

1877/78

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ANNUAL
PROGRESS REPORT



OF THE

IRRIGATION DEPARTMENT, PUNJAB,

FOR THE YEAR

1877-78.



LAHORE:
PUBLIC WORKS DEPARTMENT PRESS.
1878.

ANNUAL

REPORT

OF THE

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

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ANNUAL
REPORT

FOR THE YEAR

TELEVISION DEPARTMENT, BUREAU

FOR THE YEAR

1958

U.S. GOVERNMENT PRINTING OFFICE

ANNUAL PROGRESS REPORT
OF THE
IRRIGATION DEPARTMENT, PUNJAB,
FOR THE YEAR 1877-78.

CHAPTER I.

INTRODUCTORY.

1. As in the case of last year's report, and with the approval of the Government of India, the Annual Progress Report of this Department is forwarded direct, and separately from that of the General Branch.

Report submitted
separate from that
of General Branch.

2. Before commencing the detail of the report it may be interesting to mention briefly the principal events of the year under review.

Principal events :—

3. After a protracted correspondence with the Civil and Canal Officers concerned, the Lieutenant-Governor decided that it was not desirable to expend more money on the maintenance of these works from the grant at the disposal of this Branch. It was held that the people whose lands are protected, and who benefit by the works, should contribute towards their preservation and repair, and that this could best be arranged for through the Local Civil Officers; professional assistance being given by the Canal Officers, at the usual charge, when required.

Delhi and Gurgáon
Works.

4. A series of protective works were constructed in the bed of the River Jumna some little distance below the new head of the canal at *Tájawála*. These works are intended to protect the canal from the encroachment of the river, and they afford security to a number of villages in their vicinity. The cost has been considerable, and has been debited to the canal; but arrangements whereby the villages protected may have their assessments somewhat increased are in progress; this enhancement will be exhibited to the credit of the canal.

Protective works at
Mandáwála on the
River Jumna.

5. Before the *Bári Doáb* Canal was made, and for some years after its irrigation had commenced, a considerable tract of land near the head was regularly watered during the summer crop. The crop was almost entirely rice; and as the land had a great slope towards the river, and as the soil is very porous and much exhausted, the waste of water was considerable. When water-rates were increased, this irrigation decreased till it almost ceased to exist. It was ascertained that the people had become poorer, and were in much distress at the beginning of the *kharif* crop in April, and at that time

Irrigation in the
Pathámkot Tahsil.

Irrigation in the
Pathánkot Tahsil.

as there was plenty of water in the river, the rules regarding irrigation were relaxed as far as was consistent with justice to cultivators further down the canal. The result has been in every way satisfactory. An excellent rice crop has been secured, the irrigation further down the canal has not been interfered with, and the position of the people is greatly improved. This matter will be gone into more fully in its proper place—the Revenue Report of the year.

Supply of water-
power to the Punjab
Sugar Works Co.
Limited.

6. An arrangement was made whereby this Company is to have the privilege of water-power to the extent of 100 H.P. for six months in the year, at Rs. 1,000 a year, for three years. The rate is intentionally low to encourage the enterprise. Rates, which need not here be recapitulated, at which water-power will be supplied to the general public have been fixed.

Rules under Act VIII
of 1873.

7. Rules under the Canal Act, prepared in this Province and approved by the Lieutenant-Governor, were submitted to the Government of India for sanction in October.

Station Canal in the
Shahpur District.

8. An extension of this canal to tail into the Sahíwál Canal was sanctioned; the work to be carried out by the Deputy Commissioner of the District.

Scarcity in certain
districts.

9. Owing to the failure of the regular rains it became necessary to arrange for the employment of able-bodied but distressed people from the Delhi and Hissár Divisions. This was done, and a few people were sent, but many returned to their homes preferring to take their chance there to working at a considerable distance from them. There can, however, be little doubt but that the extensive excavation work in progress on the Sirhind and Western Jumna Canals employed usefully a great number of men who might otherwise have required relief.

Rain-fall.

10. The rain-fall during the year was markedly below the average, and the rivers were exceptionally low throughout the flood season.

Establishment.

11. A revised schedule for establishment was forwarded in September 1877, showing that a considerable reduction in Executive Engineers could be made.

12. Throughout the year Major R. Home, R. E., officiated as Chief Engineer and Secretary.

CHAPTER II.

BARI DOAB CIRCLE.

1ST DIVISION BARI DOAB CANAL.

BARI DOAB CANAL.

13. The 1st and 3rd Divisions Bári Doáb Canal were amalgamated on the 1st July 1877, and the head-quarters of the 1st Division were removed to Amritsar on the 1st January 1878, the head-quarters of the 1st Sub-division being transferred on the same date from Gúrdáspur to Mádhopur.

Amalgamation of 1st and 3rd Divisions.

14. The *Shahpur* gauge having become useless owing to the cutting of the river-bed, a new site was chosen at *Taen* (about 5 miles above *Shahpur*), where the River Ravi runs between high rocks only 640 feet apart. The gauge was established at this point in November 1877, and, since the 1st March 1878, has been read regularly twice a day, as well as at flood times. This gauge is, moreover, self-registering.

New gauge on River Ravi.

15. As usual, many floods passed down the river, but no remarkable ones.

Floods.

16. On the 1st July 1877, a crack was observed at the tail of the weir outlet, 200 feet beyond the end of the floorings. Soundings showed that the hole was deeper than the foundation of the tail wall. On the 4th July, crates strongly bolted together, and loaded with boulders, were placed in the hole, branches of trees loaded with boulders being placed on the top of the crates. Further damage was by these means prevented until October, when the whole was properly repaired.

Head-works.

17. About the 26th August 1877 it was found that a row of concrete blocks, forming the outer edge of the outlet floorings, had been scoured out, and the safety of the hammered stone flooring endangered. Baulks of timber were put in, fastened down with iron straps and spikes, and the flooring stones wedged up. These measures answered the purpose until the whole was made secure in October.

Damage sustained.

18. In October the permanent repair of the damage above mentioned was commenced. A drain, 3000 feet long, was first excavated down the centre of the channel below the outlet flooring, and after tamping the outlet gates, the site was drained of water. A good bed of crates was put in in front of the left flank, and a row of crates, 10 feet wide, was put in the whole length of the flooring.

Repairs performed.

The row of baulks was replaced by one of hammered stone, and the whole of the flooring repaired and pointed with Portland cement. All doubtful crates were taken out and replaced with larger and stronger ones, the pitched outer slope was repaired, the drain filled in, and all spoil levelled off and made regular.

BARI DOAB CANAL.

Repairs to Jacob's Spur.

19. In September it was found that a deep channel had been scoured out along the foot of the bund known as "Jacob's Spur," and that some of the boulder pitching had been washed away. Some brush-wood spurs were at once put in to prevent further action, and in October a series of loaded crates were put in, and the boulder pitching prolonged at a slope of 1 in 5 well below the level of the bed.

Repairs to No. 3 Spur.

20. At this spur it was found that the last row of crates had been much disturbed, and that a deep hole existed on the down-stream side. An additional row of crates was put in lengthways to the same depth as the row of crates some distance below this spur.

Repairs to spurs.

21. Petty repairs were executed on the whole series of bunds and spurs.

Dhangu cut.

22. Some conglomerate reefs that had shown themselves at the entrance of the cutting at *Dhangu*, in the bed of the *Chakki*, were blasted with gunpowder, and the bunds repaired with boulder pitching and well filled in with shingle.

Mills.

23. The mills at *Dháriwál* were completed during the year, and the work of building an inlet and outlet for the Punjab Sugar Works Company, Limited, was in hand.

