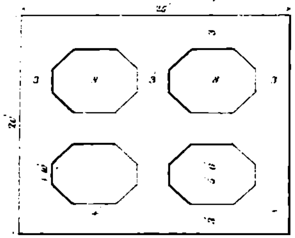
Scale, 120 Feet to an Inch.



Plan of Blocks N^{os} 14, 23, 261, 270.

Sup^l cont. 353 . 4 Octagon

— do — 324 . 0 Square



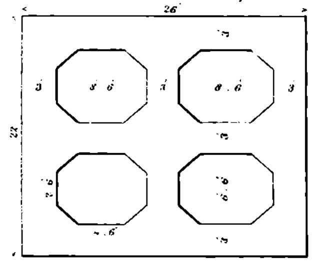
25 x 20 - 5·5 x 8 x 4 - 324

25 x 20 - 5·5 x 8 x 4 + 1·83 x 3/4 x 16 - 353·3

Blocks N^{os} 15, 16, &c. Total 16.

Sup^l cont. 383 . 0 Oct.

— do — 351 . 0 Sq.



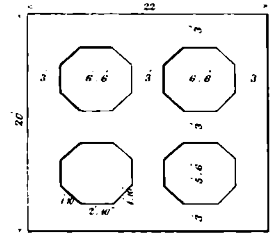
26 x 22 - 6·5 x 8·5 x 4 - 351

26 x 22 - 6·5 x 8·5 x 4 + 2 x 1/2 x 16 - 383

Pier Blocks N^{os} 40, 41 &c. Total 112.

Sup^l cont. 323 . 10 3/4 Oct.

— do — 297 . 0 Sq.



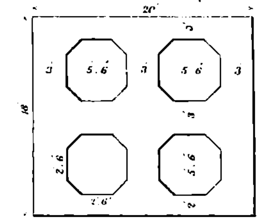
22 x 20 - 6·5 x 5·5 x 4 - 297

22 x 20 - 6·5 x 5·5 x 4 + 1·83 x 1.83/2 x 16 - 323·3

Blocks N^{os} 6, 7, 30 &c. Total 8.

Sup^l cont. 257 Oct.

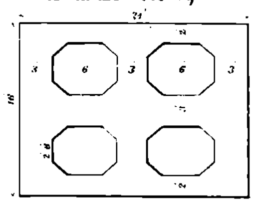
— do — 239 Sq.



Blocks N^{os} 8, 10, 12, &c. Total 12.

Sup^l cont. 240 Oct.

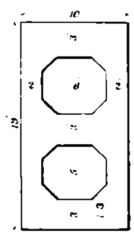
— do — 228 Sq.



Blocks N^{os} 9, 11, 13, &c. Total 6.

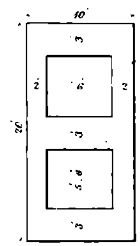
Sup^l cont. 137 . 6 Oct.

— do — 130 . 0 Sq.



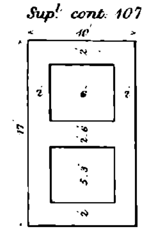
Blocks N^{os} 276, 288, Total 2.

Sup^l cont. 134



Blocks N^{os} 274, 278, 286, 290 Total 4.

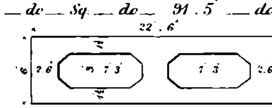
Sup^l cont. 107



Curtain Blocks N^{os} 37, 38, 49, 50, 259, 260, 271, 272

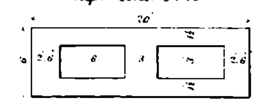
Area of Oct. portion 95 . 5 Square Feet.

— do — Sq. — do — 91 . 5 — do —



Curtain Blocks N^{os} 51, 53, 64, &c.

Sup^l cont. 84 . 0

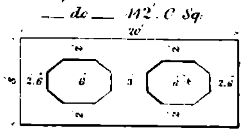


N.B. The Curtain Blocks between and including N^{os} 147 and 129 on the upstream and down-stream sides of the aqueduct respectively, and the left abutment, have their tops only here represented in plan. Their walls are of equable thickness, as here shown, and their ends are vertical, but their sides have a batter of 1 in 8.

Cutwater Blocks, Total 28.

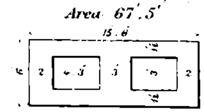
Sup^l cont. 118 . 0 Oct.

— do — 112 . 0 Sq.



Curtain Blocks N^{os} 52, 65, 68, 81, &c.

Area 67 . 5



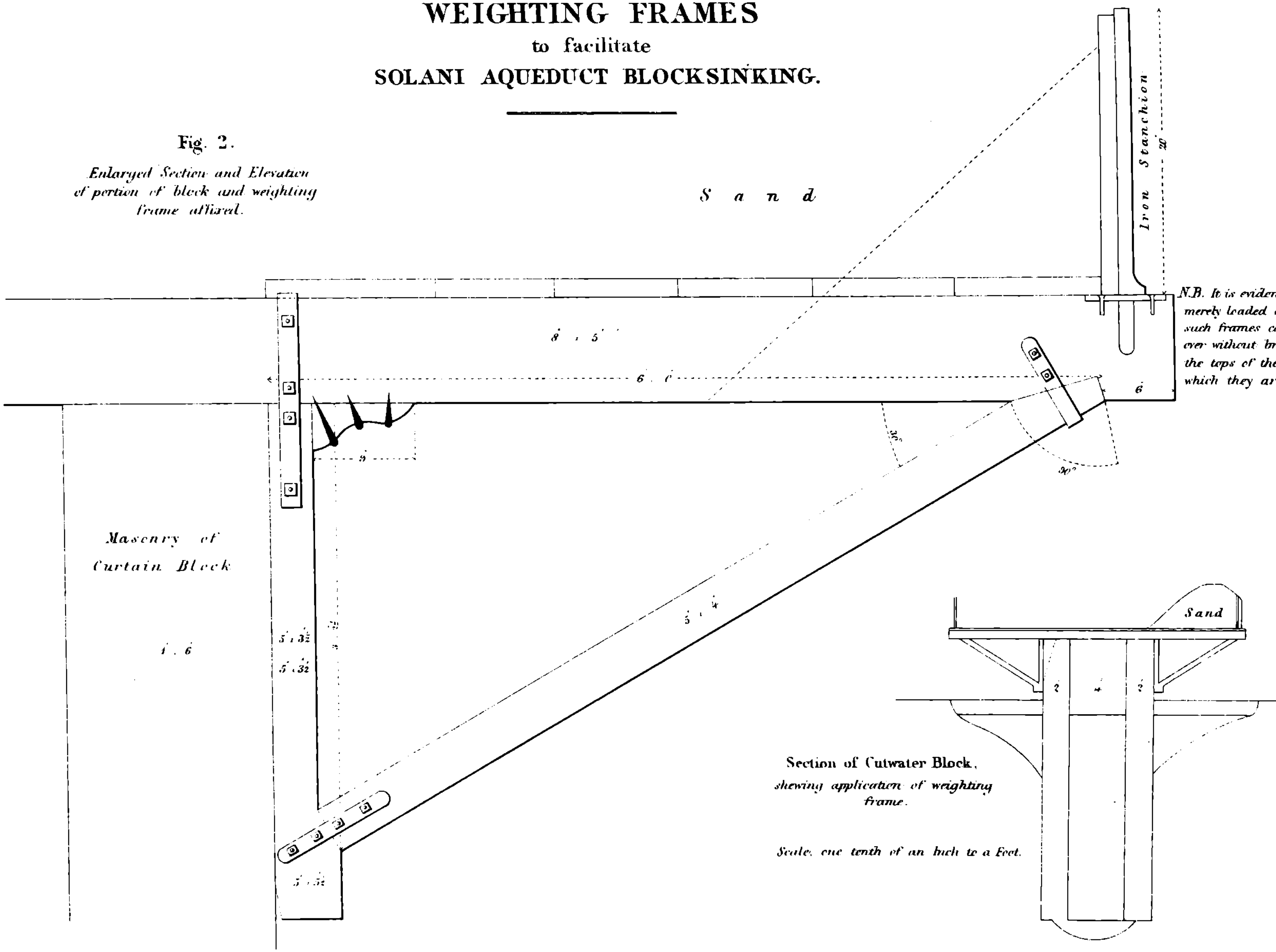
Scale, 16 Feet - One Inch.

10 9 8 7 6 5 4 3 2 1 0 10 20 Feet

WEIGHTING FRAMES
to facilitate
SOLANI AQUEDUCT BLOCKSINKING.

Fig. 2.

Enlarged Section and Elevation of portion of block and weighting frame affixed.



N.B. It is evident that altho' merely loaded on one side, such frames cannot tilt over without breaking off the tops of the blocks on which they are fixed.

Section of Cutwater Block,
shewing application of weighting frame.

Scale, one tenth of an Inch to a Foot.

Scale for Fig. 2 _ One Foot to an Inch.

Ins 12 6 0 1 2 3 4 5

Appendix O.
To face page 268.
Vol. 3.

that the cost of sinking the block from 14 to 17 feet was the same as that from 17 to 20 feet, or that, consequently, as far as the valuation of work goes, 17 feet is the correct mean.

6. In reality, the expense of sinking varies more nearly as the cubic contents of the crater caused by that operation, added to a certain amount of excavation from beneath the crater, or as the cubic contents of a portion of the block taken solid of the depth sunk, added to some multiple of the cube of that depth sunk, than in any other proportion I am aware of. But what this multiple of the cube of the depth is, can only be ascertained by considering each particular block.

7. For further exemplification, suppose progress as above stated to have occurred on a detached block 20 feet square, the soil to be moved being equal to the content of a crater whose sides run up from the foot of the block everywhere at an angle of 45°.

The cubic content of such a crater would be—

$$\overset{\text{L.}}{20} \times \overset{\text{D.}}{20} \times \overset{\text{D.}}{20} + 4 \times \overset{\text{L. or B.}}{20} \times \overset{\text{D.}}{\frac{20^2}{2}} + \frac{4}{3} \times \overset{\text{D.}}{20^3}, \text{ or}$$

$$20 \times \left\{ \begin{array}{l} \text{area included in} \\ \text{circumference of} \\ \text{base of block.} \end{array} \right\} + 3\tfrac{1}{3} \times 20^3.$$

And the works executed on each foot of sinking between 14 and 20 feet would be as follows :—

		Modulus C. F.		Rs.	A.	P.
15th foot	$1 \times 400 + 3\frac{1}{3}(15^3-14^3) =$	2,503⅓	costing	16	9	5
16th „	$1 \times 400 + 3\frac{1}{3}(16^3-15^3) =$	2,803⅓	„	18	9	3
17th „	$1 \times 400 + 3\frac{1}{3}(17^3-16^3) =$	3,123⅓	„	20	11	2
18th „	$1 \times 400 + 3\frac{1}{3}(18^3-17^3) =$	3,463⅓	„	22	15	2
19th „	$1 \times 400 + 3\frac{1}{3}(19^3-18^3) =$	3,823⅓	„	25	5	4
20th „	$1 \times 400 + 3\frac{1}{3}(20^3-19^3) =$	4,203⅓	„	27	13	8
By addition,	$6 \times 400 + 3\frac{1}{3}(20^3-14^3) =$	19,920	„	132	0	0

The number of cubic feet of the modulus, or supposed quantity of soil displaced, due to each foot of sinking being known, the cost of each foot is calculated, on that number, by simple proportion; the total number of cubic feet of the modulus being found by the expression; $6 \times 400 + 3\frac{1}{3} (20^3-14^3)$ to be 19,920, and the total expense being known to be Company's rupees 132.

8. Now, from this it appears that the mean depth, as far as expense is concerned, is 17½ feet nearly, instead of 17 feet, and that the lower 2½ feet cost as much as the upper 3½ feet, on the whole monthly progress of the block in question.

9. By some such calculation greater accuracy in the statement of mean depths might undoubtedly have been obtained, but the work would have run out to a length that, with the limited time and means at my disposal, I could not pretend to follow.

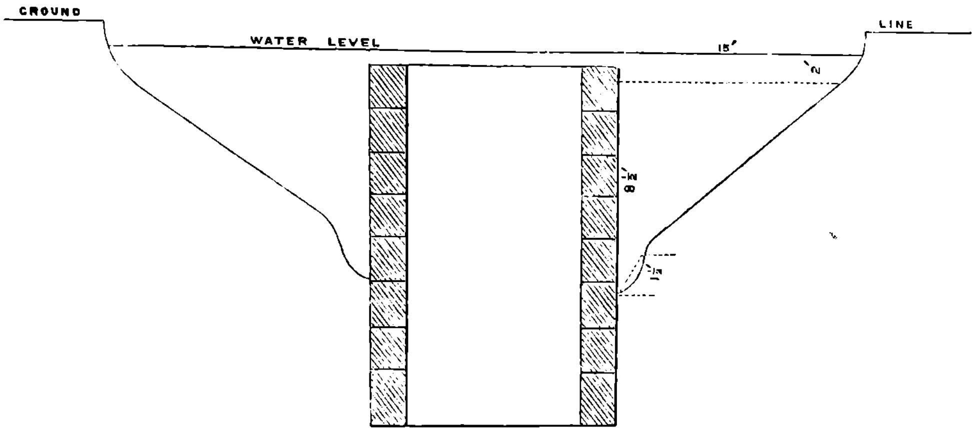
10. The above example is wholly supposititious, and must not be taken as a guide for rates.

11. In the case of heavy blocks, *i. e.* those of 1st, 2nd, and 3rd classes, and of the cutwater blocks of the 4th class, the soil has been found at the sides of the craters at a somewhat steeper slope than in that of the long curtain blocks of the 4th class; or rather, I believe, to speak more correctly, in the case of the latter the sand runs down the sides of the craters in a somewhat less steep slope than in the case of the former, owing, as I suppose, to the greater rapidity with which the heavy blocks sink. What I mean to say is, that, in the case of the large blocks, the sand has not time to take the same angle of repose as with the small ones, and consequently the apparent disturbance in the vicinity is less.

12. The section of these craters of course varies with the proportions of clay and sand in the soil, but the following may be taken as average sections:

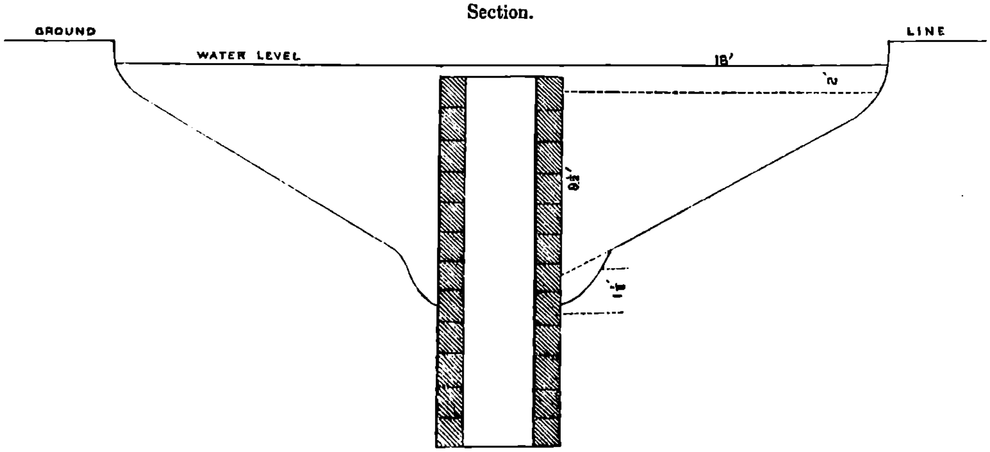
1st, 2nd, and 3rd Classes, and 4th Class Cutwater Blocks.

