

IRRIGATION (GODAVERY, &c.)

RETURN to an Order of the Honourable The House of Commons,
dated 16 March 1853;—for,

COPIES or EXTRACTS of DOCUMENTS referring to the WORKS of IRRIGATION
on the *Godavery River* and *Kistnah Annicut*, in the PRESIDENCY of *Madras*.

East India House,
12 April 1853.

JAMES C. MELVILL,
Secretary.

COPIES or EXTRACTS of DOCUMENTS referring to the WORKS of IRRIGATION
on the *Godavery River* and *Kistnah Annicut*, in the PRESIDENCY of *Madras*.

GODAVERY.

THE Annicut across the Godavery River, for the purpose of irrigating the Rajahmundry district, was first projected by Major Cotton, who submitted a report to the Madras Government, dated the 17th April 1845; the undertaking having received the unqualified approval of Lieut. Colonel Lowe, the chief engineer, was submitted for the favourable consideration and orders of the Court in a despatch from the Madras Government, dated the 1st September 1846, and the Court's orders on the subject were conveyed to the Government in a despatch of the 23d December of the same year.

The land comprising the delta of the Godavery within the Rajahmundry district, is divided by the river into three distinct portions, which may be called the eastern, western and central, containing respectively 450, 700, and 550 square miles; one-fourth being deducted for sundry tracts, roads, channels, sites of villages, &c., leaves fit for cultivation about 800,000 acres.

The irrigated portions of these lands have hitherto derived their supply of water from the local rains, aided by the river.

The Godavery River has its sources in the Ghauts to the north-west of Bombay, near Trimbuck and Nassuck, these being fed by the rains of the never-failing south-west monsoon; it flows down into the Deccan, in passing across which it receives the Manjuvah and other tributary streams, and finally, after a course of upwards of 760 miles, enters the sea by several mouths between Masulipatam and Vizagapatam, on the Coromandel coast. Though the waters of the river itself never fail, the countries through which it passes are periodically more or less visited with drought; this is more especially the case on the Coromandel coast, where, owing to a periodical failure of rains, seasons of famine come round in regular cycles, when we are presented with the anomaly of a large population occupying a delta of about 3,000 square miles of the richest soil in India, suffering from all the horrors of famine, whilst the fertilising streams of the noble river, which a bountiful Providence has furnished for the purpose of preventing such a calamity, are allowed to run to waste into the ocean, instead of being harnessed by human industry, and turned to the purpose for which they were given.

It is to remedy these evils, and to apply the river to its legitimate purpose, that Major Cotton has, with great industry and talent, drawn up his plan of throwing an Annicut across the river, and thus saving part of the waters for the regular irrigation of the delta. The objects, then, to be gained by this work are,—

“First. The preservation of a large population from the constantly recurring scourge of famine.

“Secondly. To check the annual deterioration of the revenue of the Rajahmundry district, which Major Cotton calculates will, under the system hitherto prevailing,

Extracts Report
by Lieut. Colonel
Lowe, Chief
Engineer, dated
31 March 1846.

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prevailing, amount to about 90,000 rupees annually; a calculation from which the collector, in the 21st paragraph of his report, does not dissent.

"Thirdly. To increase the wealth of the population to a vast extent, and by so doing greatly add to the revenues of the state.

"With reference to the plan and sections of the proposed work, everything requisite for strength and permanency has been provided by Major Cotton, and a glance at the sections will show that the water behind the Annicut will command the country to the right and left of the river, and as Major Cotton's plan provides for a system of canals, the farmer will thus have the means of immediately transporting his produce to the market; the plan may altogether be pronounced the most perfect for drawing out the natural resources of a large tract of this country that has ever yet been submitted."

Major A. Cotton,
Report dated
17 April 1845.

Paras. 1 to 7. Referring to his former report, in which he pointed out the neglected state of the district of Rajahmundry, its destitution of artificial works of irrigation, and the results of leaving the land subject to the natural consequences of the great rivers that run through them; taking a general view of the water of the river, and the facilities it offers for works to lead off its waters to the lands, and describing the extent, quality, and state of the lands to be watered.

Para. 8. We thus easily establish these three fundamental points: 1st. That there is an ample supply of water for a rice crop in all the land forming the delta of the Godavery, and as far as the Kistna also, and there is certainly water enough in the river for a very large extent of cultivation, probably not less than 100,000 acres, all through the dry season.

"2d. That there is a vast extent of rich alluvial land, not less than 820,000 acres, within the district of Rajahmundry, and nearly as much in Masulipatam; taking in the whole tract as far as the Kistna, to which the water may be applied.

"3d. That by means of an Annicut of a very moderate height, and main channels only two or four miles in length, the last drop of water in the river may be brought to the surface of the country at a level which will command the whole of the above-mentioned tract.

"4th. We may consider also the practicability of the construction of an Annicut (omitting for the present the question of its cost) fully established by the same thing having been already effected in similar instances in the two Coleroon Annicuts, the difference of such a work standing being decidedly in favour of the Godavery, viz., the velocity of the river being only about three-fourths of that of the Coleroon at its head, which more than compensates for the greater height that is above proposed for this work, the Coleroon Annicuts having been only six-and-a-half and eight feet high.

"9. There seems no possible room for doubt on these fundamental points, and we may therefore proceed at once to consider the remaining questions which appear to me, first, whether any evil can arise out of such a work as a dam across the Godavery, and, secondly, what the cost and returns would be.

"10. The Annicut will be situated similarly to the lower Coleroon Annicut, extending quite across the river; its only effect, therefore, must be to raise the water in the river above it; but it will not raise it to the same extent, owing to the very low velocity of the river. If it be built at the site I propose, and 17 feet high above the deep channel of the river, it will close up about 2-7ths of the whole water-way of the river in high floods, which, at so low a velocity as three and a half miles per hour, would scarcely cause a perceptible elevation of the surface of the water above it.

"11. When the water in the channel of the river below the Annicut is just level with the top of that work, I calculate that the upper water will be raised to about one and a half foot above the crown, and this difference of level between the water above and that below the work must of course diminish as the river rises, and in severe floods the difference of level will be reduced to two inches. With respect to its effect on the bed of the river, the ordinary effect of such works is, of course, to raise the lands on the upper side, and to produce deep excavations on the lower. The former is a very serious evil, and, unless counteracted, the tendency will be to fill the irrigation channels with sand. The principal means

proposed

proposed to prevent this, is the construction of six ranges of under sluices, of 40 vents each, their flood level with the apron of the Annicut, and eight feet below its crown; four of these to be placed near the heads of the irrigating channels, and the whole of them left open whenever there is water in the river to spare. The influx of sand into the channels will be further checked by leading them off at right angles with the river, and as much out of the set of its current as possible, and also by making the heads of the channels capacious, so that the water may enter them with too low a velocity to carry much sand with it. The other effect of the excavation of deep pools below the works affects only the stability of the work itself. The operation is greatly checked by the section given to the work, similar to those in the Coleroon; by making the body of the work nearly perpendicular on the lower side, and laying an apron sufficiently strong to bear the over-fall of the water, its force is so greatly broken, that but little effect is produced in the bed of the river below; and the remainder is counteracted by an ample apron of loose stones of large size beyond the solid apron, which must always be the grand protection of such works as sluices and Annicuts in a delta where there is nothing more solid than sand around and beneath the works.

* Paras. 12 and 13 relate to the effect of the proposed works in obstructing the navigation of the river, and the means for providing against or lessening the evil.