Water-course heads.

24. Three additional water-course heads on the rájbahás were fixed during the year.

Closure of canal for repairs.

25. The canal was closed for annual repairs on the 15th January 1878, and re-opened on the 25th February 1878. Extensive repairs to the channel, rapids, falls and bridges were executed, of which a special report has been made.

Rájbahás.

26. The rájbahás of the Main Line and Main Branch Upper were kept in good working order during the year. On the Kasúr Branch, the *Jaura*, *Pakhoki* and *Pindori* rájbahás were completed, and the *Tarn Taran* and *Khem Karn* rájbahás nearly completed. On the Sobráon Branch, the *Ráya* rájbaha was nearly completed, and the *Patti* rájbaha just commenced.

Bridges.

27. On the Kasúr Branch, seven foot bridges were completed, and two were in progress. On the Sobráon Branch, also seven were completed, and two were in progress.

Buildings.

28. All the buildings at *Mádhopur* and on the Main Line and Main Branch Upper were kept in good repair. On the Kasúr Branch, the *Khem Karn* bungalow was in progress; and on the Sobráon Branch, the godown at *Ráya* was completed; all the existing buildings on these branches being kept in good repair.

BARI DOAB CANAL.

29. The *Gulpur* and *Malikpur* escapes were cleared during the year.

Escapes.

30. The *Sujánpur* and *Nalloa* drainage cuts were kept in thorough repair.

Drainages.

31. The *Kánowán Chhamb* and *Pakhowál* defence bund were transferred in August 1877 to the Amritsar Division of Provincial Works.

Kánowán Chhamb.

32. 225 young Bombay mango trees were grafted, and 175 transplanted and tended. Over 14,000 young trees of various kinds were transplanted and tended, and 1855 square feet of land prepared for seedlings.

Plantations.

33. The Executive Engineer, Mr. Doyle Smithe, reports the following results :—

Observations of River discharges.

RIVER RAVI.

Date.	Place.	Discharge.	
		C. ft. per sec.	
18th September 1877	... .. Sidhauri	... ..	6660
3rd November	... .. " "	... ..	3006
30th "	... .. Taen	... ..	4999
24th December	... .. Kamwál	... ..	6945
19th January 1878 Sidhauri	3740
19th March Kamwál	7308

RIVER BEAS.

19th January 1878 Naushahra	6276
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2ND DIVISION BARI DOAB CANAL.

34. Major R. H. Palmer, Executive Engineer, reports as follows :—

35. *Original Works.*—The new rájbahás, *Thamman* and *Turkwind*, which were reported to have commenced working at close of last year, have been further developed during the year under review; irrigating outlets have been allotted to the various villages on the line.

Thamman and Turkwind Rájbahás.

On the *Thamman* rájbaha, 36 miles in length, 36 new villages have been brought under irrigation, and 150 outlets constructed for the distribution of the water.

On the *Turkwind* rájbaha, $20\frac{1}{4}$ miles in length, 18 new villages have been brought under irrigation, and 53 outlets constructed for distribution.

The construction of these rájbahás is now complete; on the *Turkwind* rájbaha an inspection bungalow was completed during the year, and on the *Thamman* rájbaha an auxiliary rájbaha head at *Pambay* was completed.

BARI DOAB CANAL.

Bridges.

36. *Minor Works.*—Two foot bridges have been constructed during the year—one on the Main Branch Lower and the other on the Lahore Branch; they supplied a want that has long been felt by some villages whose lands were cut off by the canal.

These bridges were built of concrete blocks with light arches of brick-work; their average cost was Rs. 1,425.

Masonry works.

37. The masonry works on the canal have needed only slight repairs, due to ordinary wear and tear.

Clearance of canal channel.

38. The canal channel that was reported to be badly silted in last year's report has, during the year under review, been very efficiently cleared; the whole of the Lahore Branch, a length of 59 miles, has been completed; and out of 90 miles of the Main Branch Lower, 60 miles have been completely cleared; 13 remain to be done; and 17 require nothing to be done urgently. Measures have also been taken to reduce the declivity of the canal-bed towards the head of both branches, by putting in weirs of a temporary nature at head and various points down the line, thus increasing the depth of water and checking the velocity; it is hoped by this means that the costly silt-clearance that has been necessary during this year will not be required again; about 31,051,099 cubic feet of silt were removed at this clearance.

Rájbahás.

39. The rájbaha channels have all been satisfactorily maintained and repaired; the intense demand for water during the summer months of 1877 brought an unusual strain upon the banks and works which they have stood remarkably well.

Plantations.

40. The canal trees have been carefully thinned, and all vacant spaces filled up; a large quantity of fire-wood has been thus collected and sold; upwards of 30,000 maunds have been disposed of.

With the exception of some few places where the soil is very unsuitable, the whole of the canal-banks have now been planted, and a considerable income from the thinning of trees, which has now become necessary, may be expected annually.

Mills.

41. There were 25 flour-mills working during the year; they were rented at rates varying from Rs. 6-8-0 to Re. 1-4-0 per day, according to the number of stones and water-power available; the total income from these mills for the year was Rs 26,704.

MADHOPUR WORKSHOPS.

MADHOPUR WORKSHOPS.

Buildings.

42. The buildings are reported to be in fair order, and the usual repairs were executed.

Machinery.

43. The machinery is reported to have worked well.

MADHOPUR WORK-
SHOPS.

44. The out-turn was small, as no jobs were undertaken which could not be completed before the closure of the shops, orders relative to which reached the Executive Engineer on 15th February 1877.

Out-turn.

UPPER SUTLEJ DIVISION INUNDATION CANALS.

UPPER SUTLEJ DN.
INUNDATION CANALS.

45. The tail falls of the *Chunián* and *Atári* rájbahás were completed during the year. Materials were collected for putting up wooden railings to the timber-bridges on the *Atári* rájbaha, and bench-marks were built at intervals of 1000 feet along the *Chunián* and *Pakhoki* rájbahás.

Katora Canal.

46. The clearance of the *Katora* Canal, which was incomplete at the end of 1876-77, was completed in April 1877. Since then no clearance has been necessary, as the canal was open the whole year, and but little silt had accumulated.

Silt-clearance.

On the *Khánwah* Canal, also, owing partly to the favorable position of the head, and partly to the absence of high floods in 1877, comparatively little clearance was required at the head: 10½ miles at the tail were cleared of silt. Lengths of 8 miles at the head and 11 miles at the tail of the *Upper Sohág* Canal and 4 miles at the head of the *Lower Sohág* Canal were cleared of silt.

47. The Executive Engineer, Mr. Stevens, reports as follows:—

Discharge of River
Sutlej.

19th December 1877, at Madieki and Dirja, 13,541 cubic feet per sec.
19th January 1878, at Betu 8,283 " "

SWAT RIVER CANAL DIVISION.

SWAT RIVER CANAL.

48. Captain Jacob, R. E., the Executive Engineer, reports as follows:—

49. This year has been one of great discouragement. The disturbed state of the border prevented supplies of materials being obtained, and the works were at a stand-still for a great portion of the year. Materials are, however, being procured now tolerably fast, and it is expected that no further hitch will occur in this respect.

General remarks.

The land at the head of the canal, as far as the *Lundai* nallah, had unfortunately not been made over up to the end of the year on account of political difficulties, so that no work could be commenced in that portion; the right of entry on this land has, however, since been given. The nature of the soil in this portion could therefore only be judged of from the surface appearance, and the foundations of the head works are not yet determined.

SWAT RIVER CANAL.

Fortified enclosures
for protection of
work-people.

