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MADRAS RECORD OFFICE.

Government of Madras.

Revenue **DEPARTMENT.**

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369. 370

Dated 24. 12. ~~19~~ 1862.

Not to be folded or roughly handled

Proceedings of the Madras Government, Revenue Department, 24th December 1862.

No. 369. Read the following Proceedings of the Madras Government in the Public Works Department, dated 19th December 1862, No. 3,045:—

Passing orders on Colonel Ludlow's report on the state and progress of the Irrigation Company's works. } (Vide Public Works Proceedings, 19th December 1862, Nos. 374—379.)

No. 370. ORDER THEREON, 24th December 1862, No. 2,690.

Communicated to the Board of Revenue who will report on the suggestion referred to in paragraph 13.

(Signed.) J. D. SIM,
Secretary to Government.

Letter from Lieutenant-Colonel S. O. E. LUDLOW, R. E., late Officiating Consulting Engineer for Irrigation and Canal Company, to Colonel W. I. BIRDWOOD, R. E., Secretary to Government, Public Works Department, dated Chepauk, 29th October 1862, No. 76:—

SIR,

1. In accordance with the instructions conveyed in the Proceedings* of Government dated 24th July 1862, having examined all the works executed and in progress on the Irrigation Company's Canal, between the Sunkasala Anicut and the Metacondal cutting, and made as full an inspection as circumstances would admit, of the course fixed upon or designed for the channel between Metacondal and the site of the lowest Pennair Anicut at Somaishweram, I have the honor to submit the following report for the information of Government.

* No. 1,772.

2. The works executed and in progress are situated on the portion of the line between the head at Sunkasala and the Metacondal cut, a distance of 72 miles, beyond which no ground has been broken, the largest quantity being towards the upper part of the Canal.

3. Between the Metacondal cutting and a point a little above the junction of the Kundaur and Vykaloor streams, as far as the 148th mile, the course of the Canal has been definitively settled. The estimates for the works as far as Nundyal (the 103rd mile of the Canal) have been received, and after examination have been laid before Government. The estimates down to the junction of the two above mentioned streams are in a forward state and will, I understand, be soon submitted.

4. Between the junction of Kundaur and Vykaloor and Cuddapah the course which the Canal will take, though not finally settled may be said to be nearly so.

5. Between Cuddapah and the Somaishweram Anicut the course of the Canal is yet under consideration and examination, and some time will yet I think elapse before the exact mode in which this part of the scheme is to be carried out is finally decided, and the estimates for the works be ready.

6. The estimates for the Somaishweram Anicut and the Canal through the Nellore District are already before Government.

7. I shall now proceed to remark upon the different works executed and in progress and on the course of the Canal from the Sunkasala Anicut downwards.

8. The Sunkasala Anicut (across the Toombuddra $17\frac{1}{3}$ miles above Kurnool) and its head works comprise—

The two branches of the Anicut.

The embankment across the intervening island and those on the north and south sides of the river above the Anicut, for the protection of the lands above from floods. A set of under or scouring sluices at the south extremity of the south branch of the Anicut.

The head sluices of the Canal, Office buildings and Stores.

9. *Anicut.*—No material alteration in plan has been made in carrying out the north branch of the work. In the south branch a deviation has been made from the line originally proposed in order to accommodate the work to the form of the rocky bed of the river. By this change a saving of 100 feet in the length of the Anicut has been effected.

10. The crown of the Anicut will be when completed $2\frac{2}{10}$th feet higher than was originally intended, the addition of 1 foot being intended to secure an increase of head in the surface level of the Canal and the remainder to meet an alteration made in the level of the Canal bed.

11. The breadth of the work throughout at the crest will be 8 feet with a batir of $1\frac{1}{2}$ inches to a foot on either side, occasionally more to adapt it to the shape of the rocks. Its height where greatest will be 25 feet and here the base will be $14\frac{1}{2}$ feet broad.

12. The body of the works consists of two strongly built walls of large rubble stone set in chunam of thickness varying according to the height of the work, but no where less than 3 feet.

29. Canal between Anicut at Sunkasala and Hindry Aqueduct near Kurnool.

The length of this portion of the Canal is 17⅓ miles. It here runs parallel to and not far ant from the river and with the exception of the 3 miles at its head and that adjoining the ueduct has a bank on the lower or river side only.

30. The fall was to have been 10 feet between the floor of the head sluice and that of the ueduct. It actually has, as I am informed, a fall of 11 1/10 feet, the head of the channel having n raised, whereby a saving in excavation has been effected. This fall is unequally distributed ying inversely as the breadth of the channel, from 20" per mile to nearly nothing in parts.

31. The breadth is very variable, but in one part only (the 3rd mile where it is as narrow 75 feet) is it less than 90 feet at bottom; but generally it is much broader and in most parts onsiderable breadth of land on the upper side will be submerged. This land is mostly waste of a very inferior class. One small hamlet has been removed which stood in the course of the nal.

32. The height of the bank above the ground also varies considerably. It averages about or 17 feet, but in places where it crosses water courses it is occasionally as high as 34 feet· top breadth is from 6 to 9 feet, and the average of a number of sections gives it a mean tional area of 70 square yards. Since first thrown up it has sunk from 1½ to 2 feet, and will so yet still and have to be raised to bring it to the designed height of 4 feet above the Canal ater level.

33. The slopes vary from 1·1 : base 1 height to 3·3 : base 1 height. The mean being bout 1·8 base to 1 height. The soil of which the bank is composed is mostly of a very inferior escription being either black cotton earth or a silty soil of a worse quality still. Gravel ccurs in places.

34. The quantity of work in this portion of the Canal; according to the estimate, is

14,10,215	Cubic yards of earth-work in excavation and embankment.
8,49,672	Cubic yards of rocky cutting or excavation.
22,59,887.	

From a number of rough sections which I had taken, I calculate the quantity of material rown up in the bank to be rather better than 23,00,000 cubic yards.

35. The banks however still want much trimming, dressing and raising; two large breaches, urposely left open in the 15th and 16th miles, have to be filled in and masses of rock in the rd, 4th, 5th, 6th, 7th, 14th, and more especially in the 1st and 17th miles yet remain to be emoved. The quantity of earth-work yet remaining to be done is estimated by the Engineers t 92,480 cubic yards, and of rocky excavation at 21,900 cubic yards. The former quantity take it to be under-estimated, but when compared with the quantity actually executed what emains to be done is small and the work may be said to be nearly completed. With ordinary ctivity the whole should be completed by the end of the present year. There are at present ,523 men and women coolies and 64 buffaloes employed between the 3rd and 18th miles.

