



Another feature, in connection with famine as affected by rainfall, which Sir Arthur never tired of mentioning, was that, often-times years of greatest distress were years of considerable rainfall. Frequently the rain came too early. If it were stored that did not matter much; as frequently, perhaps, it came after sowing-time. That, apparently, was fatal for the usual crops, but with the kindly sun ever at hand, in the greater part of India, some crop or other could be obtained. Further, a second crop is nearly always possible. On this point his observations seem to me to be most pertinent. He writes:—

“It will be well, perhaps, to remark on some mistakes which are almost universal on this subject. The first is that, if a tract of land has plenty of rain, there is no necessity for irrigation. . . . No quantity of rain will prevent a famine unless it is tolerably distributed. The fact is, that water from irrigation is required in almost every part of India, even to prevent famine. But, further, there is never a season when, at some time or other, additional water would not improve the crop. Again, when we say ‘irrigation,’ we always mean the complete regulation of the water, that is, including draining; so there is never a season when there is not, at some moment, excess of rain, which requires to be carried off by a system of drains. It is this REGULATION OF WATER that is needed, and which so abundantly repays the cost of works. God gives us rain, but, as in everything else, He leaves something for us to do, which, if we are too indolent to do, we must suffer for it.”

It may be well to show, by a reference to the figures analysed above, what the actual rainfall was, in some instances, in the years when famine prevailed.



PLACE.	Famine Year.	Rainfall in inches.
Madras	1823-24	{ 26.62 33.72
Bombay	1824-25	{ 33.87 72.24
North-West Provinces	1825	*
Madras	1833-34	{ 37.11 39.00
Bombay	1833	71.39
Upper India	1833	*
Madras	1854	43.20
North-West Provinces and Punjab	1860-61	*
Orissa	1865-66	60.00
North Bengal	1865-66	*
Madras	1865-66	{ 41.64 51.39
Northern India	1868-69	*
Central Provinces	1868-69	{ 25.49 ¹ 33.38
Bombay	1868-69	{ 62.12 91.66
Bengal	1873-74	*
North-West Provinces and Oudh	1873-74	*
Bombay	1876-77	50.91 ²
North-West Provinces and Oudh	1877-78	*
Madras	1876-78	{ 21.6 ³ 66.3 28.7
Mysore	1876-78	22.02 ⁴

* No record.

¹ For Jubbulpore, another recording station in the Central Provinces, the figures are 28.80 and 62.77 respectively.

² 1876 only, 1877 not given.

³ "Notes of Evidence, Famine Commission, Jan. 30, 1879," by Norman R. Pogson, C.I.E. In those notes Mr. Pogson makes the following most serious statement :—"In my Administration Report to the Madras Government for 1874-75, I made the following remark : 'Five consecutive years of excess having now been experienced, the evident periodicity of tropical rainfall renders it probable that some years of corresponding deficiency may be expected.' This since fully verified prediction, though duly printed in the spare copies of my Report, was suppressed by the compiler of the Annual Volume of Administration Reports for 1874-1875. It is to be regretted that suppressions in and alterations of the Observatory Reports are ever permitted without the Astronomer being allowed a voice in the matter."

⁴ 1876 only, latest year recorded in tables.



The official observations¹ in Madras on the year 1877 were to the effect that the rainfall was remarkable more for its distribution than for actual deficiency. "Taking the mean readings of the two hundred and twenty-eight registering stations under the charge of revenue and other officials, the following were the results:—

Mean of five years ending 1874, 47·87 inches on 62 days.

"	"	"	1875, 37·26	"	56	"
"	"	"	1876, 27·81	"	42	"
"	"	"	1877, 47·95	"	65	"

In eleven of the revenue districts, namely:—

Bellary	Madura	Tanjore
Coimbatore	Malabar	Tinnevelly
Kistna	Salem	Trichinopoly
Madras	South Arcot	

the total rainfall in 1877 was equal to the average, and, in some cases, very much in excess; in the other nine districts, namely, in:—

South Canara	Ganjam	Nellore
Chingleput	Godavari	North Arcot and
Cuddapah	Kurnool	Vizagapatam

the aggregate rainfall in 1877 was deficient in comparison with the mean results of the five years ending 1874."

In view of the present famine (1900), and because of its bearing on the storage of rainfall, and the control of river and rain water as a preventive of famine, the following table from Mr. Blandford's Meteorological Report for 1898-99² is both interesting and instructive:—

¹ *Madras Administration Report*, 1877-78, p. 40. These figures do not agree with those in the *Famine Commission Report*. Both are official publications, and I quote from each as it stands.

² Page 31.



RAINFALL OF SEASON, JUNE TO OCTOBER.

PROVINCE.	Average Actual, 1898.	Average Normal.	Variation from Normal.	Percentage Variation from Normal.
	Inches.	Inches.	Inches.	
Burma	97'60	93'84	+ 3'76	+ 4
Assam	72'75	73'26	- 0'51	- 1
Bengal	68'19	59'84	+ 8'35	+14
Chota Nagpore	52'52	47'49	+ 5'03	+11
Bihar	52'49	43'50	+ 8'99	+21
N.-W. Prov. and Oudh	41'75	34'70	+ 7'05	+20
Punjab	12'85	15'15	- 2'30	-15
Central Provinces	45'61	45'80	- 0'19	0
Central India	36'70	40'95	- 4'25	-10
Rajputana	12'16	18'66	- 6'50	-35
Berar	26'31	37'48	-11'17	-30
Bombay	41'59	41'27	+ 0'32	+ 1
Madras	34'84	34'20	+ 0'64	+ 2

The need for water storage is specially shown by the records extant for the district of North Arcot for a period of sixty-eight years. Details which I have examined indicate that during this time there were:—

31 years *below* the average, years in which the rains were deficient or fell at wrong periods.

29 years *above* the average, and fairly prosperous.

8 years which may be denominated medium.

—
Total 68 years.

The ominous words: "famine," "scarcity," "distress," "lengthened distress," occur many times during this period. With a sufficiency of irrigation channels, and storage to keep the tanks and channels filled, the North Arcot district might have been continuously prosperous.

With such facts on record in official publications, I ask once more, in Sir Arthur's oft-expressed ideas: "Why blame Almighty God for the famines, declaring they occur because He does not send rain, when, as a matter of fact, He does



send rain enough for all our needs, but we are too careless to store it against the day of need ? ”

“Why should the water of any manageable river waste itself in the sea ? ”¹

APPENDIX

Through the Famine Districts

IN THE PUNJAB—WHAT IRRIGATION HAS DONE

(From the Special Correspondent of the “*Manchester Guardian*,”
May 30, 1900)

HISSAR, PUNJAB.

“Now I have given the darkar [district] of Hissar,” so ran a proclamation of Akbar Shah Badshah in 1568, “to the great, the fortunate, the obedient, the pearl of the sea of my kingdom, the star of my Government, the praised of the inhabitants of the sea and land, the apple of my kingdom’s eye, my son Sultan Muhamed Salim Bahadur (may God grant him long life and greatness). My wisdom wishes that the hopes, like the fields of those thirsty people, may by the showers of liberality and kindness be made green and flourishing, and that the canal may in my time be renewed, and that other waters may be conducted into it, that thus it may endure for ages. For God has said, From

¹ Sir Monier Williams, K.C.I.E., in a letter to *The Times* of Nov. 7, 1877, said : “In other directions we might do more. For example, we might carry on a more systematic defensive warfare against drought and famine by the storage of water in tanks, and its distribution for irrigation. India is blest with abundant rivers. Why are not more aqueducts, canals, and reservoirs made ? Why should the water of any manageable river waste itself in the sea ? ” Sir Monier had shortly before visited India, and, in *The Times*, had placed on record how greatly he had been struck with the advantages of irrigation. “All the belts of land,” he remarked, “reached by the grand system of irrigation, which stretches between the Godavari, Kistna, and Cauveri rivers, . . . present a marvellous contrast to the immense tracts of arid waste which meet the eye of the traveller as he travels by the Great Indian Peninsular, the Madras, and the Southern India railways.”



water all things were made. Therefore I ordain that this jungle, in which subsistence is obtained with thirst, be converted into a place of comfort, free from all evil." The edict went on to say that the canal was to be "excavated deeper and wider than formerly," and that "on both sides of the canal down to Hissar trees of every description, both for shade and blossom, be planted, so as to make it like the canal under the Tree in Paradise."