50. The fortified enclosures were carried on as vigorously as circumstances would permit; there was, however, abnormal rain-fall during the whole cold weather, and the progress of these works was consequently much retarded, and much damage done by the rain. With the exception of the *Lundai* enclosure, which could not be taken in hand as the land in the first mile was not made over, the other enclosures on main line are well advanced, and consequently difficulties about accommodation will not recur.

The absence of accommodation combined with this abnormal rain-fall and the disturbed state of the border rendered labor very dear, and even at very high rates very little could be obtained till March. In March, however, very fair progress was made.

Earth-work.

51. The rates will always remain high; the *Pesháwar* District rates are much higher than rates in other parts of the Punjab, and the proximity to the border will keep the rates above the average of those in the district. At these high rates, however, there will be no difficulty in finishing the earth-work by the time the masonry works are ready.

Masonry work.

52. The masonry rates will be high, as well as the rates for earth-work, and for the same reasons.

As sanction was not given to commence any of the masonry works on the canal till the 1st March, nothing was done except the commencement of the excavation for the foundations of two works, viz., the *Nowedan* aqueduct and *Narrái* culvert. The head works and *Lundai* superpassage could not be commenced, as the land was not given over. The *Jinda* aqueduct will be commenced next cold weather; the foundations can only be put in during the cold weather when the water is low.

The *Hissára Kanda* and *Ziám* culverts (the two other large works) will be commenced as soon as the enclosures there are finished.

Prospects of early
completion of
works.

53. The prospects are now hopeful, and if there is no lack of money, and the establishment is kept to the necessary strength, there is no reason why the canal should not be ready for opening in four years from the present time, and possibly in three.

Much delay occurred in framing the estimates, as many points required much discussion before settlement; all doubtful points have now been settled, and the revised estimate was approaching completion at the close of the year.

SWAT RIVER CANAL.

Guards for protection
of workmen.

54. The workmen were guarded by four Military detachments—one at the *Jinda*, one at *Narraí*, the two others were moveable; but one was generally at the *Ziám*, and the other at *Sarkai*; the *Sarkai* one has now returned to head-quarters. In addition to these, Civil levies guarded the intermediate points; they generally carried their own arms; but some Brunswick rifles and ammunition were provided by the District Authorities. No attacks, however, occurred; but, as there were several alarms and rumours, it is possible that but for the guards mischief might have occurred.

55. The district traversed by the canal is, no doubt, much more tranquil now than it has been. The canal road has been of much assistance both in enabling materials to be transported and in opening out the district. The Patháns are supposed to have no appreciation of good roads; but they go some distance out of the direct course to strike on to the canal road which is now by far the best one in the tract of country between the Swát, Kabul and Indus Rivers. The traffic between *Hashtnagar* and *Yúsafzai* has increased since the opening of the canal road.

Local traffic increased
since opening of
canal road.

WESTERN JUMNA CANAL CIRCLE.

KARNAL DIVISION WESTERN JUMNA CANAL.

WESTERN JUMNA
CANAL.

56. The Head Works Division was amalgamated with the Karnal Division on the 1st April 1877.

Closure of Head
Works Division.

57. The head works at *Tájawála* were pushed on during the year under review, and were nearly completed at its close.

Head works.

58. Four travellers and 12 pairs of iron gates for the undersluices were received and got into place. Owing to the great delay which occurred in despatching the gates from the Roorkee Workshops, considerable difficulty was experienced in getting them to site and into position after the river had risen from the melting of the snows.

Travellers for under-
sluices.

The raft entrance was repaired and fitted with lock gates, which, however, do not as yet work satisfactorily.

59. The purchase and repair of Mr. Duncan's house as a residence for the Executive Engineer was completed.

Capital, ordinary.

60. A strip of land was taken up for a road from the Jagádhri Railway Station to the Canal Bungalow at *Abdullapur*.

Road from Jagádhri.

61. The compound for the *Radaur* bungalow was marked off and gazetted for acquisition.

Radaur Chauki.

W. J. CANAL.

Radaur Bridge.

62. A brick-field for the *Radaur* bridge was also marked off and gazetted for acquisition, and the collection of materials for the *Radaur* bridge was commenced.

No. IV. Rájbaha.

63. The work of erecting boundary pillars to demarcate the land of No. IV. Rájbaha (one of the new distributaries) was put in hand.

Repairs and maintenance.

64. As the gates and travellers for the undersluices at *Tájáwála* were not received in time, the usual work on the temporary bunds to maintain supply of water in the canal had to be carried out; and as, owing to the prevailing drought, the demand for water was quite abnormal, the duties of watching and sending down the extra supply entailed very heavy work on the establishment, which was most satisfactorily performed. The temporary bunds entailed the execution of—

Gabion and boulder work	...	...	303,460 cubic feet.
Excavation to get in supply	...	...	244,150 ditto.

Mandáwála works.

65. In addition to the above, the works in the river at *Mandáwála*, some three miles below *Tájáwála*, were carried on. These works are intended to prevent the river leaving its present bed and cutting into the old branch of the Jumna between *Tájáwála* and *Dádúpur*, as explained in last year's report.

The difficulty of carrying on these works in the bed of the river with small floods constantly coming down was very great.

Protection of loop above dam.

66. As the river above the Eastern Jumna Canal head showed a tendency to cut into the left bank, shingle spurs paved with boulders were run out, and, it is hoped, will cause a deposit of silt in the bay already cut.

Works connected with maintenance of supply.

67. The normal full supply of the canal is 2557 cubic feet, which gauges 4.33 feet at the *Dádúpur* bridge: the demand for water, however, was so great that 3161 cubic feet marking 5.1 feet on the above gauge was sent down. To enable the canal to carry this, dowels had to be made the whole length of this Division, and a system for constantly patrolling the banks was organized. The arrangements were very successfully carried out by the Officers of the Division; had only the ordinary full supply been maintained, the failure of crops would have been very great, for the hot parching west winds necessitated their being irrigated every second or third day.

Flying Bridge at Radaur.

68. A flying bridge consisting of two iron boats decked to carry carts and cattle was established at *Radaur*, as the traffic was too great for an ordinary ferry.

69. Some wood and iron straps were collected for repairs of the *Meerut* road bridge over the *Budákhera* escape near *Karnál*; but until the large beams have been received from the Forest Department, nothing more can be done.

Meerut Road Bridge.

70. 1,648,000 cubic feet of silt were removed from the bed of the *Budákhera* escape, but much has still to be done to make it efficient.

Clearance of Budákhera Escape.

71. Owing to the drought it was not possible to keep No. IV. *Rájbaha* closed long enough to get it thoroughly cleared, but 475,000 cubic feet of silt were removed.

Clearance of No. IV. *Rájbaha*.

72. The high supply maintained necessitated additional bushing and staking of the canal-banks, as the increased velocity caused extra erosion.

Protection of banks from erosion.

DELHI DIVISION.

73. No. IX. *Rájbaha* (one of the new distributaries), with all its branches, water-course heads, &c., was completed, and did good work, irrigating 18,878 acres during the year.

No. IX. *Rájbaha*.

74. No. XII. *Rájbaha* (new distributary). The land of both Northern and Southern Branches was acquired by private bargain on favorable terms. The earth-work of both branches was about one-third done, and the masonry works well advanced; good block kunkur found in the vicinity of some of the works has been extensively used with good results both as to progress and cost.

No. XII. *Rájbaha*.

75. The out-houses were built, the well commenced, and the chauki itself run up to the plinth; a quantity of timber, doors, &c., were ready, so that it will not take long to finish.

Sarúgthál Chauki.