36. In the estimate, the proportion of earth-work to rocky excavation is as 14 to 8½, what elation the one bears to the other in the mass actually removed would in the present irregular nd incomplete condition of the work be impossible to state with any accuracy. In the three upper iles of the Canal where the section is best defined and where the rocky excavation bears a large roportion to the earth-work, the estimated quantity of work is 1,99,985 cubic yards of earth-work· ,11,680 cubic yards of rock, total 6,11,665 cubic yards. The Executive Engineer states that he actual quantities in these three miles (which do not correspond with those in the estimate) will mount when the work is complete to 6,00,188, being about 11,500 cubic yards less than the stimate.

37. The channel here has an average width at bottom of 103 feet and supposing slopes of to 1 (which is more than there are) a mean width of 119 feet, allowing then for the difference f width between this and the estimate and the diminished depth due to the raising of the channel ead I calculate that there are about 30,000 cubic yards less of work and this mostly rocky xcavation in these three miles.

38. These calculations are necessarily founded on somewhat rough data, but the comparison has been made favorably for the work, and I think that when it comes to be measured, as it should be on completion, it will be found that, though the total quantity of work executed may be equal to or even in excess of the estimate, the relative proportion of rock to earth will be less, a fact which must of course affect the rates.

39. The estimated cost of the Canal excavation and embankments is 3,97,966

Add proportion of sundries 23,008

4,20,974

The actual expenditure in cash by the Executive Engineers up to end of August was 3,78,981

Probable cost of completion 26,863

4,05,844

But this does not include either temporary establishments or tools and sundry expenses. I have not yet been able to ascertain either from the local Officers or the Agent what sums are chargeable on these accounts to the different works. It is probable however that the sum to be charged to the Canal on this score will at least swallow up the balance remaining of the sanctioned estimate and possibly cause an excess, but the excess should not be large, and my opinion is that the work has been very economically executed.

40. I have not included in the above Statement of expenditure a sum of 5,920 Rupees expended in rough pitching a length of 1,565 yards of the Canal bank in the 6th mile, no allowance having been made for this in the estimate.

41. I was much struck by the very weak and insecure appearance of these banks. They are of a considerable height, average 16 or 17 feet, rising in one place to 34 (above the natural level of the ground), are formed of a very loose and friable soil for the most part loosely thrown up with insufficient slopes, 1·8: base 1 height, and in many parts of the Canal will be subjected in consequence of the extensive outspread of the water to a very violent and destructive action of the waves when agitated by strong gales of wind; to protect them from such action they have with the exception of the 6th mile, no revetment.

42. Such revetment I consider to be indispensably necessary for a very considerable length of the Canal, and until it is formed, I look upon the banks as decidedly unsafe; but even with this there will always I think be a considerable amount of leakage through these black Cotton soil banks resting on a thin stratum of soil which again rests on the bare rock. Even now wherever the rain water has lodged in little pools above the bank a corresponding pool is invariably seen on the lower side. The leakage will be necessarily much more considerable when there is a great head of water in the Canal. I suppose that at least 7 miles of this bank will require to be revetted, which judging from the cost of the part already completed would amount to 46,599 Rupees, but the rate may I think be reduced from 12 Annas to 8 Annas which would reduce the cost to 31,066.

43. A deduction of 20,000 Rupees was made from the total of the Canal estimate for the value of stone; what amount has been already realized on this account I do not know, but have reason to suppose that it is small. Much of the material may however be brought to use hereafter for the revetment.

44. *Calingulahs and culverts between Sunkasala and Kurnool.*—The estimated cost of these works was as follows :—

		Estimated cost including sundries.
9	Calingulahs	22,689
11	Culverts	21,135
		43,824

The number of calingulahs was to have been nine, of a total length of 3,240 feet and with an effective water-way of 2,430.

45. These nine calingulahs are nearly completed. Their lengths have been somewhat altered. Their total length being 3,149 feet, effective water-way 2,362 feet. But a 10th calingulah 100 feet long, on a very low level (at present entirely buried in the bank) has been added at a distance of 3 miles from the head, which it is intended to use if necessary as a large under-sluice to scour the upper part of the channel. There are also 34 feet length of calingulah over one of the culverts, so that the means of discharge (already more than enough for a drainage of only 42 square miles) has been slightly increased. The fault is however on the right side.

46. Some of the calingulahs have had openings left in them for the discharge in case of rain of land floods, and others are left open for the purpose of having irrigation sluices formed in them, and under-sluices have been made in several of the calingulahs.

47. Considerable deviations have been made from the original plan in the case of the culverts.

A square culvert in No. 4 mile has been converted into an oval one. This culvert is objectionably short, straightening the banks at the point where it is placed and likely to cause a dangerous set of the current. It will be lengthened.

A four vent culvert in No. 9 mile has had the middle pier removed, and the two middle vents thrown into one, thus forming a road-way large enough for cattle and small carts under the Canal, which will be a very great convenience.

48. I may here observe that the inconvenience which the inhabitants of the villages situated near the Canal will suffer from the stoppage of the thoroughfare must be very serious, and the ferries proposed to be established will but very imperfectly remedy this evil. It is therefore very desirable that as many of the culverts as possible should be made sufficiently capacious to admit of the passage of men and cattle and, when circumstances will admit, of small carts under the Canal.

49. In the upper part of the Canal two culverts have been dispensed with altogether, and three have been superseded by drains conveying the water into the Canal.

50. The estimated cost of the calingulahs and culverts as stated above is Rupees... 43,824
Their cost when completed will be... 53,271

Giving an excess of... 9,447

which is probably rather less than the truth as something will have to be added for stores and superintendence.

51. These masonry works differ so entirely from those originally planned that it is impossible to say without taking accurate measurements of all whether this excess arises from increase of quantity or increase of rate. Foundations had to be given to many of the works when none were allowed in the estimate (as the site showed the presence of rock), and a calingulah not provided for at all in the estimate has been built, but on the other hand some works have been altogether omitted. Increase in quantity will probably partly account for the excess, I believe that the rate of 2 Rupees 8 Annas per yard allowed for rubble masonry in chunam has not been found generally sufficient hitherto, but work is now I understand being done within this rate.

52. Of the twenty irrigation sluices two have been completed according to the sanctioned plan, six on a plan slightly different and two have been made in the calingulahs. There will be no excess on those works when they are completed.