Section.



4th Class Curtain Blocks.

Section.



The sectional areas of these craters possibly vary from 220 to 280 square feet, but neither of these amounts adequately represents the true quantity of soil removed in block-sinking; this true quantity, when the circumferences of blocks are the same, varying inversely in some proportion of the weight to the base of the block, although the discovery of what that proportion is, exactly, is still a desideratum.

13. Any one who has watched the bubbling up of springs, throwing up as they do, when first opened, large quantities of the soil through which they pass, will, I think, agree, that, in estimating the craters as running from the feet of the blocks upwards at an angle of 45°, too great an allowance would not be made for the quantity of soil to be removed. My calculations, as far as they go, prove this; and unless even greater value is assigned to weight of blocks, in proportion to their bases, than I am disposed to allow, the conclusion appears quite sound that, in calculating the soil removed thus, the results are under, rather than over stated. As far as I can discover, no advantage results from the consideration of the above sections as shown in diagram. I give them merely to show that they do not, as might be supposed, afford from mere inspection data for estimating the quantity of soil removed. It must be remembered, also, that all that is

necessary is to fix a modulus which will afford results *relatively* correct; their being *absolutely* so or not, is not a matter of any practical importance.

14. Having premised thus much, a set of formulæ will follow, by the application of which to the several months' progress and expenditure, the value of the above-stated conclusions may be tested. It is, in fact, supposed that the quantity of soil removed is the same as would be excavated could the blocks be "laid in" dry, in a soil that would stand at an angle of 45°.

The expressions obtained are not the simplest possible algebraically, but are such, as, with the aid of good tables of squares and cubes, will, it is believed, give results with the least possible labour.

Let l be the length in any line of blocks, as a pier, taken up by one block.
b ,, breadth of the block.
d ,, depth sunk.
s ,, space or interval between blocks.
n ,, number of blocks.

Thus—

For any number of blocks, of uniform breadth and length in a continuous line, other than the end ones .... the formula is,

$$\begin{cases} n\,\overline{(l+s)\,bd + (l+s)\,d^2} \text{ or} \\ n\,(l+s)\,(bd+d^2) \end{cases}$$

For end blocks of uniform length and breadth, terminating such continuous lines .... ,,

$$\begin{cases} n\,\overline{\left(l+\frac{s}{2}\right)bd + \left(l+\frac{s}{2}\right)d^2 + \frac{b}{2}\,d^2 + \frac{2}{3}\,d^3} \text{ or} \\ n\,\overline{\left(l+\frac{s}{2}\right)(bd+d^2) + \frac{b}{2}\,d^2 + \frac{2}{3}\,d^3} \end{cases}$$

For any single detached block .... ,,

$$\begin{cases} lbd + ld^2 + bd^2 + \frac{4}{3}\,d^3 \text{ or} \\ lbd + (l+b)\,d^2 + \frac{4}{3}\,d^3 \end{cases}$$

When the lengths and breadths of blocks in a continuous pier are all uniform, then for the whole pier, including end blocks .... ,,

$$\begin{cases} (n-2)\,(l+s)\,(bd+d^2) + 2\left\{\overline{\left(l+\frac{s}{2}\right)(bd+d^2) + \frac{b}{2}\,d^2 + \frac{2}{3}\,d^3}\right\} \text{ or} \\ d\left\{\overline{n\,(l+s) - s}\,(b+d) + bd + \frac{4}{3}\,d^2\right\} \end{cases}$$

Hence, when calculating cost of work at any intermediate stage of progress, if
d represent the greater depth arrived at,
d_1 ,, less ,, ,,

Then—

For any number of blocks of an uniform breadth and length, in a continuous line, other than the end ones ...... the formula is,

$$n\,(l+s)\,\overline{bd + d^2 - \left(bd_1 + bd_1^2\right)}$$

For end blocks of uniform length and breadth terminating such line ... ,,

$$n\left\{\left(l+\frac{s}{2}\right)\overline{bd + d^2 - \left(bd_1 + bd_1^2\right)} + \frac{b}{2}\,d^2 + \frac{2}{3}\,d^3 - \left(\frac{b}{2}\,d_1^2 + \frac{2}{3}\,d_1^3\right)\right\}$$

For any single detached block .... ,,

$$\left(d - d_1\right)\overline{lb + (l+b)\left(d + d_1\right)} + \frac{4}{3}\left(d^3 - d_1^3\right)$$

When the lengths and breadths of blocks in a continuous line are all uniform, then for the whole pier, including the end blocks .... the formula is,

$$\overline{n\,(l+s)-s}\times\overline{b\,\left(d-d_1\right)+\left(d^2-d_1^2\right)}+b\left(d^2-d_1^2\right)+\frac{4}{3}\left(d^3-d_1^3\right)\ \text{or}$$

$$\overline{n\,(l+s)-s}\times\left(d-d_1\right)\left(b+d+d_1\right)+b\left(d^2-d_1^2\right)+\frac{4}{3}\left(d^3-d_1^3\right)$$

15. It now remains to examine how far this agrees with practice. Certain months have been taken as a test, quite at random, and the rates have been struck on the modulus thus obtained. In the comparison the cost of merely the labour of undersinking has been taken into consideration, as it is obvious that, when the total expenditure is not proportionate to the mere cost of labour of undersinking, the causes are foreign to the matter at present under consideration, which is how far this theory is supported by the results obtained from all blocks large or small, and whether it deals satisfactorily with the admitted difference of cost of sinking blocks of varied shape at varying depths.

16. May, 1848, is the first month examined. It may be proper to state that the calculations have in all cases been made with the utmost care (they are not inserted on account of their length), and that where great differences existed in the mean depths at which sinking was performed, the true quantity of work done has been estimated, as nearly as possible, by dividing the work into small portions, in which the variation in depth was less marked. By the aggregation of the results, obtained from these small portions, totals have been found, on which the rates have been struck. These rates are as follow :—

May, 1848	1st class	11·93	annas per 100 c. f. of the modulus.			
	2nd „	7·90	„	„	„	
	3rd „	11·80	„	„	„	
	4th „	9·78	„	„	„	

The variation in rate here noticed is considerable, and it now remains to ascertain what causes exist affecting the rate in some classes more than in others.

Firstly :—

1st class blocks, $\frac{3,187}{6,733}$ or 0·473 of the whole number of workmen were employed at night.

2nd „ „ $\frac{2,365}{5,683}$ or 0·416 „ „ „

3rd „ „ $\frac{784}{2,492}$ or 0·315 „ „ „

4th „ „ $\frac{767}{1,985}$ or 0·386 „ „ „

This varying proportion of men, employed by night on each class of blocks, *may* be a reason of difference of rate. Lieutenant G. Price, the officer in immediate executive charge of this work, is of opinion that work by night is a saving merely of time, and thinks with me that if possible it should not be resorted to, as being more expensive than work by day only. The difference is not material, however, and I do not assign to this first cause the variation in rate which I seek to explain.*

* These remarks were made merely with reference to defective supervision, and interruptions attendant on work performed at night; but, subsequent to writing them, Lieutenant E. Walker, of the Engineers, drew my attention to the fact of much greater progress being made in sinking a well of his when workmen were employed at considerable intervals than when the work was carried on uninterruptedly. This was corroborated in the case of a well sunk in my own compound. The experiment was then extended to six blocks in the Dhunouri revetment foundations, which were worked at every other day only. The record of the result there was, however, most unfortunately vitiated by circumstances which need not be detailed; still every reason exists for believing that the result was the same as in the two former cases. Paradoxical as advocacy of intermitted block-sinking may appear, I strongly recommend its *trial*. Any one who has examined old kutcha wells and has observed in what way the bottoms, only, of the cylinders fall in, will see how intermitted sinking may be recommended by argument as well as by fact. Whether, however, the benefits that might accrue from sinking, thus performed, would not be counterbalanced by the extra expense of either moving the block-sinking apparatus, or of making up a double set, is a point that must depend on other circumstances; not the least important of which may be variety of soil to be worked through.—A. G. G.

Secondly :—

The effective surplus weight in proportion to the bases of the blocks in their average state of immersion, was :—

1st class,	572	lbs.	to 1 square foot of area included in circumference of base of block.
2nd ,,	507	,,	,, ,, ,, ,,
3rd ,,	642	,,	,, ,, ,, ,,
4th ,,	552	,,	,, ,, ,, ,,

That the varying proportion of weight to the area of the base has a very material effect on the cost of sinking is beyond dispute, but unfortunately no data exist by which the ratio of velocity of sinking to weight can be accurately determined.

Thirdly :—

And this consideration appears the most important of all in the present instance, the height, from whence the jham had to be worked, must be looked to. In the case of the 1st and 3rd class blocks, the masonry being 20 feet high, it mattered nothing at what average depth sinking had to be performed, as far as the labour of bringing up any given quantity of earth was concerned. Directly the block was built up from its first height of 12 feet, to its final height of 20 feet, every jham load was raised that height, and the jham-worker had to handle a staff 8 feet longer than before. The time required to work a jham, at the bottom of a block built up to a height of 20 feet, is about one-fourth more than when that block was only 12 feet high. Moreover the jham cannot be forced into the ground so deep as before; and, as the depth of water increases more and more of the contents of the jham are washed out during its passage upwards; so that the total labour of sinking when the block is 20 feet high, is to the same work when the block is only 12 feet high, as 3 to 2 nearly; or, to speak more correctly, the labour of bringing up any given quantity of soil under these two differing conditions is in this proportion, for it must not be forgotten, that, owing to difference of weight, the *progress*, as before stated, will be greater on any high block, for the same quantity of excavation, than on a low one of the same length and breadth. Now, in the case of the 2nd class blocks, $\frac{204}{672}$, or 0·391, of the work was performed at a height of 12 feet, and, in the 4th class block-sinking, $\frac{64}{479}$, or 0·14, was done under the same circumstances. If, then, correction, fairly due on account of different heights, be applied, giving the workmen credit, as it were, for their work valued at the 12-feet standard, the comparative rates on the modulus would be :—

1st class blocks,	7·95	annas	per 100 c. f.
2nd ,,	6·30	,,	,,
3rd ,,	7·90	,,	,,
4th ,,	6·96	,,	,,

It would be easy to show, that, by more accurate calculation of the variation caused by height of blocks, just at the point where the mean depth at which sinking was performed begins to exceed 12 feet, and where the depth of water has not yet materially increased, consequently where the contents of the jham are not materially lessened in their upward passage, these rates would approach each other still more nearly.

17. The next period taken was that of

May, 1849. { 2nd class blocks, 7·97 per 100 c. f. on modulus.
4th ,, (no curtain blocks) 8·25 per 100 c. f. on modulus.

$$\text{2nd class, } \frac{5{,}103}{11{,}761} = 0\cdot434 \text{ of the workmen were employed at night.}$$

$$\text{4th ,, } \frac{646}{1{,}370} = 0\cdot471 \quad \text{,,} \quad \text{,,}$$

The effective surplus weight in proportion to the bases of the blocks, in their average state of immersion, was—

2nd class,	615	lbs.	to 1 square foot of area included in circumference of base of block.
4th ,,	634	,,	,, ,, ,, ,,

18. These rates agree very nearly with each other; but to render the comparison quite fair, a correction, as before, has to be applied, although owing to a different cause; after which they may be placed beside those of May, 1848.

19. On 1st December, 1848, the number of men to each jham was reduced by Lieutenant Price from 4 to 3, and on 1st November of the same year the pay of beldars was lowered, by order of the Director of the Works, from 4 rupees to 3-8 per mensem.

The mistri employed superintending the block-sinking asserts that three men work a jham *quite* as well as four; yet this is neither Lieutenant Price's opinion nor my own, although we agree that they perform *nearly* as much work as four. I have very little doubt that the mistri was influenced in his report by a desire to make it as agreeable as possible. Now—

The pay of a squad consisting of 1 tindal at 6 rupees per mensem and of 30 beldars at 4 rupees per mensem, was, before 1st November, 1848 . . . . Co.'s rupees 126

Do. do. when the beldars' pay was reduced to 3-8 per mensem, after 1st November, 1848 . . . . „ „ 111

It appears that a saving of $\frac{15}{126}=\frac{5}{43}$ was made, on labour, by the Director's reduction, and nearly of $\frac{1}{4}$th by Lieutenant Price's reduction; the total saving being $\frac{5}{43}+\frac{1}{4}=\frac{63}{172}=0{\cdot}366$.

20. Therefore the same work which was done before 1st December, 1848, for one rupee, was done afterwards for $\frac{109}{172}$ of a rupee.

Consequently the work which in May, 1849, cost 7·97 annas, would, in May, 1848, have cost 12·57 annas.

21. A reduction on account of the 12-feet standard to which the work for May, 1848, was reduced, or—

$\frac{1}{3}\times\frac{539}{778}\times 12{\cdot}57=2{\cdot}90$ annas, must be applied to 2nd class blocks, and the proper reduction to the 4th class blocks also, leaving the results for—

2nd class blocks 9·67 per 100 cubic feet on modulus.
4th class do. 9·74 do. do.

22. If, instead of taking the mistri's statement of saving of one-fourth, by the reduction of windlass men from 4 to 3, it were taken at one-fifth, which is probably nearer the truth, the corrected rate on 2nd class sinking would be 8·77 and that on 4th class sinking nearly the same, affording a very close approximation to the reduced rates of May, 1848. As it is, however, the agreement is quite as near as could reasonably be expected, and is nearer than I had anticipated when I commenced the investigation.

23. May, 1850, has next been taken.

4th class 10·8 annas per 100 cubic feet on modulus.

$\frac{1262}{2772}=0{\cdot}455$ of the whole number of workmen were employed at night.

The weight on the area included in the circumferences of the bases of the blocks is 505 lbs. per square foot, in the average state of immersion.

This work would, in May, 1848, have cost 17·04 annas per 100 cubic feet of modulus, and applying correction of $\frac{1}{3}$ of $\frac{222}{236}$ of 17·04, to effect a reduction to the 12-feet standard of comparison, the rate becomes 11·53 per 100 cubic feet of the modulus.

24. For June, 1850.

4th class blocks: 11·98 annas per 100 cubic feet of modulus.

$\frac{6774}{14340}=0{\cdot}472$ of the whole number of workmen were employed at night.

In the average state of immersion of the blocks, the weight on the area included in the circumferences of their bases was 613 lbs. to the square foot.

Applying corrections necessary, as before described, the rate becomes—

$\frac{172}{109} \times 11{\cdot}91$, less one-third of this amount (as all the blocks on which sinking was performed this month were at their full height), or 12·6 annas per 100 cubic feet on modulus.

25. For July, 1850.

4th class blocks: 13·62 annas per 100 cubic feet of modulus.