76. *Sitauli*, *Sardhána*, *Khánakheri*, *Anandpur*, and several other bridges, were repaired during the year, as well as the *Darhália* aqueduct and *Bhowána* regulator.

Repairs.

77. The *Delhi* flour-mills were also repaired. The buildings are old, and the roof had got into a dangerous state. The various inspection bungalows and the canal-banks were kept in repair.

Mills and Buildings.

78. Mango gardens were maintained, and 525 cubic feet of timber and 21,264 maunds of fuel were collected.

Plantations.

79. Bunds in the *Delhi* and *Rohtak* Districts were made over to the Civil Officers in November 1877, and those in *Gurgáon* on 31st March 1878, so that these works no longer belong to this Circle.

Bunds in Delhi and Gurgáon Districts.

80. Discharges of the river were taken as follows :—

Discharge of River Jumna.

Date.	Place.	Discharge.
		C. ft. per sec.
19th December 1877	Wazirabad Ghát near Delhi	1791
19th January 1878	Ditto	2062

W. J. CANAL.

HANSI DIVISION.

Repairs and maintenance.

81. The year was one essentially of revenue work. The silt-clearances of rájbahás, the repairs of breaches caused in the banks by the abnormal supply, and the distribution of the water, kept the establishment incessantly employed.

Masonry works.

82. The inspection houses were kept in repair, and petty repairs were done to the bridges.

Plantations.

83. The mango gardens were maintained, and fuel collected.

Jind Rájbahás.

84. Mr. Cotton and staff were employed surveying the lines of the proposed *Jind* rájbahás to admit of detailed estimates being submitted. The field work was brought to a close shortly after the end of the year, and the plotting and estimating remain to be done.

NEW MAIN LINE DIVISION.

Earth-work.

85. Sanction to proceed with the works was received in July, when they were at once put in hand and pushed on. The prevailing scarcity made coolie labor abundant, and 111,619,952 cubic feet of earth-work were completed in the year.

Masonry works.

86. The bricks and lime for the masonry works having been previously collected, 724,928 cubic feet of brick-work, or nearly one-half of the total estimated quantity, was done during the year, many of the structures being practically finished.

NEW DELHI BRANCH.

Earth-work.

87. This Division is longer, and has a smaller channel than that of New Main Line, and the rock-cutting through the ridge near Delhi is an obstacle to rapid progress; nevertheless, 52,333,281 feet of excavation was got out, of which $3\frac{1}{2}$ millions were rock-cutting; 173,605 cubic feet of rubble stone has been brought on stock from this cutting in the ridge, as well as some very fine ashlar blocks.

Masonry works.

88. 47,508 cubic feet of masonry of all sorts has been done. The want of mills and other machinery prevented the work being pushed on faster, and the difficulties of working in a contracted area were very great.

INDUS INUNDATION
CANALS.

DERAJAT CIRCLE.

DERA GHAZI KHAN DIVISION INDUS CANALS.

Extensions and improvements.

89. A culvert to pass the *Kála Khand* drainage under the *Mánka* Canal, below Choti, was commenced.

The No. 1 *Shoria* regulator was almost completed during the year. The three new straight reaches of the *Shoria* Canal were completed, but the upper one could not be opened during the irrigating season, as the regulator was not complete; the other two were opened, and worked remarkably well.

*INDUS INDN. CANALS.

90. Nearly 342·5 lakhs cubic feet of silt were cleared from 297 miles of the total length of 618 miles of canals in this Division.

Silt-clearances.

91. The plantations were maintained and extended.

Plantations.

92. The spurs thrown out last year for the protection of the river-bank south of the *Kharakwála* chauki were maintained during the year, and were completely successful, the deep bay which threatened the *Kot Dáúd* embankment having been filled up with sand. Serious erosion, however, set in along a line 14,000 feet above the chauki between the *Morád-wála* and *Jahánwála* supply-channels of the *Mánka* Canal, and along this length about 88 acres was carried away. Efforts were made to stop this; they were at first unsuccessful; three out of four spurs being completely lost, the fourth stood and the erosion diminished at this point, only however to set in lower down. The high state of the river and the unusual winter floods made the work more than ordinarily difficult.

River diversion works.

93. The various protective embankments were watched during the inundation season, as well as those portions of the canals which were likely to be injured by floods and inundation.

Protective embankments.

LOWER SUTLEJ AND CHENAB DIVISION INUNDATION CANALS.

94. The construction of two chaukís, one at *Shujábád*, the other at *Lodhrán*, was commenced. About one-third of the former and one-fourth of the latter were completed during the year.

Chaukís.

95. The various chaukís were repaired during the year.

Repairs.

96. The *Chenab* embankment was repaired at a cost of Rs. 4,841.

Embankment.

97. The plantations were maintained.

Plantations.

98. Upwards of 650 lakhs of cubic feet of silt were cleared from the 673 miles of canals in this Division by the statute laborers.

Silt-clearance.

99. The canals in the Sutlej Sub-division were levelled with a view to their future improvement.

Levels of these canals.

SIRHIND CANAL CIRCLE.

SIRHIND CANAL.

100. The report of this Circle is quoted in extenso: the progress is satisfactory.

MAIN LINE DIVISION, SIRHIND CANAL.

101. The collection of *Kerithpur* boulders was stopped at the commencement of the rains, the *Lohand* nallah having

Collection of materials.

SIRHIND CANAL.

Collection of materials.

been cleared of all boulders of a serviceable size. The total yield from this source has been 2,245,631 cubic feet, of which 340,978 cubic feet were collected during year under review.

Nālagarh Stone quarries.

102. The *Nālagarh* quarries have been worked very satisfactorily during the year. In last year's report it was stated that the supply had failed in the western face, and that a fresh quarry was about to be opened on the southern face of the hill. A system of large blasts (varying from 30 to 40 maunds of gunpowder) was introduced last October, and has been successfully employed in removing great masses of hard and indurated clay with which the better quality of building stone was overlaid. Fortunately, a very superior quality of stone has been found in large quantities in the upper portion of the hill.

A great improvement in the working has been effected by an extensive introduction of task work in place of daily labor, and there seems every reason to suppose that the high debit that was incurred in the removal of the vast masses of earth overlying the portions now opened out will eventually be cleared.

Trial pits for new quarries.

103. The sufficiency of the present quarries to supply all the stone necessary for the completion of the work is, however, doubtful, and trial-pits have been therefore opened out in the neighbourhood. The Executive Engineer is of opinion that stone of a fair quality can be obtained from the back of the hill now being worked, and that its transport can be provided for, and the matter is receiving attention, though there is no immediate fear of the exhaustion of the present quarries.

Patarheri Kunkur quarries.

104. The quarries at *Patarheri* have been re-opened during the year, and are still in progress.

Brick manufacture.

105. A Bull's kiln for burning bricks has been started at *Rāmpur* with most satisfactory results, an out-turn of 90 per cent. of well burnt first class bricks having been obtained. This kiln will be capable of turning out all the bricks required for the completion of the works.

Soorkhee.

106. Soorkhee for Main Line Division is now exclusively made from Sirhind *rova*, of which a large quantity has been delivered by the Sindh, Punjab and Delhi Railway during the rainy season.

Fire-wood.

107. Fire-wood is getting very scarce in this Division, but 319,503 cubic feet were collected during the year.

Excavation of channel.

108. During the year a stationary engine and large pumping station was erected for the purpose of unwatering the channel in the 2nd, 3rd and part of the 4th mile, and has been

SIRHIND CANAL.

