"Yet in this same paper the writer dares to quote the Holy Scriptures and say, 'Every enlightened Hindu and Mahommedan, as well as every enlightened Englishman, may cordially unite with us and join us in praying, in the words of the Psalmist, that "our works may be so done in truth and equity as to stand fast for ever and ever."' We do most heartily pray that Mr. Laing's works may not stand for this one year."

Throughout these years, India's needs, and the remedies for those needs, were my father's constant thought. Growing deafness kept him more and more to that privacy which, though a great hindrance to his intercourse with friends, was never allowed to be a hindrance to his literary activity. Much of his conversation was carried on by slips of paper, on which the converser stated his point and Sir Arthur replied *viva voce*. Quite a number of these "conversation" slips are in existence, many of them in the handwriting of Mr. Robert Scott, of *The Christian*, who spent several hours every week with Sir Arthur during the last two years of his life. One of these one-sided records—reminding one of a telephonic conversation heard by a bystander—the answers to which can often readily be imagined, though they cannot be heard, may be given. The "writer" was Bishop Thoburn, a most experienced Indian missionary; the speaker, "whose words are silence," was Sir Arthur.

NOTES OF A CONVERSATION BETWEEN BISHOP THOBURN AND SIR ARTHUR COTTON.

Bishop: We have a mission at Sironcha and one at Ingdalpur in Bastar. Both are new. We wish to open mission work at other points.

I am in my thirty-ninth year of service in India.

It is given out that Lord Cromer cannot leave Egypt this year.

And a strong man is needed as Governor-General.

The whole Godavari country is looking up. We have planned for a mission with stations at Raipur, Ingdalpur, Sironcha, and

possibly two other stations in Bastar. We have three thousand famine orphans, and intend to settle many of them there.

I have not been nearer than Jellandu coal-field—two years ago.

General Haig used to worship with us in Calcutta, and held meetings constantly among the seamen. For several years he and I were constantly associated together. He often told me of his work on the Godavari. Some of his mission work is now in our hands.

I superintend our missions all over India. The work has spread down to the Straits, where there are now many Chinese colonists. We are now preaching in twenty-four different languages and districts. We have one hundred and ten thousand Christians of all ages, and two thousand native preachers of all grades. The work extends very rapidly among the lower castes. We are greatly straitened for means, owing to reductions in the grants from home, and the rapid extension of the work. But for this we might succeed to almost any extent.

A Commissioner in North India said some years ago, in his official report, that if our work among the Chumars went on, it would lead to a revolution. He feared for the result. In every direction the lower castes are waking up.

Many of the Hyderabad officials are friendly to our work. They aid us in many ways.

They will take up irrigation again before many years. The Nurbadda could have saved the valley in the recent famine. In all sub-mountain regions irrigation could be introduced by forming reservoirs among the hills. Sir Henry Ramsay did this with perfect success in Kumaon.

Ours is an American mission. I came out in 1859, when twenty-three years of age. Most of our missionaries are Americans, but we have some representing England, Scotland, Ireland, Wales, Germany, and Scandinavia. Our foreign force is not increasing. We aim to give increased responsibility to Indians, and this gradually puts responsibility upon them.

Men love to do as they did in ancient times—follow "the traditions of man."

I am much pleased to find that you have read a brief account of my work, and it greatly encourages me to know you approve my method in baptism. I was *led* into it, and after finding this

path I discovered that it is the very way the New Testament deals with the question.

They were left to the development of Providence.

Only the simplest elements of a system of government are found in the church of Pentecost. The situation was new. We are on the threshold of a *new era.*

How many years did you spend in India?—Forty-five years. I shall quote that freely when I go back to India.

You quite believe in a system of great reservoirs, do you not?

There has been a revolution in medical treatment even since I came out. They told me I *must* drink brandy-pāni. For thirty-six years I have abstained, and now I feel that I am still a young man. We have now three thousand orphans under our care in India. Most of them are survivors of the late famine. It is a great delight to me to have this interview with you. It will interest people in India intensely to hear of your welfare. You are truly "a wonder unto many."

CHAPTER XVII

Life in England—Letters from Florence Nightingale, Sir Bartle Frere, Sir Colin Scott-Moncrieff, R.E., and others

WHEN my father went to India, after his retirement, and on special irrigation business, we removed from Devonshire to Tunbridge Wells, where we awaited his return. When he rejoined us there, later on, it was his last home-coming; though sundry schemes were on foot in after years, and he had thoughts and opportunities of returning, he did not again leave England. Instead, he endeavoured to serve India in this country, by trying to gain the support of those who had power to carry out his great schemes.

He longed for quiet and freedom from too much social intercourse, and often sighed during the few weeks after his return for a real country life. His resources were endless, and he had never known, perhaps for one moment, the meaning of the word *ennui*; he did not like his time broken up by constant visiting.

While at Tunbridge Wells he thus wrote to a friend: "I find they have been making a great mistake all this time in examining the wrong branch of the Tungabudra for sites for tanks; they have reached the Eastern, which is the one with the great fall. I could not understand what they told me about the site having so great a fall; it never occurred to me as possible that they could be wasting their time on the wrong branch. I forget whether I sent you Fife's letter; if not, I will send it. He was

hoping to begin soon upon a tank of three hundred million cubic yards. This is the grand thing; if once the storing of water upon a large scale is begun the battle is won. It is curious how both Calveley and Haig have been baffled on this point for so many years. Rundall has a most noble site, on the Tel, which drains the western slopes of the Eastern Ghauts, when the rains are so excessive, two hundred inches at Jeypore. They plan a tank of two thousand millions with a bund of one hundred feet. I have nothing yet from Calcutta. The India Office Engineers are going to make another desperate effort; they think, I suppose, that C. had not made the most of it."

It was at this juncture that he was summoned, with a party of other engineers, to examine into the cause of the disaster that took place at Sheffield, when the embankment of a reservoir suddenly burst in the middle of the night, and a great portion of the city was flooded. He received a telegram early one morning while we were at breakfast, requesting him to proceed to the spot to aid in investigating the cause. His portmanteau was at once packed, and we went by the next train; I say "we," for he would have me go with him to see the wonderful sight. He suggested our going on to Ireland, that we might pay a visit to Lord Roden, who had married a connection of ours, and had most cordially invited us to stay at his place in County Down.

No sooner said than done. Two hours had not elapsed before we were on our way to Sheffield, and, during our long train journey, I had to listen to the discussions of the five engineers, who were travelling together to inspect this important work.

When we arrived at our hotel the scene was an unparalleled one. Confusion reigned in every street, and the sight that met our eyes was indeed strange. The water was pouring in a vast volume down the river bed and far beyond it on either side, carrying with it houses, haystacks, boats, farming implements, and every other imaginable species of wreckage in conglomerated heaps.

Amongst these strange piles were many bodies of unfortunate people, who had been swept away from their houses by the rising water and drowned, whilst men lined the sides of the river, dragging out the bodies, and laying them on the higher ground. It was altogether a terrible sight, but fortunately lasted only a short time as the torrent naturally soon subsided.

Our two days at Sheffield interested my father greatly, as it lay so entirely in his own line of work. We also visited some of the great steel and iron works, and saw the huge plates for the sides of iron-clad vessels prepared, as well as the delicate manipulation of a dainty pair of scissors.

On our journey from Sheffield, the engine broke down, and for two hours the passengers were delayed. My father devoted the period to a study of the engine and the cause of our misfortune. He soon was master of the whole subject, and when some one commiserated us at the end of the journey on our loss of time through this accident, his reply was, "Loss of time, do you call it? I thought it the most interesting and useful two hours of the whole journey."

We soon arrived in Ireland, and after a long drive of about eighteen miles from the station, we were rewarded by the interest of driving up to the great gates of Tollymore Park: he was perfectly entranced with the view; mountains rising over mountains, all tipped with snow, and also the hills richly wooded, ending abruptly in a delicious ravine, through which a bubbling, rushing stream-torrent flowed, sometimes tumbling over the rocks in waterfalls and cascades. The house stood amongst the woods, surrounded by shrubs, and fronted on the west side by an immense bed of rhododendrons just in flower. But it was the mountain view that so enchanted him. From the house we could see the sea, only two miles off,—a glorious view it was! Mountain, sea, and woods combined! He felt in a moment that this was the air, and this was the scene, that would be the greatest refreshment to him now,

wearied as he was in mind and body. And when, in the course of the day, Lord Roden drove him down to see a charming house that he had recently put in order, with a gate that opened into the park, and offered it to him for a few months, he could not resist the temptation of making this his home for a time at least. The climate and scenery were everything to him, and he felt that he could use the one power left now—his pen—in this quiet retreat, better than he could in any more frequented place.

In a very short time we all moved to Bryansford, the pretty village into which the gates of Tollymore opened. And there we remained for three years. He wrote incessantly, morning and evening, and drove in the afternoon through the beautiful scenery of the neighbourhood, or made expeditions to the mountains on foot. He was singularly active and fond of walking, and, however weary he might feel, it always seemed to refresh and invigorate him. He would visit the lonely farms scattered through the mountains, his pockets filled with books, with which he would endeavour to cheer the solitude of these lonely people, who were always grateful and pleased to see, as well as cordial in their welcome of, a visitor. They loved him truly, and many a one would offer their rooms for a little reading or prayer, when he would open his Bible and tell them of the Water of Life, which flows so freely from the Throne of Grace, and can satisfy the most needy heart.

Lord Roden's daughter, the Countess of Gainsborough, one of the Queen's ladies-in-waiting, used often to come to Tollymore to stay with her father;—a most charming woman, with handsome features and queenly presence; none that ever knew her could forget her exquisite manners and delightful conversation. Lord and Lady Dufferin, Lord and Lady Lurgan, Sir Arthur Blackwood, and many other friends used to be the guests of that hospitable home. Miss Marsh, the authoress of *Hedley Vicars*, was one of his favourite visitors; and Mr. Richard Nugent, with his wife and daughters, often came to Tollymore.

We often visited Lord Annesley's beautiful place, Castle Wellan, with its remarkable pinetum and far-reaching lake. The house stood in an exquisite position, looking down on the undulating park, with the water shining between the trees.