No work was done at night.

In the average state of immersion of the blocks, the weight on the area included in the circumferences of their bases was 351 lbs. only per square foot. This small proportional weight is due partly to a rise in the water level, this month.

Applying the corrections necessary, the rate becomes—

$\frac{2}{3}$ of $\frac{172}{109}$ of $13{\cdot}62 = 14{\cdot}33$ annas per 100 cubic feet of modulus.

26. The last three rates are for light curtain blocks with splayed bases. They agree well with each other, and appear to point to an error in the formulæ in calculating the section of soil removed, in the case of a line of blocks, at $bd+d^2$, representing a slope of 45° for the craters. It is very desirable that the expression $bd+3d^2$, representing a slope of rather more than 33°, should be tried; perhaps the results thus obtained would be found to agree better with each other than those obtained from the formulæ I have made use of.

27. It appears that, on the Solani works—

0·135 of a tindal's day's work, or $\frac{1}{222}$ of his month's work, with 4·054 of a beldar's day's work, or $\frac{5}{37}$ of his month's work, is equal to the execution of 100 cubic feet of the modulus, including leave on Sundays; but when the proportion of effective weight to the bases of the blocks may be less than that which obtained in the case of the Solani works, the rate on the modulus must be increased in estimating the cost of labour on future works.

28. What has been stated above refers only to the *labour* of undersinking. It is necessary now, however, to see what the total charge on the modulus, including the cost of removing sand from the tops of blocks, of providing tools, and of defraying sundry trifling contingent expenses, attendant on the work, has been.

May, 1848.	1st	class,	23·220	annas	per 100 c. f.	of the modulus.	This variation in rates is owing, in great measure, to the variable distances to which soil was transported.
	2nd	„	17·800	„	„	„	
	3rd	„	21·390	„	„	„	
	4th	„	20·010	„	„	„	
May, 1849.	2nd	„	17·800	„	„	„	
	4th	„	17·590	„	„	„	
May, 1850.	4th	„	38·350	„	„	„	
June, 1850.	„	„	25·850	„	„	„	
July, 1850.	„	„	30·512	„	„	„	

29. Calculating for a large new work I should say that a rate, on the modulus, of 20 annas per 100 cubic feet would cover all expenses, out of which the expense of mere labour of undersinking would not exceed 9 annas per 100 cubic feet; the remainder of the charge being for material, such as rope, oil for torches, &c.; cost of removing sand from blocks; percentage for tools, and sundries. A great saving might be effected on the rate of 20 annas per 100 cubic feet, by the employment of chain instead of moonge rope. I believe the use of coir rope, even at Roorkee, would have been cheaper than that of moonge.

30. On each block, between every two wells, and on the shore side of that block, an earth trough is placed. When operations were first commenced, prior to the earliest date over which this record

extends, ten men were told off daily to the service of this trough, whose duty it was to see that no accumulation of sand took place. This number was soon reduced to seven. On 1st December, 1848, when the reduction of men on each windlass from four to three took place, the number on each trough was reduced to six, and about four months later to five. The latest distribution for a four-well block is as follows:—

Four windlasses, at three men each	12
Two earth troughs, at five men each	10
Total ..	22

This is the smallest number of men that can work a four-well block with advantage, according to our latest experience.

31. Very much still remains to be done in determining accurately the relative cost of our block-sinking operations in the bed of the Solani; and I look on this paper merely as one step towards that end, involving as it does a satisfactory explication of the laws which regulate the expense of block-sinking. I have found difficulties in valuing the work start up at every step, in the shape of varying circumstances under which, at different periods, sinking was performed, and, until the true value of these disturbing causes is ascertained, absolutely accurate expressions cannot be entered in the formulæ of calculation. Again, until the formulæ are accurately settled, the effects of disturbing causes cannot be properly measured, and thus these two facts cause the question to vibrate like a balance, and each tends, by degrees, to bring the other to a state of rest.

32. From what has been put forth, it appears that when it is possible to avoid resorting to blocks with splayed bases, they should never be used, at any rate, if the soil through which sinking has to be performed is sandy. The success of such splayed blocks as regards economy, in a clayey soil, is still doubtful; though I think the balance of probability is against their succeeding as well as perpendicular-sided blocks even here. I do not, of course, allude to a case where a broad base is an especial desideratum. I merely say that the minimum width of a block at top being fixed, if that width admits of a perpendicular-sided block being sunk, and if the same width for the base is reckoned sufficient to ensure the stability of the superstructure, a perpendicular-sided block, as susceptible of being sunk far cheaper than a sloping one, is to be preferred; the difference of cost being calculable by the formulæ given above. But a block, 6 feet wide at top, with sloping sides, may undoubtedly be sunk where a perpendicular-sided block of the same width at top will not go down at all; generally owing to its falling over on one side, from unskilful working. However, a line of blocks $8\frac{1}{2}$ feet wide, with perpendicular sides, will be built at the same cost, and sunk cheaper than another of the same length, 6 feet wide at top and 11 feet wide at bottom. In the sloping block, the greater loss of weight, during partial immersion, has something to do with this result.

Blocks might always be advantageously designed in such a way that the weighting frames fixed on narrow ones should be applied with equal facility to wide ones. Three such frames as are used on the Solani Aqueduct block-sinking will bear a weight of 25,000 lbs. with safety; nor, with proper precautions, is there any danger in loading half this weight on one side of a block only.

A. G. Goodwyn, *Lieut.*,
Executive Engineer, Northern Division, Ganges Canal.

Roorkee, 26*th August,* 1851.

REPORT showing the PROGRESS made, monthly, in sinking each FOUNDATION BLOCK of the SOLANI AQUEDUCT PROPER, from 1st APRIL, 1848, to 31st JULY, 1850.

Roorkee, 26th August, 1851.

Class	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.*
1st.	April, 1848.	22	5·10	2·550	13·005	
		23	9·21	4·605	42·412	
		261	6·75	8·835	59·636	
		262	3·67	10·375	38·076	
		263	0·34	12·040	4·094	
		268	1·00	11·710	11·710	
		269	2·00	11·210	22·420	
		270	8·00	8·210	65·680	
			8)36·07		257·033	7·120
			4·51			
	May, 1848.	23	2·43	10·425	25·332	
		261	7·62	16·020	122·072	
		262	7·95	16·185	128·670	
		263	7·66	16·040	122·866	
		264	7·96	16·100	128·156	
		265	7·41	15·995	118·523	
		266	5·79	14·935	86·473	
		267	7·70	16·060	123·662	
		268	8·20	16·310	133·742	
		269	7·20	15·810	113·832	
		270	9·87	17·145	169·220	
			11)79·79		1,272·548	15·948
			7·25			
	June, 1848.	15	0·54	13·010	7·025	
		16	0·20	12·840	2·568	
		17	0·21	13·005	2·731	
		18	0·38	12·340	4·689	
		19	5·84	9·940	58·049	
		20	7·41	9·985	73·988	
		21	7·39	7·165	52·949	
		22	6·68	8·440	56·379	
		261	2·25	20·955	47·149	
		262	1·92	21·120	40·550	
		263	2·21	20·975	46·354	
		264	2·00	21·080	42·160	
		265	2·38	20·890	49·718	
		266	4·25	19·955	84·808	
		267	2·17	20·995	45·559	
		268	1·67	21·245	35·479	
		269	2·67	20·695	55·255	
			17)50·17		705·410	14·060
			2·95			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
1st.	July, 1848.	14	0·82	13·480	11·053	
		15	8·58	17·570	150·750	
		16	7·71	16·795	129·489	
		17	7·20	16·710	120·312	
		18	7·53	16·295	122·701	
		19	6·28	16·000	100·480	
		20	4·62	16·000	73·920	
		21	2·62	12·170	31·885	
		22	2·36	12·960	30·585	
		23	0·17	11·725	1·993	
			10)47·89		773·168	16·144
			4·79			
	Aug., 1848.	14	4·62	16·200	74·844	
		16	1·21	21·305	25·779	
		17	0·95	20·785	19·745	
		18	1·08	20·600	22·248	
		19	1·12	19·700	22·064	
		20	2·08	19·350	40·248	
		21	5·24	16·100	84·364	
		22	6·41	17·345	111·181	
		23	5·58	14·600	81·468	
			9)28·29		481·941	17·035
			3·14			
	Sept., 1848.	14	1·08	19·050	20·574	
		17	0·60	21·560	12·936	
		18	0·72	21·500	15·480	
		19	1·60	21·060	33·696	
		20	1·47	21·125	31·053	
		21	3·14	20·290	63·710	
		22	1·31	21·205	27·778	
		23	4·47	19·625	87·723	
			8)14·39		292·950	20·358
			1·80			
	Oct., 1848.	14	2·27	20·720	47·054	20·720

* Obtained by dividing the sum of the products, in the sixth column, by the sum of the depths sunk, exhibited in the fourth column, thus, $\frac{257 \cdot 033}{36 \cdot 07} = 7 \cdot 12$

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
2nd.	April, 1848.	7	0·29	21·715	6·297	
		30	11·90	5·950	70·805	
		31	11·28	5·640	63·619	
		103	6·50	15·030	97·695	
		104	4·98	15·560	77·489	
		106	4·49	15·275	68·585	
		107	6·04	14·920	90·117	
		108	4·48	14·640	65·587	
		109	3·17	14·775	46·837	
		110	4·71	14·255	67·141	
		279	12·21	6·155	75·152	
		280	12·21	6·155	75·152	
		292	12·21	6·155	75·153	
		293	12·21	6·155	75·153	
			14)106·68		954·782	8·950
			7·62			
	May, 1848.	30	1·86	12·830	23·864	
		31	2·07	12·315	25·492	
		103	1·00	18·450	18·450	
		104	2·11	18·775	39·615	
		105	0·17	13·995	2·379	
		106	1·64	18·010	29·536	
		107	1·30	18·260	23·738	
		108	0·95	17·025	16·174	
		109	1·05	16·555	17·383	
		110	0·88	16·720	14·714	
		215	14·00	7·000	98·000	
		216	12·67	6·335	80·264	
		217	13·92	6·960	96·883	
		218	12·42	6·210	77·128	
		219	12·67	6·335	80·264	
		220	12·67	6·335	80·264	
		221	12·58	6·290	79·128	
		222	12·93	6·465	83·592	
		279	7·87	16·145	127·261	
		280	7·04	15·730	110·739	
		292	7·79	16·105	125·458	
		293	8·24	16·330	134·559	
			22)147·83		1,384·885	9·360
			6·72			
	June, 1848.	103	1·83	19·865	36·353	
		104	2·03	20·795	42·214	
		105	6·82	17·490	119·282	
		106	2·43	20·045	48·709	
		107	2·37	20·095	47·625	
		108	3·82	19·410	74·146	
		109	3·32	18·740	62·217	
		110	1·78	18·050	32·129	
		215	7·50	17·750	133·125	
		216	8·83	17·085	150·860	
		217	7·58	17·710	134·242	
2nd.	June, 1848.	218	9·08	16·960	153·997	
		219	8·83	17·085	150·861	
		220	8·83	17·085	150·861	
		221	8·92	17·040	151·997	
		222	8·57	17·215	147·532	
		279	2·00	21·080	42·160	
		280	2·83	20·665	58·482	
		292	2·08	21·040	43·763	
		293	1·63	21·265	34·662	
			20)101·08		1,815·217	17·950
			5·05			
	July, 1848.	30	3·89	15·705	61·092	
		31	3·30	15·000	49·500	
		87	..	..	..	
		88	..	..	..	
		89	..	..	..	
		90	..	..	..	
		91	..	..	..	
		92	..	..	..	
		93	..	..	..	
		94	..	..	..	
		103	1·08	21·320	23·026	
		105	0·96	21·380	20·525	
		106	0·60	21·560	12·936	
		107	0·49	21·525	10·547	
		108	0·54	21·590	11·659	
		109	1·24	21·020	26·065	
		110	2·92	20·400	59·568	
			9)15·02		274·918	18·300
			1·67			
	Aug., 1848.	30	2·07	17·685	36·608	
		31	4·90	19·100	95·590	
			2)6·97		132·198	18·960
			3·48			
	Sept., 1848.	30	2·14	20·790	44·491	
		31	0·31	21·705	6·728	
		87	11·07	5·535	61·272	
		88	11·07	5·535	61·272	
		89	11·07	5·535	61·272	
		90	9·00	4·500	40·500	
		91	8·50	4·250	36·125	
		92	8·50	4·250	36·125	
		93	8·50	4·250	36·125	
		94	4·75	2·375	11·281	
			10)74·91		395·191	5·27
			7·49			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
2nd.	Oct., 1848	90	2·07	10·035	20·772	
		91	2·57	9·785	26·947	
		92	2·57	9·785	26·947	
		93	2·57	9·785	26·947	
		94	6·32	7·910	49·991	
			5)16·10		151·604	9·420
			3·22			
	Nov., 1848	87	3·53	12·835	45·307	
		88	2·03	12·085	24·532	
		89	2·28	12·210	27·839	
		90	1·45	11·795	17·103	
			4)9·29		114·781	12·360
			2·32			
	Dec., 1848	87	4·02	16·610	66·772	
		88	5·65	15·925	89·976	
		89	5·02	15·860	79·617	
		90	5·35	15·195	81·293	
		91	6·05	14·095	85·275	
		92	4·88	13·510	65·929	
			6)30·97		468·862	15·140
			5·16			
	Jan., 1849	87	1·22	19·230	23·461	
		88	1·57	19·535	30·670	
		89	1·95	19·345	37·723	
		90	1·89	18·815	35·560	
		91	2·35	18·295	42·993	
		92	2·52	17·210	43·370	
		93	5·98	14·060	84·079	
		94	4·98	13·560	67·529	
			8)22·46		365·385	16·270
			2·81			
	Feb., 1849	87	0·48	20·080	9·638	
		90	0·56	20·040	11·222	
		91	0·13	19·575	2·240	
		92	1·25	19·145	23·931	
		93	2·42	18·260	44·189	
		94	4·27	18·185	77·650	
		199	9·18	4·590	42·136	
		200	9·93	4·965	49·302	
		201	9·18	4·590	42·136	
		202	9·85	4·925	48·511	
		203	10·60	5·300	56·180	
		204	10·60	5·300	56·180	
		205	10·76	5·380	57·889	
		206	9·76	4·880	47·629	
			14)88·97		568·833	6·390
			6·35			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
2nd.	Mar., 1849	91	0·62	19·910	12·344	
		92	0·50	19·970	9·985	
		93	0·33	19·635	6·480	
		183	11·43	5·715	65·322	
		184	12·59	6·295	79·254	
		185	11·18	5·590	62·496	
		186	12·59	6·295	79·254	
		187	12·59	6·295	79·254	
		188	12·59	6·295	79·254	
		189	12·57	6·285	79·002	
		190	12·57	6·285	79·002	
		199	2·92	10·640	31·069	
		200	2·34	11·700	27·378	
		201	3·17	10·765	34·125	
		202	2·46	11·080	27·257	
		203	1·75	11·475	20·081	
		204	1·79	11·495	20·576	
		205	1·63	11·575	18·867	
		206	2·56	11·040	28·262	
			19)118·18		838·262	7·090
			6·22			
	April, 1849	126	1·65	16·975	28·009	
		183	1·36	12·110	16·470	
		185	1·61	13·035	19·376	
		199	7·37	15·785	116·335	
		200	5·95	15·245	90·708	
		201	5·77	15·235	87·906	
		202	6·75	15·685	105·874	
		203	8·04	16·370	131·615	
		204	6·50	15·640	101·660	
		205	7·04	15·910	112·006	
		206	6·21	15·455	95·975	
		231	14·03	7·015	98·420	
		232	14·03	7·015	98·420	
		233	14·03	7·015	98·420	
		234	14·03	7·015	98·420	
		235	14·03	7·015	98·420	
		236	14·03	7·015	98·420	
		237	14·03	7·015	98·420	
		238	14·03	7·015	98·420	
			19)170·49		1,693·294	9·930
			8·97			
	May, 1849	126	1·73	19·665	34·020	
		183	8·47	17·035	144·286	
		184	8·67	16·925	146·740	
		185	8·47	17·035	144·286	
		186	8·67	16·925	146·740	
		187	8·67	16·925	146·740	
		188	7·57	16·375	123·959	
		189	8·26	16·700	137·942	
		190	7·24	16·190	117·216	