The pearl of the sea must have done his work faithfully, for the banks of his canal are shaded with all manner of trees up to and through Hissar, and there is water enough for a good belt of fields on each side, the crops of which were glistening in the sun as I rode along the bank this morning. The oriental fervour of this strange old utterance seems nothing more than natural after a thousand miles of wilderness and the extermination of all agriculture. To see groups of people in the fields again, to see things growing, oxen standing in the shade, squares of land glistening under the film of water from the canal, and, climax of all, a big company of men and women threshing the yellow wheat, is a wonderful thing. But this "place of comfort, free from all evil," is, after all, a narrow strip running through a great waste of wicked desert; and out in the desert, in which their fields have disappeared, the people of Hissar, in numbers that range from a hundred to a hundred and sixty thousand, according to the work to be got elsewhere, are digging tanks and living in famine camps. Numbers of villages are absolutely deserted, and for more than six months past the worst famine within human memory has had its grip on Hissar.

SCARCITY OF FOOD AND FODDER.

The scarcity of food is worst in this southern corner of the Punjab, a corner about as large as Yorkshire; but the fodder famine throughout the whole province has reached a point of such intensity that the Lieutenant-Governor has just declared that, in spite of all the efforts of the local government and the Government of India, it is impossible to secure supplies for keeping life even in the indispensable plough cattle. Thanks to the supplies of fodder from the Chenab and other canals, the calamity has been put off for months, and it is hard, indeed, that this great province should have to look on now while its cattle are dying by hundreds of thousands, as they died last year in Rajputana and Gujerat. It becomes more and more difficult to see how the



cultivators of the stricken districts are to get back to work again, in the face of this measureless destruction of their cattle. Even the beasts on the great Government cattle farm, which covers an area of sixty square miles, are in a half-starved state, and it is lamentable to see them roaming about in their vain search for food. The question is forced upon one again whether some system of Government fodder storage or the provision of local ensilage depôts ought not to be energetically taken in hand when once the Government have time to look round. It is rather surprising to find so little attention being paid to this matter. Again and again the peasantry have been stripped bare of their capital, and nothing has been done to provide against future calamities. India has an enormous Forest Department, and it ought surely to be able to take steps for keeping, say, ten per cent. of its live stock from death by famine.

“WHAT ABOUT CANALS?”

“But what about canals?” the reader who has studied irrigation will ask. “Is not the Punjab the classic ground for irrigation?” The answer is that the situation would be far worse—and that hardly puts it strongly enough—but for the magnificent system of artificial watering begun by the old rulers of India and continued, up to a point, by us. Let me deal with the matter more in detail. The total area of crops matured in the Punjab during the year ending September, 1899, was 20,738,687 acres, and of this area 8,967,391 acres, giving a yield of forty-three per cent. of the crops of the year, were cultivated by irrigation. The chief forms of irrigation are—(1) the canal which draws its water all the year round from one of the snow-fed rivers of the Himalayas and spreads them over a great tract of country by a system of minor canals and ducts; (2) the inundation canal, fed by cuts in the river banks through which the waters find an exit in times of flood; and (3) the irrigation wells. The immense importance of the well in Indian agriculture will be seen from these two facts—that during the past ten years more than sixteen thousand new masonry wells have been sunk in the Punjab, to say nothing of the simple pit or cutcha well, and that close on four millions out of the nine millions of irrigated acres were watered by the well. The inundation canals, owing to want of flood-water, did badly, and a decrease of half a million acres of watered lands from the previous year must be set down to their account.



SLOW PROGRESS "NOTHING LESS THAN A TRAGEDY."

Of the great and constant-flowing canals, whose shaded banks are the pleasantest refuges the plains can offer you in the hot weather, it can only be said that they have done so magnificently well that the failure to extend them faster is nothing less than a tragedy. I say nothing at the moment of their financial success, except that they are by far the best investment that the Government of India have ever made. They have largely extended the cultivation of new crops such as rice and sugar, they have given India a permanent granary, and they have opened up huge tracts of desert country to cultivation, relieving the congested districts in the process. This is an old story, no doubt, but the man who comes back from a camel-ride through a once-cultivated desert by way of Sultan Salim's water of Paradise sees more in a canal than the "moral and material progress" Blue-books disclose to him at home.

Take the Chenab canal, the latest big scheme which the Government of India have carried through, and consider its effect, direct and indirect, upon the local famine districts—the rainless corner of Hissar and the half-dozen other districts of the Punjab less severely hit by the food famine than Hissar, but still pretty badly touched. Now the Chenab has opened or is opening up four million acres of pure desert, it has given any quantity of employment to the distressed people during the famine, it looked as if it was going to save the cattle out of its supplies of fodder, and it will certainly give to the Punjab a new productive colony of a quarter of a million or so of workers and their families, all of them carefully selected from the congested districts. That is an achievement of which the proudest Government can afford to be proud, and Colonel Ottley, the master mind of the Chenab, who has gone home to irrigate the minds of the young men at Cooper's Hill, will be glad to know that, in the opinion of a high official of the Government, "the Chenab has largely saved the situation in the Punjab."

THE "EXCESSIVE DELIBERATION" OF GOVERNMENT.

In face of all this, the excessive deliberation with which the Government set about realising the rest of the approved canal schemes is simply mysterious. The Jhelum project was fully authorised in 1888, but nobody seems to quite know when it will be ready to hold water. Then, after the Jhelum, there is the



HARVESTING IN IRRIGATED REGIONS 431

Sind-Sagar project for spreading Indus waters over another enormous stretch of desert, and there are some enthusiasts who hold the belief that about 1920 there may be a chance for the Montgomery project—a scheme which might have been half put through by this time if the Government had allowed a Company to carry out the work. Some addition is being made this year to the pittance which the Government annually devote to irrigation, but the Punjab presents an irresistible case for large and adequate treatment. A forward policy means, of course, more men and bigger establishments; but then so does a famine. And, for the rest, if the approved schemes are all finished in a dozen years instead of fifty there will still be plenty of work for the engineering staff, even supposing that India is by that time surfeited with canals.

NOT HOPEFUL OF LARGE EXTENSIONS.

To come back to Hissar, I must confess that opinions gathered here and in other parts of the Punjab are not at all hopeful about any extensive scheme of irrigation being possible for this district, and in these matters one is necessarily in the hands of the experts. But, at the worst, a large canal policy would give permanent openings to many people in this famine-haunted region, and abundance of work, at least for a generation, to emigrants during times of famine. The drop of numbers on the relief works from 160,000 to 110,000 is due, so I am told, to the people going off harvesting in the irrigated regions.

MINOR TANKS FOR GROUPS OF VILLAGES.

It is at least satisfactory, too, to know that every stroke of famine labour is making in the direction of more water storage. I visited with Mr. Humphreys, the Deputy Commissioner who is "running the famine," two of the tanks which are being dug out for the future use of groups of villages. A large number of these tanks are being made, and it is work of which the people well know the value. There is no complaint whatever of skulking. The day's work for the gang is marked out, and it is generally done within the day. A leading principle of Major Dunlop-Smith's administration of the last famine was that the people should clearly understand what was expected of them; he found that the trouble taken in explanations was well repaid, and that the results of famine labour compared very fairly with ordinary

labour, and evidently the tradition sticks. The people on the works struck me as in good condition, and there was practically no sickness—the best test, I suppose, of good all-round administration. Hissar, however, has not been spared by the cholera, which is raging at the present moment in many of the towns and villages. The famine camps had their worst time some months ago, and there was a terrible outbreak on some canal works, many miles away, to which eleven thousand of the Hissar people had been deported; so bad, indeed, that the whole camp had to be broken up and the people brought back. Mr. Humphreys also took me to the village of Tahvandi Rana, five miles away, a cluster of mud hovels picturesquely heaped together on a mound in the desert, and deserted by all but the aged and infirm, who are receiving a weekly dole. These poor creatures were waiting for us outside the village, formed up in a group under a big sandbank. There were old men leaning on their staffs and women shaking with palsy, the usual collection of village decrepitude, and five blind. On the other side of the road were the fresh applicants for relief, who told their cases. One of them was an old man who had lost two of his sons. He was keeping their wives and their three children and his old mother of ninety. He had no land, and his bullocks, from which he got a living, were dead. He and five more were put upon the list. Altogether in the village, which is a large one, there are thirty-one people on Government and twenty-nine on charitable relief.



CHAPTER XIV

The Money, Moral, and Material Value to India
of Sir Arthur Cotton's Work

"With the northern practice the name of Sir Proby Cautley will be handed down to the grateful remembrance of posterity, and with the southern practice, that of Sir Arthur Cotton. Of the many benefactors of India in recent times, there are few who have done more material good than Sir Arthur Cotton during this generation. Both he and Sir Proby Cautley have raised, or contributed to raise, a school of hydraulic engineers, whose deeds have shed lustre on the public service in the Presidencies of Bengal and of Madras. The name of Fife is similarly associated with the irrigation works of the Bombay Presidency."—SIR RICHARD TEMPLE, G.C.S.I., *India in 1880*, p. 257.