Para. 14. (Extract.) "The main question now remains to be considered; viz., whether the cost of the works will be repaid in their effect upon the district? The estimate for the works now proposed, viz., an Annicut, the head sluices for two main irrigating channels, viz., one on the west side of the river, and one at the head of the central tract (the upper part of which is called the Rallee Estate), locks at each end for passing boats round the Annicut, and those for carrying them past the head sluices into the irrigating channels (which is all that is included in the present estimate), amounts to—

	Rs.	a.
Annicut, with six sets of 40 under-sluices	3,88,004	2
Five locks	18,419	6
Two head sluices	13,148	8
Excavations	4,000	-
Superintendence	12,000	-
Contingencies, &c.	30,000	-
TOTAL	Rs. 4,75,572	-

"This sum is very small, whether the magnitude of the work or that of the expected results is considered. The length of the Annicut will be 4,200 yards; and it will be seen by the plans that I propose to build it on a substantial and permanent plan, so as to be nearly independent of periodical repairs.

"Para. 15. Taking the cost at four lacs and three-quarters of rupees, we ought to consider that if there be a fair prospect of a return of 30 per cent., or 1,42,500 rupees, in direct revenue, besides the benefits to be derived by the inhabitants, there is more than ample ground to justify the construction of the works. One-third of this would be considered most abundant in England; and if it yielded only five per cent., or 23,750 rupees, it would pay the Indian interest of the cost, and the benefits obtained by the ryots would be a clear advantage.

"Para. 16. The results of the Annicut may be properly divided into two heads; viz., the ultimate results, when, by means of additional channels of irrigation, drainage, &c., the water is led to the whole of the lands commanded by the Annicut; and, second, the immediate results of the works now estimated for throwing water into the present channels, which will probably be realised to a great extent in the first year. First, we are to examine into the probable ultimate effects of the Annicut.

"It is evident that as the crown of that work will command the whole delta, there can be no possible reason why every acre of it should not be perfectly irrigated for one crop; that is, during the four months the freshes continue;

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and that all the best lands, to the extent that the Godavery can supply water, may be irrigated all the year round. We have, therefore, to consider the extent and present produce of these lands. The water from the Annicut may, of course, be conveyed all the way to the Kistna, and it must necessarily affect all the country below the Colair Lake; but it does not seem necessary here for me to go beyond the part of the delta lying in Rajahmundry."

Paras. 16 to 20 give detailed statements of the extent of revenue, the permanent assessment of the land, the average assessment throughout the delta, and various calculations under different modes of assessment.

Paras. 21 to 30 advert to the supposed advantages of the district for sugar-cultivation.

" Para. 31. We have thus, in a most palpable shape, a fair opening for an increase of revenue to the extent of 20 lacs, and of produce to the extent of 124 lacs in the lands only that are in the hands of Government. If it be asked how is this great sum of money to be obtained, the answer is by simply converting the water of the Godavery into money, instead of letting it run into the sea. At this moment water is paid for by the sugar-growers at about one rupee for 800 cubic yards, the cost of raising it by peccottahs. There are now about 420,000 cubic yards of water per hour flowing into the sea, worth, at the rate at which it is now actually and profitably purchased, 500 rupees per hour, or 12,000 per day, which for 240 days (the portion of the year in which the district is not supplied at all) gives 28,80,000 rupees. The water, if applied to the land, would be worth to the cultivators, full 50 lacs. This whole of this is at present lost. Through the remainder of the year, that is during the cultivation of the great crop, about four times this quantity of one and three-quarter million cubic yards per hour are allowed to flow into the sea that might be profitably applied to the land, and in this way it may be understood by anybody, how easily 100 lacs a year may be lost. That some such amount is actually lost just for a want of proper care of the district, is shown in such a way that the conclusion is inevitable by the actual state of Tanjore. The only question is, what expenditure is required to give us the full benefit of our natural advantages. I have before estimated it roughly at 16½ lacs, and the further examination of the district that I have since made, has given me a more favourable view of the case than I before had. It has several facilities that I had not calculated upon, especially in respect to the site of the Annicut, which I thought would be 20 miles further up the river. The site now proposed being at the head of the delta, will save the conveyance of the water 20 miles, and the construction of an aqueduct to carry the water to the central tract.

" 32. My rough estimate for the whole of the works required to put the delta in good order, is now as follows:—

	<i>Lacs.</i>
" Present estimate for the Annicut, with its locks, sluices, &c.	5
" Embankments to the river	1
" Irrigation channels	2
" Drainage works	1
" Sluices, locks, and other small works of masonry	1
" Roads and bridges	2
" TOTAL Lacs	12

" Para. 33. This expenditure may appear as absurdly small as the estimate of the capabilities of the district appear large, but it is also very well supported by the case of Tanjore, if the circumstances of the two districts are considered. In my former report I calculated the total expenditure on improvements in Tanjore at 16 lacs in 40 years, during which time the revenue had risen 16 lacs; but here we have, in the first place, the prodigious advantages of the experience gained from all that has been done in Tanjore; and secondly, what has been done piecemeal, while here, we can make the improvements on one complete plan, which will make a very great difference. The cost of labour is also lower here, and materials are much cheaper."

Paras. 34 to 37 contain a comparison of the revenue collections in Tanjore and

and Rajahmundry from 1801 to 1843, with statistical statements and remarks thereon.

" Para. 38. Thus we have on the one hand the estimate of the produce that the land of the district is capable of, when properly irrigated, taken from a portion of the district itself; and on the other, most extraordinary results actually realised from works, similar to those now proposed here, already executed in another delta. How we could possibly have stronger grounds for proceeding boldly with the projects now under consideration, I cannot imagine; and it must be remembered that all the above calculations include only 17,000 square miles in the Rajahmundry district, and omit entirely 1,300 square miles in the Masulipatam zillah, which would be commanded by the Annicut, and of which 300 square miles on the east side of the Colair lake, and as much round that lake, must be immediately benefited prodigiously by this work, the present channels terminating in that reservoir. The bed of the Colair, which is now lost to cultivation from its being used as a reservoir, and which contains about 160 square miles, capable of bearing a population of 7,000, and yielding a revenue of three lacs of rupees, would be made available as arable land, if a regular and constant supply of water were thus procurable from the Godavery, unless I have been misinformed as to the quality of the soil."

Paras. 39 to 54 refer to the results of irrigation in the South Arcot district, and anticipated advantages to Rajahmundry deduced therefrom in reference to the projected Annicut.

" 54. Upon the due consideration of these calculations and statements, surely there cannot be a doubt as to the results of the construction of an Annicut, considered separately from the other works which the delta requires. Estimating it to cost 480,000 rupees, it seems certain that within a very few years it would yield at least 2½ lacs, or 50 per cent.; and that when the sugar cultivation had extended considerably, 100 per cent. would be by no means an improbable return; and when to this we add the immense change it would make in the circumstances of the people, there seems to be no possible room for doubt as to the advantages derived from such a work being such as to counterbalance the outlay several times over. Take the case of one single year of famine, and consider the dreadful amount of suffering which it involves, to say nothing of the lasting injury to the revenue, which is the certain consequence of it, and the incalculable blessing that an Annicut would be to the district may be well imagined. That such a thing as a famine in any of the districts near to Godavery should ever take place, is indeed the deepest reproach to us. The consideration that such a time has been, and that it will inevitably occur again within a few years if an Annicut is not built, ought alone to be sufficient to induce us to build one, even if there were no returns in ordinary years. This work would not only secure this district from famine, but would necessarily much mitigate it in the neighbouring districts. Indeed it would effectually secure the whole of these Circars from the fearful extremities of starvation to which some of them have been exposed so lately. Had this work been in existence during the last 20 years, undoubtedly more than 100,000 lives would have been saved by it. In 1836-37 there was so great a failure of the north-east monsoon, and consequently of the crop throughout the whole of the southern districts around Tanjore, that there was a scarcity approaching to a famine, and if it had not been for the Coleroon Annicut, which had been built the same year, and without which a large portion of the main crop in Tanjore also would have been lost, that district, instead of having a large surplus with which it supplied the surrounding country, would itself have had to import grain, and have thus incalculably increased the distress.