Lady Annesley's house at Newcastle, Donard Lodge, was another delightful place in the neighbourhood. It was a real enjoyment to my father to walk on the terraces overlooking the sea, and then to wander in the woods, and watch the splendid waterfalls, which, in winter and after rain, were a sight which people would drive miles to see.

One day when my father was driving with Lord Roden, beside the river that ran through the park, he was pointing to the bridges which crossed it, each of which had its history and its own special character, and greatly added to the charm of the grounds. He pointed to one particular turn of the stream, and said, "We have always wanted a bridge there, but have never put one up." My father immediately said, "You can easily have a wooden chain bridge, swinging across from bank to bank; it would be very ornamental, and exceedingly useful for foot passengers, though it would be too light for carriage traffic." They drove together to the carpenter's shop—always a great scene of interest—attached to the saw mills, where busy work was constantly going on. After a little conversation with the man in charge, it was decided that my father should draw out a plan for the construction of this bridge. This was soon done, and to this day the bridge may be seen, a specimen of light, strong, work, useful for its purpose and picturesque as well.

On the recovery of my father's health, he desired opportunities to extend the irrigation interests of India. For this reason he determined to leave Ireland, and take up his residence within easy reach of London; he finally settled at Dorking in Surrey.

He was on the Committees of the Church Missionary Society, the Bible Society, and the Irish Church Mission. He continued his connection with these Societies for

WOODCOT, DORKING.

many years, his attendance only being prevented afterwards by increasing deafness. He was devoted to active exercise, and used to take very long walks, enjoying the sight of fresh views or new country. His activity was wonderful. After the severe illnesses that he had passed through, and the zeal and labour of his life in India, with its many privations, exposures, and difficulties of a thousand kinds, at the age of sixty-seven years he thought nothing of walking thirteen or fourteen miles in a day.

One day we were crossing some fields, and were obliged to pass a large herd of cattle. Some of them looked rather fierce, and one made a dead set at us with its horns down. I immediately ran to a stile that was near, and got out of the way. When my father joined me he was smiling.

"You are just like a woman," he said; "all women are the same."

"What have I done now," I asked, "to merit such a rebuke?"

His reply was: "A woman runs away when there is no danger; but, when there is danger, she is as brave as a lion and knows no fear!"

When he was walking, or driving, he was often so absorbed in calculations on a gigantic scale, millions of rupees, or miles, or measurements of some kind, that he did not utter a word; and, if he was addressed, he did not appear to be conscious that any one had spoken to him. He could often preserve this abstraction in a crowded room, with people talking all around him; he would busily write out his notes or jot down his figures, carrying out his own line of thought at the time.

We did not reside very long in the cottage that we had rented at first at Dorking; my mother's brothers were anxious to build her a house, and they asked my father to choose the kind of house they both would like. A charming spot was selected—a sunny slope, crowned with a wood, and having a pleasant view. My father had said several times that he would have liked very much to have a house built on the plan of one he had seen on the island

of Guernsey, belonging to Colonel de Haviland—an old friend of Indian days who had died a few years previously. The coincidence, which now occurred, is interesting. A new curate had come to the parish; my father met him. In the course of conversation it came out that this clergyman's family belonged to Guernsey.

"Oh," said my father, "that is a very curious thing; I should like to ask if you ever knew General de Haviland, who lived there a few years ago. When I was a young man I stayed at his house, and shall never forget its picturesque inner hall with a gallery round it. I have often said I should like, if ever I had a house built for myself, to have it arranged on that plan."

The curate answered, "Strangely enough an uncle of mine has taken rooms for a few days in this town. He lives in that very house in Guernsey, having rented it since the General's death"; adding, "If you will call upon him, he will be delighted to see you, and perhaps can give you some information about it."

My father walked over to pay this visit and found the gentleman at home. When the inquiries were made, the reply was: "I have here in my desk the actual plans of the house."

Sir Arthur begged the loan of the plans, showed them to an architect, and a house was built which was in accordance with his earliest wish.

My brother was at this time in Northern India, having left Sandhurst with flying colours. He arrived at Woodcot one Saturday afternoon as usual, for he always spent Sunday with us; and, as he came into the room, he greeted my father with the words: "What would you say if I were to tell you that I have won the first prize for fencing?" So saying, he exhibited a very handsome pair of fencing-sticks to our joy and pride. Then he added: "Look at this!" and put into his father's hands a sword; "it is the Good Conduct Sword!" Out of eight hundred young men his son had received this honour! My father's delight and surprise were indeed very great. Soon, however,

my brother had to leave to join his regiment; there were sad hearts at Woodcot, for he had always been a devoted son.

From his own correspondence a few excerpts are made to indicate the character of the letters he wrote, and the unceasing interest which he took in everything appertaining to the advantage of India, or the greatness of England.

(1) "*The Daily Telegraph* editor wrote to me that Sir Bartle Frere had told him to apply to me for a series of letters on the famine, which I am now writing; two have appeared, and I have sent a third, and should like to write one or two more. It is a great opportunity, as the *Telegraph* has an enormous circulation.

"Frere seems quite to support me. Sir Lewis Mallet also wrote to me, protesting against spending money on works not suited to India, railways, but seems to think it useless to attempt to oppose the system, only resisting individual works.

"I wrote to call his attention to your translation of the French Commission paper, which he thanks me for and says he has got it. Mr. Waterfield, of the India Office, writes to me, saying that you and I say that goods can be carried by water at one-tenth of a penny, and asks for our authority for it. I told him we both give our authority in the papers, and I repeated it in my answer. This shows that the India Office cannot any longer resist the pressure, but is compelled at last to look into the matter. The fact is they must hear of it now. I said to him what a pity they had not asked the difference between the cost of land and water carriage before they spent one hundred and thirty millions on the former.

"I highly approve of your memo., and have no doubt it will have effect. But all the pressure that can possibly be brought to bear upon the matter in England will be required. There is to be a discussion on it to-night at the Society of Arts, under Sir B. Frere, but I cannot go as I have a cough. Another is to be held by the East India Association next week—a paper by W. Tayler, who

asked me to give him a memo. on the subject. I have written two letters to Sir George Campbell, urging the execution of the Navigation canal to Jessore, and the pushing on of the different parts of the main line of canal up the Ganges. I have also written two letters to *The Times*, especially insisting upon this—that one crop in a famine would pay the whole cost of the most expensive irrigation works twice over. It would pay the whole cost of the Orissa works, with accumulations of interest, if not an acre was watered nor a boat passed along the canal for ten years. I am very glad the canal is open to Midnapur. It's also a grand point that you are able to water so much land from the Sone, putting in the strongest light the effect of such works in a famine.

"I think the high level canal I proposed to Jessore and the main Ganges of the greatest importance, as opening the communications for the whole year, at the least possible expense of time and money. F. says he wrote a memo. on it and that he would send it to me, but I have not got it yet. I wish you could get it put in hand now."

(2) "I am anxious to hear, first, what effect upon the whole you think the famine will have upon your project as a speculation—whether you think the depopulation and impoverishment of the district will materially delay the use of the water. That it must seriously affect the traffic there seems no room for doubt. Surely it will fully account for what you say of the small traffic in your last letter.

"Next, what effect will this advance of funds by the Government have upon your works?

"I see they offer £20,000 a month, and that B. has accepted it. Will you be able to make use of it, and find labour enough, and what will it do for you this season?

"I should be very much obliged to you for your opinion of the prospects of the project now. They seem to be now doing everything that they ought to have done fourteen months ago. I should suppose that in your present posi-

tion, with some of the heavy works finished, the money ought to go far in the distribution.

"I should be glad to see any Indian papers that comment on the Ganges canal controversy. The report was an extraordinary failure. I am so glad they didn't call you in, or anybody on my side. I have the Godavari report, too, quite as complete a failure, though free from bias.

"I wrote to Frere and asked him to help in seeing that the matter received a fair hearing in the India Office.

"I wrote also to Sir Stafford, and begged him to read the papers himself, which he promised to do. They have lately printed for the House of Commons papers about irrigation—a most melancholy affair—papers by almost everybody, but not one single thing *done*, even by Lord Cranbourne. Buckle says most truly that this is the char acteristic of the age—everybody writes and says, but nobody *does*.

"And nothing will be done while the Council is the executive in public works ; they are an incompetent body, and there is no hope till we have a separate Board of Works, who have time to make themselves acquainted with their business, and to acquire an interest in it, and to have nothing else to attend to.

"They are going on just the same with the Upper Godavari works. Sir Charles Wood told J. B. Smith that the last thing he did before he left the India Office was to order the vigorous prosecution of the Godavari works at all the Barriers ; but to this time the Indian Government have not issued the orders, and another season is lost.

"I have some idea of trying to make a move by seeing Frere, Sir Stafford, and others, this month. Frere is a man whose deeds do not belie his words, and perhaps he may effect something. I am writing an answer to the Upper Godavari report. But they now talk of millions as they used to talk of thousands. There never was such an opening in respect of capital ; the rogueries of last year have left the public afraid of all private enterprise and the

accumulation is prodigious. I suppose any amount could be obtained by Government.

"I am in hopes I may hear from you soon. The majority which the Government have just obtained will probably set Sir Stafford at liberty to attend to his own business; but I see no signs whatever, yet, of anything effective being done about public works, though I am in hopes it may still creep on as it has done of late.

"They have sent another officer, Forbes, down to the Godavari, showing that while they affect to ignore these works, they find them too hard a nut to crack; they will find all sorts of faults with them, quite forgetting that all they say against them will only strengthen my arguments, for if, with all the mistakes, the works have produced such results, it only confirms the more all I say about the profits of irrigation.

"God has favoured us with a termination to the Abyssinian Expedition beyond all our hopes, though I must say it's a terrible disappointment to me, too, for I could not help hoping that we should be inextricably entangled in the country, and be compelled to inaugurate a state of peace and order there and in the surrounding countries.

"I have had some conversation with a Mr. Vesey Fitzgerald, a man of property in Ireland, who takes a great interest in India, and made a tour in it some years ago. He is a literary man and, I believe, a man of some influence; he is a Liberal, but a member of the National Club. He sent for me, and is trying if he cannot do something to force on works in India. In this way there is now a very considerable undercurrent working, but it may yet take long before anything is done.

"If you see the Rajah of Benares, tell him I have just been to see his well, within a few inches of where I was born, in Oxfordshire. It is three hundred and fifty-eight feet deep. It was in beautiful order, and the water was delicious, an invaluable gift to that neighbourhood."