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
2nd.	May, 1849.	199	1·67	20·305	33·909	
		200	2·92	20·680	60·386	
		201	3·02	19·630	59·283	
		202	2·08	20·100	41·808	
		203	0·75	20·765	15·574	
		204	2·25	20·015	45·034	
		205	1·71	20·285	34·687	
		206	2·58	19·850	51·213	
		231	7·37	17·715	130·560	
		232	7·37	17·715	130·560	
		233	7·19	17·625	126·724	
		234	7·37	17·715	130·560	
		235	7·37	17·715	130·560	
		236	7·37	17·715	130·560	
		237	7·37	17·715	130·560	
		238	7·37	17·715	130·560	
		247	13·94	6·970	97·162	
		248	14·11	7·055	99·546	
		249	14·18	7·090	100·536	
		250	14·39	7·195	103·536	
		251	14·32	7·160	102·531	
		252	14·24	7·120	101·389	
		253	14·20	7·100	100·820	
		254	13·69	6·845	93·708	
			33)256·58		3,322·695	13·00
			7·78			
	June, 1849.	126	0·47	20·765	9·760	
		188	1·10	20·710	22·781	
		189	0·43	21·045	9·049	
		190	1·45	20·535	29·776	
		233	0·18	21·310	3·836	
		247	7·33	17·605	129·045	
		248	7·16	17·690	126·660	
		249	7·09	17·725	125·670	
		250	6·88	17·830	122·670	
		251	6·95	17·795	123·675	
		252	7·03	17·755	124·818	
		253	7·07	17·735	125·400	
		254	7·58	17·480	132·498	
			13)60·72		1,085·638	17·88
			4·67			
3rd.	April, 1848.	25	11·40	5·700	64·980	
		27	11·58	5·790	67·048	
		29	10·53	5·265	55·440	
		273	9·00	7·710	69·390	
		275	8·75	7·835	68·556	
		277	12·21	6·155	75·152	
		287	9·92	7·250	71·920	
		289	9·50	7·460	70·870	
		291	12·21	6·155	75·152	
			9)95·10		618·508	6·50
			10·57			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
3rd.	May, 1848.	25	1·67	12·235	20·442	
		27	1·75	11·455	20·046	
		29	2·89	11·975	34·607	
		273	7·70	16·040	123·508	
		275	6·62	15·520	102·742	
		277	2·62	13·520	35·422	
		287	6·95	15·685	109·011	
		289	9·87	17·145	169·221	
		291	4·95	14·695	72·740	
			9)45·02		687·739	15·28
			5·00			
	June, 1848.	12	0·12	12·880	1·545	
		273	2·17	20·995	45·559	
		275	3·25	20·455	66·479	
		277	7·25	18·455	133·799	
		287	2·92	20·620	60·210	
		291	4·92	19·620	96·530	
			6)20·63		404·122	19·58
			3·44			
	July, 1848.	12	8·92	17·400	155·208	
		25	1·74	13·940	24·256	
		27	6·06	16·390	99·323	
		29	5·87	16·355	96·004	
			4)22·59		374·791	16·59
			5·65			
	Aug., 1848	25	7·05	18·335	129·262	
		27	2·47	20·625	50·944	
		29	2·57	20·575	52·878	
			3)12·09		233·084	19·28
			4·03			
4th.	April, 1848.	9	0·46	21·630	9·950	
		24	10·41	5·205	54·184	
		26	10·37	5·185	53·768	
		28	9·58	4·790	45·888	
		70	5·33	14·085	75·073	
		102	3·62	12·850	46·517	
		111	6·41	11·625	74·516	
		274	3·84	10·290	39·514	
		276	7·42	8·500	63·070	
		278	8·75	7·835	68·556	
		286	3·09	11·415	35·272	
		288	6·50	8·960	58·240	
		290	9·75	7·335	71·516	
			13)85·53		696·064	8·14
			6·579			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	May, 1848.	24	2·88	11·850	33·128	
		26	2·97	11·855	34·209	
		28	3·45	11·305	39·002	
		70	3·58	18·540	66·373	
		102	0·56	14·940	8·367	
		111	0·30	14·980	4·494	
		214	14·25	7·125	101·531	
		223	14·92	7·460	111·303	
		274	5·54	14·980	82·989	
		276	0·87	12·645	11·001	
		278	0·37	12·395	4·586	
		286	7·37	15·895	117·146	
		288	5·87	15·145	88·901	
		290	4·12	14·270	58·793	
			14)67·05		761·823	11·36
			4·79			
	June, 1848.	11	0·80	18·880	15·004	
		13	3·04	14·260	43·351	
		102	2·07	17·785	36·815	
		111	4·28	18·800	80·464	
		214	7·25	17·875	129·594	
		223	6·58	18·210	119·822	
		274	4·33	19·915	75·332	
		276	9·00	17·580	158·220	
		278	9·50	17·330	164·635	
		286	2·50	20·830	52·075	
		288	4·00	20·080	80·320	
		290	5·75	19·205	110·429	
			12)59·10		1,066·061	18·04
			4·925			
	July, 1848.	11	2·58	20·570	53·071	
		13	6·08	18·820	114·426	
		24	4·77	15·675	74·770	
		26	5·47	16·075	87·930	
		28	5·62	15·840	89·021	
		37	2·55	1·275	3·251	
		38	2·67	1·335	3·564	
		51	2·65	1·325	3·411	
		52	1·43	0·715	1·022	
		53	0·72	0·360	0·259	
		54	0·70	0·350	0·245	
		63	11·60	5·800	67·280	
		67	0·78	0·390	0·304	
		68	1·55	0·775	1·201	
		79	8·92	16·400	146·288	
		102	2·80	20·220	56·616	
		111	0·92	21·400	19·688	
			17)61·81		722·347	11·69
			3·64			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	Aug., 1848	24	2·91	19·515	56·789	
		26	3·05	20·335	62·022	
		28	3·21	20·255	65·018	
		37	9·79	7·445	72·886	
		38	8·01	6·675	53·467	
		51	6·61	5·955	39·362	
		52	8·50	5·680	48·280	
		53	6·54	3·990	26·095	
		54	5·31	3·355	17·815	
		67	6·56	4·060	26·633	
		68	5·13	4·115	21·110	
		69	6·26	3·130	19·594	
		83	6·47	3·235	20·930	
		84	4·59	2·295	10·534	
		85	3·85	1·925	7·411	
		99	3·93	1·965	7·722	
		100	6·32	3·160	19·971	
			17)97·04		575·639	5·93
			5·71			
	Sept., 1848.	24	0·89	21·415	19·059	
		37	3·19	13·935	44·453	
		38	1·75	11·555	20·221	
		49	7·00	3·500	24·500	
		51	4·77	11·645	55·547	
		52	3·58	11·720	41·957	
		53	6·02	10·270	61·825	
		54	4·77	8·395	40·044	
		64	5·50	2·750	15·125	
		65	6·00	3·000	18·000	
		66	7·00	3·500	24·500	
		67	5·11	9·895	50·563	
		80	8·00	4·000	32·000	
		81	7·68	3·840	29·491	
		82	5·33	2·665	14·204	
		83	0·75	6·845	5·134	
		86	10·16	5·080	51·613	
		95	9·00	4·500	40·500	
		96	8·10	4·050	32·805	
		97	7·68	3·840	29·491	
		98	8·39	4·195	35·196	
		99	0·75	4·305	3·229	
		102	0·16	21·270	3·403	
		112	8·00	4·000	32·000	
		113	8·00	4·000	32·000	
		114	8·00	4·000	32·000	
		130	8·00	4·000	32·000	
			27)153·58		820·860	5·34
			5·69			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	Oct. 1848.	37	1·08	16·070	17·356	
		49	1·30	7·650	9·945	
		50	2·16	10·800	23·328	
		51	3·08	15·570	47·956	
		52	5·60	16·310	91·336	
		53	2·58	14·670	37·848	
		54	3·50	12·500	43·750	
		64	3·18	7·090	22·546	
		65	2·43	7·215	17·532	
		66	1·43	7·715	11·032	
		67	3·16	14·030	44·335	
		68	6·31	9·835	62·059	
		69	3·60	8·060	29·016	
		80	1·68	8·840	14·851	
		81	1·50	8·430	12·645	
		82	3·10	6·880	21·328	
		84	8·69	8·935	77·645	
		85	3·18	5·440	17·300	
		86	0·87	10·595	9·217	
		95	2·20	10·100	22·220	
		96	0·50	8·350	4·175	
		97	0·75	8·055	6·041	
		98	1·16	8·970	10·405	
		99	0·72	5·040	3·629	
		100	1·88	7·260	13·649	
		102	0·51	21·605	11·018	
			26)66·15		682·162	10·31
			2·54			
	Nov. 1848.	37	1·24	17·230	21·365	
		49	2·94	9·770	26·924	
		50	7·59	5·955	45·198	
		51	3·29	18·755	61·704	
		52	1·29	19·755	25·484	
		54	6·12	17·340	106·121	
		65	3·54	10·200	36·108	
		66	2·32	9·590	22·249	
		68	2·86	14·420	41·241	
		69	6·07	12·895	78·272	
		81	0·98	9·670	9·477	
		82	0·81	8·835	7·156	
		85	5·31	9·685	51·427	
		86	3·57	12·815	45·750	
		99	6·20	8·500	52·100	
		100	3·31	9·855	32·620	
		63	1·42	12·310	17·480	
			17)58·86		680·676	11·56
			3·46			
	Dec. 1848.	37	0·60	18·150	10·890	
		49	3·27	15·875	51·911	
		50	2·68	11·090	29·721	
		65	3·71	13·825	51·291	
4th.	Dec. 1848.	66	4·10	12·800	52·480	
		69	0·85	17·355	14·752	
		81	5·52	12·920	71·318	
		83	0·81	7·625	6·176	
		84	1·50	14·030	21·045	
		85	2·94	13·810	40·601	
		86	1·60	15·400	24·640	
		99	0·10	11·650	1·165	
			12)27·68		375·990	13·59
			2·31			
	Jan. 1849.	37	1·10	19·000	20·900	
		49	0·44	14·730	6·481	
		50	2·27	13·565	30·792	
		53	1·27	16·505	20·961	
		64	5·44	11·400	62·016	
		66	0·35	15·025	5·259	
		67	1·52	16·370	24·882	
		68	1·54	16·620	25·595	
		69	1·23	17·395	21·396	
		80	2·44	10·900	2·260	
		82	4·63	11·555	53·500	
		83	6·44	11·250	72·450	
		84	1·44	15·500	22·320	
		85	3·02	16·790	50·706	
		86	0·61	16·505	10·068	
		95	1·35	11·875	16·031	
		96	1·19	9·195	10·942	
		97	1·52	9·190	13·969	
		98	0·99	10·045	9·945	
		99	2·93	13·165	38·573	
		101	5·72	2·860	16·359	
		112	0·95	8·475	8·051	
		114	0·20	8·100	1·620	
		115	5·96	2·980	17·761	
		116	6·96	3·480	24·221	
		117	5·96	2·980	17·761	
		130	1·28	8·640	11·059	
		131	0·20	13·300	2·660	
		132	1·66	13·990	23·223	
		133	0·70	13·640	9·548	
			30)71·31		651·309	9·13
			2·38			
	Feb. 1849.	63	3·95	14·995	58·480	
		64	2·08	15·160	31·532	
		67	0·75	17·505	13·287	
		68	0·41	17·595	7·213	
		80	1·91	13·075	24·973	
		82	1·33	14·535	19·331	
		83	0·08	14·510	11·608	
		85	0·30	18·450	5·535	
		86	0·99	17·305	17·331	

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	Feb. 1849.	95	3·84	13·470	51·590	
		96	3·83	11·705	18·942	
		97	1·75	10·825	36·972	
		98	1·33	11·205	14·902	
		99	2·34	15·800	38·972	
		101	1·93	6·685	12·902	
		112	0·83	9·365	7·772	
		113	1·87	8·935	16·864	
		114	4·17	10·285	42·888	
		115	1·58	6·750	10·665	
		116	0·58	7·250	4·205	
		117	1·08	6·500	7·020	
		131	1·92	14·360	27·571	
		132	4·00	16·820	67·280	
		133	4·83	16·405	79·236	
		148	10·43	5·215	54·392	
		198	10·01	5·005	50·100	
		207	10·85	5·425	58·861	
			27)78·97		790·424	10·09
			2·92			
	March 1849.	49	1·67	15·785	26·360	
		50	1·25	15·325	19·156	
		63	1·42	17·680	25·105	
		64	0·88	16·640	14·643	
		65	0·94	16·150	15·181	
		66	1·42	15·910	22·592	
		67	0·65	18·205	11·833	
		68	0·69	18·145	12·520	
		69	0·52	18·270	9·500	
		83	1·74	15·420	26·830	
		85	1·60	19·400	31·040	
		97	0·17	11·785	2·003	
		98	0·58	12·160	7·052	
		99	1·92	17·930	34·425	
		100	2·02	12·520	25·290	
		101	4·22	9·760	41·187	
		112	3·84	11·700	44·928	
		113	4·94	12·340	60·959	
		114	0·66	12·700	8·162	
		115	6·57	10·825	71·120	
		116	8·09	11·584	93·714	
		117	4·82	9·450	45·549	
		130	2·75	10·650	29·301	
		131	2·31	17·475	40·367	
		132	2·18	19·910	43·403	
		133	2·18	19·910	43·403	
		148	6·22	13·540	84·218	
		182	12·51	6·255	78·250	
		191	12·55	6·275	78·751	
		198	2·34	11·180	26·161	
		207	1·50	11·600	17·400	
			31)95·15		1,091·403	11·47
			3·07			
4th.	April, 1849.	49	1·69	17·465	29·516	
		50	1·78	16·940	30·753	
		63	1·06	18·920	20·055	
		64	2·48	18·320	45·433	
		65	0·52	16·880	8·778	
		66	0·40	18·820	0·753	
		67	0·24	18·650	3·676	
		68	0·20	18·590	3·718	
		69	1·20	19·130	27·956	
		85	0·11	20·255	2·228	
		86	1·18	18·390	21·700	
		95	0·69	16·735	11·547	
		99	0·21	18·995	3·989	
		100	1·28	14·170	18·138	
		101	2·27	13·005	29·523	
		113	1·23	15·405	18·948	
		114	1·41	13·735	19·366	
		115	1·61	14·915	24·013	
		116	1·23	16·245	19·981	
		118	2·48	19·460	48·260	
		130	1·98	13·520	29·769	
		131	0·45	17·875	8·043	
		148	4·34	18·820	81·678	
		198	7·46	16·080	119·956	
		207	6·29	15·495	97·463	
		230	14·03	7·015	98·420	
		239	14·03	7·015	98·420	
			27)71·85		918·480	12·78
			2·66			
	May, 1849.	118	0·30	20·850	6·255	
		182	8·75	16·885	147·744	
		191	8·71	16·905	147·242	
		198	1·33	20·475	27·232	
		207	2·50	19·890	49·725	
		230	7·37	17·715	130·560	
		239	7·37	17·715	130·560	
		246	14·86	7·430	110·410	
		255	15·40	7·700	118·580	
			9)66·59		868·308	13·40
			7·40			
	June, 1849.	80	0·16	14·110	2·258	
		82	0·25	15·325	3·831	
		96	0·08	13·660	1·093	
		100	0·74	15·180	11·233	
		101	0·61	14·445	8·811	
		246	6·41	18·165	116·437	
		255	5·87	18·335	107·626	
			7)14·12		251·289	17·79
			2·02			