Excavation of channel.

working very satisfactorily, and almost without intermission since last August. In the 2nd mile the earth-work inclines were re aligned and lowered after the rains to within 7 feet of the canal-bed. The work in this mile has been done entirely by prisoners; the earth being disposed of by engine transport and inclines on both sides of the canal. The prisoners are paid as daily laborers, as some difficulties have arisen in the way of introducing task work, which it is hoped may shortly be removed. In the 3rd mile the excavation has also been done by convicts under contract, and was carried down to between 3 and 6 feet above bed-level. This mile will be completed during the current year. Between the 4th and 8th miles 90 lakhs were excavated, all below spring level, so that the channel had to be artificially unwatered.

The total quantity of channel excavated, all below spring level, was 22,889,761 cubic feet. In addition, 36 lakhs cubic feet of spoil have been shifted at sites of superpassages.

109. At the end of the year the walls and boulder work of the weir had been carried up to R. L. 860.0 across the minor channel of the river, and beyond that channel to R. L. 863.0 for a total length of 700 feet from the right flank wall. The excavation of an additional 600 feet length was completed, ready for commencement of masonry at the end of the year.

Head works.

110. The masonry block flooring of the sluices has been nearly completed, and some progress has been made with the stone-pitching above and below the curtain walls. The right flank wall has been built to the full height, but the abutment is not yet completed.

Dam sluices.

111. The regulator piers and arching of sluice openings have been completed, and the arching of the bridge and roadway was in progress at end of year.

Regulator.

112. The head of the lock channel has been completed, with the exception of cornice and parapets, and also the connection of the up-stream wing with the paved slope of the river embankment.

Lock channel.

113. The site of the *Siswán* superpassage has been definitely fixed, and large masses of earth and spoil removed in clearing and opening out the ground. A scheme for draining the site and laying in foundations in concrete has been elaborated by Executive Engineer. A large pumping station was in course of erection at the end of the year, and unwatering operations will shortly commence. Materials in great quantities have been collected at the site.

Siswán superpassage.

SIRHIND CANAL.

Budki superpassage.

114. The site of the *Budki* superpassage has also been definitely fixed, and about 10 lakhs of earth and spoil removed, preparatory to commencing work; and at the close of the year sidings and tram roads were being laid down on a carefully considered plan and a scale commensurate with the magnitude of the proposed work.

Protective works in torrents.

115. A fascined spur has been constructed on the left bank of the *Siswán* near the canal crossing, and another some distance above the railway crossing was in course of construction at end of year. Some petty protective works on the *Sugh* nallah were also executed.

Chamkaur Regulator and Escape head.

116. The whole of the well foundations for the works at *Chamkaur* were completed during the year. The foundations, stone-flooring and curtains of the rapid below the escape head have all been laid, and the superstructure raised to five feet above bed-level. On the regulator a few wells still remained to be filled, and the concrete bed of the flooring was in progress.

Great credit is due to Mr. Preston, the Sub-divisional Officer, for the high quality and moderate rates that have been maintained at this work.

Bridges.

117. The *Bhelolpur* and *Kálka* road bridges were completed; only the pier-caps remained to be added at commencement of year.

Rámpur inlet.

118. Enquiries into the conditions of the *Rámpur* drainage pointed to the feasibility of constructing an inlet in place of the costly syphon that had been contemplated at this site, and work was commenced shortly before the close of the year.

Doráha regulator.

119. At the commencement of the year, the foundations of the *Doráha* regulators had been partially laid. During the year, the regulators for the Combined Branches and the Feeder Lines were both nearly completed; and only the pier-caps, road-metalling, parapets and water-wings, and the earth-work in approaches and widening out of canal, remained to be done.

Maintenance.

120. Breaches in slopes and banks of canal have been made good as usual. Temporary and permanent quarters, station roads and drains, protective works on the nallahs, and other minor works, were kept in proper repair. Temporary quarters at *Bassi*, *Nilon* and *Bhelolpur* were dismantled, and the land re-sold to the original owners.

121. The following are the results of observations and calculations of the discharge of the river Sutlej at Rúpár during the year :—

Discharge of River Sutlej.

Date.	Place.	Discharge.
19th May 1877 ..	Rúpár ..	4561 c. ft.
22nd December 1877 ..	Do. ..	3380 „
19th January 1878 ..	Do. ..	3405 „

122. The average number of prisoners in the Rúpár Jails during the year was 2134·13, the number in the previous year being 1928 ; of this number an average of 1335·37 men were actually employed on the canal works, as against 1168 men in 1876-77.

Convict labor.

123. One of the principal difficulties in this Division is that of obtaining sufficient labor, the wet digging and handling of heavy stone and other materials being unattractive to free laborers who swarm to work elsewhere.

Free labor.

The following is a statement of the average labor employed per working day :—

Skilled labor	...	...	...	314·77
Unskilled „	...	...	...	1,715·29
Contract „	...	...	...	2,580·93
Prison „	...	...	...	1,335·37
Total				5,946·36

124. The Accounts Division continued to work satisfactorily in relieving Officers from details of accounts. Important work was also done by the Accounts Officer in the preparation of the Revised General Estimate for the Main Line Division which was submitted during the year.

Accounts Division.

RAILWAY AND WORKSHOPS DIVISION.

125. The following is a detail of the running during the year :—

Railway traffic.

Nálágarh stone	...	...	10,298 wagons.
Patarheri kunkur	...	...	2,073 „
Mixed traffic	...	...	2,817 „
Total			15,188 „

the corresponding number of the previous year being 16,883.

Running continued to the 29th June, when the line was broken by floods and traffic suspended. On the 11th October, the stone traffic was resumed, but has been much interrupted by the heavy winter rains. The Nálágarh Line was worked for 177 days during the year. A more detailed report will be made on this subject at close of present running season.

SIRHIND CANAL.
Nálagarh Railway.

126. The 10th mile of the Nálagarh Railway was protected by the construction of three new culverts to pass the drainage with very satisfactory results, as no damage was done to the banks in this mile during the winter rains which were exceptionally heavy.

Maintenance of line.

127. The cost of maintenance was considerable during the year, owing to the heavy winter rains, and the annual estimate was slightly exceeded.

New smithy.

128. A new smithy was commenced during the year, and the necessary tools and plant in connection with it were in course of manufacture.

New siding.

129. A diversion of the Main Line was carried out at *Chamkaur*, as it was impossible with the line as previously laid to get in the south abutment of the regulator. A new siding was also put in at *Nálagarh*, in order to bring the railway up to the working face of the quarry.

Repairs of plant.

130. The usual repairs to the locomotives, rolling-stock and tools and plant have been carried out.

Foundry.

131. Castings, aggregating 3460 maunds, were turned out of the foundry during the year; this was nearly double the out-turn of the previous year, which was 1817 maunds.

3RD DIVISION SIRHIND CANAL.

Collection of materials.

132. Brick-making was carried on near the head of the Abohar Branch, and at the 10th, 21st, 26th, 36th and 48th miles, and on the Bhatinda Branch at the 7th, 12th, 19th, 22nd, 25th, 32nd and 44th miles. The brick-fields below the 12th mile on the Bhatinda Branch were not started until after Christmas. Bull's kilns continue to give satisfaction, and new ones have been erected at the 7th, 12th, 19th and 22nd miles. There is great difficulty in obtaining fuel in this Division, and the question of an extended use of concrete in place of brick-work is engaging attention.

Earth-work.

133. On Abohar Branch the channel excavation has been practically completed a few crossings and two chains near the proposed head of Sutlej Navigation Channel only remaining.

Channel excavation on first 12 miles of Bhatinda Branch was started after Christmas, and was nearly completed, with exception of grassing.