IT has been suggested that it might be useful if the value of Sir Arthur Cotton's work to India, reckoned in £ s. d., were computed. If the question be asked, How much is India the better for Lieutenant Cotton's adoption of an Indian career? obviously the answer is difficult. There are certain tangible results which "he may read who runs"; the intangible are harder to indicate. A page or two of this biography, however, may, not unusefully, be devoted to a consideration of this method of estimating Sir Arthur Cotton's work.

I. THE MONEY RETURN.

(a.) *To Government (after Interest on Capital Expenditure has been reckoned).*

	Rs.
Godavari Delta System	3,70,98,763
Kistna Delta System	2,02,11,515
Cauveri Delta System	2,35,38,320
Lower Coleroon	94,10,951
Total, Direct	Rs. 9,02,59,549 ¹

¹ *Madras Administration Report, 1898-99*, section, "Irrigation."



	Rs.
Brought forward	9,02,59,549
Of remainder, one-half may be reckoned, as it is certain but for the earlier successes so much irrigation would not have been undertaken	58,74,758
	<hr/>
Total in Madras, Direct and Indirect.	Rs. 9,61,34,307
Much of this was earned at the old rate of currency (Rs. 10=£1), and might, half of it, be represented at this=£9,508,430. The present rate, however, may be taken, Rs. 15=£1	£6,408,954

Did ever before engineer or civilian in India divert so magnificent a stream of easily-borne revenue into the Government Treasury? And, at the rate of several millions sterling per annum, a contribution to the revenue is going on, and may go on for hundreds of years. Shall he, who provided all this by his courage, ability, and humanity, ever be forgotten? And shall his teaching and example go for nothing?

(b.) *To the Districts Affected, and the People thereof.*

Some difference of opinion exists as to the increase in produce which comes from irrigated land: certain authorities give Rs. 10 per acre in Northern India, Sir Arthur Cotton says Rs. 15,¹ and as he appears to have had good ground for his estimate, it is only fair to him to calculate on his basis. There are 5,875,374 acres under irrigation in Madras. Sir Arthur Cotton, who designed and executed, or (as in Kistna) was the originator and partial designer of the great works, may be credited with this increased produce. The annual increased value thus given to the land, the extra money coming into the hands of the people, is Rs. 8,81,30,610; or, at Rs. 15 to £1 sterling £5,875,374

¹ I should like to put the Government estimate, but it varies so much that I cannot strike a fair average. Generally, the rate for wet cultivation is four times that for dry cultivation. The Hon. R. A. Dalryell, of the Madras Board of Revenue, gives statistics for 1856 and 1866, which would justify a much higher calculation than is given here, but, all through, I have been desirous to give estimates below the actuals (p. 399, *Administrative Experience Recorded in Former Famines: 1874*).



Sixty years have passed since one of the greatest of Sir Arthur Cotton's works was completed—the Cauveri delta—and nearly fifty since the Godavari began to yield large returns. It would not be unfair to reckon for such an estimate as this, thirty years of the above figures. Such an estimate shows that Sir Arthur Cotton has been the means of adding to the income of the inhabitants of certain districts in Madras only, $£5,875,374 \times 30 = £176,261,220$

Summarised, we have this :—

	£
(a) Money return to the Government, wholly profit, as interest has been already reckoned, £800,644 per annum, also multiplied by 30	= 24,019,320
(b.) Money return to the people	176,261,220
Total	<u>£200,280,540</u>

A fairer tribute to Sir Arthur Cotton would have been to add thirty-three per cent. to the above estimate, by giving forty years' amount of the returns, which would reach the sum of **£267,040,720** sterling.

Nothing has been reckoned for the rest of India, though much might, in strict justice, have been reckoned. There can be no doubt that, but for the success in Tanjore and Godavari, very little of the canal irrigation in other parts of India would have been undertaken. Nor is any heed given to the great saving effected through the improvement of the Paumben Channel. Directly and indirectly, Sir Arthur's beneficent work is almost past finding out, certainly it cannot be accurately reckoned up.

2. THE MORAL AND MATERIAL RETURN TO COUNTRY AND TO PEOPLE.

This is incalculable in a double sense. No one can measure the force which prosperity gives in increasing the happiness and comfort of every home affected thereby, or adequately state it, even if it were apprehended. Some idea of the other side of the matter might be obtained if



one were to garner and set forth the awful condition which famine causes. Utter destitution falls upon vast multitudes, the money loss from partly-withered crops or from want of crops is great, demoralization affects practically all, and vast numbers become quite destitute and the recipients of Government relief and private charity. As for those others who are able somehow to pull through a time of little or no work and extremely, almost prohibitory, high prices for food, who have to deny themselves everything beyond mere maintenance,—

“ Their skin cleaveth to their bones; it is withered, it is become like a stick.”—(*Lam. Jeremiah*, iv. 8.)

“ They that are slain with the sword are better than they that be slain with hunger ;

“ For these pine away, stricken through for want of the fruits of the field.”—(*Lam. Jeremiah*, iv. 9.)

All this is impossible where the views of Sir Arthur Cotton have prevailed. In every other part of India it is not only possible, but, in many parts, certain, that hideous suffering recurs at short intervals, as in the case of the Central Provinces, ravaged in 1896-97 and again in 1899-1900, with the consequence that, in one part of that region, forty per cent. of the inhabitants are receiving Government relief !

The Indian people cry, with a loud voice :—

“ How long, O Master, wilt thou permit us thus to suffer ? Bring succour that we perish not ! How long shall the land mourn, and the herbs of the country wither ? ”

Alone amongst British subjects do the Indian lieges of the Queen thus suffer. Is it possible, with the teachings of Sir Arthur Cotton in our hands for our guidance, that Englishmen and Englishwomen will permit this state of things to continue ?



CHAPTER XV

Work for all India

BEFORE leaving India, Colonel Cotton wrote joyfully of the well-being of his greatest undertaking :—

"I am happy to state that, from whatever cause, the Godavari district is prospering beyond all expectations; we can show that, deducting our large expenditure during the last four years, amounting to £1,110,000, the net revenue has greatly exceeded the average of previous years; the excess in the last year but one is no less than £19,500. 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 irrigation, and the increase of exports under a vigorous revenue management."

He printed for private circulation a pamphlet on Public Works in India. It was afterwards reproduced with an introduction by General Fischer, R.E., and is still of considerable value for the suggestions it contains concerning useful projects. He alludes to some of the former mistakes in the plan and execution of road work, and yet observes, with reference to the improved road from Madras to the westward, that it has saved, in the cost of transit, cent. per cent. on the capital expended upon it. In commenting on this road from Madras he shows that it saves the country £1,850 per mile, on an expenditure of £1,000—nearly 200 per cent.; and that Cochrane's Canal, only ten miles long, yields to the Government annually £3,000,



on an outlay of £15,000, or twenty per cent., besides the saving to the community by its cheap transit; and that an expenditure of £25,000 on the Paumben Channel, between the mainland and Ceylon, has reduced the cost of freight between Tanjore and Ceylon by two-thirds, saving in the carriage of grain alone more than £40,000 or 160 per cent.

Most earnestly he was again espousing the cause of navigation on the great rivers, and he argued at length on the commercial advantages of opening up the Upper Godavari, especially for navigation. His project, however, was not accepted by the authorities; it may be hoped that, in the reforms which must come in the early future, its importance may be recognised and the necessary works undertaken.

STORAGE OF SALT WATER.

Another topic, of this time especially, is that of the storage of salt water for the production of salt—"a great necessary of life," and always much prized by the people, though it was an article which they had great difficulty in obtaining. He proved that it would be a great gain "to raise the water to higher levels than the lowest, which alone were occupied in the native manufacture."

In 1862 Sir Arthur left England for India, and investigated the Behar project of irrigation and navigation in the valley of the Sone river, originally examined and estimated by Colonel Dickens, under the orders of Government, and having made a highly favourable report on the project, sent the same to the East India Canal Company, who published it. The Company found they could not raise the requisite capital without a guarantee from the Government, so they were compelled to relinquish all idea of executing the work; it was accordingly taken up by the Government, whose officers have successfully completed it. It proved of most essential service during one of the famines, and irrigated five hundred and fifty-five thousand



one hundred and fifty acres, from which otherwise scarcely any crops could have been raised.

His visit to Orissa in 1862 was fruitful of wise comment and judicious observation :—

“All deltas require essentially the same treatment. They are all subject to dreadful evils if unregulated and the rivers left uncontrolled. All are capable of almost incalculable improvements, all cause a far greater expense by their being neglected, than by the execution of the most complete system of works ; all require the same means to be used to regulate their waters, and convert the natural constant succession of flood and drought into a constant and invariable supply of that which makes the whole difference between plenty and famine, comfort and misery, wealth and poverty, so far as material things can do it.”

“Upon the regulation of the waters of every country depends, incomparably more than on anything else, its material well-being ; this is especially the case in all tropical and other countries which have defined periodical rains.