Extract.

" 55. It is impossible to calculate what the benefit thus arising from the construction of the Annicut was in the very year in which it was built. I may here also mention how fully the estimated effects upon the revenue from the Coleroon Annicuts have been realised, as it would tend greatly to encourage us to hope that the estimate made from the present state of things in this district will prove equally correct."

Paras. 55 and 56 show the results from irrigation in Tanjore.

" Para. 57. In the present case, we may confidently estimate that the Annicut now estimated, with some trifling sums for small channels, will within a year after its completion produce an increase of one lac, and that by the tenth year there will be an increase of five lacs, or cent. per cent. on the outlay.

" 58. Upon the whole, therefore, we may consider the Annicut as—

" 1st. Laying the foundation for the complete irrigation for a rice crop of the whole delta of the Godavery, and part of that of the Kistna, in all 3,000 square miles, or nearly 2,000,000 of acres.

" 2d. Providing for leading out on the land of every drop of water of the Godavery in the low freshes, and thus making use of what is now totally lost.

" 3d. Opening the way for the conversion of the delta from a mere grain district to a sugar plantation.

" 4th. Thus the produce of this tract, which at present probably does not exceed 3,000,000, would, when full advantage is taken of the water thus distributed over it, be increased to at least 200 lacs.

" 5th. This tract, which now pays with great difficulty about 22 lacs, would then with great ease pay 50 or 60 lacs.

" 6th. A complete system of internal irrigation intersecting the whole delta would be established throughout the year.

" 7th. Every village would be furnished with a stream of pure water for the people and cattle at all seasons.

" 8th. The present estimate provides for the full irrigation of all the tracts at present partially irrigated by the principal channels of the Godavery.

" 9th. It will give us at once the use of a large portion (about one-third) of the water of the low freshes during the whole summer, thus providing for sugar cultivation to the extent of about 30,000 acres.

" 10th. It will give a constant supply of water to these tracts, which, like Tanookoo Talook, are situated near the present channel, but which receive no benefit from them at all.

" 11th. It will put a famine in this or the neighbouring districts out of the range of probability.

" 12th. It will provide immediately two or three most important lines of water communications from Rajahmundry through the heart of the delta to the sea, available at all seasons.

" 13th. It will have the important effect of showing to the people what can be done for them. At present they have no idea of the water being thrown into the channels during the summer; and from the first moment that water is seen passing through any villages in the low freshes, the whole people of the delta will be awakened to its great capabilities, and will be prepared to welcome the opening of channels throughout the whole tract, and to extend the cultivation of the sugar and other things which are at present limited by the want of water.

" 14th. It may be estimated to yield one lac of rupees, or 20 per cent. on the outlay, in the first year, and at least five lacs, or cent. per cent., within 10 years. This is much less than the new works in Tanjore yielded under circumstances which did not offer anything like the advantages that the state and capabilities of this district hold out.

" 15th. But it seems to me that the most important point of all in the present state of this district is its capabilities as a sugar plantation, and the Annicut will immediately provide for the most unlimited extension of that culture. When this work is executed, there will not remain a single obstacle to this most valuable plant becoming the main produce of this district. Water would be provided for at least 3,000 pooties, producing with the Indian cane sugar of the value of 1,300 rupees per pooty, and with Mauritius cane, if I am rightly informed, double that sum, while grain produce is worth only 120 rupees per pooty.

" 59. Upon

"59. Upon the whole, we have in this case almost everything that the most timid could desire to encourage us to prosecute the undertaking: on the one hand, the most perfect success and almost unprecedented results from precisely similar works in Tanjore, and, on the other, immediate returns for what has already been done in this district, more than ten times as great as would have been an ample return for the expenditure." Added to this, we have a product which can be raised here probably at one-fourth the cost that it can be produced in the countries from which it is at present chiefly obtained. Both the culture and manufacture have been fully tried, and nothing is wanting but that the water which flows perpetually through the district should be applied to the lands, and this can be done at a cost which, compared with the object in view, is most insignificant. What this district may become if this matter be taken in hand with only a small part of the energy it deserves, it is not easy to conceive. The unfailing river, an immense expanse of the richest soil, a safe and accessible port, a complete internal water communication with teak forests, a climate and soil perfectly suited for sugar, and abundance of labour at only $1\frac{1}{2}$ d. a day, form such a contribution of advantages as, I suppose, cannot be found in the world, and certainly not under such a Government as ours. The climate being quite healthy and free from excessive heat all along the seaboard, also opens it so fully to the establishment of sugar works under European superintendence; its situation too, between the two great ports of Madras and Calcutta, makes it very convenient for commercial undertakings."

"60. I conclude this Report without entering upon many points which might be considered, because it does not seem desirable to make it too long. I believe all the important points have been examined, and that much more than enough is stated to establish the importance of the proposed works. I do not attempt to answer the objections that will of course be started in this case, as there were when the Tanjore works were proposed; but I have fully satisfied myself that no objection can be preferred that has not been fully answered already by the results in that district, or which cannot be easily answered on sound grounds. So far as the objections to those works were made known to me, and I was allowed an opportunity to answer them, there was no difficulty in showing their futility; those which were withheld from me, so that I could not refute them at the time, have since been answered by the works themselves.

"61. It will be evident that the future progress of this district depends above everything upon the means which may be provided for the sugar culture, and that it is hardly possible for the Government to take too decided measures for promoting this most valuable cultivation. The providing water is, of course, the first thing, but it is very possible that many minor means might be employed which would have an important influence in the matter: An ample supply of the Mauritius cane, which the ryots are anxious to substitute for the common kind, and which thrives well; the collection of the whole of the rent of the land after the crop is secured, or the institution of custom duties at the place of exportation for the greater part of the rent, so as to diminish as far as possible the capital required for the culture, and force the ryots from the interference of the Government servants and of the money-lenders; a lower assessment for the first year upon the lands cultivated with Mauritius cane.

"These are some of the means which would tend to forward the culture, if upon consideration they appeared to be admissible on other grounds. The subject deserves the most careful examination; and upon the means that may be used will depend in a great degree the rapidity with which the works now recommended will produce the results which they are calculated to yield.

"62. I will only add the following remarks:—

"1st. With respect to the estimated cost of the works now proposed, viz., 4½ lacs; that it provides for a solid and permanent work, and that the prices allowed are those at which such works can now be executed, without allowing for many reductions that may confidently be expected; if subordinate European superintendence is made use of, a sum of 30,000 rupees, or 6½ per cent., is allowed for sundries and contingencies; if it should be considered that in dealing with so large a river this is not sufficient, any additional sum might be sanctioned, though I think we have no right to calculate upon contingencies which would require a

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larger per-centage than this. Both the Coleroon Annicuts, and, I believe, every one of the subordinate works of any consequence, were executed under the estimated amount.

"2d. With respect to the estimated returns, I have given a statement of the lands, their present collected revenue, the permanent assessment, &c., from which any person may form their own judgment of the probable effects of these works; I think they must fully support any expectation that they will yield 100 per cent. on the outlay, and this also is abundantly supported by the actual returns in Tanjore, which have already much exceeded that per-centage, though under circumstances much less favourable than those of Rajahmundry.

"3d. The sum for which sanction is now requested being the cost of the Annicut and subordinate works for keeping the present channels supplied, is 4½ lacs; the remaining works necessary for the completion of the irrigation, navigation, embanking and roads of the delta within Rajahmundry, is roughly estimated at 7 lacs; this does not include the detailed works that would be required in the Masulipatam district, if it should be determined to extend the channels as far as the Kistna. If this further tract of country should be in the same manner provided with such works, I have no doubt that returns little short of 100 per cent. would be obtained there also."

Report by Lieut.-
Colonel Lowe,
Chief Engineer,
dated 8 June 1847.