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	July, 1849.	80	1·96	15·170	29·733	
		81	1·60	16·380	26·208	
		82	0·87	15·885	13·820	
		96	1·28	14·340	18·355	
		100	5·62	15·761	88·577	
		101	1·60	15·550	24·880	
		112	0·78	13·910	10·850	
		130	1·80	15·410	27·738	
			8)15·51		240·161	15·48
			1·94			
	Aug. 1849.	80	1·04	16·670	17·337	
		81	2·16	18·360	39·658	
		82	0·88	16·760	14·749	
		96	0·76	15·360	11·674	
		100	0·71	21·475	15·247	
		101	1·19	16·945	20·164	
		112	1·67	15·235	25·442	
		113	0·03	16·035	0·481	
		130	2·01	17·315	34·803	
			9)10·45		179·555	17·18
			1·16			
	Sept. 1849.	80	2·37	18·375	43·549	
		81	1·86	20·370	37·888	
		82	3·86	19·130	73·842	
		96	0·16	15·820	2·531	
		101	2·50	18·790	46·975	
		112	4·76	18·450	87·822	
		113	2·30	17·200	39·560	
		115	3·00	17·220	51·660	
		130	2·50	19·570	48·925	
			9)23·31		432·752	18·56
			2·59			
	Oct. 1849.	80	2·20	20·660	45·452	
		82	0·94	21·530	20·238	
		96	0·18	15·990	2·878	
		101	1·48	20·760	30·754	
		113	1·65	19·175	31·639	
		115	2·44	19·950	48·654	
		130	1·18	21·410	25·264	
			7)10·07		204·879	20·34
			1·44			
	Nov. 1849.	147	11·05	5·52		5·52
	Dec. 1849.	147	6·56	14·330	94·005	
		149	12·93	6·465	83·592	
		150	13·09	6·545	85·675	
		163	12·38	6·190	76·632	

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth at which Sinking was performed on each Block.	Product.	Mean Depth at which Sinking was performed struck on whole Class.
4th.	Dec. 1849.	164	12·67	6·335	80·264	
		165	12·84	6·420	82·433	
		166	13·05	6·525	85·151	
		179	12·63	6·315	79·758	
		180	13·01	6·505	84·630	
			9)109·16		752·140	6·89
			12·13			
	Jan. 1850.	147	4·85	20·035	97·170	
		149	7·68	16·770	128·793	
		150	9·35	17·765	166·103	
		163	8·23	16·495	135·754	
		164	8·64	16·990	146·793	
		165	9·60	17·640	169·344	
		166	9·39	17·745	166·625	
		179	8·68	16·970	147·300	
		180	9·43	17·775	167·618	
			9)75·85		1,325·500	17·48
			8·43			
	Feb. 1850.	149	1·83	21·525	39·391	
		163	1·83	21·525	39·391	
		164	1·02	21·820	22·256	
		179	1·83	21·525	39·391	
			4)6·51		140·429	21·57
			1·63			
	April, 1850.	127	12·71	Mean depth is half of total depth.	80·772	
		128	11·30		63·845	
		129	11·66		67·978	
		143	11·94		71·282	
		144	10·64		56·605	
		145	9·81		48·118	
		146	10·53		55·440	
		159	12·12		73·448	
		160	11·30		63·845	
		161	11·10		61·605	
		162	11·02		60·720	
		176	10·39		53·976	
		177	11·04		60·941	
		178	10·41		54·184	
		192	11·73		68·796	
		193	11·81		69·738	
		194	10·47		54·810	
		208	10·85		58·861	
		209	11·58		67·048	
		210	11·60		67·280	
		224	10·51		55·230	
		225	10·68		57·031	
		226	11·71		68·562	
		240	10·08		50·803	
		241	10·47		54·810	
		242	9·68		46·851	
		256	10·04		50·401	

Class.	Date.	Number of Block.	Depth sunk during Month.	Arithmetical Mean Depth *at which* Sinking was performed on each Block.	Product.	Mean Depth at which *Sinking was* performed struck on whole Class.
4th.	April, 1850.	257	10·43	Mean depth is half of total depth.	54·392	
		258	9·93		49·302	
		271	8·77		38·456	
		272	9·58		45·888	
			31)335·89		1,831·018	5·45
			10·84			
	May, 1850.	127	3·63	14·525	52·726	
		128	1·82	12·210	22·223	
		129	0·26	11·790	3·065	
		144	2·23	11·755	26·214	
		145	1·15	10·385	11·943	
		146	3·26	10·693	34·859	
		159	3·98	13·930	55·441	
		160	2·82	12·710	35·842	
		161	3·35	12·775	42·796	
		162	3·35	12·695	42·528	
		175	1·13	12·685	14·334	
		176	3·31	12·045	39·869	
		177	3·26	12·670	41·304	
		178	3·13	11·975	37·482	
		192	1·39	12·425	17·271	
		193	1·94	12·880	24·987	
		194	2·73	11·835	32·310	
		208	1·94	11·820	22·930	
		209	1·17	12·165	14·233	
		210	1·03	12·115	12·115	
		224	3·03	12·025	36·435	
		225	3·11	12·235	38·051	
		226	1·16	12·290	14·186	
		240	3·00	11·580	34·740	
		241	2·45	11·695	27·653	
		242	3·28	11·320	37·129	
		256	1·58	10·830	17·111	
		257	1·11	10·985	12·193	
		258	2·82	11·340	31·979	
		271	2·77	10·155	28·129	
		272	1·88	10·520	19·777	
			31)73·07		881·855	12·07
			2·36			
	June, 1850.	127	2·23	17·455	38·925	
		128	3·90	15·070	58·773	
		129	4·84	14·340	69·406	
		144	2·88	14·310	41·213	
		146	4·94	16·260	80·324	
		159	2·48	17·160	42·557	
		160	3·74	15·990	59·803	
		161	4·67	16·785	78·386	
		162	4·75	16·745	79·539	
		175	3·52	15·910	84·641	
		176	4·11	15·755	64·753	
		177	4·82	16·710	80·543	
4th.	June, 1850.	178	5·06	16·170	81·314	
		181	12·00	6·000	72·000	
		192	5·30	15·770	83·581	
		193	5·37	16·435	88·256	
		194	5·47	15·935	87·164	
		195	11·17	5·585	62·384	
		196	12·17	6·085	74·054	
		197	15·13	7·565	114·458	
		208	2·53	14·055	35·559	
		209	5·33	15·415	82·162	
		210	5·35	15·305	81·882	
		211	15·63	7·815	122·148	
		212	16·46	8·230	135·466	
		213	18·21	9·105	165·802	
		224	4·86	15·970	77·614	
		225	5·07	16·325	82·768	
		226	5·03	15·385	77·386	
		227	17·09	8·545	146·034	
		228	16·92	8·460	143·143	
		229	16·46	8·230	135·466	
		240	5·52	15·840	87·437	
		241	5·68	15·760	89·517	
		242	5·02	15·470	77·659	
		243	17·75	8·875	157·531	
		244	18·88	9·440	178·227	
		245	18·46	9·230	170·386	
		256	6·49	14·865	96·474	
		257	6·44	14·760	95·054	
		258	5·42	15·460	83·793	
		259	18·34	9·170	168·178	
		260	18·63	9·315	173·538	
		271	6·40	14·740	94·336	
		272	4·19	13·555	56·795	
			45)386·51		4,256·428	11·03
			8·59			
	July, 1850.	195	6·08	14·210	56·397	
		196	5·62	14·980	84·187	
		197	3·54	16·900	59·826	
		211	2·87	17·065	48·976	
		212	2·37	17·645	41·819	
		213	1·29	18·855	24·323	
		227	1·99	18·085	35·989	
		228	2·58	18·210	46·982	
		229	3·04	17·980	54·659	
		243	1·75	18·625	32·594	
		244	0·28	19·020	5·325	
		245	1·04	19·000	19·760	
		259	1·16	18·920	21·947	
		260	0·87	19·065	16·587	
		181	6·00	15·000	90·000	
			15)40·48		669·371	16·53
			2·69			

A. G. Goodwyn, *Lieutenant, Executive Engineer, Northern Division, Ganges Canal.*

TABULAR STATEMENT of the Cost of Undersinking Foundation Blocks of

Date of Sinking.	Class of Blocks	Detail of Blocks worked at, as numbered in Plan of Aqueduct Foundations.	Mean Superficial Area embraced by Circumferences of Bases of Blocks.	Arithmetical Mean Depth at which Sinking was performed.	Mean Monthly Progress.
			Square Feet.	Feet.	Feet.
April, 1848	1st	Nos. 22, 23, 261* to 263*, and 268 to 270	524·15	7·12	4·51
May, ,,	,,	Nos. 23, and 261 to 270	554·02	15·95	7·25
June, ,,	,,	Nos. 15 to 22, and 261 to 269	568·77	14·06	2·95
July, ,,	,,	Nos. 14 to 23	570·51	16·14	4·79
Aug., ,,	,,	Nos. 14 and 16 to 23	546·04	17·03	3·14
Sept., ,,	,,	Nos. 14 and 17 to 23	544·23	20·36	1·80
Oct., ,,	,,	No. 14	500·00	20·72	2·27
April, 1848	2nd	Nos. 7, 30, 31, 103, 104, 106 to 110, 279, 280, 292, and 293	385·88	8·95	7·62
May, ,,	,,	Nos. 30, 31, 103 to 110, 215 to 222, 279, 280, 292, and 293	421·13	9·36	6·72
June, ,,	,,	Nos. 103 to 110, 215 to 222, 279, 280, 292, and 293	433·24	17·95	5·05
July, ,,	,,	Nos. 30, 31, 103, and 105 to 110	401·70	18·30	1·67
Aug., ,,	,,	Nos. 30 and 31	360·00	18·96	3·48
Sept., ,,	,,	Nos. 30, 31, and 87 to 94	437·38	5·27	7·49
Oct., ,,	,,	Nos. 90 to 94	440·00	9·42	3·22
Nov., ,,	,,	Nos. 87 to 90	440·00	12·36	2·32
Dec., ,,	,,	Nos. 87 to 92	440·00	15·14	5·16
Jan., 1849	,,	Nos. 87 to 94	440·00	16·27	2·81
Feb., ,,	,,	Nos. 87, 90 to 94, and 199 to 206	440·00	6·39	6·35
March, ,,	,,	Nos. 91 to 93, 183 to 190, and 199 to 206	440·00	7·09	6·22
April ,,	,,	Nos. 126, 183, 185, 199 to 206, and 231 to 238	440·00	9·93	8·97
May ,,	,,	Nos. 126, 183 to 190, 199 to 206, 231 to 238, and 247 to 254	440·00	13·00	7·78
June ,,	,,	Nos. 126, 188 to 190, 233, and 247 to 254	440·00	17·88	4·67
April, 1848	3rd	Nos. 25, 27, 29, 273, 275, 277, 287, 289, and 291	336·00	6·50	10·57
May, ,,	,,	Nos. 25, 27, 29, 273, 275, 277, 287, 289, and 291	336·00	15·28	5·00
June, ,,	,,	Nos. 12, 273, 275, 277, 287, and 291	336·00	19·58	3·44
July, ,,	,,	Nos. 12, 25, 27, and 29	336·00	16·59	5·65
Aug., ,,	,,	Nos. 25, 27, and 29	336·00	19·28	4·03
April, 1848	4th	Nos. 9, 24, 26, 28, 70, 102, 111, 274, 276, 278, 286, 288, and 290	184·61	8·14	6·58
May, ,,	,,	Nos. 24, 26, 28, 70, 102, 111, 214, 223, 274, 276, 278, 286, 288, and 290 ...	174·96	11·36	4·79
June, ,,	,,	Nos. 11, 13, 102, 111, 214, 223, 274, 276, 278, 286, 288, and 290	179·79	18·04	4·92
July, ,,	,,	Nos. 11, 13, 24, 26, 28, 37, 38, 51 to 54, 63, 67, 68, 79, 102, and 111	163·70	11·69	3·64
Aug., ,,	,,	Nos. 24, 26, 28, 37, 38, 51 to 54, 67 to 69, 83 to 85, 99, and 100 ...	124·73	5·93	5·71
Sept., ,,	,,	Nos. 24, 37, 38, 49, 51 to 54, 64 to 67, 80 to 83, 86, 95 to 99, 102, 112 to 114, and 130	122·05	5·34	5·69
Oct., ,,	,,	Nos. 37, 49 to 54, 64 to 69, 80 to 82, 84 to 86, 95 to 100, and 102	114·22	10·31	2·54
Nov., ,,	,,	Nos. 37, 49 to 52, 54, 63, 65, 66, 68, 69, 81, 82, 85, 86, 99, and 100	125·05	11·56	3·46
Dec., ,,	,,	Nos. 37, 49, 50, 65, 66, 69, 81, 83 to 86, and 89	115·40	13·59	2·31
Jan., 1849	,,	Nos. 37, 49, 50, 53, 64, 66 to 69, 80, 82 to 86, 95 to 99, 101, 112, 114 to 117, and 130 to 133	114·13	9·13	2·38
Feb., ,,	,,	Nos. 63, 64, 67, 68, 80, 82, 83, 85, 86, 95 to 99, 101, 112 to 117, 131 to 133, 148, 198, and 207	138·74	10·09	2·92
March, ,,	,,	Nos. 49, 50, 63 to 69, 83, 85, 97 to 101, 112 to 117, 130 to 133, 148, 182, 191, 198, and 207	131·11	11·47	3·07
April, ,,	,,	Nos. 49, 50, 63 to 69, 85, 86, 95, 99 to 101, 113 to 116, 118, 130, 131, 148, 198, 207, 230, and 239	148·30	12·78	2·66
May, ,,	,,	Nos. 118, 182, 191, 198, 207, 230, 239, 246, and 255	160·00	13·40	7·40
June, ,,	,,	Nos. 80, 82, 96, 100, 101, 246, and 255	153·30	17·79	2·02
July, ,,	,,	Nos. 80 to 82, 96, 100, 101, 112, and 130	107·43	15·48	1·94
Aug., ,,	,,	Nos. 80 to 82, 96, 100, 101, 112, 113, and 130	112·50	17·18	1·16
Sept., ,,	,,	Nos. 80 to 82, 96, 101, 112, 113, 115, and 130	115·18	18·56	2·59
Oct., ,,	,,	Nos. 80, 82, 96, 101, 113, 115, and 130	115·58	20·34	1·44
Nov., ,,	,,	No. 147	220·00	5·52	11·05
Dec., ,,	,,	Nos. 147, 149, 150, 163 to 166, 179, and 180	193·99	6·89	12·13
Jan., 1850	,,	Nos. 147, 149, 150, 163 to 166, 179, and 180	193·38	17·48	8·43
Feb., ,,	,,	Nos. 149, 163, 164, and 179	212·24	21·57	1·63
April, ,,	,,	Nos. 127 to 129, 143 to 146, 159 to 162, 176 to 178, 192 to 194, 208 to 210, 224 to 226, 240 to 242, 256 to 258, 271, and 272	200·40	5·45	10·84
May, ,,	,,	Nos. 127 to 129, 144 to 146, 159 to 162, 175 to 178, 192 to 194, 208 to 210, 224 to 226, 240 to 242, 256 to 258, 271, and 272	202·52	12·07	2·36
June, ,,	,,	Nos. 127 to 129, 144, 146, 159 to 162, 175 to 178, 181, 192 to 197, 208 to 213, 224 to 229, 240 to 245, 256 to 260, 271, and 272	208·17	11·03	8·59
July, ,,	,,	Nos. 181, 195 to 197, 211 to 213, 227 to 229, 243 to 245, 259, and 260 ...	208·11	16·53	2·70

* Both 261 and 263 included. "To" bears this meaning throughout the column.