“The cause of all the mischief we are now lamenting [the Orissa famine] is perfectly obvious, and has been clearly pointed out by Captain Short. It is the change that has taken place in the heads of the Kujooree and Mahanudi within the last few years, in consequence of which a much larger portion of the whole water now enters the former river than its lower parts are capable of carrying off. All delta rivers continually change, if left to nature, when, by some change above, the set of the stream is so thrown upon the head of a branch as to widen and deepen it, till the channel is capable of holding the increased body of water down to the sea ; but, in the meantime, the mischief that is done by flooding and destroying land is incalculable in a highly-peopled country.”

The remedy for this was some trifling works at the point where the evil originates, viz., at the termination of the hill country six miles above Cuttack, by which the



excessive evils now experienced could have been stopped at once, and by which they can even now. Indeed, the turning of the water into the Mahanudi had already commenced as the effect of the small works already executed.

In the preceding twenty-three years there had been :—

Three years of famine,
Four years of drought,
Seven years of inundation,
Seven years of moderate seasons.

His practical conclusion, after this inspection, was to this effect, that, "if the works should cost Rs. 5 an acre, the increase of produce would be two hundred or three hundred per cent., abundantly sufficient for our purpose."

In another report, written at the same time, he says :—

"To me it is no more a question whether the waters of the delta ought to be regulated, than whether food ought to be cooked, or a broken leg to be set. It is no more a question whether flood water ought to be let in upon the inhabitants of a delta, than rain water upon those who are living in a barrack; and that before long it will be treated as a matter of course, that £1,300,000 ought to be spent in sheltering two millions of people in a province from the floods and drought, just as much as in sheltering twenty regiments from the weather—that it is as necessary a piece of economy and of mercy."

One party of ryots, in discussing with him the spread of irrigation, finished their statements by saying, "Oh! if you give us such works as you speak of, what with sugar, and all sorts of things that we shall then grow, the land will produce *six times* what it does now!"

In 1864 he wrote to Sir Stafford Northcote as follows :—

"I am not pressing upon your attention a matter which is of comparatively small importance, but one which is certainly at this time one of the great vital questions in the management of India.



LETTER TO SIR STAFFORD NORTHCOTE 441

"You will see that the views of my opponents and myself are diametrically opposed; one of them must be rejected in the future conduct of the matter. The future progress of India in every respect must most materially depend upon no mistake being made as to which of those views is the true one.

"I have a letter to-day from an Englishman, who has for many years been farming in the delta of the Godavari, who writes as follows:—

"‘Last year, in the sub-division of the Godavari district, land yielding £30,000 revenue was thrown up in May, as the ryots saw no chance of obtaining water; in portions of this land the seed had been sown; this was also sacrificed. The navigation in some canals is greatly interfered with by their not being properly cleared of the silt, and many irrigation canals are choked with mud, and are of very little use.

"‘The same is the case with the great works in Tanjore.’

"I quote this as a proof of the strange indifference with which this great subject has been treated during the last two viceroyalties of India. I need only refer to the astonishing indifference which has been shown respecting the famine. Not only has there been no effective prosecution of irrigation and navigation for the last five years, but even the successful works yielding such great returns in Madras have not been kept in repair. Nor has anything worth mentioning been done to correct the errors in the Ganges Canal, or to extend its operation; it has been allowed to linger on in an unproductive, and even a dangerous, state, for many years.

"I may add one fact to show the vast importance of this question, if anything were wanted to be added to that of the famine, viz., that the increase of revenue in the Godavari district since the works were begun, has been £270,000 a year, a sum which, if extended to the other one hundred and thirty districts, would amount to £35,000,000, which would be the difference in revenue between India irrigated and India left to the natural



state of things, besides the loss of millions of lives by famine."

And to Sir Lewis Pelly (alluding to a pamphlet enclosed):—

"You were good enough to hear what I had to say about the Orissa works. As these are now the works upon which all who are opposed to irrigation and water transit fix their attention, it seems to be of the first importance that their circumstances should be well considered; and I, therefore, try to lay before you in writing what I said at our meeting, with some other things that in the hurry of the meeting I omitted.

"I offer these remarks, not only as having had fifty years' successful experience in these matters, but also as, being out of office, I have time and leisure to examine them in a way that those who are overwhelmed with details, and even that those who are in the thick of the operations, cannot.

"There were four classes of engineers in India—those who aimed at nothing, and succeeded in effecting it; those who aimed at something that was in itself a mistake, and succeeded in doing mischief; those who aimed at something right, but failed through mistakes in carrying it out; and those who aimed at something right and, by God's blessing, succeeded."

In advocacy of the claims of the East India Irrigation Company, and the importance of its promotion, he wrote as follows to the Governor-General:—

"I am informed that the true state of the case is that authority was actually given some time ago to the Governor-General to raise loans to the amount of £20,000,000 in the course of some years, with a full determination that no more projects should be executed by companies (not even in Oudh), though the Government had themselves offered it, and approved of the East India Irrigation Company going to the expense of examining that tract; but that large projects should be executed by Government



itself; but since then I hear that these instructions have been countermanded, and that only eight millions should be raised in five years to build barracks, leaving the question of the execution of the great irrigation works where it was before.

"I feel quite certain from all that has passed of late years, that there is not the slightest possibility of any large irrigation works being carried out by the Government; so that if they refuse to let them be done by private companies, it is certain that they won't be done at all. We paid off many millions of debt, while we have withheld £200,000 or £300,000 required for the completion of the Godavari and Kistna works, though that money would yield one hundred per cent. to Government, besides securing the districts from famine and its calamitous consequences.

"The present crisis of the Ganges Canal seems a most favourable opportunity for bringing forward the whole subject, as well as that canal's particular case.

"We have every reason to hope that both the Irrigation Company's great projects, in Madras and in Bengal, will be in extensive operation this year, and they both promise as great returns as those of the Godavari and Kistna."

The vexed question of "mistakes" occupied much of his time and attention, for he was always trying to correct them.

It would often be argued that, if a district were what is called a "rainy" district, the fall in the year being considered good, there was no need there for irrigation. This point Sir Arthur combated strongly on the ground that "the monsoon may be a very heavy one, and yet the land may suffer from famine; as in the case of the Orissa district, where thirty inches fell, and then in the drought that followed the whole of the rice crops were lost. Another thirty inches fell, but it was too late. Famine followed. Had there been a canal system available, this water would have been saved and utilised for the enriching of the country, and all the disasters of a famine averted.



Water must be stored and distributed, or it becomes an enemy—an instrument of destruction and ruin when it does appear, rather than a beneficent friend and life-giving influence; whereas, when it does not come, there is drought and dearth on every side. At all times of the year, too, water is needed." The simplicity of these assertions, one would think, needed no argument or burning eloquence to prove them.

The year 1877 was the worst year of suffering Southern India has ever known. An examination of the rainfall statistics shows 1877 to be a year of heavy rainfall, but twenty-one inches out of the total fell on two or three successive days in May—18 to 20. The quantity which then fell was at least half a year's average normal rainfall.

My attention has been specially drawn to a striking confirmation of Sir Arthur's observations just recorded. He often insisted on the fact that when he used the word irrigation, he meant it as a very comprehensive term. It included storage of water as well as the supplying and drainage of land.

"If," he said, "the careful regulation of the water is attended to, it answers admirably every requirement of the country, bringing prosperity to the population and revenue to the Government. Its necessary outlay in the cost of works is amply repaid over and over again, not only by the wealth, but the health of the territory where the money is spent. Those who are not intimately enough acquainted with the subject have suggested that such a circulation of water must necessarily cause outbreaks of fever. This also is a mistake; it is the undrained swamp, 'combined with insufficient food and clothing,' that creates India's worst scourge—fever. Place the country under a wholesome and continuous system of drainage, and it immediately is free from the dangers of sickness to a very great extent."



THE ENORMOUS VALUE OF RIVER WATER OVER WELL WATER.

By every means in his power he endeavoured to prove that in her rivers, as well as in her rainfall, India possessed a mine of unused, and, as yet, undiscovered, wealth. To quote a favourite sentence of his: "Water is India's greatest treasure." One fact that he would sometimes state was the difference between the "ryot" system of watering the land, and the superior system possible to us by river regulation. The well water raised by the primitive bullock system would provide three hundred cubic yards of water for one rupee, and only just touch the surface of the earth; in river irrigation the rich stream so feeds the crops that no manure is ever required, while the crops follow each other in natural succession year after year. The Government can provide, by means of irrigation works carried out on a right principle, one thousand five hundred cubic yards of water for a rupee, or five times the quantity for the same money of a much more valuable article.