134. The estimate for regulator at head of Abohar and Bhatinda Branches was sanctioned in October and work immediately commenced. At the close of the year the state of the work was as follows :—

Regulator at head of Abohar & Bhatinda Branches.

Lock foundations completed, and superstructure finished to one foot above level of lower bed.

Abohar Branch Regulator.—Foundations complete, and superstructure built to level of upper bed.

Bhatinda Branch Regulator.—Foundations complete, and superstructure to two feet above the upper bed.

Rājbaħa Head.—Built to same level as Bhatinda Regulator.

The progress of the work was somewhat delayed for want of stone for grooves, &c.

135. The state of works on Abohar Branch was as follows at end of year :—

Works on Abohar Branch.

Lock and fall at 5th mile		
Ditto do. 10th "	}	Completed, with the exception of the fall notches and portions of the stone-work in locks.
Ditto do. 14th "		
Ditto do. 21st "		
Ditto do. 26th "		
Ditto do. 32nd "		
Ditto do. 36th "		
Ditto do. 43rd "		
Bridges at 8th & 46th miles,—complete.		

The locks and falls in the 10th, 26th and 36th miles were for the most part built during the past year ; the other locks and falls were nearly as far advanced at the commencement of the year as at the end, their completion being delayed pending decision as to the exact form of the notches and gate anchorages. With a view of determining the former point, a series of experiments have been recently conducted on the Bāri Doāb Canal by Mr. Benton, whose report is awaited ere final orders can be given.

The bridges were complete at the commencement of the year.

136. On Bhatinda Branch the excavation for foundations for falls in 7th and 13th miles had been completed, and all preliminary arrangements made for commencing the works.

Works on Bhatinda Branch.

137. A first class chauki was commenced at 51st mile, Abohar Branch, the walls of the main building being 10 feet high at end of year.

Buildings.

Three chaukis were commenced on Bhatinda Branch, as follows :—

Mile 12.—Second class chauki : roofed in ; out-houses and chauki nearly completed.

SIRHIND CANAL.

Buildings.

Mile 22.—Second class chauki : foundations laid, and tiles for roof made.

Mile 32.—First class chauki ; same remark as for chauki at mile 22.

Survey of this Branch.

138. The alignment and bed level of Bhatinda Branch have been finally fixed for the first 37 miles ; below this point to the 44th mile some modification in the line originally proposed is necessary. This will soon be settled, as well as the further alignment to 63rd mile, cross-sections at intervals of one mile apart having been taken up to this point during late cold season.

Distributaries Abohar Branch.

139. The question of distributaries on the first 50 miles of Abohar Branch has received attention during the past year, and a preliminary scheme roughed out from the contour sheets. Trial lines have been run accordingly, with cross-sections, a mile apart, over most of them. These will shortly be plotted and the final alignment determined.

4TH DIVISION SIRHIND CANAL.

Collection of materials.

140. Materials have been collected at various sites for the works on the Sutlej Navigation Channel, to which at present the operations of this Division are principally confined. The quantities of materials that have been collected are shown in the abstract (see para. 151).

About seven lakhs of bricks have been loaded at four different points along the extension of the Abohar Branch, and will be available for chaukis as soon as these can be started.

Sutlej Navigation Channel.

141. The excavation of the first 40 miles of the Sutlej Navigation Channel was commenced in December, and was in active progress until the end of year, nearly 374 lakhs of earth-work having been completed. This work gave useful employment to over 4000 people who had flocked to it under pressure of famine from some of the neighbouring districts, as well as to the ordinary contract gangs. The alignment of the last 7 miles was also finally decided on during the year, and the land was being taken up, and estimates for excavation under preparation at the close of the year.

Buildings.

142. Two Assistant Engineers' quarters and three Overseers' quarters, reported as half finished in last year's Progress Report, were completed. Inspection chaukis have also been constructed on Sutlej Navigation Channel, as under—

Second class chauki at mile 10.—Completed.

First ditto 22.— Ditto.

Second ditto 34.— Ditto.

First ditto 40.—Nearly completed.

Materials for a chauki at the tail of the Navigation Channel have been also collected.

143. On Abohar Branch a base line has been laid down for a length of 75 miles, and three depressions apparently indicating drainages crossing the line have been surveyed and sectioned.

Abohar Branch.

The alignment of this length has not, however, been finally decided on.

144. Nothing has yet been done on the section of Bhatinda Branch assigned to this Division.

Bhatinda Branch.

5TH DIVISION SIRHIND CANAL.

145. The principal materials collected are shown in appended abstract. The principal brick-field is at Bhoray, and will supply bricks for the Sirhind Nallah Syphon, and for the bridges in 9th and 11th miles of the 2nd Feeder Line. A Bull's kiln was started here in May, and has since worked continuously, except during the months of December and January, when it stopped for want of fuel, operations being renewed in February. Executive Engineer states that the results, on the whole, have been very satisfactory.

Collection of materials.

On other brick-fields Allahabad flame-kilns have been employed, as *upla* for clamps was not obtainable.

146. The channel of 1st Feeder Line has been practically completed, and the road crossings only remain to be removed.

Earth-work.

About 16 lakhs cubic feet were excavated during the year.

On 2nd Feeder Line a few chains only remain incomplete, 27 lakhs cubic feet of earth-work having been executed during the year.

Excavation was commenced on the first 15 miles of Kotla Branch in January, and about 10 lakhs had been completed by the end of the year.

147. The regulator at head of Kotla Branch and 2nd Feeder Line was completed during the year.

Regulator at head of Kotla Branch and 2nd Feeder Line.

Of the bridges on 1st Feeder Line—

That at mile 4, 2710 feet, was complete, with exception of approaches and metalling.

Ditto 11, 4850 feet, parapet, approaches and metalling remain to be done.

Ditto 8, 1400 feet, turning of arches just completed.

On the 2nd Feeder Line the bridge in 4th mile was commenced. The work was carried up to the springing, and the centring fixed by the end of the year.

SIRHIND CANAL.
 Sirhind Nallah
 Syphon.

148. The design for Sirhind Nallah Syphon was finally decided on during year ; excavation of foundations down to spring level, and other preliminary operations, including manufacture of well curbs, were commenced.

Buildings.

149. The inspection chauki at *Dhamout* on 1st Feeder was completed in April : temporary quarters for an Assistant Engineer were built in the 11th mile, Kotla Branch, and preparations made for commencing a second class chauki near the same site.

Kotla Branch.

150. Land for the first 31 miles, Kotla Branch, was acquired and paid for during the year. The boundary roads for this length were nearly completed, and the collection of materials commenced for this Branch ; channel excavation over first 15 miles was started, as stated in para. 46.

6TH DIVISION SIRHIND CANAL.

Collection of materials.

151. The collection of materials in this Division calls for no special remark ; quantities are given in the abstract below.

Statement showing the quantity of Materials collected in the several Divisions of Sirhind Canal Circle during the year 1877-78.

MATERIALS.	Main Line Division.	3rd Division.	4th Division.	5th Division.	6th Division.	Total.
Bricks No.	376,779	4,146,426	3,000,000	3,234,000	4,538,081	15,295,286
Soorkhee C. ft.	387,363	19,247	...	...	...	406,610
Lime "	66,161	49,071	...	1,118	...	116,350
Nālagarh stone... .. "	976,967	...	...	...	...	976,967
Boulders "	340,978	...	...	...	...	340,978
Rora "	462,228	26,988	37,543	158,300	...	685,059
Concrete metal "	275,443	99,104	...	...	...	374,547
Wood "	319,503	2,702,650	59,367	72,100	...	3,153,620
Block kunkur "	203,083	...	46,000	46,700	11,478	307,261
Patarheri kunkur "	3,000	...	...	...	...	3,000
Charcoal Mds.	224	1,500	3,200	2,250	...	7,174
Spawls C. ft.	109,500	...	...	...	...	109,500
Upla ... .. "	...	...	265,427	...	...	265,427
Kúra ... .. "	...	...	58,729	...	...	58,729

Statement showing the quantity of work done on certain Sub-heads of Estimates in the several Divisions of Sirhind Canal Circle during the year 1877-78.