N.B. From 1st April to 1st November, 1848, the pay of beldars was 4 *rs.* per mensem; 4 beldars were employed working each December, 1848, the number of men working each jham was reduced to 3, with 3 men removing sand. The latter number was again caution, as, under particular circumstances, the number of men thus employed varied so considerably as to be beyond description in

Roorkee, 26th August, 1851.

the Solani Aqueduct, from 1st April, 1848, to 1st November, 1850.

Cost of Undersinking. Labour.	Cost of Undersinking. Materials.	Cost of Undersinking. Tools and Sundries.	Cost of Undersinking. Total.	Removing Sand from Blocks. Labour.	Removing Sand from Blocks. Tools and Sundries.	Removing Sand from Blocks. Total.	Grand Total Expense of Entire Operation.	Rate per Running Foot, on whole Class, for Mean Depth at which Sinking was performed.	Rate per Square Foot of Area, as detailed in 4th Col., undersunk mean Monthly Progress of Blocks, at Mean Depth noted in 5th Column.	Rate per Square Foot of Area, as detailed in 4th Column, undersunk 1 foot, at Mean Depth noted in 5th Column.
RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	ANNAS.
151 5 4	17 8 11	34 7 7	203 5 10	153 14 11	7 4 4	161 3 3	364 9 1	10 1 9	0 1 5	0·3141
935 14 11	153 2 0	34 7 8	1,123 8 7	691 12 4	7 4 5	699 0 9	1,822 9 4	22 13 6	0 4 9	0·6552
623 6 6	93 3 2	34 7 7	751 1 3	351 5 11	7 4 4	358 10 3	1,109 11 6	23 14 0	0 1 10	0·6214
378 4 8	54 4 10	34 7 7	467 1 1	257 7 10	7 4 4	264 12 2	731 13 3	15 4 6	0 2 1	0·4245
405 11 11	86 12 0	15 11 2	508 3 1	236 8 4	7 1 5	243 9 9	751 12 10	26 9 2	0 2 5	0·7696
318 1 0	67 10 1	15 11 2	401 6 3	167 9 1	7 1 4	174 10 5	576 0 8	40 6 0	0 2 2	1·2037
34 1 1	3 1 9	15 11 2	52 14 0	16 0 0	7 1 4	23 1 4	75 15 4	33 7 4	0 2 5	1·0646
417 10 1	45 7 10	43 2 10	506 4 9	371 3 9	10 4 11	381 8 8	887 13 5	8 5 2	0 2 7	0·3390
784 9 9	158 11 8	43 2 10	986 8 3	771 1 7	10 5 0	781 6 7	1,767 14 10	11 15 4	0 3 1	0·4585
1,093 9 1	155 6 6	43 2 11	1,292 2 6	714 12 3	10 4 11	725 1 2	2,017 3 8	19 15 3	0 3 9	0·7426
308 13 11	47 9 10	43 2 10	399 10 7	204 9 9	10 4 11	214 14 8	614 9 3	40 14 8	0 2 9	1·6431
116 4 1	13 0 9	10 3 9	139 8 7	70 0 6	5 4 7	75 5 1	214 13 8	30 13 2	0 4 9	1·3649
294 1 7	45 0 3	10 3 9	349 5 7	165 13 3	5 4 8	171 1 11	520 7 6	6 15 2	0 1 11	0·2559
116 12 11	12 11 0	10 3 10	139 11 9	74 0 0	5 4 7	79 4 7	219 0 4	13 9 8	0 1 7	0·4917
45 2 6	3 13 5	9 0 1	58 0 0	31 10 3	3 14 11	35 9 2	93 9 2	10 1 2	0 0 10	0·3592
248 12 8	43 6 7	9 0 1	301 3 4	201 4 1	3 15 0	205 3 1	506 6 5	16 5 7	0 3 1	0·5975
302 1 4	140 9 2	9 0 2	451 10 8	234 6 10	3 15 0	238 5 10	690 0 6	30 11 7	0 3 2	1·1269
462 10 7	216 13 8	8 12 5	688 4 8	361 0 7	7 7 0	368 7 7	1,056 12 3	11 14 0	0 2 9	0·4331
468 12 10	167 13 4	8 12 4	645 6 6	678 13 5	7 7 0	686 4 5	1,331 10 11	11 4 3	0 2 5	0·3885
942 4 5	229 12 5	33 3 10	1,205 4 8	930 10 8	21 2 2	951 12 10	2,157 1 6	12 10 5	0 4 2	0·4645
1,529 7 10	489 1 7	33 3 11	2,051 13 4	1,346 8 11	21 2 2	1,367 11 1	3,419 8 5	13 5 3	0 3 9	0·4820
574 7 6	147 5 3	33 3 9	755 0 6	259 0 6	21 2 2	280 2 8	1,036 3 2	17 0 9	0 2 11	0·6245
286 8 0	19 5 3	9 6 9	315 4 0	241 8 5	3 5 10	244 14 3	561 2 3	5 14 5	0 3 0	0·2838
341 12 10	30 15 8	9 6 9	382 3 3	233 11 10	3 5 9	237 1 7	619 4 10	13 12 1	0 3 3	0·6500
251 15 6	44 9 4	9 6 9	305 15 7	137 13 5	3 5 9	141 3 2	447 2 9	21 10 10	0 3 6	0·0174
94 14 10	10 15 11	9 6 8	115 5 5	58 14 10	3 5 9	62 4 7	177 10 0	7 13 10	0 2 1	0·3687
146 5 9	13 11 4	8 4 0	168 5 1	91 12 5	4 11 5	96 7 10	264 12 11	21 14 5	0 4 2	1·0323
192 9 1	13 6 2	12 2 4	218 1 7	209 14 11	4 12 5	214 11 4	432 12 11	5 1 0	0 2 11	0·4432
279 7 3	30 2 0	12 2 4	321 11 7	245 3 1	4 12 6	249 15 7	571 11 2	8 8 5	0 3 9	0·7829
481 12 10	55 1 6	12 2 5	549 0 9	290 3 8	4 12 6	295 0 2	844 0 11	14 4 6	0 6 6	1·3211
269 3 4	38 11 7	12 2 4	320 1 3	210 10 7	4 12 6	215 7 1	535 8 4	8 10 7	0 3 1	0·8471
278 8 8	44 0 8	18 13 1	341 6 5	201 9 2	12 13 10	214 7 0	555 13 5	5 11 8	0 4 2	0·7297
338 13 4	47 8 1	18 13 1	405 2 6	257 4 3	12 13 10	270 2 1	675 4 9	4 6 4	0 3 3	0·5715
369 5 3	38 6 8	18 13 2	426 9 1	293 4 4	12 13 11	306 2 3	732 11 4	11 1 3	0 3 11	1·5419
273 14 7	49 12 7	9 0 1	332 11 3	181 4 8	5 9 3	186 13 11	519 9 2	8 13 3	0 3 11	1·1320
207 14 5	33 2 1	9 0 1	250 0 7	173 9 1	5 9 3	179 2 4	429 2 11	15 7 11	0 4 11	2·1284
375 7 2	140 10 10	9 0 2	525 2 2	314 6 7	5 9 3	319 15 10	845 2 0	11 12 11	0 3 11	1·6456
476 4 6	95 14 10	8 4 3	580 7 7	377 14 10	6 4 6	384 3 4	964 10 11	12 3 5	0 4 1	1·3984
594 6 11	107 0 6	8 4 4	709 11 9	603 1 0	6 4 7	609 5 7	1,319 1 4	13 13 10	0 5 2	1·6829
405 10 9	83 7 11	7 4 1	496 6 9	345 4 0	4 0 1	349 4 1	845 10 10	11 12 4	0 3 5	1·2845
210 3 6	80 9 10	7 4 1	298 1 5	145 15 3	4 0 0	149 15 3	448 0 8	6 11 8	0 5 0	0·6757
239 14 8	80 15 7	7 4 1	228 2 4	68 1 7	4 0 0	72 1 7	300 3 11	21 4 3	0 5 5	2·6815
151 14 0	74 12 1	7 4 1	233 14 2	95 1 7	4 0 0	99 1 7	332 15 9	21 7 6	0 6 2	3·1756
154 13 7	100 11 6	3 0 1	258 9 2	139 9 6	3 0 3	142 9 9	401 2 11	38 7 3	0 6 4	5·4597
210 13 11	50 5 7	3 0 0	264 3 6	125 2 2	3 0 4	128 2 6	392 6 0	16 13 4	0 6 1	2·3480
101 1 2	47 13 8	3 0 0	151 14 10	66 12 2	3 0 4	69 12 6	221 11 4	22 0 3	0 4 5	3·0668
15 4 10	12 8 2	5 3 3	33 0 3	57 9 7	5 9 6	63 3 1	96 3 4	8 11 4	0 7 0	0·6335
155 10 11	68 15 7	5 3 3	229 13 9	158 7 4	5 9 7	164 0 11	393 14 8	3 9 9	0 3 7	0·2946
203 10 4	90 3 3	5 3 3	299 0 10	363 12 11	5 9 7	369 6 6	668 7 4	8 13 0	0 6 2	0·7315
50 1 1	15 11 10	13 2 0	78 14 11	117 13 5	17 0 7	134 14 0	213 12 11	32 13 6	0 4 0	2·4539
672 7 5	206 14 9	13 2 1	892 8 3	1,086 6 8	17 0 8	1,103 7 4	1,995 15 7	5 15 1	0 5 2	0·4765
352 6 0	213 10 7	71 8 7	637 9 2	585 1 6	28 13 11	613 15 5	1,251 8 7	17 2 1	0 3 2	1·3381
1,872 15 5	463 0 6	71 8 7	2,407 8 6	1,606 4 3	28 13 11	1,635 2 2	4,042 10 8	10 12 8	0 7 1	0·8246
277 10 10	16 2 9	71 8 9	365 6 4	227 9 0	28 13 11	256 6 11	621 13 3	18 0 7	0 3 2	1·1726

jham, and 3½ removing sand brought up by each jham. On 1st November, 1848, the pay of beldars was reduced to 3 *rs.* 8 *a.* On 1st reduced about 4 months later to 2½. This statement, however, as far as the removal of sand is concerned, must be received with any general notice like the present.

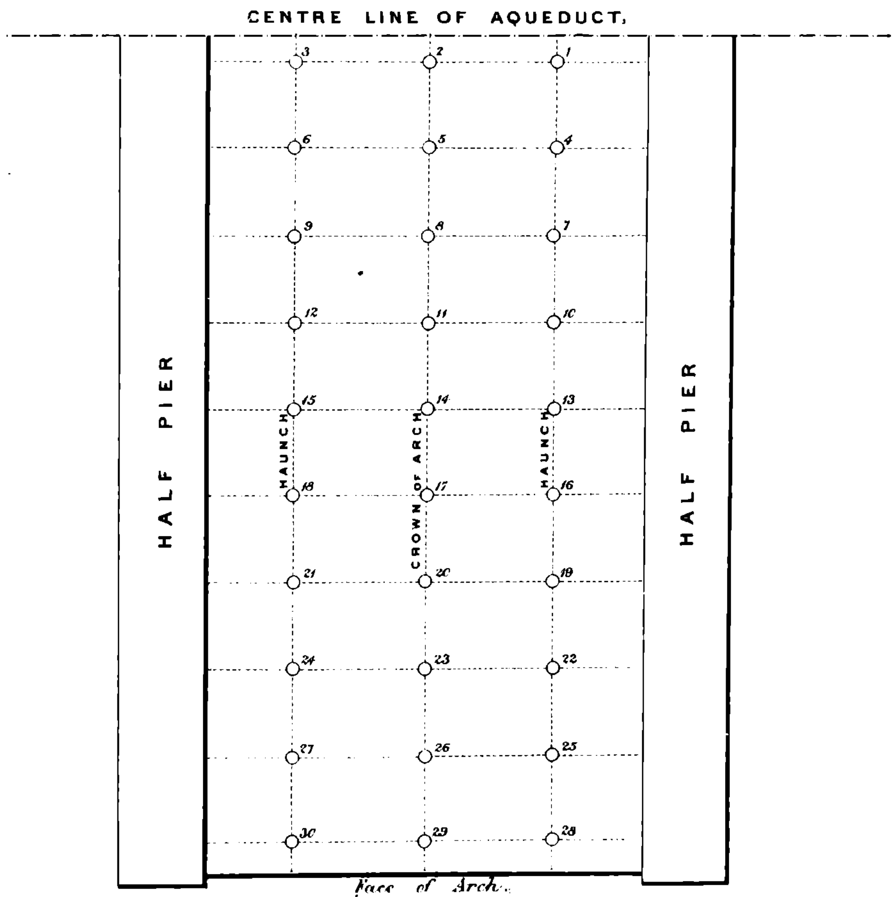
A. Goodwyn, *Lieut., Exec. Engineer Northern Division, Ganges Canal.*

APPENDIX P.