"The difference between well water and river water," he adds, "is this, that well water is not worth one-third of river water, because it contains no food for plants; while river water perfectly renews the soil; and, secondly, because well water costs from five to ten times what river water does. Nobody denies this, yet they always write just as if the one was as good and as cheap as the other. I have shown this in my last paper, as usual. There is no water lost in the canals by percolation. The river water fuddles them perfectly, but the cost of water, delivered on a large scale by river works, is so small that if the canals do lose some by percolation, it is a very small matter, and it must soon stop.

"How strange it seems that people should not ask, What does water cost by such and such a means of bringing it out on the fields? The Tungabudra, the most expensive of all the works, costs £1,600,000, and supplies 2,000



million cubic yards, which, at six per cent., or £100,000 a year, gives 20,000 cubic yards; but this is for bare raising, while the irrigation works include embanking, draining, navigation, etc., besides manure.

"In Godavari, the water costs the Government £1 for 60,000 cubic yards, with all the other effects. Nobody denies this, yet there is not the slightest allusion to it; for instance, in the common report, they write just as if water were water, whether it costs much or little, and whether it manures or not.

"As to the extent of land that could be irrigated at a practicable cost, there is literally no limit to it. At this moment they are watering from one end of India to the other, from millions of wells in every district, at a cost of five or ten times what it would cost to irrigate by works on a large scale.

"Mr. Robertson says that in Coimbatore it costs Rs. 20 an acre per annum. It costs the Government on an average six per cent. on Rs. 25, or Rs. 1½.

"It is passing strange that it should be only in the end of the nineteenth century, that people are beginning to find out that the sufficiency or insufficiency, the abundance or superabundance, the purity or impurity of water, on which depends sickness or health, wealth or want, life or death, ought to be the special subject of the attention of Government; and that when they have completely solved the problem of turning the stormy ocean from the great hindrance into the perfect means of communication between nations, at a nominal price of transport, they should have yet to learn that the same means will answer for the internal transit of countries, and is the only possible effective means; so that while they can bring the corn of India ten thousand miles through the storms of the ocean, they are effectually prevented from making use of it for want of the means of bringing it one thousand miles to the coast from the interior."



NAVIGATION TOPICS AND SCHEMES.

On the question of Indian traffic he writes :—

“The traffic through the Paumben Pass between Ceylon and the mainland is seventeen times what it was before the improvement; the main Godavari canal some twenty-fold probably; that between Orissa and Calcutta forty-fold, although the internal line is not completed.

“I am persuaded that the traffic in the Indus canal, if the North-West and Behar canals are connected, will be beyond any English ideas. Do you see the advertisement about the Panama canal? It gives the traffic in the Suez canal as half a million the first year, and four and a quarter millions now. And this without India being effectually opened. The freight to Kurrachee will soon be £1 10s., and with a charge of 10s. to Allahabad, together 1s. per bushel, the trade in various Indian grains will be immense.”

Sir Arthur compares cheapness of water with railway transit in a few terse sentences :—

“I wish we could somehow get Messrs. F. to understand the extraordinary circumstances of Kurrachee, that it must inevitably become one of the principal ports, if not the first; that it is the natural outlet of the whole of North India and of all Central Asia; and this, with its accessibility and nearness to England, gives it advantages which nothing can possibly counteract.

“But that the one thing it wants is *cheap* communication up the valley of the Indus. If a railway could carry at a halfpenny a ton, it would cost £3 10s. from the North-West; while a canal, at a tenth of a penny, would charge ten shillings, making a difference of two millions a year on a single million tons of wheat and other grains only, even when the prices in England allow of railway prices at all; but the fact is, it would make the difference between such a trade and none at all.

“In these matters we must always keep in view the conquest of the ocean. The cost of transit by sea must greatly



fall yet, low as it is. What is now before us in the way of large vessels, 700 or 800 tons, and the use of high pressure, will certainly reduce the cost of sea carriage before long to half of what it is now. The one thing now is to reduce the cost of inland carriage to correspond. If this be done, the increase of trade will be beyond all calculation."

With regard to the Indus navigation schemes, Sir Arthur wrote :—

"I think most probably that the line you suggest will be found the right one, if not the only one. I think there is no water communication between Ferozepur and the Sirlind. A canal of 100 feet by 7 feet would form a good navigation ; but if it is to water half a million acres from the Sutlej in the Punjab, and as many from the Indus in Sind, it must have a section of about 250 square yards, with a current of 3,000 yards.

"It has been of late a great question with me, whether for these large canals it would not be more economical to make them twelve feet deep ; and this is one of the points to be well considered. If twelve feet deep it would require to be sixty yards broad. The cost of the canal is not in proportion to its breadth. The two banks will be the same whether thirty yards apart or sixty. This is one of the things that make the large works so profitable. I think £3,000 a mile would probably be sufficient for the main canal, but to this must be added all the distribution works and river regulation, and drainage works.

"The supply for irrigation must be by leading water from the rivers, because it will be so much cheaper than pumping. The navigation might be supplied by pumping, where no irrigation is, because the quantity is so small.

"Even for navigation purposes the canal must be very large, for we must keep in view a traffic far beyond anything that people usually suppose. We must certainly provide for several million tons. You see how enormously the trade of India is increasing without cheap transit. Really cheap transit will give a stimulus to it that nobody now dreams of. The aqueducts over the Indus and Sutlej



would certainly be heavy works, but being only two in a line of nine hundred miles, they would not tell very heavily upon the mileage."

To a leading irrigation official in India he wrote:—

"Thank you for a most encouraging letter. What a wonderful change of affairs! Lord Mayo seems to come into your views astonishingly. Thank you also for the hint about F., which was very important. I have written to Frere,¹ telling him what a hopeful letter you have sent me, and how I hope that his great projects coming under your review will now be heartily forwarded. A year of your reviewing of the great projects now in hand or estimating will, I hope, give such a start to irrigation and navigation as India will never forget, under God's blessing. It seems as if you couldn't have come in at a more critical time, with such a vast extent of work sketched out. The Sind, Ravi, Sutlej, Jumna, main Ganges, Eastern Ganges, Sone, Lower Ganges, Mahanudi, Godavari Delta, Upper Godavari, Kistna, Tungabudra, and Tanjore—fifteen great works all more or less within reach of your revision, involving ultimately more than twenty millions of expenditure and the irrigation of fifteen million acres with ten thousand miles of navigation, besides many minor works, and especially the great storage works. So you have got a field wide enough before you. The completion of the first tank, viz., Ekrookh, is a grand point gained. And at this moment, too, the great point has been conceded and acted upon of borrowing money for such works, only £3,500,000 indeed this year, but I hope you will soon get that increased. That Lord Mayo should at once begin by resuming the Orissa works is beyond all my expectation. Of course, it will be a question at what rate of speed each individual work had best be carried on, but we must always take care rather to err on the side of making hay while the sun shines.

"What a point it is, too, that you can give the Sone

¹ Sir Bartle Frere, G.C.S.I., then a Member of the Secretary of State's Council.



such a start! I think you should do your utmost to get the line undertaken at once throughout its whole length to Allahabad, especially now that the point is established that the communication above is to be continued to that place. I consider this completion of the line up the valley of the Ganges of such extreme importance, that I would press these works on to the utmost. I see in a *Times of India*, to-day, that the railway cannot beat even the Ganges. They are paying, I think, £3,500,000 for goods by railway, on which alone there would be a saving of £3,250,000 if carried by water, and ten times the quantity could be carried. There is a sum of £1,750,000 paid on the Ganges railway alone for goods, on which the saving would be more than £1,500,000 a year, and only about two hundred thousand tons carried instead of two millions for the same money. The canal will certainly force itself on, but I would certainly at once undertake every mile of it that I could. I would also urge the aqueduct at Allahabad to connect the Doab canals with those of the Sone, as an essential work to be commenced at once if possible. Could you not also now put the navigation of the Ganges canal on an efficient footing by putting Government steamers on it?

"Pray consider what I say about your proceeding as soon as you can see your way a little. What is wanted is the connection of the various irrigations, so as to complete steamboat communication from Ludiana, by the Sutlej, Jumna, Sone, Ganges, Mahanudi, Godavari, Kistna boat canals, and one from Nellore through the Carnatic to Ponany, so as to bring produce to a point opposite to Aden at an almost nominal cost. That's the grand object."

To the same correspondent he further wrote :—

"It is impossible to over-estimate the importance of completing the line from Burdwan to Calcutta.

"About crossing the branch rivers, I can't give you my ideas without referring to your note. I would send the water through an aqueduct across the Bhagavati at four



thousand or five thousand yards an hour, two or three times the velocity in the canal; it would save so much time as well as money, and I would consider thoroughly how far the work could be hastened by the use of iron, even at an increase of expense. And so with the anicut also, whether you couldn't receive the fall, for instance, on an iron apron instead of stone, as it could be laid in so very short a time. I wish you had sent me profile of the line of canal; I forget the level of Colgong or Rajmahal.