	Main Line Division.	3rd Division.	4th Division.	5th Division.	6th Division.	Total.
	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
Stone masonry ...	457,492	11,952	...	...	...	469,444
Brick " ...	30,833	352,729	...	150,733	218,541	752,836
Dry " ...	835,452	10,829	...	...	9,158	855,439
Concrete ...	71,448	132,308	...	...	...	202,616
Channel earth-work	*22,889,761	27,537,389	37,377,066	41,278,030	58,765,341	186,544,859
Other earth-work...	4,160,220	5,499,829	...	460,411	4,156,041	14,266,501

* All below spring level, except 314,000

152. The excavation of the Ghaggar Branch has been practically completed during the year. The first length of 16 miles was about two-thirds finished at the beginning of the year, while the last 38 miles were just being commenced.

Earth-work.

On the Choa Branch up to 21st mile about 28 lakhs cubic feet of earth-work have been executed. Little remains but bunds at site of locks, &c.

Excavation of Patiála Navigation Channel is complete, with exception of road crossings, &c.

On the Patiála Escape Channel about 13 lakhs cubic feet were executed.

153. The state of masonry works at end of year was as follows :—

Masonry works.

GHAGGAR BRANCH.

Regulator at Head.—Completed practically.

Fall at 4th mile, 3000 feet.—Completed, December 1877.

Do. 11th mile.—Completed during year.

Do. 23rd mile.— Ditto ditto.

Do. 27th mile.—Complete, except parapets.

Do. 34th mile.—Completed during year.

Do. 49th mile, 3000 feet.—Commenced in October ; will be finished in May 1878.

Bridge at 16th mile.—Completed.

Do. 19th mile.—Commenced and completed during year.

Bridge at 30th mile.—Commenced March 1877 ; completed during year.

Bridge at 38th mile.—Commenced and finished during year.

Bridge at 44th mile.—Commenced March 1877, and completed during year.

CHOA BRANCH.

Regulator at Head.—Completed during year.

Masonry works.

Fall in 4th mile.—Commenced and completed during year.

Do. 9th mile.—Nearly completed.

Do. 16th mile.—Commenced and completed during year.

The construction of the locks on this Branch is in abeyance.

Bridge in 4th mile.—Completed during year.

SIRHIND CANAL.

Buildings.

154. A second class chauki was built during the year at the 53rd mile, Ghaggar Branch.

State contribution works.

155. Metalled road, 17 miles in length, between *Patidla* and *Nábha*, has been completed, and was given over to traffic in December 1877.

Two culverts were constructed on escape channel, and a 2-foot fall at the end commenced and finished during the year.

Distributaries.

156. A system of distributaries for the Ghaggar and Choa Branches was laid down on the contour sheets, and trial lines and cross-sections have been levelled over for an aggregate length of 692 miles.

R. HOME, MAJOR, R. E.,

Offg. Chief Engineer Irrigation Works, Punjab.

PUNJAB PROVINCE.

PART I.

APPROPRIATION ACCOUNT OF IRRIGATION WORKS FOR THE YEAR 1877-78.

Extraordinary and Ordinary.

SERVICE HEADS.							Grant as per Budget Orders.	Final Grant at end of year.	Outlay.
CAPITAL.									
EXTRAORDINARY.							Rs	Rs	Rs
Works	...	...	...	...	...	17,88,381	19,75,081	18,17,481
Establishment	...	...	...	...	...	5,92,358	5,30,478	4,61,730
Plant	...	...	...	...	...	1,13,261	1,49,325	1,47,416
Suspense Balances	...	...	...	...	...	2,62,000	1,01,116	- 77,231
Total						27,56,000	27,56,000	23,49,396	
Less—Receipts on Capital Account						6,000	6,000	8,844	
Net Outlay						27,50,000	27,50,000	23,40,552	
Less—Expenditure in England						...	...	...
Net Expenditure in India						27,50,000	27,50,000	23,40,552	
ORDINARY.									
Works	...	...	...	...	...	1,34,932	27,958	24,236
Establishment	...	...	...	...	...	56,133	750	3,248
Plant	...	...	...	...	...	2,000	...	33
Profit and Loss	...	...	...	...	...	...	...	...
Suspense Balances	...	...	...	...	...	...	...	- 3,955
Total						1,93,065	28,708	23,562	
Less—Receipts on Capital Account						...	...	18,538
Net Outlay						1,93,065	28,708	5,024	
Less—Expenditure in England						...	...	552
Reduction in Grant						1,64,357	...	...
Net Expenditure in India						28,708	28,708	4,472	
TOTAL CAPITAL (IMPERIAL)						27,78,708	27,78,708	23,45,024	
ORDINARY AGRICULTURAL WORKS.									
Works	...	...	...	...	...	...	41,330	40,000
Establishment	...	...	...	...	...	...	11,003	10,000
Total						...	52,333	50,000	
Additional Grant						52,333	...	...
Net Outlay						52,333	52,333	50,000	
Carried over						28,31,041	28,31,041	23,95,024	

PART I.—concluded.

APPROPRIATION ACCOUNT OF IRRIGATION WORKS FOR THE YEAR 1877-78.

SERVICE HEADS.	Grant as per Budget Orders.	Final Grant at end of year.	Outlay.
	Rs	Rs	Rs
Brought forward ...	28,31,041	28,31,041	23,95,024
REVENUE.			
Extensions and Improvements	51,850	71,072	52,326
Maintenance and Repairs	4,72,300	6,23,770	5,59,274
Establishment	7,53,785	7,03,963	7,34,041
Tools and Plant	24,000	15,154	15,282
Profit and Loss ... ..	...	...	...
Total ...	13,01,935	14,13,959	13,60,923
Less—Expenditure in England	3,000	3,000	...
Additional Grant	12,98,935 1,12,024	14,10,959 ...	13,60,923 ...
Net Expenditure in India ...	14,10,959	14,10,959	13,60,923
TOTAL CAPITAL, REVENUE AND AGRICULTURAL (IMPERIAL)	42,42,000	42,42,000	37,55,947
CONTRIBUTIONS.			
CAPITAL.			
Works	7,56,677	7,69,677	6,70,565
Establishment	2,22,002	2,22,002	1,70,619
Plant	44,500	44,500	55,669
Suspense Balances	53,000	40,000	— 14,666
Total ...	10,76,179	10,76,179	8,82,187
Less—Receipts on Capital Account	3,000	3,000	5,219
Additional Grant	10,73,179 ...	10,73,179 ...	8,76,968 ...
Net Expenditure in India ...	10,73,179	10,73,179	8,76,968
REVENUE.			
Works ... ..	...	59,260	9,758
Maintenance and Repairs ... ..	...	12,979	3,976
Establishment ... ..	...	...	...
Additional Grant	72,239 ...	72,239 ...	13,734 ...
Net Expenditure in India ...	72,239	72,239	13,734
TOTAL CONTRIBUTIONS ...	11,45,418	11,45,418	8,90,702
GRAND TOTAL ...	53,87,418	53,87,418	46,46,649

PUNJAB PROVINCE.