TABLE *of* DEPRESSIONS *of the* SOLANI AQUEDUCT ARCHES *on removing* CENTERINGS.

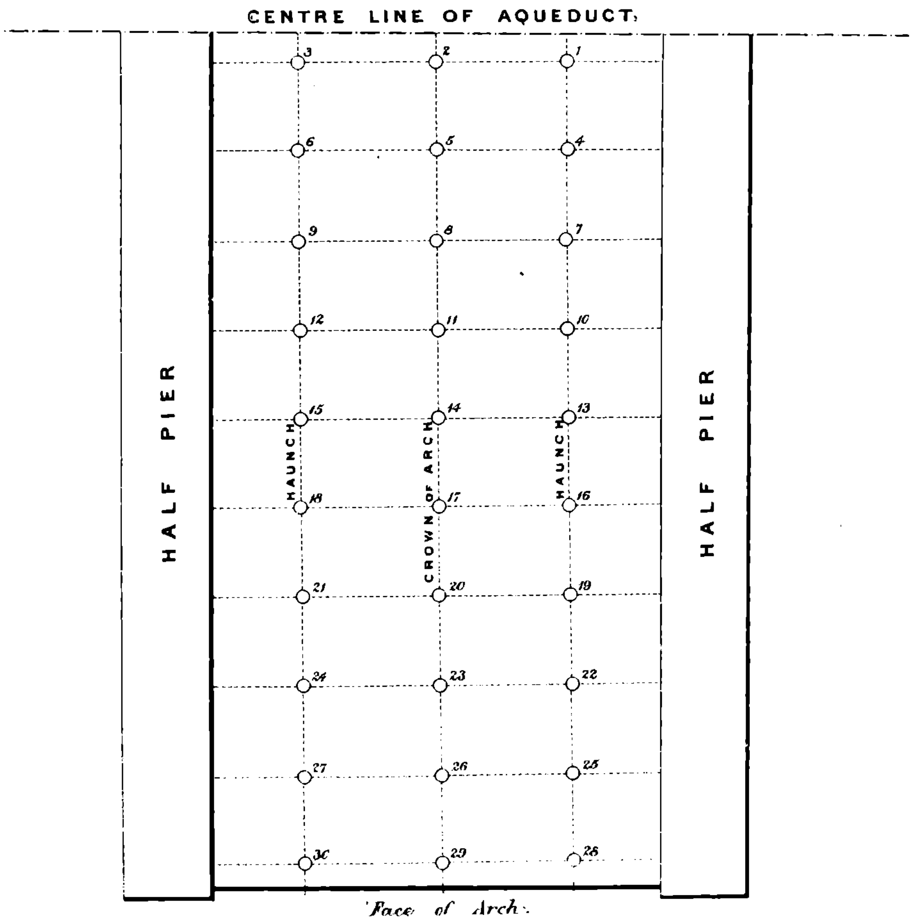
No. 1 Arch.			No. 2 Arch.			No. 3 Arch.			No. 4 Arch.			No. 5 Arch.		
Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points	Sinking.	Average.	Level Points.	Sinking.	Average.
	Feet.			Feet.			Feet.			Feet.			Feet.	
1	0·095	Haunches, average sinking of, 20 points ... 0·1005'	1	0·115	Haunches, average sinking of, 20 points ... 0·0955'	1	0·145	Haunches, average sinking of, 20 points ... 0·1605'	1	0·090	Haunches, average sinking of, 20 points ... 0·0932'	1	0·140	Haunches, average sinking of, 20 points ... 0·1135'
2	0·200	Crown, ,, ,, 10 ,, ... 0·1905'	2	0·215	Crown, ,, ,, 10 ,, ... 0·1940'	2	0·265	Crown, ,, ,, 10 ,, ... 0·2710'	2	0·180	Crown, ,, ,, 10 ,, ... 0·1785'	2	0·225	Crown, ,, ,, 10 ,, ... 0·1950'
3	0·110		3	0·115		3	0·160		3	0·085		3	0·105	
4	0·105		4	0·085		4	0·155		4	0·090		4	0·120	
5	0·175		5	0·195		5	0·270		5	0·180		5	0·190	
6	0·095		6	0·110		6	0·160		6	0·095		6	0·200	
7	0·005		7	0·095		7	0·145		7	0·095		7	0·115	
8	0·175		8	0·185		8	0·265		8	0·175		8	0·185	
9	0·095		9	0·005		9	0·150		9	0·095		9	0·085	
10	0·110		10	0·085		10	0·145		10	0·095		10	0·125	
11	0·175		11	0·185		11	0·250		11	0·175		11	0·175	
12	0·095		12	0·100		12	0·155		12	0·095		12	0·080	
13	0·110		13	0·090		13	0·155		13	0·095		13	0·115	
14	0·175		14	0·190		14	0·260		14	0·175		14	0·165	
15	0·095		15	0·095		15	0·160		15	0·095		15	0·080	
16	0·105		16	0·090		16	0·165		16	0·095		16	0·105	
17	0·185		17	0·185		17	0·280		17	0·175		17	0·180	
18	0·095		18	0·105		18	0·170		18	0·095		18	0·085	
19	0·110		19	0·105		19	0·165		19	0·095		19	0·110	
20	0·190		20	0·205		20	0·285		20	0·170		20	0·180	
21	0·095		21	0·115		21	0·180		21	0·095		21	0·095	
22	0·115		22	0·095		22	0·170		22	0·095		22	0·125	
23	0·200		23	0·200		23	0·285		23	0·175		23	0·200	
24	0·105		24	0·105		24	0·190		24	0·090		24	0·100	
25	0·120		25	0·085		25	0·165		25	0·095		25	0·120	
26	0·205		26	0·195		26	0·280		26	0·185		26	0·215	
27	0·100		27	0·110		27	0·170		27	0·090		27	0·110	
28	0·135		28	0·100		28	0·160		28	0·105		28	0·140	
29	0·225		29	0·185		29	0·270		29	0·195		29	0·235	
30	0·115		30	0·105		30	0·145		30	0·085		30	0·115	

PLAN SHEWING THE POINTS
ON THE HAUNCHES AND CROWN OF
THE SOLANI AQUEDUCT ARCHES AT WHICH THE
AMOUNT OF DEPRESSION WAS MEASURED.



London Smith Elder & C° 65, Cornhill

PLAN SHEWING THE POINTS
ON THE HAUNCHES AND CROWN OF
THE SOLANI AQUEDUCT ARCHES AT WHICH THE
AMOUNT OF DEPRESSION WAS MEASURED.



London: Smith, Elder & Co 65 Cornhill

No. 6 Arch.

Level Points.	Sinking.	Average.
	Feet.	
1	0·165	Haunches, average sinking at, 20 points ... 0·1552'
2	0·250	Crown, „ 10 „ ... 0·2475'
3	0·140	
4	0·165	
5	0·235	
6	0·130	
7	0·160	
8	0·235	
9	0·130	
10	0·165	
11	0·240	
12	0·135	
13	0·160	
14	0·155	
15	0·105	
16	0·165	
17	0·255	
18	0·150	
19	0·160	
20	0·250	
21	0·150	
22	0·170	
23	0·260	
24	0·145	
25	0·190	
26	0·280	
27	0·150	
28	0·200	
29	0·315	
30	0·170	

No. 7 Arch.

Level Points.	Sinking.	Average.
	Feet.	
1	0·235	Haunches, average sinking of, 20 points ... 0·2115'
2	0·340	Crown, „ 10 „ ... 0·3180'
3	0·205	
4	0·230	
5	0·320	
6	0·190	
7	0·230	
8	0·315	
9	0·200	
10	0·220	
11	0·315	
12	0·200	
13	0·225	
14	0·315	
15	0·190	
16	0·215	
17	0·310	
18	0·195	
19	0·225	
20	0·310	
21	0·195	
22	0·220	
23	0·320	
24	0·200	
25	0·220	
26	0·320	
27	0·210	
28	0·215	
29	0·315	
30	0·210	

No. 8 Arch.

Level Points.	Sinking.	Average.
	Feet.	
1	0·085	Haunches, average sinking of, 20 points ... 0·0965'
2	0·165	Crown, „ 10 „ ... 0·1650'
3	0·090	
4	0·090	
5	0·165	
6	0·090	
7	0·085	
8	0·160	
9	0·095	
10	0·095	
11	0·160	
12	0·100	
13	0·090	
14	0·160	
15	0·100	
16	0·095	
17	0·155	
18	0·095	
19	0·095	
20	0·165	
21	0·095	
22	0·095	
23	0·160	
24	0·095	
25	0·105	
26	0·170	
27	0·105	
28	0·115	
29	0·190	
30	0·115	

No. 9 Arch.

Level Points.	Sinking.	Average.
	Feet.	
1	0·090	Haunches, average sinking of, 20 points ... 0·0870'
2	0·150	Crown, „ 10 „ ... 0·1445'
3	0·080	
4	0·080	
5	0·140	
6	0·095	
7	0·090	
8	0·140	
9	0·090	
10	0·075	
11	0·135	
12	0·070	
13	0·090	
14	0·140	
15	0·090	
16	0·085	
17	0·135	
18	0·085	
19	0·075	
20	0·135	
21	0·085	
22	0·100	
23	0·145	
24	0·090	
25	0·090	
26	0·150	
27	0·090	
28	0·100	
29	0·175	
30	0·090	

No. 10 Arch.

Level Points.	Sinking.	Average.
	Feet.	
1	0·079	Haunches, average sinking of, 20 points ... 0·0895'
2	0·180	Crown, „ 10 „ ... 0·1895'
3	0·105	
4	0·080	
5	0·180	
6	0·100	
7	0·078	
8	0·190	
9	0·100	
10	0·084	
11	0·180	
12	0·100	
13	0·065	
14	0·185	
15	0·060	
16	0·090	
17	0·190	
18	0·105	
19	0·089	
20	0·200	
21	0·100	
22	0·078	
23	0·190	
24	0·110	
25	0·078	
26	0·200	
27	0·110	
28	0·069	
29	0·200	
30	0·110	

No. 11 Arch.

Level Points.	Sinking.	Average.
1	0·100	Haunches, average sinking ... 0·1029'
2	0·192	Crown, „ „ ... 0·1987'
3	0·110	
4	0·100	
5	0·200	
6	0·190	
7	0·094	
8	0·190	
9	0·110	
10	0·105	
11	0·195	
12	0·100	
13	0·100	
14	0·195	
15	0·100	
16	0·120	
17	0·210	
18	0·100	
19	0·190	
20	0·220	
21	0·120	
22	0·110	
23	0·200	
24	0·105	
25	0·110	
26	0·195	
27	0·000	
28	0·000	
29	0·190	
30	0·094	

No. 12 Arch.

Level Points.	Sinking.	Average.
1	0·060	Haunches, average sinking ... 0·0760'
2	0·120	Crown, „ „ ... 0·1290'
3	0·065	
4	0·065	
5	0·120	
6	0·070	
7	0·080	
8	0·130	
9	0·085	
10	0·080	
11	0·130	
12	0·080	
13	0·080	
14	0·120	
15	0·080	
16	0·070	
17	0·130	
18	0·080	
19	0·080	
20	0·140	
21	0·085	
22	0·080	
23	0·130	
24	0·080	
25	0·070	
26	0·130	
27	0·075	
28	0·080	
29	0·140	
30	0·080	

No. 13 Arch.

Level Points.	Sinking.	Average.
1	0·049	Haunches, average sinking ... 0·0502'
2	0·129	Crown, „ „ ... 0·1290'
3	0·051	
4	0·050	
5	0·126	
6	0·052	
7	0·048	
8	0·132	
9	0·050	
10	0·049	
11	0·129	
12	0·051	
13	0·050	
14	0·125	
15	0·051	
16	0·051	
17	0·133	
18	0·050	
19	0·052	
20	0·128	
21	0·049	
22	0·049	
23	0·130	
24	0·050	
25	0·050	
26	0·132	
27	0·050	
28	0·051	
29	0·126	
30	0·050	

No. 14 Arch.

Level Points.	Sinking.	Average.
1	0·076	Haunches, average sinking ... 0·0765'
2	0·142	Crown, „ „ ... 0·1419'
3	0·078	
4	0·076	
5	0·141	
6	0·079	
7	0·075	
8	0·143	
9	0·076	
10	0·077	
11	0·141	
12	0·075	
13	0·077	
14	0·141	
15	0·076	
16	0·077	
17	0·141	
18	0·076	
19	0·075	
20	0·142	
21	0·077	
22	0·076	
23	0·141	
24	0·075	
25	0·079	
26	0·141	
27	0·076	
28	0·078	
29	0·141	
30	0·076	

No. 15 Arch.

Level Points.	Sinking.	Average.
1	0·083	Haunches, average sinking ... 0·0832'
2	0·153	Crown, „ „ ... 0·1530'
3	0·076	
4	0·082	
5	0·152	
6	0·085	
7	0·090	
8	0·154	
9	0·085	
10	0·090	
11	0·150	
12	0·182	
13	0·076	
14	0·156	
15	0·083	
16	0·083	
17	0·148	
18	0·076	
19	0·085	
20	0·158	
21	0·082	
22	0·085	
23	0·153	
24	0·090	
25	0·076	
26	0·152	
27	0·082	
28	0·083	
29	0·155	
30	0·076	

No. 16 Arch.			No. 17 Arch.			No. 18 Arch.			No. 19 Arch.			No. 20 Arch.		
Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.
	Feet.			Feet.			Feet.			Feet.			Feet.	
1	0·150	Haunches, average sinking ... 0·0990'	1	0·080	Haunches, average sinking ... 0·0880'	1	0·140	Haunches, average sinking ... 0·1060'	1	0·033	Haunches, average sinking ... 0·0332'	1	0·045	Haunches, average sinking ... 0·0265'
2	0·285	Crown, ,, ,, ... 0·1875'	2	0·220	Crown, ,, ,, ... 0·1975'	2	0·300	Crown, ,, ,, ... 0·2335'	2	0·132	Crown, ,, ,, ... 0·1325'	2	0·165	Crown, ,, ,, ... 0·1135'
3	0·150		3	0·110		3	0·170		3	0·034		3	0·065	
4	0·120		4	0·080		4	0·120		4	0·032		4	0·035	
5	0·210		5	0·210		5	0·260		5	0·132		5	0·150	
6	0·115		6	0·100		6	0·140		6	0·034		6	0·050	
7	0·105		7	0·090		7	0·110		7	0·035		7	0·030	
8	0·140		8	0·210		8	0·250		8	0·133		8	0·140	
9	0·090		9	0·100		9	0·120		9	0·033		9	0·045	
10	0·085		10	0·095		10	0·115		10	0·034		10	0·020	
11	0·170		11	0·195		11	0·230		11	0·132		11	0·130	
12	0·085		12	0·100		12	0·110		12	0·032		12	0·040	
13	0·080		13	0·085		13	0·110		13	0·033		13	0·020	
14	0·155		14	0·205		14	0·235		14	0·133		14	0·110	
15	0·080		15	0·090		15	0·120		15	0·032		15	0·040	
16	0·085		16	0·085		16	0·115		16	0·033		16	0·020	
17	0·150		17	0·195		17	0·230		17	0·132		17	0·120	
18	0·075		18	0·090		18	0·100		18	0·032		18	0·035	
19	0·090		19	0·090		19	0·110		19	0·032		19	0·000	
20	0·160		20	0·195		20	0·230		20	0·133		20	0·100	
21	0·075		21	0·080		21	0·100		21	0·034		21	0·015	
22	0·085		22	0·100		22	0·100		22	0·035		22	0·000	
23	0·175		23	0·180		23	0·210		23	0·133		23	0·090	
24	0·085		24	0·080		24	0·095		24	0·034		24	0·010	
25	0·090		25	0·100		25	0·095		25	0·032		25	0·020	
26	0·190		26	0·190		26	0·195		26	0·132		26	0·070	
27	0·095		27	0·070		27	0·070		27	0·034		27	0·000	
28	0·120		28	0·090		28	0·010		28	0·034		28	0·040	
29	0·240		29	0·175		29	0·195		29	0·133		29	0·060	
30	0·120		30	0·065		30	0·070		30	0·033		30	0·000	