53. Nothing has been done to the distributing channels, and the channels for the surplus water below the calingulahs have not been commenced. No tunnels have been built.

54. When inspecting the head sluice I observed that the two south vents, which, as before mentioned, are further advanced than the others, had been cut off from the rest of the work by a temporary dam. This I was told was done when it was contemplated to admit water into the channel for irrigation in June last. That water could have been so passed down the channel there can be no doubt, but that it would have been most imprudent and dangerous to have done so, is equally certain. The bank when I inspected the works in August, as may be

gathered from what has been said above, was incomplete, the masonry works along the channel not finished, and the rocky excavation in many parts yet in progress. The state of affairs must have been still more backward two months before.

To have admitted the river water through such an insecure head opening with the chance of high freshes finding their way bodily down the channel, would have been exposing the bank to a very great risk.

Moreover all work in the channel must have been suspended or greatly delayed, for irrigation, to be of any use, must have been carried on to the end of the season; and after all what advantages would there have been to compensate for this. There are only 2,000 Acres capable of irrigation between Sunkasala and Kurnool, not one-half of which would have been brought under wet cultivation this year, so that for a prospective gain of 4,000 Rupees, all works along the channel and at the head must have been stopped, or greatly delayed, and the channel banks have been exposed to a most unnecessary and dangerous trial.

55. *Bellary road bridge across Canal at Kurnool.*—The piers and abutments of this have been carried up to the springing line of the arches. As the bed of the Canal has the same level as the road-way, which a bridge across the Hindry would have, and as the road-way of the bridge across the Canal will be 25½ feet higher than the bed of Canal, this structure with its enormous banked approaches will necessarily be both inconvenient and unsightly. It is to be regretted that a swivel bridge, or one on some other plan which would not have required such a great rise, was not adopted at first, and I would recommend that this question be re-considered, before the arches of the bridge are turned. There is another approach, but little more circuitous, and with sufficiently easy slopes under the abutment arch of the Aqueduct. The objection to it is that occasionally the Hindry when in high fresh floods it. But this happens so very rarely, and such floods are of such short continuance, that practically the objection has little importance, at all events this road under the arch would answer all purposes, until the question about the best form of bridge to build above, were decided.

56. *Hindry Aqueduct.*—The piers and abutments of this work have been carried up to the springing line of arches, the wing walls have still to be raised 9½ feet higher.

57. I am rather at a loss to know why it was even intended to turn the arches of this Aqueduct with bricks, bricks never having been before used at Kurnool, and the soil being particularly unfavorable for their manufacture, whereas stone well adapted for building, is abundant, and in general use. I presume that it was supposed, that time and money would be so saved; if so, that expectation has been disappointed, for the trials which have for several months been made to manufacture bricks sufficiently good for the purpose, have hitherto failed, and it appears to be pretty clearly proved, that if bricks of a sufficiently good quality, can be manufactured at all, they will prove to be quite as expensive as stone. The idea of using brick has therefore I believe been at last abandoned.

58. Each of the 14·40 foot arches of this Aqueduct is 102 feet long, and judging by the rate at which the other masonry works have progressed, and the means at the disposal of the Engineers, I do not think that the whole of this work can be completed by next June.

It has however been suggested, and the suggestion has I believe been adopted, that the arches might be turned in separate and independent sections or ribs, so that a part, say ⅓rd of the breadth of the Aqueduct may be completed this season. If this plan, which has in my opinion other advantages to recommend it, be adopted, as much water may be carried across the Aqueduct next season, as will amply suffice for all the land lying under that part of the channel below Kurnool, which is likely to be completed.

59. This large work as far as it is completed appears to be well and solidly built. Much more difficulty than was anticipated was found in carrying down the foundations on the right side of the river to rock. It was however, I am informed, done at last, and the work may therefore be considered perfectly stable.

60. The estimate for this work was 1,45,000 including 13,113 for sundries.

	RS.
The expenditure up to the end of August was...	77,717
And the work remaining is estimated at...	1,05,730
Making a total of.....	1,83,447
Being an excess on estimate of...	38,447
The principal items of excess will be baling and excavation estimated at 1,700 excess...	7,904
Rubble excess in quantity...	13,369
Cut stone excess in quantity and rate...	3,024
Arch work...	16,705

Of the allowance of 13,113 for superintendence and sundries, 11,660 have been spent, although the work is not half done, so that an addition will have to be made on this account. Allowing 3,500 additional only for this (which is very moderate) will bring the total excess up to 41,947.

61. I calculate therefore that the excess on all the works down to this point, viz., on the Anicut and head works 17$\frac{1}{3}$ miles of channel and masonry works, and the Hindry Aqueduct will amount to very nearly one lac of Rupees, being about 14 per cent. on 7,30,000, the total amount of the estimates for them.

62. I do not consider this over-expenditure to be excessive, on the contrary, taking into consideration the novelty and magnitude of the work, the scantiness of labor and increasing cost of it, and the numerous difficulties and discouragements which have had to be encountered, I think that great praise is due to the Officers of the Company for the intelligence, zeal, and industry which they have exhibited, and especially for the care which they all show, in husbanding the resources of their employers.

63. *From Hindry Aqueduct in 18th mile to 43rd mile.*—The excavation and embankment of the Canal are in progress along this portion, but no masonry works have been begun yet.

The 18th mile has only earth-work, about $\frac{1}{4}$th of it is finished.

In the 19th mile, there is besides embankment much heavy rocky excavation. Some considerable progress has been made probably from $\frac{1}{3}$ to $\frac{1}{2}$, but the work does not appear to be getting on very rapidly, and the parties of work people engaged upon it are not large.

In the 20th mile where there will be still heavier rocky excavation, nothing whatever has been done.

64. The estimated rate for the rocky excavation in these two miles varies from 3 Annas to 5-4 per cubic yard, the average being 4$\frac{1}{2}$. This I am confident will be insufficient, the rock being for the most part of a most difficult kind to deal with, and containing hard quartz boulders, which can neither be picked nor blasted.

65. In the 21st, 22nd, 23rd miles about $\frac{2}{3}$ths of the earth-work are completed, but not $\frac{1}{10}$th of the rocky excavation.

In the miles 24—30, the progress made is small, but the work is going on, though not apparently with much spirit.

31—4 miles, good progress has been made with the embankment, and the work is well advanced, and proceeding satisfactorily, no rocky excavation done yet.

35 and 36 miles. Not commenced.

66. 37 and 38 miles. Some progress made. The Executive Officer complains of the insufficiency of the rate, and I think with reason.