"About the locks for the large steamers, I would not make them for the present river steamers; it would require such an enormous width. When the whole line of canal is completed, of course all the steamers ought to have either stern wheels or twin screws, or, what I think would be best, a large wheel carrying a chain with small plates, say six or twelve inches square, passing over a small wheel in front and rear, so as to give a great resistance by direct action, with very little breadth beyond that of the vessel—the main wheel very large so as to give a high velocity with a slow action of engine.

"You will certainly have a great difficulty in the enormous body of water you will have to dispose of in the river, but your experience in the Muddur branch will come in well there. I think upon your plan of large gabions you would be able to master an immense stream.

"In other respects you certainly have a magnificent site. You do not tell me what you allow for the cost of the anicut; allowing for the difference of length, and three times the cost of labour, it would be £450,000. You estimate the extreme flood at two hundred millions, the same as the Godavari, which is several times independent of the irrigation. You should, of course, have a branch to connect the main canal with the Ganges somewhere about Rampur-Bauleah.

"Have you seen my memo. about high level navigation canals, with a sketch of one to connect the Gorai with Calcutta? I think that would be about the most valuable work that could be executed for the money. The Secre-



tary of State said he had forwarded the papers about it to Calcutta.

"I am putting on paper some loose thoughts about your noble project. I hope to go into it more systematically when I get home. A man who is entirely free from the pressure of the innumerable worries of office has an immense advantage in offering suggestions, though of course most of them may be nothing, because he has not the necessary detailed data; but a wise man may turn some of them to account."

The above letter referred to a large scheme which had been projected for a canal from the Ganges at Sahibgunj to Calcutta, but which was indefinitely shelved.

"I get to-day a letter from [Sir Robert] Montgomery, saying no doubt cheap transit is the great want of India. It is no small matter to have arrived at such a point as that this heresy is held by a Member of Council. And another letter enclosing a pamphlet pointing out the superiority of water to land carriage in the South Mahratta country. There can be no doubt that people are getting upon the right ground now. Fresh water against salt, even with fish in the latter, any day !

THE BENEFICIAL EFFECT OF REDUCING THE LAND TAX.

"The experiments, which have been tried in India with success as respects relief to the finances, are those which have been merciful to the people. One of these is the lowering of the land tax. There are now, happily, many districts which are proof of this. I will give two instances. In South Arcot the average extent of cultivation, for two years before the reductions, was five hundred and ninety thousand acres, and the land tax £230,000. The reductions made amounted to no less than £95,000. The extent cultivated last year was nearly one million acres, and the tax £290,000. So that the same population are now cultivating four hundred thousand acres, or sixty-six per cent., more than they once did, and at the same time



WHAT A REDUCED LAND TAX EFFECTED 453

the Government are receiving £60,000 more than they did, an increase of twenty-five per cent. And in Trichinopoly in the same way, the increase has been more than fifty per cent. in the area, and £20,000, or sixteen per cent., in the revenue. These are most striking proofs of what the old, ignorant, merciless, suicidal system was, and of the effect of a more merciful one.

"Here is a district cultivating more than two-thirds more land than it did, and, as the whole condition of the people must be greatly improved, there can be no doubt that the whole district is also far better cultivated than formerly; so that probably the land produce of the district is double what it was before the reductions, and the people must be paying £290,000 a year now much more easily than they did £230,000 before. The average land tax has been reduced from Rs. 4 an acre to Rs. 3. Think of a people able to cultivate one million acres, compelled to subsist on the produce of six hundred thousand by the intolerable tax laid upon the land! And, incredible as it may appear, it was chiefly the good land that they were prevented from cultivating by the intolerable tax demanded. It was Lord Harris who made these bold trials of a more merciful system, and the country is most deeply indebted to him, under God, for such a lesson, a lesson applicable to every branch of the management of the country. In these two districts alone is an increase of £80,000 a year, obtained entirely by lowering, not by raising, the taxes."

Still on the question of the work in India, he writes on another occasion :—

"I am so surprised that you have not seen that letter written in November last, but which I only saw the other day. In it S. expressly states that he is quite satisfied that his former views were wrong, and that I was right, and that an officer was to be sent to plan a new head for the canal below the hills. You may suppose what a pretty discussion this has produced in the Council. My friends are urging its publication, which, of course, the rest object



to, but they have advised me to get an M.P. to call for it, and I have spoken to one about it, who will probably do so. It is a most remarkable document, and I must confess gives me a new idea of S., for there are very few men who would make such a hearty acknowledgment. It is really a matter of vast importance at this moment.

"I have thought that if I had works to execute again I would look everywhere for a man who had the peculiar talent of choosing modes of execution, and give him that sole department, laying before him the plans and estimates of each kind of work, and requiring of him a report on the kind of apparatus, etc., to be used. I think it would be essential that he should have no charge, but be at liberty to go and get his apparatus to work, for the best-planned apparatus and means require immense work actually to apply them.

"I am very glad to hear such a good account of Four-acres. I thought him a very remarkable man; his management of his industrial school showed that he had some rare talents. Pray remember me to him, and tell him that I am so glad to hear how useful he is.

"You mention the extended Sone project, from which I hope that you are trying to carry out the full project. Pray try and secure the opportunity for completing the line of navigation to Allahabad and Cawnpore. I wish you could take up the high-level canal from Calcutta to the North-East, which I wrote to the India Office about, and which was sent out to Calcutta; it would be a trifling work compared with your others and would be of immense value. I see in a report of D. on what Lawrence did, or rather it should be on what he left undone, that they propose making a connected navigation of all the canals in the Punjab and North-West, eight hundred miles in one line, another proof that they have really learned something about transit."

On another occasion :—

"I am rejoiced to hear that the canal from Cuttack to



tide water is open; that is a grand step. I wish the last link between Calcutta and the Mahanudi were completed; this is of incalculable importance. I hope it is in hand. If you should write again some months hence, pray mention this. I shall be so glad to get an account of your final planning of the Lower Ganges (Rajmahal) project. You could send me a copy of your report on it without any personal labour. It will certainly be the greatest work in the world of that kind, and the most valuable. The traffic on it will be the greatest on any line of transit.

"I am so glad to hear that F. had gone on leave for two months; he certainly greatly required rest. I am in hopes that the Godavari works could now go on under other hands, and that he could be spared for higher work, where he would have less demands upon his physical powers. I wrote to Lord Mayo about him, and I find that Montgomery did the same. It is high time he was relieved from executive duties. I had a letter from him the other day mentioning many items of good news from the Godavari:—

"1st. The merchants have made arrangements for bringing down the cotton from the Warda this year;

"2nd. They have found usable coal at the first barrier;

"3rd. The trade of Cocanada is increasing remarkably. What will it be when the port is the outlet of twenty millions of people? and

"4th. Fischer has found a noble site for a tank with a fall of only four feet per mile, to contain one thousand millions [cubic yards] with a bund only seventy feet high, and four hundred yards long at top. This one would completely keep the Godavari open, and supply the delta in the dry season. The Godavari is lower than ever known, which is all in favour of his present work in the bed.

"The new steamers are a complete success, though still drawing more water than calculated."

A little later, to the same correspondent:—

"I saw Frere in London; he was very anxious to know what you would do about his great Indus project; the



last he had heard of it was that the Governor-General was determined to quash it. Of course, I told him you had written to me about it, and you would certainly do all you could to support it. The point he was anxious about was, of course, whether you would be likely to prevent its being quashed.

"I am highly pleased with all I hear respecting H.'s great tanks, and am not sorry one of them has a masonry dam, that they may be fairly compared, though I certainly would not, even on the score of expense, much more on that of safety, have tried a masonry dam, especially in a place where such awful mischief would be done by an instantaneous breach. I am glad to hear it is ten or twelve miles from Poona, but that is too near a great city. If the Sheffield reservoir had been of masonry, and had given way, instead of two hundred and fifty-two deaths, there would have been several thousands.

"Pray look well into the strength given to that bund, and don't spare to add enormous buttresses. If there is not a great superabundance of strength, a terrible accident from one of those great tanks would hinder the storing of water for many years.

"These two tanks give us capital data for the cost of storing; the sites were by no means the best that could be found in India. In many places water could be stored for half or a quarter what they have cost."

"I had to leave off in the middle of my letter yesterday before I had answered your two first letters. I have received no communication from the India Office in reply to my memo. As the Duke of Argyll promised me, so I have written to him to-day to remind him of his promise.

"F. thinks they will at once stop the Godavari works. I have not heard of Chesney's paper; of course they take care that I should not see it. I have not seen Chesney; I was asked to the opening of the Cooper's Hill College, but I didn't go. I have told the Duke that as I am sure he has fulfilled his promise, that he would have my memo.



answered, I trust he will have me furnished with copies of any papers that have been written.

