



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 *sharāki*, 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

**M**Y 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.<sup>1</sup>*

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,

<sup>1</sup> 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





## THE NORTH AFRICAN SLAVE TRADE 517

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,





## BRITISH SOLE AUTHORITY IN EGYPT 535

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 MĀSULAH, 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 1865. —

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."





Sir Arthur was told of a field on the same estate, which had been so poor, and sour, and cold, that oats would not ripen on it in bad seasons, but which, as a result of the new treatment, had just yielded forty bushels to the acre of the heaviest wheat in Great Britain—sixty-seven lbs. to the bushel. All this, too, in Midlothian, four hundred feet above sea-level, and with mean temperature of  $5^{\circ}$  below that of the South of England. Here were crops of all kinds surpassing anything he had seen in the South.

And the secret? Aeration—simply a fuller and deeper aeration of the soil. Instead of ploughing six inches only, and with the old style, clod-making plough, Lord Tweeddale had ploughed (with four horses) to a depth of sixteen inches with a plough that *made no clods*.

This set Sir Arthur thinking, and so when some thirty years ago he retired, after forty-five years' service, "old and greatly worn out," as he puts it, "by Indian hard work and sicknesses," he began such "trifling experiments" as opportunity allowed in different gardens belonging to houses occupied for short periods. "It was clear enough," he writes, "that there was something quite wrong about the whole state of farming. . . . What the Marquis had accomplished was sufficient to prove that a radical change was required in the whole farming ideas of the nation; but it was only by slow degrees that I realised the unbounded prospect that lies before us." . . . It was not until 1886, when in his eighty-fourth year, that he was able to begin that series of continuous experiments, which he is still conducting in his garden at Dorking.

#### THE GREAT PRINCIPLE.

That air is the great agent of soil-action and plant-growth is the great principle, and exposure of the soil to air by pulverization to the greatest possible depth, is the one simple method.

He related to me how the Marquis of Tweeddale, having often spoken to him of a clod-breaking machine he had invented, at his request showed it to him. "I have learnt better than that now," answered the Marquis. "Such a machine only proves bad farming. *There is no such thing as a clod on land that's well farmed.*"

Sir Arthur Cotton's plan is to *trench his land to a depth of three feet*, with a very strong cast-steel fork of his own design,<sup>1</sup> and with

<sup>1</sup> To be got at "One and All" depôts.





the one aim of pulverizing and aerating every particle of the soil. In most cases, and at first, this must be done gradually, going a few inches lower each season; for unaired soil is too unwholesome to be mixed at once, and in large quantities, with the top-spit. The particular methods, however, must be left to individual needs, experiences, and ingenuity. The great thing is to keep well in view the wonderful treasure locked up in common soil, and to remember that air is the key to it. One leading agriculturalist has declared that, of the whole weight taken from the land in the way of produce, *ninety-five per cent. comes from the air*. It is now known that air plays a great part in the nitrification of the soil. There is often plenty of nitrate present—in tropical soils sometimes as much as one per cent. is nitrate; but little of this is in a form available to plant life. Air helps by making much of this available.

Again, want of air often makes soil sour, cold, and even poisonous, and the only cure is air—with plenty of air, sour land grows sweet.

Then air is a poor conductor of heat; and so a well-tilled garden bed, being full of air, is a *blanket* to keep out summer drought and winter frost. This is why frost penetrates hard soil so much more quickly than soft.

Further, well and deeply tilled soil acts as a *sponge* as well as a blanket—a *sponge below and a blanket above*—for friable soil gives some play to the law of capillary attraction, so that deep-tilled soil is always damp six inches below the surface, even in the worst droughts known to this country. Such soil is *far* warmer and drier in winter, and *far* cooler and more moist in summer.

Again, deep tillage gives better play to root action—a most important subject which we are only beginning to explore. I was telling Sir Arthur how a friend of mine, a horticultural expert, had traced the roots of strawberries two feet, carrots three feet, onions four feet, and wheat six feet. In reply, he told me that, at a certain agricultural meeting, Lord Tweeddale was called to question for his deep ploughing—what was the good of it? wheat never required such depth. He reserved his reply till a subsequent gathering, when he gave it in the shape of a glass case in which wheat was growing, and where they could *see its roots eight feet long!* And yet nearly all farmers still plough only four, five or six inches deep, and that with a plough which, while it makes





clouds above, irons out the earth beneath into an almost impervious pan! No wonder we hear of bad times, and farming that never pays!

DEEP CULTURE VASTLY REDUCES RISK IN BAD SEASONS.