(3) "How astonishing it seems that navigation must

never be mentioned at the India Office or in the House of Commons. I am happy to say the Lower Ganges works, begun at the very spot where C. wrote a book to prove it was the greatest nonsense to talk of an anicut being built, are completely successful; and the Sirhind seems to be going on very well, but the Sone hangs fire still—why I have no idea, for not a word is said on this one fundamental point in the reports; the same with the Tungabudra.

"I had a talk with Mr. Bourke [M.P. for King's Lynn, then appointed Governor of Madras and created Lord Connemara], who seems a very efficient man, and I am in great hopes will do something to restore Madras. I pressed upon him the putting of an able man at the head of the Public Works Department, and taking up earnestly the works on which about three millions sterling have been spent without any result as yet, entirely from want of competent men. I alluded to the harbour, the Coast canal, the Tungabudra works, and the Godavari navigation.

"You see they are taking up in good earnest the North-Western Frontier, so far as advanced posts are concerned; but nothing is being done to prepare the ground base, the Indus, as you advise. This is quite beyond present men, though it is *the* point above all. But we have not a single master mind at present, unless G. expands now that he is brought to the front. I am rejoiced that F. has at last got into work worthy of his talents and of his deep Godliness. We last heard from him at Aden, he having visited all the ports of the Red Sea, and he is to go to Muscat and Bagdad and Damascus, and up the Nile. A more able man to lay the foundation of a great mission around Arabia could not be found. He is sent by the Church Missionary Society. What a grievous thing it is to think how such a man has been thrown away hitherto!

"I must acknowledge that it's a great satisfaction to me that this most able paper was prepared by you, and circulated, for I cannot but hope that it may yet help to resuscitate this most vital subject of irrigation, against which the whole Indian official body, almost, have so entirely set themselves.

"Indeed, a friend of mine, an ex-C.E., has lately written to me that he finds the India Office rather inclined to return to the subject. And I have lately found out that the Punjab Government are really heartily in earnest in the matter, in spite of the superior authorities. They have irrigated three million acres, have another great project in hand, and a further one almost ready for execution.

"But, curiously enough, I have now before me a vast railway project about which I should like greatly to have your advice. It includes such a number of first-class objects that it would quite affect all India, though the line itself is only three hundred miles long. It is from Vizagapatam to Raipur, and has been long talked of, and I rather think is actually begun, but without their the least perceiving the main point, that it is the natural and proper outlet of the whole Upper Gangetic country. I am preparing a memo., which I will submit for your remarks. What I wonder at is that I never perceived the state of the case."

One of his favourite correspondents was Miss Florence Nightingale. On the subject of Indian irrigation she was keenly interested. With a view of drawing the attention of a newly-appointed Governor to this subject and the importance of pushing forward certain works, she wrote :—

"If you could write me one of your most interesting and impressive letters, I might be able to do something with it. Will you give me the latest figures and information of the state of things in this year?"

With regard to the irrigation map that was then being prepared, and which, brought up to date, is published with this memoir, Miss Nightingale writes: "I have had but few copies made, because I hope that every year we shall have to make additions to this map; and that every year it will require correction!"

She alludes to Sir Richard Temple's minute on the famine of 1877–78 :—

"He bore testimony to the tanks, as famine relief

works (in the Bombay Presidency), and to their permanent value for the people. I always think of *you*—their father—when I read any of these passages. The more one hears of this famine, the more one feels that such a hideous record of human suffering and destruction the world has never seen before.

"I am very sorry to hear so poor an account of yourself, but there is a good time coming yet. India is forcing her way to the front. You must live for that."

Sir Arthur Cotton writes to another friend with reference to the making of railways instead of canals :—

"What an inconceivable mistake they have made in forcing on the railways in India. After trying land carriage in England for sixty years, they have decided that it is necessary to spend seven millions in water transit by the side of the rails for thirty-five miles (referring to the Manchester Canal). What a decisive judgment this is as to land carriage in India, where there are lines of one thousand miles in length! The ludicrous part of the matter is that they are working the rails generally at from eight and a half to twelve miles an hour, with only the exception of one or two lines at twenty to twenty-five miles, while canals would certainly have been worked generally at fifteen or twenty miles for whatever required it."

No wonder he adds :—

"The works suggested would secure such a supply of cheap building materials, fuel, salt, etc., as would alter the whole domestic state of the people. The works also provide for about five million acres of irrigation scattered through the whole peninsula, yielding an increased produce of ten millions per annum. This, in addition to the present five million acres in Madras (besides all in Mysore, Hyderabad, and Bombay), would secure food for twenty-five millions of people, and would effectually provide against famine in connection with the abundant means of transport of food throughout the whole peninsula, at a charge which would add very little to its cost. But what

would be the prodigious stimulus that this means of intercourse would give to the people, certainly putting new life into the community beyond all we can imagine! Besides the new irrigation, these works, by a more certain supply to the tanks in ordinary years (and that the superior river water), would greatly improve the produce and value of the present irrigation.

"But, further, the improved condition of the people would lead to a vast extension of the ordinary dry cultivation, and by the abundance of fodder, the difficulty for providing for the cattle, in consequence of the diminished area of jungle, would be completely met. The model farms have proved fully that, with a very small supply of water, fodder may be grown for cattle at a very small cost. This is one of the many things that it is necessary to put the people in the way of providing, by European instructors.

"Who, for instance, can estimate the effects of such a state of the people in respect of all necessary things, in enabling them to educate themselves? The change in Godavari in this respect, as certified in one of the Indian papers, will give some idea of this.

"Those only who have seen a famine district can judge of the change in the district of Godavari. In a country where, within living memory, men have died of famine by tens of thousands, and population has been checked by contingent consequences of famine, we now see a teeming population of stout, cheerful, well-proportioned men, women and children that will compare with any in the world for intelligence.

"In the Godavari there is scarcely a symptom of solid prosperity and rational enjoyment that is not displayed.

"Lower down the river and in the delta, the rush for education is incredible, though there are a few instances of apparent reaction."

Once more:—

"According to Whittaker, the present return on irrigation works executed by Government is 4·3 per cent., while money is borrowed at 3 per cent., 'apart from the ad-

vantages to cultivators and protection against famine'; and, he should have added, the additional revenue paid in a district, besides the water rate. Thus in Godavari, the water rate is Rs. 5 per acre—on 700,000 acres, Rs. 35,00,000—but the increase of revenue has been Rs. 75,00,000, or double the rates, almost the whole of which is due to the irrigation.

"Thus from water rates alone there is now a clear gain to Government of one and a third per cent. on irrigation expenditure.

"And this is without reckoning the actual saving at this moment to Government in respect of famine relief.

"With respect to water carriage, Mr. L.'s evidence is of inestimable importance, as of a man whose prejudices would necessarily be entirely against canals.

"Surely such a principle could not be allowed in the common business of life,—a contractor having completed his contract, presents his written agreement, and demands a hundred thousand pounds, and he is met by the statement that he is foolish to suppose that it is to be taken literally, that the hundred thousand is a mistake, and that he will receive only a thousand."

He complains that estimates are asked for, and then rejected. And that no notice is taken, when considering the famine, of the results obtained from providing a water supply:—

"A crop was raised that year (1878) worth five millions, where not an acre would have been raised without irrigation (the works having cost £1,500,000), and not only over the population of Godavari, Kistna, and Tanjore, about five millions saved, but enough was exported to save four or five millions in other districts. Not a word has been said about the effect of these works on the famine."

Alluding to the Kurnool Canal, he says:—

"It has proved itself a perfect God-send in this year of drought, and in the direct and indirect benefits it has secured to man and beast within its influence, it has fully justified its existence.

"There can be no doubt whatever that, as years go on, the area irrigated will increase, and eventually be very extensive; provided that the canal is maintained in good order, and every effort made to encourage irrigation, and to give the ryots confidence in the canal's ability to meet all their demands."

From amongst the correspondence which he received during these years are a few letters which may profitably be reproduced.

From Sir Bartle E. Frere, G.C.S.I., *Governor of Cape Colony and High Commissioner for South Africa.*

GOVERNMENT HOUSE, CAPE TOWN,
March 27, 1880.

MY DEAR SIR ARTHUR,—

I have been getting from the India Office and other sources, all the papers that I can regarding irrigation, for which there is an enormous and almost unlimited field in every part of South Africa, and for every description of water storage and irrigational work. I have got a mass of works and reports of various kinds, but nothing that satisfies me as a really complete and comprehensive description of the cost and results of your great Madras works, and I find it impossible to make time to go through Blue Books and draw up, from scattered materials, such a precis as would show my friends here, how vast were the prospects, how economically executed, and how great the financial results of your more important irrigational works.

If you could get for me a summary of a kind which would make a good review article, or, as it were, a kind of index to larger and more detailed reports, it would greatly help us. I hope we are now, in South Africa, at the beginning of a period of active irrigational works. They will not go so fast here as they did with you in Madras, for we have to depend much more upon private enterprise and private money. But the Orange and the Vaal rivers are both sources of water supply on which engineers of your school would very soon persuade the people of South Africa

to spend at least as many millions as they are spending on railways with the certainty of larger results ; for the soil is everywhere good and everywhere very sparsely inhabited and almost uncultivated.

I wish a few of the disciples of your school would take South Africa in the course of their search for health, or for a home after they have been used up in India. It is a country where old Indians find they have ten or twelve more years' work in them than when they retire exhausted from India ; and where men, who cannot live at all in India or in a cold climate, thrive amazingly. I know you will not mind trouble in such a cause, and with kindest regards, in which Lady Frere and my daughters join,

I am, my dear Sir Arthur,
Very faithfully yours,
H. B. E. FRERE.

General Sir Arthur Cotton, K.C.B.,
Dorking.

From Sir Colin (then Colonel) Scott-Moncrieff, R.E.

I.

CAIRO, *Nov.* 14, 1885.