"Para. 1. Major Cotton having ascertained after much inquiry that the number of stone-cutters procurable for constructing the proposed Annicut across the Godavery River, are not sufficient to carry forward a work of such magnitude with any prospect of its being completed in a reasonable time, and that consequently the several European officers, as well as the large establishment under them, will be detained from other services much longer than is desirable, and also that revenue to the amount of several lacs will be lost, it becomes necessary to substitute a mode of construction which will avoid these evils.

"Para. 2. In proposing such a new mode of construction, the chief points to be considered are, that it may be equally desirable, and at the same time that it will not involve a greater expenditure than the one originally proposed; if this can be effected, it is evident that nothing will be lost, and I am of opinion that not only this can be done, but that also a mode of structure may be substituted, superior to that originally intended.

"Para. 3. The form of the section in Major Cotton's original plan is that of an elevated mound of masonry, broader at the base than at the summit, over which the accumulated waters of the river rush and fall perpendicularly on a platform on the opposite side; the surface of this platform is formed of large rectangular slabs of granite or other hard stone, smoothed at top and carefully dressed in the joints, the whole being built upon masonry wells sunk in the bed of the river; this construction is similar to those across the Cavery, and, although usual in this country, is not the best.

"Para. 6. In the new weirs proposed for the improvement of the River Shannon, the section is so constructed that there is no fall whatever of any body of water, the down stream side being built concave, and having a slope from its summit to its lower extremity, down which the water rushes till it reaches the level of the river's bed: under the foundation of the extremity of the slope, a row of piling is driven, and the face or surface of this section is composed of large rough stones built in regular stages, their ends being placed outwards, and their lengths or joints perpendicular to the curve. In this form of Annicut the wear and tear is reduced to the lowest amount possible, and the structure seems incapable of any further improvement, it being as strong as possible; I am therefore of opinion that if such a section be substituted in the Rajahmundry Annicut, not only will all the evils of an unnecessary delay be avoided, but also the stability of the work will be increased."

Report by Major
A. Cotton, dated
18 August 1847.
Extract.

"Upon the whole, I think we must consider the works to have gone on well, considering our circumstances. Our principal difficulty has been, and is, the keeping the people to their work; there has been very considerable waste in some part of the operations, especially in the embankment, from their idling, it being almost impossible to find a peon who is not more idle than the men he is superintending; but as this has arisen mainly from the great numbers of people employed before we had sufficient superintendence, and from things being at first
in

in disorder, compared with the state we may hope to get them into after a time, we may hope that in this respect, also, there will be nothing to complain of, particularly with the additional European superintendence that we shall now have.

"That we have made the progress that we have, is entirely owing, under God, to the sub-collector, whose vigorous and active measures have already roused the district to a degree that could not have been expected; and it may be said, indeed, that as respects the getting public and private improvements effected, the district is 10 years in advance of what it was a few months ago. The people have come freely from all parts of the district, and both they and the native public servants now fully understand that great improvements can be effected. The actual use of the Godavery water from the new channel, as far as Samulcottah, over an entirely new tract, has also no doubt helped to enable the people to realise the practicability of improving the state of the district.

"With respect to the estimate, as we have not yet trenched upon some of the largest items, I cannot speak confidently, but so far as we have gone, I think there has been a fair result for the money expended. It will be seen from the detailed estimate contained in the statement now forwarded, that about one and a half lacs of rupees will be laid out in railways, boats, buildings, machinery, &c., all which will be of use in the execution of the remaining works included in the estimate of 12 lacs."

This Report furnishes particulars of the progress of the Annicut, states that from various causes the expenditure had so greatly exceeded the estimate, that the original amount sanctioned by the Court in December 1848, viz., 4,75,752 rupees, had already been expended, although the works were even less than half finished, and that a further sum of 1,39,100 rupees was required.

Report, Major
A. Cotton, dated
June 1848.

The Madras Government, in a despatch dated the 8th July 1848, solicited the Court's further orders on the subject, observing, "That the civil engineer has not sufficient data in the present state of the works for estimating the ultimate expenditure; and we are inclined to believe that a larger sum than that now estimated will be required to bring them to completion."

The Court, in a despatch dated the 20th September in the same year, confirmed this supplementary estimate, bringing the total amount sanctioned for this work to 614,852 rupees.

"I have the honour to transmit the required plan and sections of the line of the main irrigating channel, leading from the Annicut down the central tract of delta. The sections on which Major Cotton's estimate was founded having been discovered to be incorrect, a true section of the line was made, and in accordance with it, it became necessary to frame a fresh estimate, which amounting to Rs. 34,013 11. 9., I now beg to submit it, with a request that it may be substituted for that transmitted by Major Cotton. The work proposed to be done under either of these estimates being only a portion of that required to excavate the Rallee channel, of a sufficient capacity to supply the tract of land under its influence, I have thought it advisable, having accomplished so little this last year, and having a whole working season before us, at once to submit such an estimate as will afford employment to all who will contribute labour, and enable the country to derive some benefit next year from what shall have been done. In support of my proceeding, I beg to call the attention of the Board to the 5th para. of Major Cotton's letter, No. 108, accompanying the original estimate, wherein he points out strongly the advantages and conveniences of having a work of this kind on hand, to afford the villagers living near the line of the channel and the tank diggers who have been collected near the Annicut, the means of employment when cultivation does not demand the whole attention of the former, or when there is no work at the Annicut for the latter.

Letter from
Captain Orr, dated
28 August 1848.
Extract.

"The advantages of channel irrigation from a river such as this is, not affected by the local influence of the monsoon, requires no exemplification; but I cannot let this opportunity pass without mentioning the invaluable benefits being now conferred on portions of this district by the channels already existing, particularly by the Thooliah Bogah, and new channels, by means of which, while other parts of the country are suffering from a very deficient monsoon, the lands under these channels have had a most abundant supply of water distributed to them during the whole of the last fortnight; and even while I write, though the fresh has been subsiding for four days, there is still 9 feet of water going through the head sluice."

Letter from
Captain Orr, dated
16 September
1848.

The next report is from Captain Orr, dated the 16th September 1848, in which he submits an estimate of the probable expense of completing the Annicut, amounting to Rs. 3,56,376. 8. ; explains various alterations in the details of the original plan, and his intended course of proceeding during the next two years, and then proceeds: "In this manner two years would be fully employed; and I have thus entered into detail that the insuperable obstacles which must oppose any attempt at a too speedy progress may be readily understood. These obstacles consist principally of the great difficulty, till the working season is far advanced, of disposing of the large body of water coming down the river, and of so managing it, that there shall always be enough for the purpose of navigation, while at the same time the stream must be diverted from the neighbourhood of the building operations, and the water drained from the foundations. From the nature of the river, and the great extent of the Annicut, the only means of overcoming these obstacles and attaining the desired objects, are by the formation, at much expense and loss of time, of large temporary dams above, and by the excavation of drainage canals below the site of the work, which operations are so dependent upon the state of the river, that no amount of expenditure alone will hasten them many days. There is, also, if too much be undertaken, the uncertainty of being able to transport daily a sufficient quantity of stone to complete the work in due time, although this year we shall have greatly augmented means of transport by boats, and have more use of steam power.

"An objection may be made to leaving at the end of the season some parts of the Annicut higher than others, as likely to throw a dangerous body of water over the lower portions; but, from the experience gained this year, I do not look upon that circumstance as being of much importance. Across the two divisions of the western branch, the Annicut will be of the same height of 11 feet, and across the two divisions of the eastern branch it may also be left with safety, I think, of an equal level of 9 feet, though probably it will be advisable at the close of the season to lower the Rallee rough stone dam one foot or so, to relieve the fall over the masonry at the Dowlaisuram side.

"By carrying on the works as I have proposed, full use of the Annicut will be obtained next year during the monsoon months, which is the only season, I imagine, when any cultivation will be carried on for some time, till the people become accustomed to having a regular supply of summer water.