No. 21 Arch.			No. 22 Arch.			No. 23 Arch.			No. 24 Arch.			No. 25 Arch.		
1	0·070	Haunches, average sinking ... 0·0272'	1	0·090	Haunches, average sinking ... 0·0457'	1	0·087	Haunches, average sinking ... 0·0873'	1	0·130	Haunches, average sinking ... 0·0837'	1	0·100	Haunches, average sinking ... 0·0620'
2	0·180	Crown, ,, ,, ... 0·1155'	2	0·210	Crown, ,, ,, ... 0·1355'	2	0·152	Crown, ,, ,, ... 0·1509'	2	0·200	Crown, ,, ,, ... 0·1460'	2	0·140	Crown, ,, ,, ... 0·1060'
3	0·065		3	0·095		3	0·087		3	0·115		3	0·110	
4	0·050		4	0·060		4	0·088		4	0·120		4	0·090	
5	0·160		5	0·175		5	0·151		5	0·185		5	0·140	
6	0·040		6	0·080		6	0·090		6	0·105		6	0·090	
7	0·050		7	0·045		7	0·086		7	0·110		7	0·085	
8	0·140		8	0·130		8	0·150		8	0·165		8	0·130	
9	0·045		9	0·050		9	0·089		9	0·100		9	0·090	
10	0·040		10	0·030		10	0·087		10	0·110		10	0·070	
11	0·130		11	0·130		11	0·152		11	0·160		11	0·120	
12	0·030		12	0·045		12	0·086		12	0·090		12	0·065	
13	0·025		13	0·040		13	0·087		13	0·100		13	0·060	
14	0·110		14	0·125		14	0·149		14	0·145		14	0·110	
15	0·025		15	0·060		15	0·086		15	0·085		15	0·070	
16	0·020		16	0·030		16	0·086		16	0·090		16	0·050	
17	0·100		17	0·120		17	0·151		17	0·140		17	0·095	
18	0·020		18	0·040		18	0·087		18	0·070		18	0·055	
19	0·020		19	0·030		19	0·086		19	0·080		19	0·050	
20	0·095		20	0·115		20	0·149		20	0·145		20	0·090	
21	0·010		21	0·040		21	0·087		21	0·070		21	0·055	
22	0·015		22	0·030		22	0·089		22	0·070		22	0·050	
23	0·100		23	0·120		23	0·152		23	0·120		23	0·085	
24	0·010		24	0·040		24	0·086		24	0·070		24	0·040	
25	0·000		25	0·030		25	0·090		25	0·030		25	0·010	
26	0·085		26	0·120		26	0·151		26	0·110		26	0·080	
27	0·010		27	0·030		27	0·088		27	0·040		27	0·035	
28	0·000		28	0·010		28	0·087		28	0·050		28	0·030	
29	0·055		29	0·110		29	0·152		29	0·090		29	0·070	
30	0·000		30	0·040		30	0·087		30	0·040		30	0·035	

No. 26 Arch.			No. 27 Arch.			No. 28 Arch.			No. 29 Arch.			No. 30 Arch.		
Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.	Level Points.	Sinking.	Average.
	Feet.			Feet.			Feet.			Feet.			Feet.	
1	0·140	Haunches, average sinking ... ... 0·1067′ Crown, „ „ ... ... 0·1708′	1	0·055	Haunches, average sinking ... ... 0·0620′ Crown, „ „ ... ... 0·1340′	1	0·055	Haunches, average sinking ... ... 0·0790′ Crown, „ „ ... ... 0·1550′	1	0·065	Haunches, average sinking ... ... 0·0601′ Crown, „ „ ... ... 0·1335′	1	0·035	Haunches, average sinking ... ... 0·0485′ Crown, „ „ ... ... 0·1305′
2	0·240		2	0·133		2	0·145		2	0·125		2	0·125	
3	0·150		3	0·065		3	0·065		3	0·050		3	0·010	
4	0·140		4	0·064		4	0·075		4	0·068		4	0·045	
5	0·220		5	0·135		5	0·135		5	0·125		5	0·115	
6	0·150		6	0·064		6	0·065		6	0·040		6	0·020	
7	0·115		7	0·065		7	0·075		7	0·060		7	0·045	
8	0·195		8	0·132		8	0·145		8	0·130		8	0·125	
9	0·125		9	0·060		9	0·075		9	0·055		9	0·030	
10	0·110		10	0·070		10	0·090		10	0·070		10	0·055	
11	0·175		11	0·136		11	0·155		11	0·130		11	0·130	
12	0·120		12	0·053		12	0·075		12	0·040		12	0·035	
13	0·100		13	0·065		13	0·080		13	0·060		13	0·055	
14	0·175		14	0·134		14	0·160		14	0·135		14	0·125	
15	0·110		15	0·070		15	0·070		15	0·050		15	0·040	
16	0·090		16	0·060		16	0·085		16	0·060		16	0·065	
17	0·113		17	0·133		17	0·155		17	0·130		17	0·135	
18	0·110		18	0·053		18	0·085		18	0·050		18	0·040	
19	0·085		19	0·055		19	0·095		19	0·060		19	0·065	
20	0·160		20	0·135		20	0·165		20	0·135		20	0·130	
21	0·100		21	0·064		21	0·095		21	0·065		21	0·045	
22	0·085		22	0·065		22	0·090		22	0·060		22	0·065	
23	0·150		23	0·134		23	0·160		23	0·145		23	0·135	
24	0·090		24	0·064		24	0·100		24	0·060		24	0·055	
25	0·070		25	0·065		25	0·085		25	0·080		25	0·075	
26	0·140		26	0·133		26	0·160		26	0·135		26	0·140	
27	0·090		27	0·070		27	0·090		27	0·055		27	0·050	
28	0·075		28	0·065		28	0·095		28	0·090		28	0·075	
29	0·140		29	0·135		29	0·170		29	0·145		29	0·145	
30	0·080		30	0·048		30	0·110		30	0·065		30	0·065	

APPENDIX Q.

ESTIMATE *in* ABSTRACT *of the* WORKS *on the* GANGES CANAL, 1850.

First Division, from Canal Head to the 24th Mile.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel	8,30,920	3	7			
,, miscellaneous	2,70,830	9	4			
Masonry head works	77,571	5	8			
Fukeer's revetment and Bytuk wall	5,913	12	2			
1st class choki at Myapoor	1,458	8	4			
Lounda Leniwala outlet	2,683	12	9			
,, inlet	2,683	12	9			
,, bridge	1,133	13	5			
Mill buildings (two sets) at Kunkhul	33,639	0	0			
,, (one set) at Hurdwar	16,819	8	0			
Kunkhul inlet	971	5	9			
,, bridge	13,290	15	4			
Jowalapoor bridge	14,671	6	6			
Ranipoor 2nd class choki	372	0	0			
Super-passage for the Ranipoor torrent and works	2,67,119	14	2			
Ranipoor 1st class choki	1,609	0	3			
Mill buildings of Bahadoorabad	31,559	2	4			
2nd class choki, ditto	511	13	7			
No. 2 falls, ditto	81,518	7	9			
No. 3 locks, ditto	17,664	0	10			
1st class choki, ditto	1,780	3	6			
No. 3 fall, ditto	78,479	9	11			
No. 3 lock, ditto	16,933	6	5			
2nd class choki at ditto	665	4	5			
Suleempoor inlet	16,695	7	4			
Additions to Jumalpoor and Dadoopoor wells	185	7	6			
Super-passage of the Puttri torrent and works	3,12,624	5	11			
1st class choki at the Puttri works	1,830	5	6			
Saynibas nulla inlet	2,683	12	9			
Dhunowri workshops	1,114	13	4			
The Dhunowri works for passage of Rutmoo torrent	4,58,474	15	8			
1st class choki at Dhunowri	1,609	0	3			
Peeran Kulleeur bridge	18,755	3	5			
Muhewar bridge	18,392	10	4			
Earthen aqueduct with masonry revetments across the Solani River ...	12,41,427	10	7			
Masonry, ditto, over the Solani River	11,05,612	11	10½			
Aqueduct contingencies	3,34,921	4	10			
Roorkee bridge	18,392	10	4			
,, burial-ground	761	15	8			

	RS.	A.	P.	RS.	A.	P.
Roorkee workshops	62,645	8	8½			
„ Government bungalow	3,053	12	3			
„ hospital	1,410	1	3			
Mr. Parker's bungalow	1,008	10	6			
Director's office	4,341	4	5			
Fall at Assoffnuggur, with rajbuha head	1,06,100	10	11			
Lock with rajbuha head and mills at Assoffnuggur	29,084	0	5			
1st class choki at Assoffnuggur	1,609	0	3			
2 drains for carrying rajbuhas under tramroad	700	0	0			
Abutments adapted to a suspension-bridge	2,080	0	0			
24 mile-stones	1,200	0	0			
14 inscription tablets	210	0	0			
5 per cent. contingencies	2,30,119	7	3			
Total of 1st Division				57,47,846	0	0

2nd Division, from the 24th to the 110th Mile.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel and miscellaneous earthwork	17,04,788	2	9			
7 masonry falls, with rajbuha heads	6,08,955	8	4			
7 masonry locks, with rajbuha heads and mills	1,30,519	7	2			
Regulating bridges over the main and Futtigurh branch	26,405	3	0			
26 masonry bridges	3,41,145	5	11			
Abutments for a suspension-bridge	1,664	0	0			
6 masonry ghats to be attached to bridges on high-roads	26,740	9	0			
3 masonry outlets	33,608	10	9			
14 drains for carrying rajbuhas under high-roads	4,900	0	0			
Workshops at Munglour	1,925	7	2			
Limesheds at ditto	721	1	7			
3 pukka wells	1,898	12	3			
9 1st class chokies	11,043	7	6			
27 2nd class ditto	7,297	11	9			
86 mile-stones	4,300	0	0			
35 inscription tablets	525	0	0			
5 per cent. contingencies	1,45,321	14	9			
Total of 2nd Division				30,51,760	5	11

3rd Division, from the 111th to the 180th Mile.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel and lock and escape channels	7,00,169	15	3			
Bolundshuhur branch and main regulating bridges	23,183	7	5			
Koel „ „ „	20,571	0	3			
Cawnpoor and Etawah branch regulating bridges	22,625	8	11			
2 masonry falls, with rajbuha heads	49,819	11	10			
2 masonry locks, with rajbuha heads and mills	29,000	0	0			
23 bridges	3,22,504	13	3			
2 escapes	10,325	10	10			
Workshops	1,997	11	10			
3 pukka wells	964	15	6			
5 1st class chokies	7,132	5	1			
22 2nd class chokies	7,489	6	4			
70 mile-stones	3,500	0	0			
31 inscription tablets	465	0	0			
5 per cent. contingencies	59,987	7	7			
Total of 3rd Division				12,59,737	2	2

4th Division, 181st to 280th Mile, Cawnpoor Branch.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel and miscellaneons excavations	4,96,037	14	8			
32 bridges, one with fall of 2 feet in flooring	3,01,516	7	5			
1 lock with rajbuha head, &c.	15,750	0	0			
2 escapes	3,527	1	5			
2 inlets	2,846	9	4			
Workshops	2,558	14	0			
1 pukka well	383	13	7			
8 1st class chokies	12,637	9	4			
23 2nd class chokies	8,216	6	3			
100 milestones	5,000	0	0			
32 inscription tablets	480	0	0			
5 per cent. contingencies	42,447	11	9			
Total of 4th Division				8,91,402	7	9

Etawah Branch, 5th Division, 198 Miles.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel and escapes	6,03,869	11	5			
66 bridges, 1 with fall of 3 feet on flooring	5,38,362	13	4			
Lock with rajbuha head, &c.	16,250	0	0			
3 escapes	4,950	6	1			
Workshops	2,558	14	0			
1 pukka well	400	0	0			
Locks, buildings, &c., at terminus	86,724	0	8			
16 1st class chokies	25,275	2	8			
50 2nd class chokies	17,861	11	6			
198 milestones	9,900	0	0			
67 inscription tablets	1,005	0	0			
5 per cent. contingencies	65,357	14	2			
Total of 5th Division				13,72,515	9	10

Cawnpoor Branch, 6th Division, 281st Mile to 349th Mile.

	RS.	A.	P.	RS.	A.	P.
Excavation of canal channel and escapes	1,95,142	8	2			
25 bridges	1,87,708	15	6			
2 escapes	4,023	3	0			
Workshops	2,661	7	0			
1 pukka well	400	0	0			
Locks, buildings, &c. at the terminus and through city of Cawnpoor ...	1,60,860	9	9			
6 1st class chokies	9,719	6	0			
20 2nd class chokies	7,755	3	4			
69 milestones	3,450	0	0			
32 inscription tablets	480	0	0			
5 per cent. contingencies	28,610	1	0			
Total of 6th Division				6,00,811	5	9

Futtigurh Branch.

	RS.	A.	P.	RS.	A.	P.
Amount of the original estimate	6,22,540	0	0			
Add for 4 masonry falls	1,20,000	0	0			
Add for 54 rajbuha heads and inlets	34,830	0	0			
5 per cent. contingencies	38,868	8	0			
Total of Futtigurh branch				8,16,238	8	0

Bolundshuhur Branch.

	RS.	A.	P.	RS.	A.	P.
Amount of original estimate	1,84,520	0	0			
Add 24 rajbuha heads with inlets	15,480	0	0			
5 per cent. contingencies	10,000	0	0			
Total for Bolundshuhur branch				2,10,000	0	0

Koel Branch.

Probable cost of (*vide* Bolundshuhur branch)	2,00,000	0	0			
Add 5 per cent. contingencies	10,000	0	0			
Total for Koel Branch				2,10,000	0	0
Grand total ... ... Rupees				1,41,60,311	7	5

RECAPITULATION.

1st Division	57,47,846	0	0
2nd "	30,51,760	5	11
3rd "	12,59,737	2	2
4th "	8,91,402	7	9
5th "	13,72,515	9	10
6th "	6,00,811	5	9
Futtigurh branch	8,16,238	8	0
Bolundshuhur branch	2,10,000	0	0
Koel branch	2,10,000	0	0
Grand total ... ... Rupees	1,41,60,311	7	5

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