MY DEAR SIR ARTHUR,—

I thank you very sincerely for your most kind letter of the 31st. The approval and sympathy of such a veteran as yourself is very gratifying. I am sending you the report on which *The Times* formed their article. Do not for a moment think we have made the Barrage a sound job for twenty-five thousand pounds. Far from it. But we succeeded in holding up three metres head of water at the time of lowest Nile, when the demand for cotton and rice irrigation was at its highest. I cannot say we were quite easy about it. I insisted on a good young English engineer being always there in case of accidents, and there was a sigh of relief when the river began to rise and we could open the gates. I daresay in the old days, when you were curbing the Cauveri with that wonderful light anicut, and were battling for every rupee with an inappreciative Government, you had your anxious moments too.

Now I have got a million of money to spend, which, although not much, will help a great deal, and I have some right good officers from India to help me to spend it. We are quite a little English corps here now. Ten of us from India, and three capital young Englishmen I picked up here. And, though I say it who shouldn't, I think with God's blessing we shall leave some mark for good in Egypt. I never before thought so highly of the Indian school of training. The pashas here stand aghast at the unsparing way in which my officers knock about and work in the hot weather; and, after all, it is no more than dozens are doing daily in India, and without whom India would never have been what it is. We have almost decided to make a second weir over the Damietta branch of the Nile, a few miles north of Benha, where the railway crosses the river. This will cost, I fear, two hundred and fifty thousand pounds, and we shall spend, I fear, quite two hundred thousand pounds on making the existing Barrage quite sound. One work I have near my heart is the abolition of the corvée. When I came here I found an army of one hundred and twenty thousand men, employed annually for six months, without pay or food—a horrid, disorganised, rabble—and a system that gave the fullest play to all the corruption and rascality that flourish here.

No pasha ever sent a man to the corvée. The whole burden fell on the poor. By only a little common sense and arrangement we have shown them that for about two-thirds of the former silt clearances the same quantity of water can be obtained. And now we are battling the system altogether, I have got dredgers in to do a lot of the work. Nubar Pasha is helping us with all his influence, and though, perhaps, I am too sanguine, I am in hopes to leave Egypt two years hence without a forced or unpaid workman. But there are endless little worries and hinderances. French jealousy, palace intrigues, the lowest sense of honour on the part of the employees. In India the path was much clearer. Here we are for ever hoping to arrive at daylight through the political haze, but it seems as thick

as ever. Mr. Gladstone seems determined, if he gets the chance, to clear us all out. I disbelieve utterly in a Mohammedan country reforming itself. I know if we were to go they would fall back to their old corrupt, unrighteous, ways, and really did I not believe that somehow, in spite of Mr Gladstone and all the Radicals, we are not going to leave Egypt, I should have little heart to work here.

I have to thank you for kind words of sympathy in my domestic desolation. This is a subject on which I cannot write. Submission to the great Captain's orders is surely the good soldier's duty. Hard work is a great solace, and no one ever had more kind friends than I. Forgive this long letter, and

Believe me,
Yours very sincerely,
C. C. SCOTT-MONCRIEFF.

II.

CAIRO, *Sept.* 7, 1890.

It is true, as you say, that patching and reforming is often harder than originating. On the other hand we in Egypt have had an enormous advantage over what you had in the delta days, in nearness to Europe, and consequent facilities in procuring materials, machinery, and skilled labour. A dozen more steam pumps could be got in a few weeks. Our electric light gave no trouble, and made night work far pleasanter than day during the heat. The best of stone could be got from Trieste; Portland cement as much as we required from England; a light railway carried our materials about cheaply and easily; and then we had the benefit of your old experience to help us. You hadn't that! I think Egypt is really doing well under English guidance. I only regret that the Government at home does not speak out honestly, and say once for all we are *not* going to leave the country. Till we do that and face the opposition it must call forth, I think we are sure to have trouble with the French. It would be more honest on our part, I think. The French

thwart us very seriously. A conversion of debt has just been concluded in which they have so effectually put a spoke in the wheels, that Egypt won't get over it for fifteen years. They have sympathised in nothing we have done here. They did their best to oppose a reform, which gives me more satisfaction even than the Barrage. I mean the abolition of the corvée.

We spend annually now four hundred thousand pounds on clearing and repairing canals, embankments, etc., all unskilled labour (except some dredging), and all of which labour was performed by unpaid corvée up to 1884. This has been a great boon to the fellah, as you may suppose.

I am sending you two more notes you may care to see, one on a big flood we had in 1887, the other on the means for remedying defective floods such as we had in 1888, when the long valley of Upper Egypt is apt to be left *shardki*, that is, uncovered by the flood, and therefore incapable of tillage. My excellent second in command, Col. Ross (one of my old Indian assistants) has made this his special study, and I trust in two or three years the Egyptian will no longer be haunted by the nightmare that the Nile flood may fail him, bringing distress, if not actual famine. Our next great step must be the storage of Nile water to increase the summer supply, and this, I think, is not far off. But it is a big job. Yes, I fully recognise with you that the Almighty has blessed our work in Egypt, for which we can only humbly thank Him. He knows how poorly and lamely and selfishly much of it has been done. Yet He has blessed us. Thank you again very heartily for your most kind encouragement.

Believe me,

Yours very sincerely,

COLIN SCOTT-MONCRIEFF.

SIR ARTHUR COTTON (AGED 94)
Standing in front of 6 feet high English wheat.

CHAPTER XVIII

Many Interests at Home and Abroad

MY father did many things. I think I am saying only what is strictly accurate, when I assert that he did them all well. He certainly did them with great thoroughness. Before, however, mentioning these, I may refer to his personal friendships.

One of the friends, who came from time to time to have important conversations with him, was the late Sir William McKinnon, Chairman of that marvellous fleet, the British India Steam Navigation Company. My father had the greatest admiration for Sir William's clear intellect and genius. His Indus steamers, and his great ideas with regard to the opening up of Africa and the improvement of the Congo Territories were a constant source of mutual interest.

Sir William's invitation to us to spend a few weeks with him on the trial trip of one of his new steamers to Norway and Sweden was readily accepted. My father enjoyed intensely the cruise round the west coast of Scotland, where the mountain views seemed to unfold like a wonderful series of pictures. We then cruised northwards, and entered the Norwegian Fjords, where some weeks were spent among scenery which defies description. Great mountains rising sheer out of the water, their sides streaked with loveliest silver streams, growing sometimes into waterfalls of wondrous beauty. My father was in his element. Scenery was always a rare and special delight to him, and he loved the sea. He was an excellent sailor,

and had no dislike even to rough weather which would compel many of Sir William's guests to desert the deck.

On our return we stayed at Ballinakill, Sir William's beautiful place on the Argyllshire coast, where we had before often enjoyed his hospitality and rambles amongst the heather.

My father, in spite of stormy weather, used to take long walks on the mountain sides. I well remember how he used to say: "I am off for a ramble, who will come?" Some demurred that it was raining. To which he would reply: "The rain is nothing. Don't let us lose a moment of this delicious day." Away he would go, guiding his party to one of the summits near, whence a beautiful view could be obtained of land and sea, even across to the distant coast of Ireland.

Sir William was in constant correspondence with my father regarding a variety of subjects, such as steamers for river navigation, Stanley's expeditions, the employment of Tippoo Tib (a notorious slave-dealer), the further opening up of the Congo States, and the progress of missions connected with the Free Church of Scotland. Sir William's letters were terse and strong, and his opinions on every subject fully and clearly expressed, as though he had abundant leisure at his command, whereas he was the busiest of men.

DEVELOPING NORTH-WEST AFRICA.

A very interesting correspondence was also carried on with Mr. Donald Mackenzie, on the possibilities of taking to North-West Africa the benefits of commerce and civilization. One of the letters relating to this subject, written for more general reading, may be given here, as, from its lucidity of expression, as well as its highly ambitious suggestions, it forms a unique document, and illustrates the workings of my father's mind, with a practical issue always in view, even during his period of retirement, and at an advanced age:—

North-West African Expedition.

To the Editor.[1]

Sir,—I am very glad to see an able article in your paper advocating the North-West African Expedition. Surely the time for the emancipation of that terribly oppressed land is now come. There are, at this moment, no less than nine Expeditions that I know of (probably there are others) either now actually in operation or in preparation for the opening up of the two portions of Central Africa,—the north and south. North Central Africa may again be properly divided into east and west—viz., that from Lake Chad to the Nile, and the basin of the Niger, etc.

The following are the Expeditions I refer to, viz.: 1st, that under Col. Gordon, for the purpose of establishing the authority of the Khedive of Egypt about the great lakes at the source of the White Nile, and of destroying the slave trade in that direction,—one of the three great streams of African slavery; 2nd and 3rd, two private Expeditions, I believe Italian, for exploring in that part; 4th, the Church of England Mission near Mombaze, on the east coast, where the liberated slaves are chiefly to be received; 5th, the Free Church of Scotland Mission to Lake Nyassa, near the east coast, now starting; 6th, the Geographical Society's Mission of Lieut. Cameron, of which we heard last that he had left Lake Tanganyika to pass down the Congo to the west coast, but, unhappily, we have known nothing of this Expedition now for twelve months; 7th, Mr. Stanley's Mission to Lake Tanganyika and the westward, of whom we last heard half way from the east coast to the lake; 8th, a German Mission which has lately gone to the mouth of the Congo, on the west coast, with the purpose of exploring *up* the basin of that river; and 9th, the Expedition you have given an account of.

It seems as if in almost all human undertakings every other plan was to be tried before the plain, obvious, simple one. Thus, while the long route of 2,000 miles through various barbarous States and wild desert from Tripoli to Timbuctoo, and that from the Gold Coast through most unhealthy and savage States, and over mountains, and that by a long circuitous and sickly route up the Niger,

[1] This letter was addressed to a Bedfordshire newspaper, and comes into my hands as a cutting only, without the name of the paper being given.

which it seems is not navigable within some hundred miles of the great bend, and that from the mouth of the Gambia, through savage tribes and over a lofty range of mountains; while these routes, all involving also a long sea voyage, have been talked of and tried or used for centuries, the direct line from England, though urged fifty years ago by an intelligent merchant who had settled in the south of Morocco, has never been attempted. This is certainly the shortest, and all the information we have concurs in showing that it is incomparably the most free from difficulties, even in its present state, besides its offering a possibility of a perfect communication ultimately, if (as seems certainly to be shown by the information we have) there is a long hollow of several hundred miles into which the sea can be brought.