"It is true that there is about an equal quantity of coal carried into London by rail and by sea, but this doesn't affect our question. We are not contending for carriage by sea, but by steamboat canals, and not in England but in India. I am certain that the railways earn less by the carriage of coals, and some of the lines are losing enormously by it; but the price of railway shares rises and falls with the reported amount of traffic.

"There are ten steamers a week each way from the mouth of the Forth and Clyde canal to ports in England, and the railway company there rent the canal at six and a quarter per cent. Their manager on the canal told me, he didn't think a ton of goods was sent from there to London by rail. There are about four thousand steamers a year running along the east coast, carrying, I suppose, much more than a million tons a year, regular ones, besides innumerable ones carrying coal, etc., parallel with the railways, but with a long detour, river charges, etc. The railway running by it, which I suppose is the one that rents it, the North British, I suppose its dividends are not above two per cent. But the peculiar thing about the coal traffic is that accidents are becoming so numerous that some means must soon be adopted to separate the goods and passenger traffic; and it has been actually under consideration to lay a fifth double railway to the north solely for goods traffic. The coal, three and a half million tons, is divided between three double and one treble railway,—four hundred thousand tons per line of rails, or thereabouts.

"I have not the least doubt that locks can be passed in about two minutes when a thousandth part of the thought and money has been expended on steamboat canals that has been applied to the perfecting of railway arrangements. And on many lines in India, such as that from the Punjab to Calcutta, there would be hardly any locks. I consider it now of the very first importance that everything should be done to bring a line of canal to a most effective state for



both goods and passenger traffic ; one such line would do more than anything else to remove the present ignorant prejudice about water carriage. I was running along the Clyde and its locks in a steamer at from sixteen to eighteen miles an hour, carrying first-class passengers at about one halfpenny per mile, though the boats are laid up half the year or more, and, in an open estuary, are, of course, almost empty in stormy weather. I am sure they could average twenty miles an hour, including locks, in India at one farthing a mile first-class, if the canals were thoroughly suited for high speed. Not that I think speed of any consequence in itself, because I'm sure that for forty-nine-fiftieths of the goods and passenger traffic of India there is no need for speed.

"Brereton has written such an extraordinary account of California and a project for watering the valley of the San Joaquin ; the advantage in soil, facilities for storing, and distributing water, etc., are far beyond those of India."

A good prospect opened at one time in the South Mahratta country of a navigation system. Sir Arthur Cotton wrote :—

"A Major D., of the Engineers, has proposed the navigation of the Southern Mahratta rivers, and thinks of trying to form a company for it. A Mr. Andrew Hay, of the Oriental Club, sent me his pamphlet and asked my opinion, and whether I could take a part in the matter. I told him I was no man of business, but I thought he might write to you about it, as it might suit your plans. I entirely approve of the idea, so much so that I got the Irrigation Company to send an engineer to explore the country with that view, and I have his report. But, unfortunately, he preferred his own ideas to mine, and wrote a paper not on navigation but on irrigation, so that it contains very little information that bore upon the question, and he was, like most other people, quite ignorant of the whole subject of transit. It would exactly suit my ideas if this project were to be taken up by a company, so as to afford the instance



DUKE OF BUCKINGHAM AT GODAVARI 459

required of a level tract of country with water carriage. I sent Mr. Hay a letter containing some of my leading ideas on the subject, and have written most of a more digested paper on it.

"It is a perfect field for the exhibition of the system of storing water for the three objects—

"1st. Controlling the floods ;

"2nd. Navigating the rivers as they are, that is with partial improvements ; and

"3rd. For supplying the irrigation and navigation of the lower works, the Tungabudra, and Kistna delta, in the dry season. One thing Mr. Gordon states is that one hundred and seventy miles of the Kistna have a fall of seven inches a mile, so that a beginning might probably be made by putting steamers on that at once. In the meantime we have data of all kinds to go upon, the steamers on the Godavari, the tanks at Ekrookh and Sholapore, the anicuts and locks on the Godavari, the traffic in the delta, etc. So that a company would start with wonderful advantages.

"They have a magnificent country and a dense population to work upon in the Mahratta country, and nothing wanted, but cheap transit to a capital and port, to put entirely new life into the whole tract."

In another communication, written in 1876, he says :—

"Do you see that the Duke of Buckingham has gone up to see Kistna and Godavari, which looks well? I am glad also to see that they complain of his throwing over his Council. I hope from this that he's going really to govern. I never could see the use of a Governor subordinate to his subordinates." He adds :—

"I am also very glad to see Pelly is to be a member of Council ; I hope he will be a great improvement on the old *régime*.

"Pray tell me something about Lord Lytton. I am thinking of writing to him and asking him to let me see him.

"I wrote to Captain Warren to ask him to allow Dr. W. to use his name, which he has readily consented to. He



has sent me a most striking pamphlet of his on Palestine, showing how ripe it is for restoration, and wanting nothing but a just government to enable it to start up a young giant."

More details regarding navigation appear in the following letter :—

"I will send you the account of the passage of a regiment of natives through Madras, on their way to Bezwada, by canal. There is only a break of eight miles on that line now, and it will soon be finished. The traffic was three hundred thousand tons on the old canal. What will it be when it is in full operation to Cocanada and the Godavari? The contract rate for the regiment was : sepoy, seven miles for a penny, and the followers fourteen miles for the same amount. I reckon that with steam, even at ten miles an hour, the cost would be almost nominal.

"Fancy the Chamber of Commerce protesting against the Junction Canal being cut! This is a work of immense importance. It is long enough, and on a sufficiently important line, to show very well what water carriage is. Only think what the traffic would now be if the second barrier had been completed, and the third executed, so as to give Madras cheap coal and the whole trade of the Central Provinces! And if the line had been cut to Cuddapah! As it is, there are fourteen miles of connected canal and river open.

"The works in Bengal are getting on very well; everything there is very promising. That's a grand idea of Eden's to open the lower line to Ganjam. There will then be three hundred and fifty miles from Calcutta towards Madras, and four hundred and twenty from Madras towards Calcutta. The Sone works are getting on wonderfully. I had no idea of there being eight hundred thousand acres ready for irrigation. Why, in the estimate for the next year, does Eden suppose that two hundred thousand only will be irrigated? And why should he suppose that the navigation tolls will be the same as this year? I should think it much



more likely they would be increased tenfold. We have abundant room for the hope that next year's receipts will be many lakhs more than he estimates. The increase of sugar is a great fact. How immensely important it is that they should store water for that.

"I am so glad to see the way Levinge speaks of shutting the canals; I now hope that this insane proceeding will be stopped. Fouracres's improvement of dredging is a thing of the very first importance. I am greatly pleased with Levinge's letter. It seems to me to show that *he*, at least, takes hold of things by the handle and not by the spout. I think the Sone works must have fully paid their interest this year. Certainly not more than £700,000 can be charged to the works already opened, and £50,000 gives seven per cent. on that. Have they cost two millions up to this time? I wrote to Levinge, and begged him to send me various particulars as to cost, etc., etc.

"I will send you the Madras report. The watershed of the Kala-Nuddee and the Tungabudra is about two thousand feet, that of the Cauveri and Ponany one thousand four hundred feet. I think we should try to concentrate attention on the Carnatic tanks at this time while the iron is hot. C. [Sir James Caird]¹ will be examined, and he will not speak out about irrigation. His not seeing the improved districts is conclusive as to his not apprehending the case, or not being willing to face the current. Had he had a right apprehension of the case he would have concluded that the very first thing he had to do was to see the districts which, in point of famine, finance, and social state, were in a perfectly satisfactory condition, and that no others were. Every one of the speakers in the late debate, Bright and all, left out entirely every one of the essential points of the question. Not one word was said of the effect of all the improvements. Have six hundred miles of railway, some five thousand miles of canal, and improved

¹ Sir James Caird, eminent as an English agriculturist, was a member of the Famine Commission of 1879-80; he visited India, but, as Sir Arthur Cotton points out, did *not* visit any of the irrigated districts!



river, and one hundred thousand miles of road, besides innumerable other things, made no difference whatever in the power of the people to pay the taxes?

"In Mr. Hyndman's account of the state of the people, he omits the trifle of the wealthy classes. Fancy a man giving an account of the state of London in respect of property, and utterly ignoring everything west of London Bridge! Of all the enormous wealth of India he says not one word; of all the wealthy landowners, merchants, sowcars, with incomes of £500,000 a year, equal to £1,500,000 in England, downwards, he says nothing. The Rajah of Vizianagram has an income of £120,000 a year over his tribute, equal to £360,000 in England."

Large schemes still occupied Sir Arthur's mind.

"I am writing a paper on Madras," he remarks, "sketching out about twenty-five works, to cost fifty millions.¹ I am myself quite astonished at the result of the investigation. The Presidency may certainly be made into a perfect garden, with the most complete system of cheap transit, and with two ports better situated than any now in existence, Ponany and Cape Comorin.