The rates in these two miles are, for embankment 1·6 and for rocky excavation from 1·3 to 3·6, average 2 Annas 5 Pice. The soil is black Cotton to a very slight depth, resting on clay slate rock, so that what little earth there is, is soon exhausted, and the coolies have to go for a considerable distance to get earth for the embankment, 1·6 per yard for such work is evidently insufficient, as is also 2·5 for the rock, though it is easily split.

With the exceptions above noticed and a few other places similarly circumstanced, the rates for earth-work from the Hindry to Nagatoor, seem sufficient; but I cannot say this with respect to the rocky excavation. The rates for this vary from 1 Anna per cubic yard, to 5 Annas 4 Pice, the average being 2 Annas 4 Pice, and although the rock is a laminated clay slate, not generally hard to work, and the excavations are not deep, I consider this rate to be insufficient, and that there must be an excess on this item of the estimate.

67. 39th mile.—Nothing done.

40th and 41st mile.—Work just begun.

42nd bank nearly completed, but some cutting remaining to be done. No people at work.

43rd nothing done. In this mile the Canal will fall into the Nagatoor tank.

68. The whole quantity of work to be done, between the Hindry Aqueduct in the 18th mile and the Nagatoor tank in the 43rd mile is,

Earth-work.....34,77,251 Rocky excavation 8,16,568.

Total work done.....9,15,912. do. 52,874, being about $\frac{1}{4}$th of the former and $\frac{1}{16}$th of the later.

69. There is a strength of about 7,000 coolies at work on this portion of the line, and if, as has been recommended to the Chief Engineer, $\frac{1}{3}$rd in breadth only of the channel be excavated this season, water may be conveyed down as far as the Nagatoor tank, and possibly a little further, so as to bring a considerable quantity of land under irrigation, during next year's freshes but I do not think it will be practicable to complete the whole of this part of the channel to its full breadth by next year; in fact I feel certain, that it will not be done.

70. The soil generally on this part of the Canal course, is of a better description, than that above Kurnool, though black Cotton soil occurs in many parts. The Canal will be mostly single banked, the water over spreading the ground on the upper side to a very considerable extent, especially opposite to the villages of Purdapad, Realumpad, and near Ulloor, where large tanks will be formed. In these places and others where the soil is bad and the banks high, revetments will be essentially necessary for their safety, but I cannot find that any provision for this has been made in the estimates.

71. The additional risk which the banks will be exposed to, and the consequent expense of revetting then due to the adoption of the single bank mode of construction added to the injury inflicted on the Ryots by the submersion of much rich and valuable land, of which about 6,000 Acres will be sacrificed go far in my opinion to counterbalance any advantages to be gained from it.

72. *Canal from Nagatoor to Metacondal cutting.*—Little has been done beyond marking out the course of the Canal. In the 43rd mile a party of 500 people are at work, and about 5,000 cubic yards have been excavated. Ground has just been broken in the 49th mile, and 200 coolies are at work there; work will also soon begin in the 54th, 58th and 59th miles: work has begun in the 62nd, 68th, 69th and 70th miles, the working parties amounting to about 700 men and women.

73. *Cutting near Metacondal.*—This cutting carries the Canal, in the 71st and 72nd mile of its course, through the water shed into the valley of the Kundaur. It is 1 mile 66 chains in length, is to be 61 feet broad, with perpendicular sides, and the fall through it will be 1 foot in a mile. The depth of excavation where deepest will be 28 feet, of which 21 feet in depth is rock diminishing to nothing on either side. As originally estimated there would have been 1,95,526 cubic yards of excavation in rock at 8 Annas, 95,705 of earth at 1-6 Annas, but there appears to have been some mistake as to the depth of soil above the rock (as will be seen from the accompanying rough section of the cutting, which shows the actual state of the work) which made the proportion of rock to earth, appear less than it really is. By what quantity the rock excavation will be increased on this account it is impossible, without more accurate sections to say; it may possibly amount to 20,000 cubic yards.

74. All that has yet been done, is to remove the earth down to the surface of the rock, for a length of 1 mile. The quantity so removed is 61,100 cubic yards, and it has cost 2 Annas per yard, it being estimated at 1-6. Whether the rock excavation can be done at the estimated rate of 8 Annas per yard is doubtful. The rock is a red clay slate laminated, and not

very difficult to break up and remove in slabs, and has not been found in one trial pit to become very much harder below, than at the surface. It is just possible that by the use of derricks for raising the soil in the middle of the cuts and rails at the two ends, and by very careful management the work may be done at or near the estimated rate, but as I before said, I think it very doubtful. A Contractor who had undertaken to execute this work, has, I am informed, just thrown up his contract.

75. The stone taken from this excavation is of a very inferior quality, and not fit for use in buildings, if exposed to the action of water. A Contractor who is collecting materials for a bridge in the middle of the Metacondal cutting, is casting his stone for the work from a quarry distant 1 mile, that procurable on the spot, being considered unfit for the purpose. But a sum of 30,000 Rupees has been deducted from the amount of the estimate for the value of this stone. This deduction cannot be admitted.

76. There appears to be no rocky excavation necessary between the 43rd mile and the Metacondal cut. But the rates allowed for eath-work are from 1-2 to 1-6, which appear to me too low, in the 36th, 37th, 50th, 51st, 52nd, 53rd, 54th, 55th, 56th, 57th, 58th, 62nd and 63rd miles, the largest tanks on the line are formed, and the banks there will be of considerable height, in some places as high as 34 feet. The rates allowed, are in my opinion, insufficient for such work.

77. An allowance of 20,000 Rupees has been made for rubble pitching to the inside slopes. But the rate 2 Annas per square yard allowed, seems too low. If the revetment be $\frac{1}{3}$rd yard thick, it would be 6 Annas per yard. The revetment actually put up above Kurnool, has cost just double this, 8 Annas per yard seems to me to be a fair price, and I do not think it can be done for less.

78. It is said, that however high a rate may be, Natives will always contrive to work up to it, and that it is therefore advisable, to fix the the rates at a figure lower than the work can really be done for, since, even if the rates be exceeded, the work is in the end done cheaper than it would have been, had the estimates been framed more liberally or fairly. There is doubtless some truth in this, but if work is to be executed by contract, it is bad economy to make a rate so low, that no fair margin for profit is left. In such cases, Contractors after trial throw the work up, and the result is much delay, increased outlay on fixed establishments, and the postponement of remunerative returns. I cannot help thinking, that if the rates in this project had been somewhat more liberal, the work would have progressed more rapidly, and profits have been more quickly realized.