The point of the coast at the mouth of the delta is the nearest to England. The country there is perfectly healthy; the races on the borders of the desert there are represented as by far the most practicable people in West Africa. That part of the coast is neutral ground; it is south of the kingdom of Morocco, north of the French settlements; and the space between Capes Juba and Bogador is represented as merely a sandbank thrown up by the sea, and uninhabited, so that there is a prospect of a footing being obtained somewhere there for an English mercantile and mission settlement without any serious difficulty. It seems quite certain that there is a plain direct from that point of the coast all the way to Timbuctoo, that a portion of this is below the level of the sea, and that there is no high water-shed between the Niger and this desert, but the river actually overflows at times past the city and into the desert. The intermediate distance may be passed perhaps at first by camels, and afterwards either by a very light rail or a canal, or by letting in the sea. At present the only difficulty in the line appears to be about water, but I have myself travelled that distance in Arabia, carrying water with us, excepting a little obtained at one or two places on the road for ourselves, but none for the camels—the small quantity of herbs they picked up by the way serving them both for meat and drink. I should mention also that shelter for vessels is reported to be found on the coast near the point I am speaking of. The extraordinary amount of European manufactures that finds its way to Timbuctoo, in spite of the enormous expense of conveying it such great distances, and through so many dangers and difficulties, though no measure

of the traffic there would be if all obstacles were overcome, is yet a sure indication that if the line now proposed were opened and secured, the traffic would increase twenty- or one hundred-fold.

If we thus bring Timbuctoo within a very practicable distance of England, and establish commercial and mission premises there, we seem to strike at the very source of the northern slave trade, and to open the way for every wholesome influence to be brought to bear on the whole of the basin of the Niger and the adjoining provinces and fertile countries; and certainly there seems no comparison between this plan of accomplishing these objects and that by any of the other routes hitherto tried. What is now wanted is to find some new means for the full exploration of this line.

I may mention with respect to the letting of the sea into the depression, there is nothing to prevent a cut through, the bar being kept open, as has been shown in the case of the north end of the Suez Canal.

I must say that I know of no more noble and hopeful project, nor one of greater importance in this day of activity, and I cannot but hope that it is God's gracious purpose thus to help forward peace and truth in these oppressed countries.

The account of the four years of captivity of the missionaries in Coomassie gives us a realising idea of the state of the people, such as we have never obtained before, and cannot but make us anxious to try any hopeful plan, under God's blessing, to bring Christian light into these dark places. I trust that your readers will lend their aid to Mr. Donald Mackenzie in this grand enterprise in any way they can. The interest I take in Africa is my only excuse for asking you to have the kindness to find space for this attempt to supply your readers with an abstract of what is now being done for Africa, and of the information I have obtained respecting this route, which if fully opened would bring Timbuctoo within 2,300 miles and a fortnight of England, and effectually open a new field for British enterprise, occupied by twenty millions of people.

I remain, yours obediently,

ARTHUR COTTON.

June 7.

TEMPERANCE WORK.

The blue ribbon shown in the portrait of my father, which appears as frontispiece, renders it scarcely necessary to say that he was much interested in temperance. This interest dated from a day when, sitting at luncheon, he heard a tragic story of the results of drink which had occurred in his immediate neighbourhood. Turning to the servant, he said: "Take the decanter away. I will not have it before me again. Remember this. Do not put it on the table any more."

From that hour to the day of his death he never tasted alcohol in any shape or form, except when, once or twice, he was compelled by those around him to take a mouthful or two during an attack of faintness. On his death-bed he refused to touch brandy or any other stimulant. During the last thirty years of his life he warmly supported the temperance cause, often taking the chair, and speaking, at meetings in the town; and always, by his persistent wearing of the "Blue Ribbon" indicated where he stood.

Many a young man, starting on his way to India, would be warned by him in a fatherly manner to preserve his health, his activity, and his good name, by strictly repudiating all alcoholic drinks. "If I, an old man, can live without it, and work hard too," he would say, "why should a boy like you require such a crutch? Take my advice, and never let the thing pass your lips. You will be glad of your abstinence by-and-by."

He would collect most carefully the statistics respecting the consumption and consequences of drink, adding his own notes and comments. He thoroughly mastered each question that aroused his interest, and, as his memory was very clear and trustworthy, even to the last week of his life, it was amazing, in conversation with him, to notice the amount of information he possessed. It would have been difficult to find topics of general interest with which his mind was not thoroughly conversant; for with the greatest rapidity he could make himself master of any book worth reading.

OFFER OF A COMMISSION PRESIDENCY.

Although he was not a supporter of the Liberal Party he was the recipient, whilst the Liberals were in office, of a great compliment from a Cabinet Minister. He relates the incident thus: "Mr. Milner Gibson applied to my friends in London to know whether they could accept for me the appointment of President of the Sewage Commission, saying he required an immediate answer. General Balfour, M.P., said he thought I could not, which was right. Danby Seymour gave Mr. Gibson my address in case he wished to write to me, but, as I did not hear from him, I suppose somebody else was appointed. It would have been out of my line. Had they offered me the Thames Navigation Commission I should have been much inclined to accept it, as it would doubtless have opened the way for me to publish my heterodox views in England. Either would, perhaps, have had a great effect upon the Indian question. It makes such a prodigious difference whether a matter comes from an obscure individual or from a man recognised by the Government." Indeed it does, but the creator of the Tanjore, Godavari, and Kistna Irrigation Works was no obscure individual.

BOAT DESIGNING.

His intense zeal with regard to canal navigation led him to devote much attention to the designing of a boat specially suited for canals. His object was to lessen the resistance or friction which a vessel meets in passing through water. He produced a brass-covered double canoe, which he used to sail on the lake of a friend who lived near us. His experiments were very interesting to himself, but rather hazardous we used to think; as everything had to be tried afresh, the new shape, the new surface, and the new power of speed.

"The resistance to boats on canals," he wrote, "is made up of three items, viz., the simple resistance of displacing the water, as in open waters, that due to the piling as before mentioned, and the friction on the surface of the

boat. The first is calculated by dividing thirteen by the square of the ratio of breadth to length of entrance, multiplying the quotient by the area of the midship section in square feet for the resistance in pounds at two and a half miles per hour, the resistance to a square foot at two and a half miles, moving on a line perpendicular to its plane, being thirteen pounds per square foot. The surface friction has been ascertained by experiment to be about one-fifteenth of a pound per square foot of surface of painted wood or iron, moving at two and a half miles, and about half that on an ordinary coppered surface as usually done; but this would probably be considerably reduced by applying thick plates of hard phospho bronze accurately joined, with countersunk screw heads. This is when the surface moves on a line parallel to its plane. But on the bow, with an entrance of one to six, it is found to be double this, and on the experimental run the trials showed that there is no friction. For the resistance from piling, I have not found any investigation or experiments; and I can only make rough calculations from the imperfect data that I have. As I have stated above, if the entrance be greater than one to six, no doubt the friction would be lessened on the bow, and if the ratio be less the friction would be increased. An important point has also been settled by experiment in this respect, viz., that the resistance both from friction and displacement is the same on the same surface and angle of entrance, whether the entrance is vertical or horizontal. The large steamers on the Godavari, one hundred and twenty-four feet by twenty-four, and drawing fifteen inches, are rectangular in transverse section and deck surface, perfectly flat in the bottom, and with a vertical entrance of six to one, and the same length of run.

"These boats have been a complete success in reducing the cost of carriage on a shallow river; and I think there is special reason for giving the same form to canal boats, inasmuch as it would probably reduce the wave on the sides of the canal, there being no lateral pressure from

the bow, as in the ordinary boats with horizontal entrances. The boat, therefore, that I would propose would be in plan a rectangle of one hundred and fifty feet by eleven and a half, with a draught of six feet. The entrance, a curved slope of one to ten, and the run of seven to one. This would give a tonnage of about one hundred and sixty-five tons, and, allowing fifteen tons for the engine, a cargo of one hundred and fifty tons."

A PATENT TRICYCLE.

He was also much occupied in trying to patent a tricycle on improved lines of his own. In those days cycles were very clumsy and awkward machines; but he was bent on producing one that would be capable of a much greater speed than those generally used. He used to say to us sometimes, "Perhaps you will live to see the day when there are no cab stands in London, when the horse for transit purposes is a thing of the past; every cab will have its own cycle action and artificial power." He was trying to perfect a brake on his own machine—a brake of his own invention—and also to produce a pointed shield, which would divide the force of the wind, and remove that hindrance to rapid cycling. So intent was he on these discoveries, that when he went out to practice on the roads, he used to ask any one that was passing to come and help him, and to give their opinion on what he was doing. "Now you just watch me, and tell me how many turns this wheel makes in a minute," he would say. The astonished passer-by used invariably to yield to these entreaties, and must have wondered at the ardour of the cyclist of seventy years of age!

One day as I was driving along the high road near Dorking, I was dismayed to see my father coming down the hill near our house on his tricycle at a tremendous pace. He had lost control over his machine and speedily found himself in the hedge. I ran to his rescue, asking anxiously, "What can I do to help you?" His reply was, "Look after the machine. I can take care of my-

self." He was in a wretched plight, his face full of scratches, and his arms bruised by the fall. The only remark that he made was, "I hope my cycle is not spoilt"; and then, "I am afraid your mother will be anxious if she knows of this accident."

It was quite true; my mother was very anxious, not to say alarmed, when she heard what had happened, and, as he already had had one or two bad falls, she implored him to discontinue these perilous rides, for they were all experimental ones. His reply was: "Rome was not built in a day; it will take me a long time to complete my patent brake!" Her patience was, however, exhausted, and finding she could not persuade him to give up the cycle for his own sake, she told him a pitiful story of an excellent missionary, who needed better means of getting about his district than his donkey-cart afforded. She prevailed upon my father to send him the tricycle, but what she intended for a kindness proved to be a misfortune, for the missionary met with such a serious accident, when riding the machine one day, that he was compelled to go to the hospital with a broken arm. So the tricycle came back to my father and was eventually given away to a friend who knew how to use it.

My father's genius for invention was extraordinary. He was always working out the "ifs" of life. "If so and so could be done, how wonderful it would be!" was his continual remark.

AN ARABIC PRIMER AND "LIVING LANGUAGES."

Another study that occupied and interested my father greatly at this time was the composition of an Arabic Primer. When he was about seventy, he invited an Arabic student, who could speak some English, to stay with him for several weeks; during this time he spent hours every day in going through sentences of the languages, word by word, with him, thus working out the new Primer, which was to meet the needs of missionaries in Persia and Armenia, and other countries where Arabic is spoken.