"Three locks only, to provide for the navigation of the three main channels, as Major Cotton laid down the works, are allowed for in my estimate; but eventually it will be necessary, I think, to avoid interrupting the navigation of the river, to construct two more locks, one on Dowlaiswaram branch, and the other near Vijaiswaram.

"Having endeavoured to explain the nature and difficulties of the undertaking, I may be permitted to add, that there can be no doubt as to the practicability of constructing the Annicut, and that time and money alone are required to complete this great work, which, when finished, will confer such inestimable benefits upon these districts, by securing them from the vicissitudes of the seasons; and while giving wealth and comfort to the people, insuring to the state a certain and great increase of revenue most favourably disproportioned to the amount required to be expended."

This report is followed by one from a Committee appointed in obedience to the Court's orders, to examine and report on the actual condition of the Godavery works; and the plans proposed to be pursued for completing them. The Committee's report, which is dated the 3d January 1849, is divided into several heads, and enters into much detail on the "State of the Works," "Apparatus for carrying on the Works," "Past Expenditure," "Machinery, &c." In reference to the "Plans of the Works," it is remarked:—

"With regard to the most important point, the section of the Annicut, the Committee, after a minute consideration of the subject, are satisfied that the work may be carried forward with safety and success upon the section hitherto followed, with some improvements recommended by Captain Orr.

"The section is novel; and considering its adaptation to the description of available material, and to the necessity of rapid construction, appears to the Committee highly creditable alike to the theoretic and practical knowledge of Major Cotton. Its stability, they conceive, has been remarkably demonstrated by

by the events of the last season ; all the works that were not actually raw, having, though much of it was hastily constructed, suffered but little damage under even extraordinary trials. The excellence of the mortar made from the hydraulic lime of the neighbourhood, is an important element of the stability of the works ; and the experience already obtained in the management of this lime will render it more valuable for the future.

"The only change in the section which the Committee recommend, is a narrow wall (as originally intended by Major Cotton) in lieu of the stones and boards afterwards suggested. The latter are open to several objections ; and the Committee are of opinion, that the increased breadth of the loose stone apron will neutralise any extra force of overfall caused by the proposed wall."

Under the head "Estimate" they enter upon a consideration both of the original and supplemental estimates, and report the amount requiring sanction to be 4,07,506 rupees. The Committee afterwards remark, "It is scarcely necessary to add, that time itself in the construction of the Annicut is money. If the work is to increase the revenue, the sooner the increase begins the better ; if the increase has been in any measure rightly estimated, it will speedily pay a much larger interest upon the extra expenditure than the rate at which the Company borrow money, and a single year of drought, which may happen at any time, would compel all to acknowledge the Annicut to be of incalculable value.

"The Committee, reviewing their inspections and investigations, are constrained to record their very high opinion of the science, practical ability, and indefatigable labours of Major Cotton, displayed in the great work under report. It is scarcely possible to place that officer's qualifications as an engineer of hydraulic works higher than they stood before ; but the Godavery Annicut is a new and splendid illustration of the powers of mind and self devotion, from the exercise of which the country has already so largely benefited."

"The Committee, in submitting their report, beg leave to add their recommendation that the works may be prosecuted with all possible diligence, and that the opening of the Rallee and other irrigating channels required to extend to all parts of the district the benefit of the Annicut may also receive early sanction."

This report having been submitted to the Court by the Madras Government, in a despatch dated the 13th February 1849, the Court, in a despatch dated the 18th July following, gave their sanction to the further outlay required, "making an aggregate expenditure of 9,11,209 rupees, or 4,35,639 rupees in excess of the sum originally sanctioned for that purpose."

Given in For.
Paper, "Public
Works, India,"
622 of 1851, page
214.

"At the beginning of February, everything being in a state of preparation, no time was lost, after the receipt of authority for increasing the vote of expenditure, in resuming operations on an extensive scale, and by the middle of that month the works were all in full progress. Very satisfactory advancement has since been made, considering that, as a preliminary to building in the bed of the river, we have had to execute what is certainly the most difficult and most discouraging branch of our labour, and that which caused so much anxiety to Major Cotton, and so much expense and delay to the work last year ; namely, the construction of large temporary dams and canals, to keep the river from the portions of its bed to be built across, and to give command of water-carriage for the transport of materials. These dams have been completed with comparative facility, and the river now, at the same time that it is held back from the line of masonry, is kept at such a level as to afford a perfect means of water communication direct from the end of the railway to the wing walls at the Vijaiswaram side."

Report of Captain
Orr, dated 5 April
1849. Extract.

"3. Any one acquainted with the power of a large body of water like that contained in the bed of this river, will appreciate the difficulty, labour, and expense involved in the construction of these dams, but by those unacquainted with the subject, little idea can be formed but by personal inspection of the obstacle to our progress, which the necessity of the formation of these dams presents. To give, however, an impression of the magnitude of these operations, I may mention that the dam across the Vijaiswaram branch contains from 40,000 to 50,000 cubic yards of sand, all carried a considerable distance ; is three-quarters of a mile in length ; is rivetted throughout both sides with rollers of grass ; and that it could only be formed after a strong dam of sand, grass, and stone had been thrown with much labour across one main branch of the river two miles above.

"4. The uses of these dams and channels are however obvious, and the necessity of their formation was foreseen and mentioned in the report accompanying my supplemental estimate. I merely recur to them, that the Board may be aware of the extent of the work we have performed, which, though indispensable, does not appear in a statement of progress, and that it may perceive the causes of an expenditure, which though not explicitly calculated nor valued in my estimate, has been incurred at the very beginning of our proceedings, thereby raising the cost of work already done beyond what may seem a fair proportion. The cost of the dams and channels, and other charges which are now not covered by work performed, ought to be distributed over the whole of this year's work, when I hope it will be found that the equilibrium between the estimated and actual cost of work performed will be nearly restored without trenching far upon the allowance for sundries.

Letter from Lieut.-
Colonel A. Cotton,
dated 12 December
1850.

"In the report that I hope soon to forward, there are many additional proofs of the great value of water here besides those contained in my former reports. I am happy to say that the Annicut is in effective operation, so far as the channels are opened, and that they have now had water in them without intermission for six months, instead of for 20 or 30 days only, as formerly; and I hope the work of this year will not require us to lower the water in the river much, so that the channels will be supplied throughout the dry season for the first time.

"I am in hopes that within two or three weeks the eastern main channel will be opened, and the centre one in the course of two months. There will then be water in five lines of channels during the hot season, and thus each part of the delta will have proof of the effects of the Annicut.

"I am happy to state that, from whatever causes, the district is prospering beyond all my expectations. The accompanying statement will show that, deducting our large expenditure during the last four years, amounting to 11 lacs, the net revenue has greatly exceeded the average of years previous; the excess in the last year but one is no less than 1,95,000 rupees; that of the last would have been more but for the destructive flood of last September. The causes to which I attribute this extraordinary improvement are, the large expenditure by the Government and the sugar manufacturers, the extension of the irrigation, and the increase of exports under a vigorous revenue management. The eagerness with which the water has been received in the villages newly watered, and the rapid increase of revenue from them, are conclusive proofs of the vast effect which the Annicut may be expected to produce when the distribution of the water is more advanced. The villages under the Samulcottah channel have, in the fifth year from the commencement of that work, yielded an increase of revenue of 104 per cent. upon the average of previous collections, and of nearly 100 per cent. upon the outlay, though nothing has been done but to cut the channel and build sluices. There has not yet been an officer available to look into the details of the irrigation, and some of the villages have yet, I believe, received no water; what has been done in the way of distribution, has been entirely by the ryots themselves without assistance. The increase in the other villages of these talooks has been 40 per cent. during the same period, so that, though the district generally has, from the great expenditure, &c., greatly improved, the water has caused an increase above that of 60 per cent. I mention these facts in order that it may be seen, that though the Annicut will have cost so much more than I anticipated, yet, at the same time, we have every possible encouragement to expect, that whatever the total outlay on the whole set of works may be, the returns will be far more than amply sufficient to justify it. It is particularly to be observed, that as yet no land has received summer water, so that the more valuable cultivation, the sugar plantations, cotton, &c., have not yet been the least affected by the works."