79. No work has yet commenced below the Metacondal cutting, just below it a calingulah 300 feet long in the left bank, will discharge a large portion of the water into the Caulee river; the remainder proceeding along the Canal, the dimensions of which will be reduced. The Canal drops by a series of locks, until it falls into the Caulee at Jootoor. At Jootoor there will be an Anicut, locks, head sluices, &c., all of which are described in the Chief Engineer's specifications already submitted to Government.

80. Between the Metacondal cutting and the Caulee Anicut at Jootoor, *i.e.* from the 72nd to the 91st miles, there are to be 12 locks, 11 culverts, 4 ferries, a calingulah, and a bridge, what the cost of these locks will be is uncertain, for their size and plan are not yet finally decided upon, but for works of that class, they will be comparatively cheap, for they will be almost all founded on rock. The same remark applies to the locks lower down.

81. I examined the site of the Caulee works shortly after the occurrence of a fresh in the river, and found the rock to be so friable after submersion, that I do not consider it to be capable of resisting the action of water, whether falling over, as in the case of an Anicut or scouring as in that of a sluice. Provision must accordingly be made (which has not been done in the estimates sent up to Government) for a hard stone apron for the Anicut and linings for the vents of head surplus and feeding sluices.

82. After crossing the Caulee at Jootoor, the Canal is continued on its left bank, passing several small drainages and cutting through the Byap Goodoor tank. The portion of the tank bed below the Canal will be converted into Nunjah, and the upper portion of the tank will

be enlarged, so as to make up for the part cut off. From this the Canal proceeds to Nundyal passing above the two large Nundyal tanks, and crossing their supply channel by an Aqueduct or culvert of 5·20 foot vents.

83. I think it would be advisable to hand over this tank bodily to the Irrigation Company, on the condition of their paying annually to Government a sum equal to the average annual revenue less cost of repairs. It would be advantageous to them as their cost of construction would be diminished, and the quantity of irrigated land under the tank, would be largely increased, and it would be advantageous to the existing irrigation, for the supply of the tank would be rendered more certain and more abundant. I believe that the Company would be willing to take over the tank on these terms.

84. Below Nundyal the Canal will proceed along the water shed, between the Kundaur and Vykaloor up to their junction at the 148th mile near Changulmurry. This is an extremely favorable and easy portion of the line. There is absolutely no drainage to cross, the cuttings and embankments, except near the locks, are by no means heavy, and there will (excepting in those places) be no rocky excavation. There will however be 18 locks in this distance, but they should not for the reasons above stated be expensive.

85. The course of the Canal down to the 148th mile has been finally decided upon. I append two sketch maps and a description of it, which I received from the Executive Engineer in charge of that range. The estimates down to Nundyal (the 103rd mile) are now before Government, and those as far as the 148th mile may soon be expected.

86. I see no reason to fear that the cost of the work, between the Metacondal cutting and the junction of the Kundaur and Vykaloor will exceed the Chief Engineer's estimate. There are no engineering difficulties on this portion, and the work will be (locks excepted) by no means costly.

87. Below the 148th mile above the Kundaur and Vykaloor junction, the course of the Canal had not been finally settled, as to its details when I visited the place. The following is a general outline of the scheme.

88. The Canal crosses the Vykaloor by an Aqueduct, but some way above this point an Anicut will be thrown a cross the Kundaur and a channel cut from it to the Canal, the object of which is, to return to the Canal the water, which it will be remembered was allowed to escape higher up across the Caulee Anicut.

89. The immediate construction of this Anicut does not appear to me to be absolutely necessary, and should I think be deferred, until it is known, whether the Canal itself can or cannot carry all the water which it receives from above. Without this Anicut the Kundaur water would find its way into the Pennair, and be picked up lower down.

90. After crossing the Vykaloor the Canal proceeds in a somewhat devious course by Dhoor and Chitta Kontah and north of the Poospagherry hill to the Pennair at Adamapillay (below Komaloor on the map) where it will cross that river by an Anicut.

91. The question was raised, as to whether an Anicut or Aqueduct should be built at this place. I obtained from the Executive Engineer a rough estimate of the cost of both works. He makes out that the Anicut with its approaches would cost about 4 lacs of Rupees more than the Aqueduct. It appears to me that this difference has been much over-stated, but there can be no doubt, but that the one work would be much more costly than the other, and as I find that no line of road crosses the river at this point, no convenience would result from the use of the Aqueduct as a bridge, and there being several other objections to it, I have no hesitation in saying that the idea should be altogether given up.

92. The Adamapilly Anicut will be 2,400 feet long (exclusive of under-sluices) 850 of which will be on rock, the rest on sand. Height of crest 11 feet above deep bed of river. Area of water-way obstructed $\frac{1}{4}$th of greatest sectional area in flood.

93. Starting from the Anicut, the Canal is carried towards the Cuddapah Cantonment, which it skirts on the south side, passing the Boogoo River by an Aqueduct of 20 30 feet arches, the bed of the Canal being 11 feet above that of the river. It then crosses the old road from Chennoor to Cuddapah, passes between the lower part of the town and the upper part of the

Cuddapah large tank. A few huts only will be destroyed near the road. The supply channel of the Cuddapah tank is crossed by an Aqueduct of 3·18 foot arches. It then crosses the road from Cuddapah to Devah Cuddapah where a bridge will probably be necessary. It then trends to the north-east passing near the village of Namonpillay until it meets a range of hills running in a north-westerly direction and bounding the Cuddapah valley on that side. It runs along the foot of this range until it meets the Pennair just below the junction of the Booggah with that river.

94. It will be seen from the Memorandum by Mr. Clarkson, the Exective Engineer, (herewith forwarded) in which he describes the intended course of the line from above the Kundaur and Vykaloor junction to Cuddapah that some heavy masonry works (besides the Anicut across the Pennair) have to be constructed during that distance.

95. The really formidable difficulties however only commence at the point where the Canal strikes the Pennair near the junction of the Boogah with that river. The present design is to carry the Canal along the south bank of the river shaving the different spurs and traversing the intervening vallies as far as a village (Kaligherry) a little above the confluence of the Cheyaur with the Pennair. The Bluffs above this confluence and a little distance below it which are very formidable and the difficulty of crossing the Cheyaur, it is proposed to avoid by means of an Anicut 18 or 20 feet high to be built across the Pennair near Doongasonne 3 miles lower down, which it is supposed will back the water up some distance above the bluffs on the left or upper bank of the Cheyaur and render that part of the river bed navigable.