This Arabic Primer was printed at his own expense, and the whole theme occupied much of his leisure just then.

He had very strong theories on the subject of learning "Living Languages," his opinion being that, as every child who comes into the world learns its mother tongue orally, and at first without grammar, picking it up sentence by sentence and word by word, from those with whom it is associated, either children or adults as the case may be—the study of grammar being a matter of much later consideration,—so the learning of all modern languages would be very much facilitated by a similar process; that is, that the learner should hear each sentence repeated four or five times by a native of the country, and say it after him. This constant repetition, he considered, would give the sound and knowledge of the word so thoroughly that the mind of the pupil would be almost "possessed" by it, to the exclusion, for the time being, of other subjects. Thus, in perhaps one hundred sentences, sound and pronunciation and spelling would be thoroughly mastered in every detail, the spelling taking a secondary place in the acquisition of the knowledge imparted. The third requirement he looked upon as the grammar, which need not be touched until the language had, to a certain extent, been acquired.

Of one of the before-mentioned pamphlets he remarks: "I have been so delighted with the sale of seventy of the 'Pamphlets on Languages' without a single advertisement. It gives me great hopes that the subject will begin to be discussed. I have been trying the word system in Arabic, in order to obtain some definite idea of the rate of progress a man could make, and have been well satisfied, judging that if a stupid old man, with a stiff tongue and deaf ear, can make certain progress, a young man could make far greater. The matter of time is a small one compared with a perfectly good pronunciation and expression, which, I feel quite sure, would naturally follow the adoption of this method. I am now full of hopes that some hundreds of the pamphlets will be sold and that real investigation

will begin; and of this I am satisfied, that the great obstacle of confusion of tongues can be in a large measure removed, as those of time and space have been by steam and telegraphy. Several missionaries have said that it gave them useful hints, but nothing more has come of it. *The Times* made an excellent remark upon the subject; it said the English cannot learn languages, and the consequence is that instead of an Englishman learning Tamil, a million Tamils are obliged to learn English, and this is what is going on all over the world. It will soon become the general language. What a wonderful work God is accomplishing in and by England! She is filling the face of the world with fruit temporal and spiritual. Three hundred and forty millions are now directly under our Empress, and every nation on earth is, in a measure, touched by her influence."

To a friend in Ireland he wrote at the time of the Soudanese War:—

"I am so glad to see your Beidawi Grammar, which contains some curious peculiarities. I had no idea you had found time to go so fully into the subject. It is of great value. By how many is this language spoken? If I were younger, and not deaf, how I should like to try learning it by ear. Is it really true that they have our sound of short 'o'?

"Could they really say Cotton? I never saw a man in India who could utter this sound. They can only pronounce our 'o' as in 'political.' Pray answer this. I wanted much to know whether they have, in Africa, our common short 'o' as in 'not.'

"I am delighted with your book and think it is just what is wanted. We have had two cases of influenza, neither of them severe, but requiring the same advice as the Japanese: 'Don't despise a beaten enemy!' To one who has seen what a demoralized regiment is, the stand made by the Chinese is wonderful, and would be an honour to a British army."

"The escape of the *Gascoyne* is a wonderful proof of the conquest God has given us over the ocean.

"A society, the Land Colonization, has taken up the question of farming, I think, in a practical way at last; and the members seem likely to carry out the essential point of the *improvement* of culture effectively. They have, of course, very few helpers at present, and scarcely any money, but they are persevering, and seem, for their extremely small means, to have accomplished a good deal already. I have considerable hope from them. They are, as yet, the only men that have dared to acknowledge the possibility of improvement.

"I am glad you have brought in the magic lantern to help in Ireland. It seems to me a very important adjunct and calculated to counteract Irish difficulties greatly. If our Lord said, 'He who has not a sword, let him sell his coat and buy one,' surely He would have us keep a sharp look out for any help that may offer."

NILE NAVIGATION WHICH WOULD HAVE SAVED GORDON.

At the time of General Gordon's journey into the Soudan, and, on receiving the news of his death, Sir Arthur Cotton's mind was much exercised with regard to the slowness of communications which were occasioning such dire disasters.

He wrote to a newspaper as follows:—

"The one thing, that has been the complete hindrance in all this strange matter of the Soudan Expedition, is that England could not furnish an engineer conversant with such river navigation. The case was exactly similar to that of the delta irrigation. Millions had been spent on that, in the Barrage and other works, and nothing whatever had been effected, solely because there was no experienced irrigation engineer there.

"When Lord Dufferin went there, he saw at once that the one thing that was wanted to restore Egypt's prosperity was such an engineer, and he sent to India for one,

and I believe they sent the ablest man they had. The moment such a man arrived, he, at a trifling expense, turned the Barrage to account, in raising the water in the canals, and a complete revolution has already been effected in a great part of the delta, and Colonel Scott-Moncrieff has been publicly thanked by the community for the prodigious results he has obtained, even before a promised million had been granted him. Thousands of water-wheels and steam engines have already been thrown out of work. What has caused this? Nothing but that an engineer conversant with such work has been called in.

"And nothing else is wanted at once to bring the Nile into effective navigation, nothing but an engineer who is really conversant with such work. Take the following facts to show the consequence of placing the river under the charge of officers who had no experience in such work.

"1st. Millions spent on two hundred miles of railway, by the side of the navigable river, which would convey at one-tenth the cost by rail, without anything spent on the river.

"2nd. The boat that Gordon had conveyed to Khartoum drew six feet of water, I believe, had side paddles, and a speed of seven or eight miles, in every way utterly unfitted for the river.

"3rd. When a small steamer was sent out, it was carried in pieces on the railway, as if a steamer was made to be carried, instead of to carry, just as happened when we introduced wheel-barrows into India,—the Indians carried them on their heads.

"4th. No money was laid out on improving the river by removing rocks, etc.

"5th. To convey a force up the river rowing boats were sent out, and worked up the river by ten thousand men at eight or ten miles a day, while a single steamer could have carried a force of fifteen hundred men.

"How can we bear to think that the lives of Gordon and thousands of others, and millions of money were thrown away, solely because there was nobody who was conversant

with such river navigation! Had there been one steamer with stern wheel, drawing one foot, and having a speed of twenty miles only, we should have been in constant communication with Khartoum, and had there been a flotilla of twenty such steamers, the whole force would have been carried up without the least difficulty.

"This year I begged a friend, a member of Parliament, to try and bring this matter forward again, and on his communicating with an official, he was informed that a flotilla had now been ordered. In two months from the time that twelve steamers (of one hundred and twenty feet long) were ordered, they were at Alexandria. Who can imagine why this was not done last year? I hear that at last twenty-five steamers have been ordered, but, I am afraid, all with the essential defect of want of speed. If, however, Gordon could hold Khartoum for many months solely by the help of the clumsy steamers that he had, what may not be done with stern-wheel steamers, drawing one or two feet, even though with too low a speed, if measures are also taken, by removing rocks and concentrating the stream, to improve the river at the same time?

"I have not seen the rapids, but I have read numerous accounts of them, and I can confidently assert, from my experience on the Godavari, that a thoroughly effective navigation can be established:—

"1st. At a cost far below that of hundreds of miles of railway.

"2nd. To carry at one-tenth the cost of railway transit.

"3rd. To carry the enormous quantities that the vast Soudan, extending two thousand miles to the line, will require in import and export, when England takes up the matter effectively and gives peace and just and intelligent rule to that distracted country. Had Gordon had effective steamers on the river in his first government, he could have established effective rule over the whole region.

"The Suakim Railway was a complete mistake. It would, first, be utterly impossible to protect it. Nothing

in the world is so helpless as a railway, especially in a desert, as we see in the case of the few miles already laid. It could not carry at a cost that would answer the purpose or the quantities that the case requires.

"It is proposed to charge £2 a ton for this three hundred miles, the cost of carrying from Calcutta to London, eight thousand geographical miles. Not one-twentieth of the goods that ought to be conveyed down the valley of the Nile could bear this cost. And this is besides two transfers.

"I have no doubt that goods could be brought from Khartoum to Cairo or Alexandria for ten shillings a ton, probably for much less, when the river is improved, that is for a great part of the year, and certainly, if regulating weirs are built at the mouths of the great lakes, for the whole year.

"The cost of greatly improving the river would be quite small compared with that of railways, and I feel sure that the worst obstacles can be removed at a cost quite insignificant."

The following letter, probably written to General Gordon, bears reference to the opening up of the Nile communications:—

"I have long wished to get a complete account of the actual state of those rapids, and should be so much obliged to you if you could send me any engineering report on them. I have no distinct idea what the rapids really are. I cannot make out that they have ever been seen by an engineer who has had experience in that way. Could steamers of small draught and high speed run by them all the year, or for any considerable part of it? The Godavari steamers draw eighteen inches and have a speed of ten miles; they have power for about twelve or more, but cannot use it on account of great vibration, not being quite strong enough in their frames. With a little alteration they would carry them up very severe

rapids, but they must tow cargoes. On the Godavari our steamers are quite oblong on their plan, quite flat at bottom with perpendicular sides, and fine vertical entrances, five to one, but I think they should be finer, one in ten. I would have for the Nile such a boat two hundred feet long, sixty feet broad, and drawing eighteen or twenty-four inches, displacement six hundred tons, drawing empty ten inches, and carrying engines weighing two hundred tons, working to 4,000 H.P. indicated, and with one hundred and fifty tons of fuel on board, drawing two feet, which I reckon would allow a speed of twenty-five miles at least, and more for a spurt; this is the kind of boat that has been such a complete success on the Godavari. I don't know whether the rapids would allow of steamers so large as this. If the stretches of rapids are straight enough, such a vessel might run up alone, anchor above, and then draw up her barge.

"I wish that they had spent the money that the railway has cost in improving the rapids. Even if the river could only be used for heavy traffic for six months in the year it would be an incalculable benefit. They only use the Erie Canal for seven months, and carry four million tons by it. One thing is to me certain, that if water carriage cannot be established to the lakes, there can be no great traffic; for nothing of any consequence will bear the cost of three thousand miles of land carriage. The present head railway engineer in India, as soon as he had finished the Eastern Bengal Railway, wrote a report, showing that it was absolutely necessary to cut a steamboat canal by the side of it, and that it would return twenty-two per cent. and save one and three-quarter millions a year besides on the present traffic, thus reducing the cost of transit from sixteen shillings a ton to three shillings and sixpence.