In connexion with the Annicut, and in furtherance of the great scheme of artificial irrigation, of which the Annicut is the basis, sanction has been given to two projects for the irrigation of the right and left banks of the Godavery, at an estimated expenditure of 1,38,646 rupees and 1,76,357 rupees respectively. These projects consist of a system of channels taken off from the great ducts, with the usual auxiliary works of masonry, and were considered indispensably necessary to the full development of the benefits anticipated from the original undertaking.

Besides the expenditure in these subsidiary works, large sums have been sanctioned, from time to time, during the progress of the Annicut as "ordinary repairs."

ON THE GODAVERY AND KISTNA RIVERS.

13

repairs." By a statement received with a letter from the Madras Government, dated 22d February 1853, it appears that the sums sanctioned for the Godavery works, from the commencement to the 4th December 1852, are as follows; viz.,—

	Rs.
For the Annicut - - - - -	8,83,258
For the subsidiary works - - - - -	5,81,900
	Rs. 14,65,158
Ordinary estimate for the repairs of the works con- nected with the Annicut since their completion -	51,918
	Total Rs. - 15,17,076

An additional sum of 17,876 rupees has since (on the 8th January 1853) been sanctioned for erecting a new lock at Vyjeeswarum, making a total for these works of 15,34,952 rupees. The Madras Government, in the letter dated 22d February 1853 (received on the 7th instant), state that they "have resolved, with the view of arriving at a correct conclusion on the subject, to call for further and full particulars as to the number of works or projects subsidiary to the Annicut in hand, the outlay on each of them to the present period, and the estimated cost to complete each project; with other particulars, as the extent of land brought for the first time under irrigation by those works, and the means and capabilities of the ryots to take up this land and bring it under profitable culture, with the total contemplated outlay in the district."

THE COLAIR LAKE.

In connexion with the works of irrigation by means of the Godavery Annicut, was the project for draining a large tract of land to the east of Colair Lake, in the district of Masulipatam. This tract is described as at present "flooded by the waters of the Weyairoo and those of the Tumulairoo and Boodamair, below the Colair." "Nothing of any importance" (continues Colonel Cotton) "has ever been done for relieving it from the vast body of water brought down to it from the extensive basins which drain to it. It is more than usually exposed to both the evils of drought and flooding. On the one hand, the rivers that supply it, rising within 70 miles of the coast, fail when the local rains do; on the other hand, when the rains are general, the floods in them have hitherto concurred with the floods of the Kistnah and Godavery, and a vast accumulation of water has thus been brought over this tract, where the two basins meet. Something, however, has been done of late years, both in respect of the drought and the floods, so far as the Kistnah and Godavery are concerned. To remedy the former, additional water has been thrown into this tract from both rivers, by improving the channels that have been cut from them into the Boodamair and Weyairoo, so as to lead water from them often when the local rains are scanty. Again, the overflow from the Godavery used to be immense in heavy freshes, the flood passing over the bank of the river for many continuous miles, and pouring into the valley of the Weyairoo. The heads of the channels leading from the river into the Weyairoo were also without head sluices (excepting the Boopiah), so that they often conveyed a large body of water into this tract, when the local rains were excessive, from there being no means of closing the heads of those channels. This has now been corrected, a high and strong bank has been carried all along that side of the Godavery, and no water is admitted but through the sluices (excepting one channel yet open), which can be shut when necessary. The floods of the Kistnah, however, are not yet restrained completely.

Colonel A. Cotton's
Report, dated
23 August 1851.

"So far as the irrigation is concerned, an ample supply of water can now be led from the Godavery Annicut to this tract at all times. It remains, therefore, to provide for the floods to which it is exposed from the Weyairoo, Tumulairoo, and Boodamair.

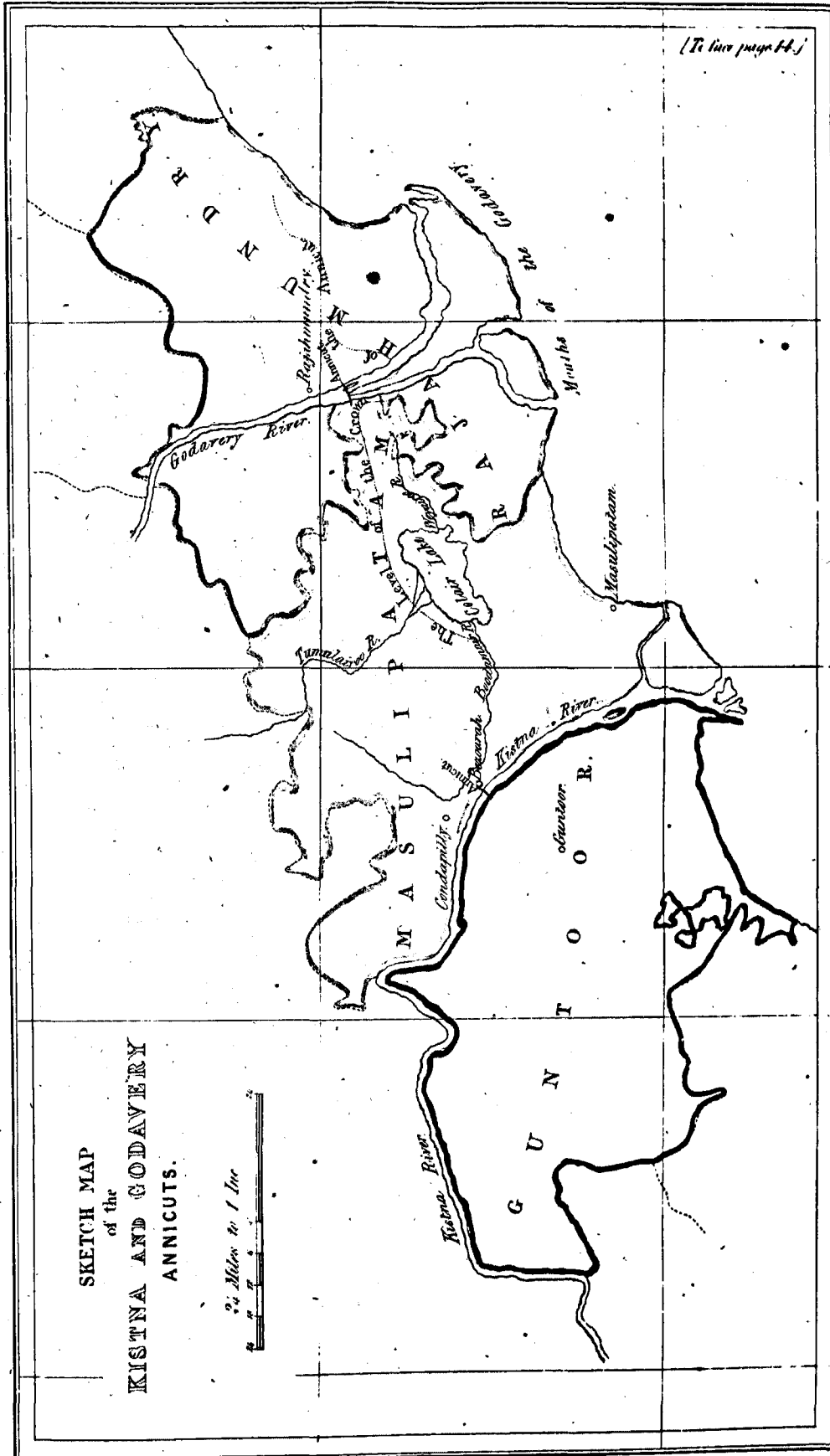
"The tract in question, though very flat, is yet not without slope. From Pippurroo, on the Weyairoo, to the swamp due south of it, which is on the level of high water, the fall is 12 feet in 15 miles. The defect is, that there is not a single channel of any size leading direct towards the sea from the Weyairoo,

and the one from the Colair, though considerable, is totally inadequate to carry off the floods of three rivers."