PART II.

APPROPRIATION ACCOUNT OF IRRIGATION WORKS FOR THE YEAR 1877-78.

Distribution of Extraordinary and Ordinary Outlay.

	New Works.	Maintenance.	Establishment.	Tools and Plant.	Profit and Loss.	Suspense Balances.	Total.	Less Receipts on Capital Account.	Net Expenditure of the year.	Less Expenditure in England.	Net Outlay in India.	Grant as per Budget Orders.	Final Grant at end of year.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
IMPERIAL.													
CAPITAL.													
<i>Extraordinary.</i>													
Western Jumna Canal	8,34,286	...	1,42,744	20,008	...	-1,32,566	8,64,472	604	8,63,868	...	8,63,868	7,49,000	9,87,202
Bári Doáb Canal	1,20,727	...	36,859	— 349	...	- 13,330	1,43,907	668	1,43,239	...	1,43,239	2,47,914	2,47,914
Sirhind Canal	7,64,426	...	2,38,675	1,12,303	...	39,376	11,54,780	7,507	11,47,273	...	11,47,273	14,15,000	12,77,804
Swát River Canal	98,042	...	43,452	15,454	...	29,289	1,86,237	65	1,86,172	...	1,86,172	3,04,846	2,37,080
Reserve ... ..	...	...	...	...	...	...	...	...	...	...	...	33,240	...
TOTAL A.	18,17,481	...	4,61,730	1,47,416	...	-77,231	23,49,396	8,844	23,40,552	...	23,40,552	27,50,000	27,50,000
<i>Ordinary.</i>													
Western Jumna Canal	8,226	...	2,058	— 1	...	— 181	10,102	...	10,102	...	10,102	26,482	...
Bári Doáb Canal ... ..	...	...	...	...	...	- 4,154	- 4,154	...	- 4,154	...	- 4,154	1,250	...
Lower Sutlej and Chenab Inundation Canals ... ..	...	...	...	...	...	440	440	...	440	...	440	8,250	...
Upper Sutlej Inundation Canals	1,950	...	487	...	...	- 1,933	454	...	454	...	454	3,750	3,255
Indus Inundation Canals ... ..	...	...	...	...	...	1,923	1,923	...	1,923	...	1,923	90,000	11,393
Special Survey Deraját Canals ... ..	...	...	...	...	...	...	...	5	— 5	...	— 5	...	...
Ditto Lower Bári Doáb Canal ... ..	...	...	...	34	...	...	34	81	- 47	...	- 47	...	...
Muzaffargarh Embankment ... ..	...	...	...	...	...	...	...	...	...	...	...	63,333	...
Shahpur Canals	14,060	...	703	...	...	...	14,763	...	14,763	...	14,763	...	14,060
Reduction in Grant ... ..	...	...	...	...	...	...	...	...	...	...	...	-1,64,357	...
Mádhopur Workshops ... ..	...	...	...	...	...	...	...	18,452	-18,452	552	-19,004	...	...
TOTAL B.	24,236	...	3,248	33	...	- 3,955	23,562	18,538	5,024	552	4,473	28,708	28,708
TOTAL CAPITAL, A. and B.	18,41,717	...	4,64,978	1,47,449	...	-81,186	23,72,958	27,382	23,45,576	552	23,45,024	27,78,708	27,78,708
<i>Ordinary Agricultural.</i>													
Muzaffargarh Embankment	40,000	...	10,000	...	...	...	50,000	...	50,000	...	50,000	...	52,333
Additional Grant ... ..	...	...	...	...	...	...	...	...	...	...	...	52,333	...
TOTAL C.	40,000	...	10,000	...	...	...	50,000	...	50,000	...	50,000	52,333	52,333
Carried over	18,81,717	...	4,74,978	1,47,449	...	-81,186	24,22,958	27,382	23,95,576	552	23,95,024	28,31,041	28,31,041

[iii]

PART II.—concluded.

APPROPRIATION ACCOUNT OF IRRIGATION WORKS FOR THE YEAR 1877-78.

Distribution of Extraordinary and Ordinary Outlay.

	New Works.	Main-tenance.	Establish-ment.	Tools and Plant.	Profit and Loss.	Suspense Balances.	Total.	Less Receipts on Capital Account.	Net Expendi-ture of the year.	Less Expendi-ture in England.	Net Outlay in India.	Grant as per Budget Orders.	Final Grant at end of year.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Brought forward ...	18,81,717	...	4,74,978	1,47,449	...	—81,186	24,22,958	27,382	23,95,576	552	23,95,024	28,31,041	28,31,041
REVENUE.													
Western Jumna Canal ...	3,983	1,44,626	2,63,853	6,263	...	...	4,18,725	...	4,18,725	...	4,18,725	3,95,690	4,39,999
Delhi and Gurgaon Irrigation Works ...	...	1,044	3,859	...	...	...	4,903	...	4,903	...	4,903	20,000	930
Bari Doab Canal ...	14,925	2,48,455	2,58,062	2,545	...	...	5,23,987	...	5,23,987	...	5,23,987	3,90,599	5,45,778
Lower Sutlej and Chenab Inundation Canals ...	2,810	8,199	54,673	665	...	...	66,347	...	66,347	...	66,347	63,058	65,508
Upper Sutlej Inundation Canals ...	307	28,661	35,567	972	...	...	65,507	...	65,507	...	65,507	1,23,274	79,621
Indus Inundation Canals ...	30,301	1,22,891	98,475	1,698	...	...	2,53,365	...	2,53,365	...	2,53,365	2,43,349	2,52,721
Shahpur Canals ...	...	5,040	960	1	...	...	6,001	...	6,001	...	6,001	11,674	7,614
Madhapur Workshops ...	...	358	18,592	3,138	...	...	22,088	...	22,088	...	22,088	35,541	20,185
Reserve ...	...	...	...	...	...	...	...	...	...	...	...	18,750	1,603
Additional Grant ...	...	...	...	...	...	...	...	...	...	...	...	1,12,024	...
Less Expenditure in England ...	...	...	...	...	...	...	...	...	...	...	...	—3,000	—3,000
TOTAL D. ...	52,326	5,59,274	7,34,041	15,282	...	...	13,60,923	...	13,60,923	...	13,60,923	14,10,959	14,10,959
TOTAL IMPERIAL, A. B. C. AND D. ...	19,34,043	5,59,274	12,09,019	1,62,731	...	—81,186	37,83,881	27,382	37,56,499	552	37,55,947	42,42,000	42,42,000
CONTRIBUTIONS.													
CAPITAL.													
Sirhind Canal ...	6,70,565	...	1,70,619	55,669	...	—14,666	8,82,187	5,219	8,76,968	...	8,76,968	10,73,179	10,73,179
REVENUE.													
Lower Sutlej and Chenab Inundation Canals ...	9,758	3,976	...	...	...	...	13,734	...	13,734	...	13,734	...	72,239
Additional Grant ...	...	...	...	...	...	...	...	...	...	...	...	72,239	...
Total ...	9,758	3,976	...	...	...	...	13,734	...	13,734	...	13,734	72,239	72,239
TOTAL CONTRIBUTIONS ...	6,80,323	3,976	1,70,619	55,669	...	—14,666	8,95,921	5,219	8,90,702	...	8,90,702	11,45,418	11,45,418
GRAND TOTAL ...	26,14,366	5,63,250	13,79,638	2,18,400	...	—95,852	46,79,802	32,601	46,47,201	552	46,46,649	53,87,418	53,87,418

A. DAVIDSON, Colonel, R. E.,
Examiner Public Works Accounts, Punjab.