"Pray excuse my troubling you with all this. The absolute necessity of water carriage has been so forced upon me in India, that I cannot bear to think of those magnificent highways, ready provided to the centre of Africa,

remaining unused, while I remember what is hanging upon their use, nothing less than the rapid opening up of that vast population to all the wholesome influences of the Word of God. It was the most unfortunate thing for Egypt that they employed a railway engineer. Like India, the grand treasure of Egypt is water, and there the railway engineers have been compelled to see that railways are a complete mistake. I beg to offer for your reading some of my late papers, in which you will find many things that bear equally upon Egypt.

"The question of internal improvement there, is now at length, I hope, coming to an issue, but it is a hard fight; the old India party cannot bear to give up their idol—railways—after having spent one hundred and sixty millions on them, but they are terribly puzzled when their own oracle comes forward and insists upon a canal by the side of a railway that has cost £20,000 a mile, and has been tried for twelve years. How wonderfully hopeful all the prospects for Central Africa are now. Every month we hear of some new proof that God is working for its emancipation. May He abundantly prosper your work."

In another letter he continues his suggestions:—

"The works required are:—

"1st. The blasting of dangerous rocks, which can be done at the cost of a few pounds of dynamite.

"2nd. The closing smaller channels by large blocks of stone, so as to concentrate the stream, which also would be a very inexpensive work, if powerful apparatus is used, for it is cheaper to work large blocks than small, the cost of breaking up being saved in the former.

"3rd. Probably in some places throwing rough stone dams of large blocks across the stream, and building locks to pass the boats round them.

"By such means as these an engineer of some experience and talent for such work would very soon effect a perfectly good navigation to Khartoum for most, if not all, of the year. . . .

"But excellent use can certainly be made of the river,

even in its present unimproved state, if only effective steamers are used, carrying all the power they can on one foot draught, 1,000 or 1,500 H.P. in a steamer one hundred and twenty feet long, with stern wheel and a speed of twenty or twenty-five miles.

"One engineer writes that he went up in the clumsy country boats with nothing but sails, probably not more than 20 or 30 T.H.P. of wind, and with this ran up all the rapids, when the river was low. What difficulty could there be with steamers with fifty times as much power on board?

"Having had so long experience in this matter on the Godavari, I cannot but hope you may think it worth while to offer this with other papers on the subject for the consideration of the gentlemen who are preparing to bring the subject of Nile navigation before the public in Manchester and London."

Sir Arthur Cotton's great object in pushing these practical theories was the double one of promoting the welfare, spiritual and temporal, of the people throughout the vast continent of Africa.

In allusion to one of his pamphlets on the subject, Sir Henry Johnstone wrote to him:—

"I sat up late last night, and got up early this morning to read through the pamphlet which you kindly gave me yesterday to look at; and now I have great pleasure in returning it to you before I leave for London.

"I must express my gratitude to you for calling my attention to the observations made by Mr. Picot on his recent visit to the Ashanti capital. His letter is painfully interesting, especially in some parts. Deeds of cruelty and bloodshed are still being perpetrated in that dark land. To all outward appearances it is, as it were, hermetically sealed to the heralds of salvation. I pray God that, in spite of all the efforts made by king and chiefs to prevent it, a way may soon be opened by Him for the introduction of that everlasting Gospel, which alone is capable of changing the hearts and lives of the people.

"I thank you sincerely for all your labours on behalf of my country. May the Lord bless you abundantly, and crown your efforts with success!"

At this time he was also intensely interested in the opening up of Palestine by inter-communications. To the Society of Arts he addressed himself with regard to the Arabian railway to Busrah:—

"It is indeed a question of fundamental importance to the empire. The line from Acre to Damascus will soon be completed, overcoming the only serious difficulty in the connection of the Mediterranean and the Gulf, viz., the deep depression of the Jordan valley, which it crosses at the south end of the lake of Tiberias, leaving only the seven hundred miles of level country between Damascus and Busrah, surely the easiest seven hundred miles in the world for a railway.

"I accompanied a caravan by this line, and, for almost the whole way, the country was one absolute tract of dry alluvium without sand, stones, or waterways, so that, for hundreds of miles, the rails might literally be laid on the ground as it is. There was, for weeks on the journey, a clear, level horizon, like that at sea.

"I may add that all this vast tract of country requires nothing but canals from the Euphrates to make it capable of bearing a population of scores of millions, and these canals might be cut at an expense of one-fourth of that of the great delta irrigation of Madras, owing to the works requiring no provision for heavy local rains such as occur in the Carnatic, and to the small size of the Euphrates, about three hundred yards broad, compared with the Godavari, for instance, four miles broad, the weir for which required just one million tons of masonry, besides one and three-quarter miles of vast earthen embankments.

"This second line of communication with India, as it would be in a certain important manner, will be of incalculable value.

"I ought also to refer to the great point brought forward

in Col. F.'s paper, that these plains are the site of an immeasurable deposit of fuel, in the state of bitumen, and probably also, of course, of coal; so that, independent of the fact that a line of railway across them would help to strengthen the connection of the two halves of the British Empire, it would certainly bring effectively into use a material worth hundreds of millions.

"These three things combined, namely—

"1st. A subsidiary connecting link for England with India, and all the East.

"2nd. The giving access and value to the vast field of fuel.

"3rd. The opening of the way for the population of, perhaps, one hundred thousand square miles of rich alluvial country, combined with assuredly laying the foundations for peace and justice throughout Arabia by English influence, as in Egypt; these things give a weight to the subject of an Arabian railway that no words can express, and render it, perhaps, as great and suitable a subject for the Society's consideration as could possibly be found.

"May I hope that my own experience in respect to the passage of the desert of Arabia, and to irrigation in India, will be allowed to excuse my presuming to offer my thoughts in this matter?

"I might add that the port of Acre, the termination of the railway, is naturally the port of Palestine, as it requires only a breakwater extended from Mount Carmel, which can be constructed at a comparatively small cost, to make a perfect harbour of any size that may be required."

The following letters from one of my father's correspondents interested him very much, and he often quoted sentences from them:—

I.

"I went to Hit to see the bitumen spring in connection with my idea that nearly all our coal is a volcanic product ejected and rained down upon the vegetation to which geo-

logists, I think erroneously, solely ascribe the origin. What I saw there is all in confirmation. But I suspect that under the Euphrates there are vast coal fields, and that this was one of the reasons, no doubt, among others, why, from the Tower of Babel onwards, a great city was never permitted to be built on the Babylon site.

"These coal fields will keep the new route going.

"Both the state of the Turkish Empire and the Egyptian question must force on this acquisition of Arabia, but it will be accomplished, I think, when the Turks have to quit Europe by a Moslem rally at some centre—probably Damascus—this rally being followed by a series of very critical events."

II.

"General N. has the wants of Mesopotamia in view, whereas, I contend, they are secondary to the direct Indian interests in the Egypt and Persian Gulf line, with the virtual annexation of Arabia, nearly all the coast districts of which, from Bahrein to Yeddah, are in a state of Bedouin insurrection, not remotely due, I suspect, to the brisk trade in Martini rifles which, I hear, has been going on through the Persian port of Mohumra.

"I look upon the Arabian line as now essential to the safety and progress of India, and certain to be made before long. One of the points for discussion is whether Alexandria should be the terminus of the route, or an entirely new British port opened somewhere on the Egyptian coast between Port Said and Philistia, quite clear of the Suez Canal and European politics. This question I have not attempted to raise.

"There is no doubt that under comparatively slight British direction of affairs, both Turks and Arabs would make progress at a much more rapid pace than the feebler natives of India. There is no want of either intelligence or enterprise at places like Bagdad. But, as long as Christians and Mohammedans are not equal before the law, and a few hundred oriental fanatics have the control of the revenue,

and the real power is in their hands at Constantinople, so long they must be depressed, and nothing can be grown or done in the districts, except by a man with a bludgeon in his hand or a gun at his back.

"I have found the word 'swift beasts' to which you refer: Isaiah lxvi. 20. KURKRUT in Hebrew, or 'running things of the nature of machines,' which the dictionary translates 'dromedaries,' and they do the running now. Exactly the same word I find in Arabic—KARKARA, 'running like a machine,' from the root—Kar, to turn round and round, the origin of the Latin 'curro,' and our 'current,' and other words. My two munshis could not attach any distinct meaning to Karkara, it not being in common use as a noun. It certainly was not their word for dromedary.

"The usual Hebrew word which, I am inclined to consider, means a railway, in prophecy, is MÁSULAH, and 'embankment' from the 'SULAL,' to heap up, which is very suggestive. The translators make it 'highway,' as you are aware.

"Steamers again seem meant by the Hebrew 'KLI GAMA.' The latter is possibly the Arabic—GHAYM, 'cloud,' signifying vapour vessels, in French, 'Vapeurs.'

"There are a number of aged and worthless cattle killed round the large markets from the quality of the steaks one gets, but not nearly enough to produce an improvement of agriculture. With European officials tending to become fewer and fewer, it will be some time before the natives see how they are being eaten out of a subsistence by these vampires. But the Arabian route and its daily mails would bring in a fresh stock of European ideas."

As regards British relations with Egypt, my father puts this distinctly on record as his opinion: "The establishment of British Sole Authority in Egypt is incomparably the greatest political event that has happened in my long life."

On the Opium question, a subject which was always one of keen interest to him, he made proposals of his own

for the increase of revenue in the place of the direful growth of that which must, in the end, impoverish rather than enrich the country. He writes:—

"I cannot trust the report. I wish very much to see the real evidence of the anti-opium men. How we are reminded of that word: 'Send help from the Sanctuary, for vain is the help of man.' If God were not dealing with us, as He has not dealt with any nation, what would be the weight of His wrath on a nation guilty of the immeasurable crime of the opium trade?

"But He, Who in infinite patience delivered us from the transgression of slavery, without demanding one drop of blood, can bear with us in this also. And we are to-night to pray hopefully: 'Deliver us from all our transgressions.'"