"Thus those lands are suffering in the very same year from both floods and drought; there being too much water for them to do anything during the monsoon, and then having to take the chance of the dry season cultivation. The whole of this tract, 340 square miles, or 190,000 acres of cultivated land, is rich soil, and probably one-half its value is lost by this state of things. Besides the embanking of the Godavery and the closing the heads of the river channels, the only thing that has yet been done towards the relief of this land, is the construction of lines of embankment within the tract itself, to prevent the flood passing over certain portions of land. Of course, whatever is done in this way throws the water back on the lands, and only retards the escape of the floods."

Colonel Cotton then describes the plan he proposes for the removal of the evil, at an estimated cost of 66,060 rupees, which he states, "will materially affect 190,000 acres, or at the rate of about $\frac{1}{3}$ rupee per acre, making, with its share of the cost of the Annicut and other works, about $1\frac{1}{3}$ rupees per acre. It will require further expenditure for the drainage, besides the branch channels for the irrigation of the tract."

Colonel Cotton, in a second report, dated 22d December 1851, states, "The great works for conveying water to this tract are already nearly completed; but their effect will be greatly weakened till the means of relieving it from the floods from the upper country are in operation. The tract to be thus relieved, is about 190,000 acres, more or less exposed to injury from floods; the value of the crop on this at present cannot be less than 12 lacs of rupees; it will be greatly increased now the regular supply of water is applied to it (it is now actually passing through it by many channels), if only the floods are carried off; and, therefore, an estimated expenditure of 66,000 rupees is calculated to produce a greater effect here than anywhere else. At this moment I am obliged to restrict the quantity of water from the Annicut to this tract (though much more could be used than we could give it), because some parts of it are so flooded, that in helping others, we should be injuring those. Taking the value of the crop at only 12 lacs, it may easily be seen that an expenditure of 66,000 rupees, even if it only in a considerable degree relieved it from floods, may have an extraordinary proportional effect; every year large tracts of crop are totally destroyed, and much larger, more or less injured; and in so flat a country, a foot difference in the height of the water makes the difference of a fine crop, or total loss on perhaps 50,000 acres. I state the value at six rupees an acre; this is the common value of an acre of black paddy, but a great proportion of this is transplanted paddy, worth 20 rupees an acre, and much of it bears two crops. Some idea may be formed of the critical state of things here by the following circumstance: we this year made a small cut to drain off the last of the water in the Colair, which, it appears, has never been done hitherto. It is well known, that in such lagoons (which the Colair properly is), when nearly all the water has been evaporated, what remains is brackish. By making a cut at the end of the dry season, we let the water flow off till the new rains had thoroughly washed the land; when this was effected, and it became a question whether the cut should be closed or kept longer open, about 60 villages entreated that it should be kept open, and about 80 that it should be closed; the difference of the level of the two sets of villages not being more than a foot or two, and the best level of the water for one being such as would materially injure the other. There is, of course, no remedy for this, but to have the means of both draining and irrigating the different tracts independently of each other. It is owing to the want of a thorough investigation of these things, that this extraordinary rich tract of country has hitherto been comparatively so unproductive. I may mention another fact connected with the state of this part of Masulipatam. We had a remarkably dry season this year, not a single shower having fallen for six months, and in the month of May a message was sent to me from some of the villages there, that if I did not shut the head sluice at Vijasweram, they could not find a dry spot to thrash their grain upon; and soon after, I passed over the land and found they had just finished their harvest, and the land was still wet. It will be understood thus, that drainage may be just as necessary as irrigation, and



by vertical pressure. The Committee have no doubt that the object is attainable even in the most unpromising sites by the skilful disposition of the material, of which there is an inexhaustible supply on the igneous rocks of the vicinity.

“ RETURNS TO BE EXPECTED.

“ 5. These in their full extent depend, of course, upon the actual command of the Annicut, a point to be hereafter discussed; but the Committee propose, in the first place, to exhibit those profits which may be reasonably expected from an Annicut within the limits of any sites or heights that have been or are likely to be suggested.

“ 6. In the statements already laid before Government, the Committee observe that those of Masulipatam are deficient in specification of the sources of more immediate profit, and that those of Guntoor include lands which are on too high a level for irrigation probably within a considerable period. In both there is a want of discrimination between the existing wet and dry cultivation, at least with reference to the expected effect of the Annicut thereupon.

“ 7. The Committee have, therefore, after careful inquiry, prepared the new returns, which are appended to the Report, and upon which they beg leave to offer the following remarks:—

<p>Boodemair 13,129 Pulleiroo 24,015</p> <hr style="width: 100px; margin-left: 0;"/> <p>37,144</p>	<p>“ 8. In Masulipatam, the highest revenue derived from the Boodemair and Pulleiroo in one year amounted to, for both channels, 68,183 rupees, when prices were somewhat above the average. The revenue will not, for the future, depend upon prices, but money rents are expected to the full amount of the best years when the channels are permanently supplied. The increase is therefore estimated at the amount of difference between the highest and average returns, that is, at 37,144.</p>
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“ 9. The foregoing increase is calculated from the greatest extent of land under the channels hitherto cultivated, namely 6,917 acres, and is, therefore, an increase from richer produce only. There are, besides, 11,535 acres in the Ayacut, of which three-fourths, or 8,651, are expected to be immediately cultivated, and to yield 43,255 rupees.

“ 10. There are also 20,991 acres of wet land at present uncultivated in other parts of the district favourably situated with reference to the Annicut, and from these an increase of 34,985 rupees is expected in the first year after the construction of the Annicut, 69,970 in the second, and 1,04,955 in the third and following years.

“ 11. An increase of 4,708 rupees is calculated from difference of assessment on the present wet cultivation.

“ 12. On 33,000 acres of dry, to be converted into wet cultivation, 12,000 rupees are expected in the first, 24,000 in the second, 36,000 in the third, and 48,000 in the fourth and following years, after water has been supplied by the Annicut.

“ 13. In a zufted estate, which will shortly become the property of Government, the increase is estimated at 9,690 rupees in the first, 19,380 in the second, 29,070 in the third, and 29,820 in the fourth and following years.

“ 14. The foregoing estimate has been purposely made at a low amount, but if the expected increase on dry land be deducted on account of the possible difficulties of conversion at an early period, the profit in the first year will still be about 1,20,000 rupees, provided that proper means for distributing the water be employed.

“ GUNTOOR.

“ 15. In this district, the present irrigated lands lie in the Bopetlah, Repully and Purroor talooks, and amount, as it will appear by the annexed memorandum, to 36,117 acres, the average revenue upon which (a part only, of course, being cultivated) for 10 years amounted to 62,928 rupees, and the highest to 1,43,802 rupees, the difference less the profit obtained from the Toongabuddra and Vellatoor channels, namely, 16,544 rupees, being expected as an immediate increase-

increase from the construction of the Annicut. The revenue having hitherto been collected by shares, the extent of land cultivated in the best year is not known, but was, it is certain, considerably within the Ayacut, prices being high and the revenue large proportionately to the cultivation. As it is expected that, by means of the arrangements for the field assessment just concluded, a fixed rate of rupees to the acre will be obtained, the probable yield of revenue from the Ayacut will be $36,117 \times 6 = 2,16,702$, which, compared with the average return, gives an increase of 1,53,774 rupees, less 16,544, or 1,37,230 instead of 64,330.