96. The eventual construction of another Anicut across the Pennair just above the Cheyaur is also contemplated by the Chief Engineer, to obviate the obstruction likely to be caused by the accumulation of sand at the confluence of the Cheyaur.

97. Below the Doongasonne Anicut the channel will be resumed on the south bank and carried to a point a little above the Somaishweram (the last and lowest) gorge. In this gorge the river bed is to be rendered navigable by the daming up of the water by an Anicut to be built just below the gorge at Somaishweram.

98. Besides the difficulties in the Doongasonne and Somaishweram gorges which it is intended to pass by means of Anicuts as abovementioned several have to be encountered higher up which must be overcome by other means. There are three difficult and hard rocky spurs at Guindy just below the confluence of the Booggah, 28 chains in length. Rock, vitrified sand stone and slate. Cross section about 2 to 1. Opposite Sideout a rocky projection. Slate slopes 3 or 4 to 1. A little further on 3 spurs. Cross section 3 to 1; $2\frac{1}{2}$: 1 and $1\frac{1}{2}$ to 1. Length 56 chains.

99. Above Pennypayroor there will be a rocky cutting between two hills of about 870 yards in length and an average of 1 yard deep.

100. Near Bundalapilly however the most formidable of all the difficulties occur. There is first a detached spur 350 yards long with cross section of 2·1. A small valley and then a steep face of rock coming down to the river, 5 chains in length. Section 2·1. Then 16 chains, very precipitous, making an angle of from 10° to 25° with the vertical. Then 12 chains with slopes of 2·1.

101. A tunnel through a rocky hill near Coormaloor 176 yards in length will also be required.

102. It is proposed to pass these rocky spurs where the face of the rock is not too steep by partially cutting into the rock and building up a wall resting on the toe of the slope on the river side.

103. But at Bundalapillay the face of the rock is too precipitous to admit of this, and the Canal must be carried along the river at the foot of the rock either by means of a river wall built upon wells or on a rough stone bank. I am of opinion that the latter is the plan to be preferred. A mass of rough stone blasted from above and thrown in, if a sufficient slope is given it on the river side, will soon settle permanently and be afterwards unaffected by the action of the stream. This mode of construction has the advantage of cheapness and facility of execution, whereas a river wall on wells would be difficult of construction and much more expensive.

104. I roughly estimate the cost of building a Canal 30 feet broad on a rough stone bank, with a proper flooring and towing path at 100 or 120 Rupees per running yard. The cost of forming a Canal of the same breadth by part scarping and part wall will be from 50 to 60 Rupees per yard.

105. While examining the difficulties along the proposed course of the Canal along the south bank, I could not help being struck by the apparently less formidable nature of the obstructions which the north bank of the river presented. The rocky spurs on the north bank at Guindy are less formidable than those on the south bank opposite. A little below near Ponisale there is one very precipitous bluff on the north, but it is of no great length and between that and the Cheyaur there are no other serious difficulties whatever on that side. Down to that point therefore it would be decidedly in my opinion easier to carry a Canal by the north than by the south bank (an Aqueduct across the Suggelair excepted). Opposite to the confluence of the Cheyaur and further down at Doongasonne there are two long and difficult faces on the north side but they are not as far as I can judge so difficult, but that a 30 feet Canal might by scarping and building be carried along them. They are unquestionably less formidable than the corresponding difficulties on the south bank which will necessitate the construction of one if not two Anicuts.

106. I cannot help thinking that these Anicuts are a very cumbrous, expensive, and inefficient mode of completing the navigation, and that if they can possibly be dispensed with even at some increase of cost, it should be done. I feel confident that the water will not be found to stand so high above them as is calculated upon, that the accumulation of sand on their upper side will seriously obstruct the traffic and encumber the locks and if of considerable height they will be exposed to risk and cost much in repair.

107. My opinion is that at little, or no increased expense, the Canal may be carried along the rocky faces, and the two Anicuts at the Cheyaur and Doongasonne be altogether dispensed with, and if this be done, the north bank of the river I certainly think presents greater advantages for the course of a continuous Canal than the south.

108. It seems to me also to be a question whether it would not be better to dispense also with the upper Anicut at Adamapillay and bring the Canal by the north bank at once to the Guindy spurs avoiding Cuddapah altogether. Several miles of Canal would so be saved. By doing this some advantages would be unquestionably sacrificed. The communication with Cuddapah and the present line of the Railway would be lost, the opportunity of irrigating the Cuddapah valley and an additional supply of water from the river there, be given up.

109. If it be deemed unadvisable to sacrifice these advantages the upper Anicut might be built below the Poospagherry hill, where it might probably be founded on rock, and the Canal be taken off on the north side, a branch only being taken from the south side for communication with Cuddapah and irrigation, if there be water enough. But my idea is that all the water which is ever likely to be brought down the Canal from the Toombuddra will be barely sufficient for the supply of the irrigation, which is very extensive, in the Kundaur Valley, and for the feeding of the Canal as a navigable one down to Somaishweram.

110. I would strongly advocate a careful examination and survey of the north bank of the Pennair with a view to determining whether the facilities offered on that side for a Canal are not greater than those on the south bank, and especially whether by adopting that bank it would not be possible to make the course of the Canal continuous down to the Somaishweram gorge and so dispense with the Anicuts at Doongasonne and the Cheyaur.

111. As the designs of the works below the Kundaur and Vykaloor junction are not made or even the surveys completed it is impossible for me to offer any certain opinion as to the probable cost of this portion of the line. The masonry works will, as above observed, be heavy, the difficulties along the Pennair are of a very formidable description and the expense of

overcoming them, whatever mode of doing so be adopted, must be great, and I think that the excess over the original rough estimate is likely to be considerably larger here than on any other part of the line.

112. The site selected for the Somaishweram Anicut appears to me to be good, and as there can be no doubt about the indispensable necessity for this work, permission to proceed with it at once should be accorded. This work should certainly have a head sluice on the north as well as on the south side.

(Signed) S. O. E. LUDLOW, Lieut.-Colonel, R. E.,
Late Offig. Cons. Engineer for I. & C. Company.

PUBLIC WORKS DEPARTMENT.
Public.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

Read the following papers:—

From the Consulting Engineer Irrigation and Canal Company.

Forwards for sanction Plans and Estimates amounting to Rupees 1,35,400 for works required in the second section of the Canal (from the 92nd to the 103rd mile) from the Village of Jootoor to the Town of Nundial. } (Here enter No. 74, dated 20th October 1862.)