It will be noticed how, in all these anxious questions, his mind reverted continually to the Divine promise of succour and help to those who trust in the King of Kings and believe His word.

And now for some remarks, which I am fully aware will be wholly inadequate to the importance of the subject, respecting that devotion of his to the soil and its productiveness. It was a great enjoyment to him to lay out the gardens of our new house at Dorking, trenching them after his own fashion, three feet deep, and at the same time manuring highly; afterwards he considered it a mistake to do this on too rich a scale. He took immense pains with the production of both flowers and vegetables; his efforts were rewarded with remarkable success. A plant of American blackberries, for instance, placed in this prepared soil, would produce blackberries of an extraordinary size and flavour. He did the same with everything: currants, gooseberries, and raspberries. Then his potatoes, turnips, and other vegetables were indeed a sight to be remembered. It was a great pride to him to desire the gardener to show us a single potato root, with an enormous crop, both the quality and quantity surpassing anything that one had ordinarily noticed. Then he would have

SIR ARTHUR COTTON (ÆTAT 94)
In front of the plot of maize grass grown by him in 1876. A. 537.

it weighed, so that he might know exactly what the produce would amount to per acre. By degrees he interested himself intensely in agriculture, experimenting on wheat, oats, and Indian corn. He found that he could produce seven times the ordinary result from one grain of wheat. In the "Appendix" to this chapter will be found a description of his working out of this problem. He would aerate the ground two or three feet deep, pulverising the soil, his theory being that plants needed air as much as water.

One summer there was a great lack of grass in the neighbourhood, while, of course, the supply of hay was small. But when, that same summer, we visited the experimental plots in his garden, we saw grass growing there quite five feet high, thick and strong, abundantly luxuriant; yet he had never given it one drop of water. It had fared like the rest of the fields as regarded the rain supply. The only difference was in the mode of cultivation. The depth of the soil had been sufficient to feed it, and provide it with this vigour of growth. But, as I said before, his resources were endless. His active brain was always working out some new theory, and, with his natural energy and practical common sense, putting it into everyday use.

On this subject he wrote to the *Manchester Guardian*:—

"Your paper of yesterday contained some remarks on my experiments on cultivation, which do not require any direct answer, as they do not amount to any real description of the great national question of improving cultivation, but I should like to take occasion from them to give some information on this vital subject.

"My first is to repeat the fundamental question: 'What can possibly be the reason why everything else in the kingdom should be under improvement, and that with a success altogether beyond anything thought of beforehand by the improvers, and yet that the whole body of agriculturists, without exception, should utterly refuse to attempt anything in the way of improvement, or even to write

or utter a word?' Nobody can possibly answer this question.

"And, still more, these very men are, with the utmost intelligence and perseverance, doing just like all other classes in improving their animals, and with the same results.

"In passing along the roads we meet, continually, such horses, cattle, and sheep as were not thought of seventy or eighty years ago; but, if we look over the hedges, we see precisely the same cultivation, four or five inches deep, the same enormous clods, and the same miserable crops as we did in our boyhood.

"And, again, reports of hundreds of agricultural meetings where thousands of prizes are granted for improved animals, but not one for improved crops in respect of *quantity*, *quality*, or *cost*.

"And, if we read the leading agricultural papers, one thing is certain, that the word improvement as to crops is never admitted. To meet this state of things, I do what I can in my circumstances to try what a certain soil *can* be made to produce, though without the advantages of an ordinary farmer with experience, considerable extent of land, and effective implements, etc. And here the result is, not from any enrichment of the soil, which is a pure imagination of your writer, for the soil is exactly the same as before, a very poor one, much below the average. The only change is by cultivation. The result is such crops, in spite of seasons, as nobody could have thought of, for instance, a plant of wheat from a single grain, six feet high, with one hundred and ninety ears on it.

"And as respects seasons: in a year when not a green blade was seen in June on farm meadows owing to drought, a crop of rye grass five feet high, at the rate of three tons to the acre—this without any watering.

"Upon the whole trial, of ten or twelve years, the produce has been about four times that of the farms in potatoes, wheat, grass, and roots. If any farmer wants to have some idea what it would cost to aerate his soil to the

depth of two or three feet, he has only to take an hour to calculate it. He has plenty of materials for this.

"I will only add here what I hear is going on at this time in this way. One man writes, to show how little I know about the matter, that he tried my system, and it was a failure, but that by a system of his own he made a clear profit of £8 an acre the first year, counting all the cost of his permanent improvement as if they were current expenses. This was a curious way of showing I was mistaken in saying that cultivation could be improved! If every acre in England were so cultivated as to yield a profit the first year of £8 per acre, the whole body would at once be set upon its legs, and agriculture would be the most profitable industry in the country.

"Further, I have now full evidence that many farmers are already setting themselves to this grand work.

"Two great landowners that I know of are setting about it in earnest. One writes to me that, the year before last he cultivated twenty-five acres to the depth of eighteen inches, and that he had an astonishing crop of rye grass of three tons per acre, with a promise of as much more by further cuttings. Another man wrote that he saw wheat, on the land of the other landowner, two feet higher than on the adjoining farms.

"I have seen also several letters from tenants saying that they have had splendid crops the first year from improved cultivation. One said sixty-seven bushels of wheat, more than double the average of farm lands, and so on.

"I have no doubt, therefore, that there are now many more improvers, both owners and tenants, scattered over the country, and that none of the present false leaders can possibly stop the change, especially when they write only in the way of your writer, without a word of real argument on the subject.

"I am fully assured, after carefully looking into the whole matter, that, with present prices, agriculture would be the most profitable industry in England, if only the multitude of intelligent men, rich and poor, now engaged

on the land, would go to their work every day with one thought in their minds: Improvement.

"The reports of harvest this year give an average of thirty-five bushels of wheat, six above the usual average. Of course, the great question in this case is: 'How much of this is due to the season, and how much to the results of improvement?' I have great reasons to believe that a considerable portion of it is due to the latter; but, of course, no agricultural paper would dare to hint at this.

"This is a great vital question in every way, and I most earnestly beg you to allow your readers to see this side of the question."

To a friend he remarks:—

"We have had glorious weather, exactly what we wanted, both for the hay and the corn; but to-day I am sorry to see the temperature has greatly fallen. The hay is safe, but the wheat is not, and a few cold days now would do terrible mischief to the latter. My wheat promises a crop beyond any former, but it is not safe yet, though much forwarder than that on the farms.

"The progress of the enquiry about the new cultivation is far beyond that hitherto with new discoveries. Two Scotch lairds came to see the wheat. They took great interest in all they saw, and said they would both make experiments in the system."

In allusion to a gift of pamphlets and papers on the all-absorbing question of improving the soil, he writes:—

"We have now intimation from so many quarters that men and women are really setting themselves to answer this question, though, as yet, not a single leader in agriculture has condescended to pay the least attention to the subject. But I am sure that very soon we shall see the same conquest over the land in respect of produce as we already see in the ocean, which has now been made the safe, cheap, and speedy highway, moving all nations, by Him Who declared that such was His purpose, three thousand years ago."

Of his agricultural experiments he never tired. A friend writes :—

"Sir Arthur's wheat, sown last autumn, seed by seed, each on a square foot of land, is now about three feet in height (while the ordinary farmer's sowing is three or four inches), and one hundred to one hundred and twenty straws from each seed, and the ground is so fully occupied as to almost entirely cover the soil.

"I find that some friends in America, to whom I had spoken of the three feet digging, imagined that the seed had to be sown unusually deep,—but this is quite a mistake,—Sir Arthur's seeds were put in at the depth of one inch!"

"The facts I have brought forward," said my father, "are quite conclusive as to the wonderful capacity of the worth of produce, and every one acquainted with cultivation can easily notify himself, by an hour's calculation, that farming can be conducted profitably if anything approaching real cultivation is used. There is, however, now an extensive enquiry going on, and some, even, of the old landowners are honestly setting themselves to investigate the subject. The Government, also, have ordered trials to be made."

Appendix

A MODERN SEER AND A NEW HOPE FOR BRITISH AGRICULTURE

(*By a Student of the System.*)

There is almost a dramatic completeness in Sir Arthur Cotton's life. The great subject of his prime was land and water; and now, in his extreme age, it is land and air. Then he saw, in the waste of India's treasure of flood-waters, the chief cause of her poverty and famine: with equal clearness he now sees a parallel waste in our own home lands—the unthought-of waste of air, that great agent of soil-action and plant-growth. He sees, too, this waste, like that of India's monsoon floods, to be inconceivably

vast—vast enough to fully account for our agricultural depression, and all that it involves. He considers this land and air question to be almost as vital to Great Britain as the land and water problem is to India.

The parallel is even closer. He himself solved the Indian question practically—so far as he was allowed—by superbly successful undertakings, the turning of two semi-deserts, the deltas of the Cauveri and Godavari rivers, into gardens; and now, during these last twelve years—from his eighty-fourth to his ninety-sixth year—he has given a remarkable practical answer to the home problem. It matters little that in the latter case the experiments are on a very tiny scale, his garden giving him scarcely a square yard for every square mile he dealt with in India. Each plot bears its exact relation to the acre, and all weights and measurements are made, and all observations taken, with extreme scientific exactness, so that the results are as instructive and reliable as they would have been had the experiments been far larger. The advantage is really on the other side. These experiments have been made by a very old man, without agricultural training, and on so small a scale that labour reaches its highest proportion of expense. As he puts it: "Without horses, or steam, or any agricultural experience, and in old age, I can do nothing here as it might be done on a large scale." Add to this that the land is poor, fully sixteen per cent. below the average for the country, and one feels the growing significance of the wonderful success he has made. How much more may be done under better conditions! Also, he has purposely avoided all other special aids, *e.g.* high fertilizers, in order to establish his one point—the importance of the fuller aeration of the soil. Let these be used in addition and far greater results still may be expected.

HOW THESE EXPERIMENTS BEGAN.

They began with the eighth Marquis of Tweeddale and the Yester Deep Cultivation. The Marquis, as Governor of Madras, had been a great strength to Sir Arthur in his Godavari battle. Their friendship continued, and when Sir Arthur visited him some forty-five years ago, he shewed him twelve hundred acres he was then tilling on the Deep Culture principle. "Four years ago," said he, "I got this farm into my hands, and there is now *four times* the value of produce there was when I came into possession."