Difference	80,874
Deduct -	16,544
Increase -	64,330

" 16. In the Repully talook there are tracts of waste land favourably situated for irrigation, from which 77,860 rupees are expected as an early if not immediate increase, and in the Tenally and Punnor talooks a large area, now cultivated with red paddy, will, it is believed on very good grounds, be quickly converted into wet land, and yield an increase of 1,86,528 rupees.

" 17. The four talooks above mentioned are very favourably placed to receive water from the Annicut, and the Committee have no reason to doubt that the expected increase therein will be quickly realised. It amounts altogether to 3,28,718 rupees, if the best yield only of the present wet lands be taken as the standard, or to 4,01,618 rupees, if the more probable return, at the rate of the field assessment, be admitted.

" 18. In the Prutessand talook, a further immediate increase of 62,559 rupees is expected; but, regarding this, the Committee, considering the relative level of the lands, cannot record a decided opinion with the same confidence.

" 19. The superiority of the profits expected from Guntoor to those of Masulipatam is to be accounted for by the fact, that in the latter district no account has been taken of the jary estates, which are, in amount of acres, as 244 to 118 of the lands in the possession of Government, and as 244 to 131 of the Government and zuffed lands together, excluding from both reckonings the whole of the enams.

" 20. Upon the arrangements to be made with the zemindars and with the enamdars on the Government estates, the Committee will offer some suggestions towards the close of their Report. They now having shown, as they trust, the more immediate profitable character of the project, observe that but a small portion of the returns that may most reasonably be expected from the Annicut, as already proposed, has been exhibited.

" 21. It has been the desire of the Committee to show clearly the immediate advantages, because those which are more distant, though not less certain, cannot be estimated with the same accuracy, being, in fact, much dependent upon the increased resources which will be created by the Annicut itself. At another part of the Report the Committee will treat of these later returns, with reference to the actual site and height of the work as proposed by them, and now to be discussed."

* * * * *

" ESTIMATE.

" 42. The Committee have endeavoured to prepare a liberal estimate, without indulging in mere conjectures, but they feel the responsibility of this part of their duty to be very great; and while they cannot undertake to certify the correctness of calculations so liable to be disturbed by contingencies, they trust that they will be considered to have done all in their power to prevent disappointment in the cost of the work.

" 43. The Committee believe that no inconsiderable portion of the plant may be provided from that of the Godavery Annicut; but they are unable to estimate this portion, and therefore make no deduction on its account. The cost of cut stone may also probably be diminished by bringing it from the Condapilly Fort, where a large quantity is ready for use; but here again, the expense of transport being doubtful, they have thought it proper to fix the rates sufficient to prepare the material on the spot.

" 44. The Committee consider it essential that the work should be placed under the

the charge of an officer on the allowances of a civil engineer, since the civil engineer of the division could not attend to it, having at the same time the duty of superintending the Godavery irrigation. They have also provided for the pay of two first and two second assistant civil engineers, though it is not certain that so many extra officers will be required.

" 45. It is of great importance that, contemporaneously with the preparation for the Annicut and its actual construction, surveyors should be employed in laying out the channels required for the distribution of water from the main ducts, the Boodemair and Toongabuddra.

" 46. It is further the decided opinion of the Committee, that if the work is sanctioned, a legislative enactment should be obtained to enable the local authorities to obtain possession of property indispensably necessary for the prosecution of the work and for the distribution of the water. The necessity of such a measure is particularly great at Bezoarah, where the Annicut will touch the village, and where private property must be acquired to obtain room for working.

" 47. The Committee have now to recommend, that if the work is sanctioned, the Board of Revenue may at once be authorised to make known to the enamdars on the Government estates in both districts the terms on which they may be supplied with water.

" 48. The zemindars of the jary estates should, in the opinion of the Committee, be invited to declare whether they will accept of the proposed irrigation upon certain terms, and should be cautioned that, in the event of a refusal, they will not be allowed the benefit at any future period.

" 49. It should be observed, that in the calculations of increased revenue in Masulipatam, the Deevy purgannah, now under the management of the Court of Wards, has not been taken into account.

" 50. In the estimated returns the Committee have limited their observations to those immediately or early expected from the known resources of the districts and the disposition of the ryots; they will now briefly add, that the Annicut, as proposed by them, will command in Guntoor about half a million of acres, and the same in Masulipatam (of Government and other lands), exclusive of Deevy, and that the supply of water for this tract will be most abundant during the season of cultivation of paddy, and very considerable even in the lowest state of the river; so that there is every reason to believe that the whole will eventually be cultivated.

Govt. Land	1,80,000
Zeminary	8,40,000
Enama	60,000
	<hr/>
	5,80,000

" 51. The level of the Annicut has not been proposed without anxious consideration, and the Committee have rather stated its maximum height than fixed it at a definite point for the irrigation required; it will be readily understood that the latter is a question of no ordinary difficulty in a locality where nearly all the land is dry, or if wet, has been hitherto, with small exception, supplied from the local rains. In Tanjore the height of the upper Annicut was determined simply with reference to a mark on the grand Annicut, at which it was known that the river furnished a full supply for all the irrigated lands; but in the case before the Committee no standards of the kind exist, and a large system of levels, with minute calculations of the fall of water in the channels, would be necessary to enable them to predetermine the height of the Annicut with anything like perfect accuracy; they can, however, without hesitation declare, that should the maximum height be eventually adopted, there would be at least six feet water at the heads of the channels for 130 days in the year, which is considerably more than the period required to perfect a crop of paddy, and that there would almost always be an abundant supply for a large tract of sugar cane, should that plant be cultivated.

" 52. For, having measured the quantity of water now passing down the river, and from that estimated the quantity in the driest season, they find that there would be even then sufficient for about 100,000 acres of sugar cane.

" 53. In conclusion, the Committee desire to record their conviction of the very great importance of the proposed work, and of its early sanction. That it would in all human probability avert the possibility of a destructive famine in

this region, seems an argument of the greatest possible weight, independent of profitable expectations, which are themselves most promising. Again, its early sanction is important to meet the expectations of the ryots and the contingency of drought, and to hasten the profitable returns: in addition to which, the sooner the valuable experience acquired at the Godavery is brought to bear upon the Kistna project, the more effective it will be.

" 54. The loss of revenue by the famine of 1832-33 is estimated at least at one crore, the loss of property at a far greater amount, of life at 200,000 or 300,000, and of cattle at 200,000 (at the lowest) in Guntoor alone, besides the ruin of 70,000 houses. These facts will, the Committee believe, bespeak more effectively than the most laboured arguments, the favourable attention of the Honourable Court of Directors to the project now submitted, as one of indispensable and urgent necessity. The famine of the Northern Circars in 1833, and that of the North-west Provinces of India at a later period, prove with irresistible force that irrigation in this country is properly a question, not of profit, but of existence.

" The amount of the revised estimate is Rs. 7,49,165. 4. 2."

The work had been delayed for the completion of the Godavery Annicut, but in the early part of last year a portion of the establishment of the latter was transferred to Kistna, and at the date of the last despatch on the subject, the 7th September 1852, the necessary preliminary arrangements were progressing under the superintendence of Captain Orr, in view to the immediate commencement of operations.

The aggregate amount sanctioned for the works referred to in this paper, is shown to be as follows:

	<i>Rs.</i>
Godavery Annicut and subsidiary works - - -	15,34,952
Drainage of the Colair Lake - - - - -	66,060
Kistna Annicut - - - - -	15,50,000
	<hr style="width: 100%; border: 0.5px solid black;"/>
	<i>Rs.</i> 31,51,012

Statistical Office, East India House, }
12 April 1853.

Edw. Thornton.