Reports on the condition and progress of the Company's works as required in Proceedings of Government, dated 24th July 1862, No. 1,772. } (Here enter No. 76, dated 29th October 1862.)

Minute by the Honorable the President. | (Here enter — November 1862.)

Minute by the Honorable Mr. E. Maltby. | (Here enter 10th November 1862.)

Minute by the Honorable Mr. T. Pycroft. | (Here enter 12th November 1862.)

ORDER THEREON, 19th December 1862, No. 3,045.

1. Colonel Ludlow's report dated 29th October 1862, No. 76, recorded above, is a clear and valuable paper, as it not only brings to the notice of Government the state and progress of the Irrigation Company's works already commenced, but affords some means of judging of the plans which may hereafter be submitted for their completion, and will therefore materially aid the Government in dealing with future questions connected with the Company's operations.

2. Colonel Ludlow* divides the scheme as follows:—

(1.) Between the head at Sunkasala, and the Metacondal cut, a distance of 72 miles.

(2.) Between the cut and a point a little above the junction of the Kundaur and Vykalore streams as far as the 148th mile.

(3.) Between the junction of these streams and Cuddapah.

(4.) Between Cuddapah and the Somaishweram Anicut.

(5.) Between the Anicut and the coast through the Nellore District.

3. It is expected† that all the head works included in the first section, viz., Anicut, sluices and embankments will be fully completed by the end of May next or in time for the reception of the first freshes of 1863. The expenditure upon the works up to the end of July last was Rupees 1,10,482, and the work remaining to be done is estimated by the Company's Engineer at Rupees 44,697, exclusive of stores and plant. Colonel Ludlow, however, notices certain deficiencies in the estimate for completion, and he therefore allows Rupees 15,857 in addition, thus raising the probable cost of work to be done to Rupees 60,554, and the probable total cost of the works when completed to Rupees 1,71,036. The sanctioned estimate having been Rupees 1,25,000, the probable excess amounts to Rupees 46,036, or nearly 37 per cent.

4. The Government learn‡ that the banks of the Canal, comprised in the same section, between the Anicut at Sunkasala and the Hindry Aqueduct near Kurnool, about 18 miles long, present "a very weak and insecure appearance." They are said to average 16 or 17 feet in height and to be formed of a very friable soil loosely thrown up with insufficient slopes. In consequence of the extensive outspread of the water, it is apprehended that the banks will be exposed to the violent action of the waves when agitated by strong gales of wind, and to protect

* Paragraphs 2 to 5.
General remarks.
Work in progress.
Course of the Canal settled. Estimate for the portion between the cut and Nundial (103rd mile of Canal) now before Government, and that for the remainder, *i. e.* down to the junction in a forward state.
Course of the Canal not finally settled.
Course of Canal yet under consideration.
Estimates before Government.

† Paragraph 23.

Paragraph 28.

‡ Paragraph 41.

them against such action, Colonel Ludlow considers it to be indispensably necessary that they should be revetted for a considerable length of the Canal, but even such protection it is feared will not prevent leakage. The estimated cost of the Canal and embankments is Rupees 4,20,974. The actual expenditure up to the end of August last was Rupees 3,78,981.

* Paragraph 51.

5. Considerable* deviations are reported to have taken place from the original plan in the case of the culverts and calingulahs constructed between Sunkasala and Kurnool, and while some of the masonry works have been altogether omitted, the designs for others have been considerably modified, and certain works not provided for in the estimate have been carried out. The probable excess on these works is given at† Rupees 9,447.

† Estimate ..... Rs. 43,824
Probable cost of completion 53,271
Excess ... 9,447

6. In paragraph 48 Colonel Ludlow brings to notice the necessity for rendering the culverts as capacious as possible to admit of the passage of men and cattle, as otherwise the inconvenience which the inhabitants of the villages situated near the Canal will suffer, will be very serious. The Government observe however that in Proceedings dated 11th April 1862, No. 736, they directed that if feasible the culverts should be so constructed as to meet this desideratum, and that additional ferries should also be furnished for the purpose. Further orders on this subject were passed in Proceedings dated 2nd December 1862, No. 2,869.

7. From paragraph 54 of Colonel Ludlow's report, the Government observe that instead of any unnecessary impediment having been raised by them to the commencement of irrigation in the past season, the Company's works were not in a fit state for such a purpose, and that while the sum gained would have been trifling, the damage and danger would have been great, both to the Company's works and the adjoining villages, and that even now water could not with safety be admitted into the Canal until its banks have been strengthened and revetted.

Paragraph 55.

8. With regard to the Bellary road bridge across the Canal at Kurnool, Colonel Ludlow suggests that the plan of the structure should be re-considered. According to the sanctioned design the bridge will be 25½ feet higher than the bed of the Canal, which is on the same level as the roadway. It must necessarily, therefore, be both inconvenient and unsightly. Colonel Ludlow will be good enough to refer the matter to the Company's Chief Engineer, who will be requested to see whether the modification might not be carried out.

‡ Paragraph 56.

9. It appears‡ that the Hindry Aqueduct as far as it is completed, has been substantially built, and the arches will be turned in separate and independent sections, so that a portion may be completed this season. By this expedient it is anticipated that an ample supply of water will be carried across the Aqueduct next season for all the land lying under that part of the channel below Kurnool which is likely to be completed. The estimate for this work amounts to Rupees 1,45,000; the expenditure up to the end of August was Rupees 77,717, and it is expected that the estimates will be exceeded by Rupees 41,947.

§ Paragraphs 61 and 62.

10. The aggregate excess§ over estimates on the whole of the works between Sunkasala and the Hindry Aqueduct will it is supposed be about 14 per cent., and it is satisfactory to note the opinion recorded by Colonel Ludlow that the excess is by no means large, considering the novelty and magnitude of the works, the scarcity and increasing cost of labor, coupled with the many difficulties which have had to be overcome.

Paragraph 63.

11. The Canal from the Aqueduct in the 18th mile to the Nagatoor tank in the 43rd mile is in different stages of progress, and if as has been proposed to the Chief Engineer one-third in breadth only of the channel be excavated this season, water may be conveyed to the Nagatoor tank and a large extent of land brought under cultivation during next year's freshes. The Canal in the section under notice will be single banked for the most part. Colonel Ludlow states that the water extends over a large area on the upper side where large tanks will be formed, and that Officer is of opinion that in

Paragraph 70.

places where the banks are high and the soil is bad, revetments will be essentially required to ensure their safety, but for this the estimates do not provide. On the question of a single embankment, Colonel Ludlow writes as follows :—"The

Paragraph 71.