"With respect to population for the Indus Canal, there are plenty in the Punjab. Fred says a great deal was said about the fear of want in this, in Sind. The land is freely taken up for irrigation in Orissa and Midnapur, to the end of September,—one hundred and thirteen thousand and one hundred thousand acres respectively. There is also a good increase in the Lower Ganges and the Agra; but I am disappointed about the Sone, only seventy-four thousand. What is the cause of this? Ganges Canal, to September, four hundred and twenty-seven thousand; Lower Ganges, twenty-seven thousand; Agra, thirty thousand."

Of the author of two most interesting technical works on the Godavari and Kistna deltas, Sir Arthur remarks:—

¹ See *ante*, pp. 301-303.



IRRIGATION UNDER SIR ASHLEY EDEN 463

"I have had Mr. Walch, of Godavari, with me to-day. He gives a most flourishing account of the state of the Western delta, vast improvements in the works, and a state of prosperity surpassing probably any tract in the world. They will soon irrigate three hundred thousand acres in that delta alone. He says Brownlow and other foreigners expressed their astonishment at the result, and especially at the traffic, in the strongest manner."

To the correspondent who received most of the preceding letters, he wrote in November, 1878 :—

"I am astonished to think that I never answered your last most interesting long letter, and now I have another as interesting. I have loads of things to say about both letters. I will begin with the new one. The accounts of Orissa are altogether satisfactory. If I had only had these extracts when I was before the Committee! The water rate levied is a very small matter compared with the water being used. It is, of course, a good stone to throw at a dog to show that the works do not pay the Government. But the great thing is that the country should have the benefit of them.

"Fancy the irrigation under Sir Ashley Eden being already ten times that in Sir George Campbell's time. Is that a result of the change in the works or in the management? I will copy these things for Caird.

"I received the papers about the canal to Calcutta. Mr. Wyllie's report is of the highest importance. What do you now think is the increase of crop due to the irrigation there? F. at first wrote a paper from which I made out that it was about Rs. 15, but since he has made it much less. He said in one paper that the people in Midnapur had begun to empty their fields of rain water in order to fill them with river water. I have no doubt this is the grand thing to get them to do. I reckon that if they carry out the whole scheme the cost will not be more than Rs. 30 an acre, and the water rate alone at Rs. 2½ will be eight per cent., besides tolls, giving a net return of about



seven per cent. in all on the cost, and five on cost and interest. But what will the whole return be? At £1 an acre, with saving in carriage, protection of land, etc., certainly fifty per cent. There cannot be a question but that the whole province is now rapidly rising out of its dreadful state of depression. The astonishing increase of trade alone is conclusive of this. What will be the trade when there is direct communication with Calcutta by canal? Pray send me the navigation returns.

"I greatly approve of all that has been done, and the way it has been done. Now suppose that sickness or anything should bring Lord Lytton home, the country would certainly call for Frere, and then what might take place with respect to irrigation and navigation? I am so glad [R. K.] Puckle [of the Madras service] had several interviews with Caird; he knows more about Indian agriculture than anybody, and was just the man to give him solid information. I am glad to hear that [General Sir Richard] Strachey is likely to be at the head of the Commission again. I think he is the best man we could have to be associated with Caird.

"I look upon Cyprus as a most wonderful acquisition, and, in connection with the appointment of Midhat Pasha to Damascus, and the arrangement of a loan for Turkey guaranteed by us on the security of the revenues of Syria, I consider it tantamount to our having the complete control of Palestine."

An important letter, that is to say, one explaining this method for keeping the tanks in the Madras Presidency supplied from the never-failing large rivers in the Peninsula, must be quoted because of the light it throws on the great project Sir Arthur submitted to the Select Committee Inquiry, in 1878. He says:—

"Mrs. Caird read me several extracts from her husband's letters, from the Punjab, North-Western Provinces, Oudh, and Bengal. He was leaving Calcutta for Cocanada. He was greatly interested in Indian agriculture. He said nothing about what he thought of the irrigation works.



He went over the Sone works with Haig. Haig was to leave Calcutta in the middle of last month, and to go to Doomagoodien. Levinge succeeds him. I think he must be the best man for this, and that he will heartily support Eden in his energetic proceedings. I see they are bringing forward a bill for extended irrigation, with compulsory water rates, at Bombay. The amount proposed is £3,500,000. Somehow or other they have made a very poor business of it in Bombay. You see [Sir R.] Strachey is taken off the Commission, and another member has left from ill health. Lord Lytton asked Mr. Caird to select a colleague in place of the last. He wants Scott-Moncrieff.

"I have sent Caird a rough sketch of a project for supplying the Carnatic tanks from the Tungabudra and Kistna, to cost, perhaps, £34,000,000. Its foundation is the great Bellary tank, to contain three thousand million cubic yards, and deliver, during the five months, twelve thousand million cubic yards, leaving it full at the end for dry season watering. From it one large canal on a dead level to the Kistna, where there would be either anicut or a tank, which would support the Tungabudra one. From the reservoir a very large canal to carry the water clear of the hills, and then to divide into four canals. One to carry water to the Eastern ghauts above Chittoor, and discharge its water over the ghauts, into a dead level canal to cross North Arcot on a level of perhaps one thousand feet. A second branch would carry the water to a feeder of the Pennair, and by that river into Nellore, with an anicut at the entrance of the hills to turn the water into a dead level canal from the Kistna to Tinneveli, and thence to Cape Comorin. Anicuts to be thrown across all the rivers in the Carnatic to turn their waters into the level canal, by which they would be carried both north and south, and distributed to the tanks under it, so as to make the most of the short floods in those rivers. This canal to be one hundred yards broad and four deep. From it two branches would connect it with Madras. From the Kistna I would carry a similar great canal, through the Nizam's country, passing near



Hyderabad to the Godavari and Kistna, having a fall of four or five inches. I would also connect the main canal from the tank with the Irrigation Company's canal, and water a million acres in Bellary. This would give grand lines of communication through Hyderabad, the Ceded Districts and the Carnatic, and secure the irrigation altogether of some twenty million acres of dry cultivation. What do you think of such a project?"

Interesting letters were often received from intelligent inhabitants of Southern India, expressing their gratitude both for personal kindnesses rendered to them, and also for the general prosperity that had come to their districts by the Cottonian irrigation works.

A few of these, herewith given, show both gratitude and appreciation,—yes, gratitude, even though there be those who have resided in India who declare that the quality is unknown to Indian races. One Indian gentleman writes:—

"I always feel thankful, first to God, and then to you, for my prosperity in this world. I have been reading for several years about irrigation works, but, although it is a well-known fact that they are beneficial both to Government and to the public at large, yet it cannot be said when worthy projects will be thoroughly realised.

"It is hard to understand what is meant by the statement that the ryots refuse water, which is contrary to the real fact. The authorities must have accepted the reports of some inexperienced and young officers in India. Some say that the excessive water spoils the land. Allowing it to be so, why not adopt proper measures to make bunds, and so prevent the water submerging the land, and use a proper quantity when required?

"In the month of January last, a member of Parliament came to Madras, and I had the pleasure to meet him at Government House on a certain night, and to hold some conversation with him on irrigation. I explained what was necessary for India, and the benefit derived from the Kistna and Godavari anicuts. I was glad to find that



"THE FATHER OF THE GODAVARI DELTA" 467

he concurred with me that irrigation works are much needed."

The Godavari District Association wrote of him as "Sir Arthur Cotton, the Father of the Godavari Delta," adding :—

"This Association and the people of this district are immensely pleased to know that he is still strong and active. They ever remember him with feelings of gratitude, and ever pray for his long life and prosperity. The Association has not been able to get his address hitherto, to send him a copy of the Memorials. His views of them will be very valuable indeed, and must necessarily carry great weight.

"The Association proposes to build, rather, is building, a town hall here. It will be a decent building, which will cost between £1,500 and £2,000. It wishes to place in the hall a picture of Sir Arthur Cotton."

The same society, through one of its influential Hindu members, wrote to Sir Arthur, as follows :—

"Allow me, Sir, to assure you, and I hereby convey to you, very feebly, the voice of the people of the Godavari district, that there is not one man in the whole of the district who fails to remember your name on looking at the magnificent anicut that your providential genius has been able to devise and construct for him, and the network of canals that you gave him. He sows the seed in his acres with *your* Godavari water, raises corn with *your* Godavari water, cooks it with *your* Godavari water, eats it with *your* Godavari water, and drinks *your* Godavari water. Your long and arduous labours in connection with these water works have justly placed you on the high and proud pedestal of the Godavari people's grateful memory! And it is a very rare honour, denied to many, that one's name should be gratefully remembered for generation after generation by the people amongst whom he spent the best