"additional risk which the banks will be exposed "to, and the consequent expense of revetting "them due to the adoption of the single bank mode of construction added to the injury inflicted "on the Ryots by the submersion of much rich and valuable land, of which about 6,000 Acres will "be sacrificed, go far in my opinion to counterbalance any advantages to be gained from it."

12. The substitution of a dam for a sunken Canal was advocated and sanctioned chiefly on the ground that it would be less expensive. The objections to it, however, were that a quantity of land would be submerged, the amount being variously estimated by the Engineer and Collector. It appears from Colonel Ludlow's report that the bank by which the water is retained in the Canal has been made of bad materials, of imperfect section and is likely to receive constant damage. The view taken by the Government was* that only so much land should be furnished by them as will be required for the construction of the Canal with double embankments, and that any land required beyond this must be paid for by the Company; but this was not intended to cover such land as the Engineer by a change of plan might submerge unnecessarily. Looking both to the safety of the works and of the people who may live below the banks, the Governor in Council is of opinion that the Company's Engineer should be requested to arrange his plans for the whole of the sections of the work not commenced so as to retain the water of the Canal between two banks, providing of course for the drainage of that part of the country which is below the surface water of the Canal. With reference to the first section where the work has been laid out and commenced in places, the Company's Engineer should be requested to mark off such land as he would consider sufficient to form the Canal with two banks, and the Consulting Engineer will then report as to the competency of the amount required, while the Collector will require the Company's Engineer to compensate the Ryots for any land which may be taken or inundated, in excess of the amount required. There seems no reason why when the Company gains largely by the single bank arrangement, the Government should be called upon to pay for this saving by furnishing an additional quantity of land.

* Proca. 17th March 1862, No. 459.

Paragraphs 72 to 74.

13. The course of the Canal from Nagatoor to the Metacondal cutting has been marked out, but little more has been accomplished, and all that has been done to the cutting is the removal of the earth down to the surface of the rock for about a mile. The estimated rates it is said will prove insufficient. The Metacondal cutting carries the Canal through the water shed into the valley of the Kundaur. No work has yet commenced below the cutting. The estimates for the continuation of the Canal from the cutting to the Caulee Anicut at Jootoor, viz., from the 72nd to the 92nd mile, were sanctioned in Proceedings dated 3rd July 1862, No. 1,555. The suggestion therefore made in paragraph 81 of Colonel Ludlow's report should be communicated to the Company's Chief Engineer. The Canal takes off from the Caulee at Jootoor, and then runs through the Byap Goodoor tank, which Colonel Ludlow recommends should be handed over to the Irrigation Company on their paying annually to

Government a sum equal to the average annual revenue less the cost of repairs. This suggestion* seems worthy of consideration, and will accordingly be referred to the Revenue Department. From the Goodoor tank the Canal will be continued to Nundial, and thence passing along the water shed between the Kundaur and Vykalore, to their junction at the 148th mile near Changalmurry. The course of the Canal up to this point has been finally decided upon.

* Paragraphs 83 and 84.

14. In paragraphs 87 to 110, Colonel Ludlow gives a general outline of the works to be carried out below the 148th mile until the Canal reaches the river Pennar. Of the works comprised within this section of the Canal, two require special notice, viz., the proposed Anicuts across the Kundaur and Pennar. Colonel Ludlow does not consider the immediate construction of the former to be absolutely necessary, and he is of opinion that it is even advisable to defer it until it is known whether the Canal can carry all the water which it receives from above, or not. With regard to the other work, viz., the Anicut across the Pennar at Adamapilly below Komalore, Colonel Ludlow adverts to the question raised as to whether an Anicut or Aqueduct should be built, and he gives the preference to the former. Starting from this Anicut the Canal will be carried in the direction of Cuddapah until it meets the Pennar below its junction with the Booga. The chief difficulties to be overcome are said to begin at this point. The Canal is to be taken along the south bank of the river until it reaches the Somaishweram gorge, an Anicut being constructed across the Pennar near Doongasonne, and another across the same river just above the Cheyaur. Colonel Ludlow explains the manner in which he considers that the very formidable difficulties near Bundalapilly might be overcome, and he then points to the apparently less formidable nature of the obstructions which the north bank of the river presents, and he suggests therefore that the Canal be taken by that bank instead of the south. Colonel Ludlow then advises the expediency of dispensing with the proposed Anicuts at Cheyaur and Doongasonne as well as the upper Anicut at Adamapilly, as being a cumbrous and inefficient mode of completing the navigation, and he shows by what means those works might be avoided. Colonel Ludlow further suggests a careful examination and survey of the north bank of the Pennar with a view to the relative facilities offered by the two banks being ascertained, as also the possibility of dispensing with the Anicuts at Doongasonne and the Cheyaur by adopting that bank. The suggestions specifically adverted to in this paragraph will be referred to the Company's Chief Engineer for consideration.

15. Authority was granted in Proceedings dated 12th November 1862, No. 2,721, for the commencement of the Somaishweram Anicut, and under the views expressed above in regard to the plans for the sections of the Canal not commenced, the Government resolve to return for such revision as they may need, the plans and estimates for works† required between the 92nd to the 103rd mile.

† Consulting Engineer's letter, dated 20th October 1862, No. 74.

(True Extract.)

(Signed.) W. I. BIRDWOOD, Colonel, R. E.,
Secretary to Government.

To the Consulting Engineer for the Irrigation and Canal Company.
„ Agent for do. do.
„ Revenue Department.

Exd. S. T. Augustin.

Rev. 1862 Oct. 24
Pro: of Gov. 57 for Dec.
W. 3350.

Copy in a letter to Engr
dd 12 September 64 No 32
Mil

Proceedings of the Indian
Courts in the Public
Works Dept

Pro. of the Board of
Rev. 2710 April 63
& also 860.

Noted 19th Dec 3 Oct
Received 22nd " 1862.

W. 3045.

Passing orders on
Colonel Ludlow's report
on the state and progress
of the Irrigation Company
works

W. 369 & 370.

W. 2690 - 24 Dec.

With Order

W. 2690.

Communicated to
the Board of Revenue who
will report on the suggestion
referred to in para 13.

From Lt. Genl
24th October 1862
No 1 Copies
To
The Bd of Rev
with Pro. of W. D. 2690.
Dated 24th