When I asked Sir Arthur Cotton about this, he answered with a quiet smile: "The year 1893 was one of the worst hay years in the century to us in these parts. By the first of June there was not a blade of green grass in any of the fields about Dorking. Yet, on that very day, I cut a plot of rye grass, sown the previous autumn, that stood five feet high, green and luxuriant, yielding at the rate of four and a half tons to the acre of splendid hay—while two subsequent cuttings gave me three tons more! It had received nothing but an ordinary dressing of liquid manure, and the land was poor!

#### RESULTS.

*Potatoes.*—1. Planted in deep, rich, sandy soil, in Tunbridge Wells, cultivated once to the depth of three feet. One plant to the square yard, yield fourteen lbs. to each plant (average), or thirty tons to the acre, worth, at 70s. per ton, £105.

2. Planted in Dorking in 1895. Yield twenty tons per acre, with cabbages planted between the rows of potatoes, yielding another crop of thirty-five tons to the acre. Potatoes, at 70s. = £70, and cabbages (for fodder) at 20s. = £35. Total value (at the rate of) £105 per acre.

*Maize.*—This has fully ripened for some years in succession—a remarkable thing in this country. The corn raised one year is used as the seed of the next in the hope of acclimatizing it as a fodder plant. It has already withstood frost that cut neighbouring potatoes down to the ground, and grows luxuriantly to a height of eight and nine feet, yielding, at the flowering time, thirty-five to forty-five tons to the acre of excellent fodder.

*Peas.*—This year's crop, despite long drought and poor soil, grew splendidly to a height of eight feet, yielding the finest peas I ever ate. The sweet peas stood six feet high.

*Wheat.*—Hand-sown, each grain twelve to fifteen inches apart, and bearing often an average of about fifty ears per plant. Once, a single grain produced one hundred and twenty ears, and once one hundred and ninety!<sup>1</sup>

The 1896 crop was a marvel, yielding at the rate of some one

<sup>1</sup> This year two plants have produced 120 ears each.—A. C.





hundred and thirty bushels per acre, instead of twenty-nine, the usual average for the country generally. It also yielded straw of remarkable quality, six feet high (average), and weighing at the rate of ten tons to the acre. The grain, too, shows a striking improvement in quality as well as amount.

*Rye Grass*.—Under ordinary methods this plant has a profitable life of only two years; but Sir Arthur's is now in its *seventh* year. This is the first year it has shewn any decline; but even this diminished crop has weighed at the rate of five tons of splendid hay per acre! During the six previous years, there has been an almost steady yield, in three cuttings, of seven to seven and a half tons of hay to the acre, though some of these seasons have been extremely bad. The *cost* of cultivation has been very small, when spread over these seven years. Besides the cost of seed and harvesting, and four or five ordinary dressings of liquid manure, there was merely the first and only cultivation of the land to a depth of three feet, costing about £25 by hand labour. This crop, therefore, has been enormously profitable.

It is true that these cases enumerated are among the best; still, the average for twelve years, over a great variety of crops and seasons, is fully four times the farm average of the country for similar land, and there is little doubt that better land and better conditions would have yielded still more startling results.

#### A REMARKABLE DISCOVERY.

"I made a remarkable discovery this year," Sir Arthur said to me, as we were turning away from the wheat plot: "The wheat was sown on the 1st of September, but the birds got at some of it, so there were gaps left which we filled up with fresh sowings about the end of October. Thus we had two crops—the early sown, and the late sown—and the difference in the behaviour of these was very striking. The late sown scarcely grew at all in the winter, and never came to a fair crop at last; but the early sown grew and tillered the whole winter through, without a stop even in frost, and reached an average of forty-five ears per seed sown, against twenty ears only in the case of the late sown. And no wonder! for in the coldest spells of the winter, when the surface was frozen, the thermometer registered 47° at a depth of three feet! Only think what that means—*Deep culture adds three months to the growing season.*"

Talk of Klondike and its gold mines! Here in this discovery





are possibilities enough to stagger the imagination. It tells us of vast wealth hidden, not in the cruel, frozen North, but here close at hand in our own familiar fields.

The power of deep tillage is gradually becoming known. The famous Tintara Vineyards of Australia are cultivated on this principle, and Mr. Cecil Rhodes plants 3,000 fruit trees every year in deep-tilled soil, and says he means to do so as long as he lives. The advantage of deep culture is specially felt in tropical lands. Sir Arthur shewed me a letter from a coffee planter in the West Indies, to whom he had sent two of the garden-forks to be used in place of the hoe. This letter reported that the result of deep culture, by means of these forks, had been to raise the coffee yield per acre from 200-400 lbs. to 2,500 lbs.!

The best of this deep tillage, as Sir Arthur is never tired of pointing out, is its availability to every one who has any land whatever. He who tills but one square yard can turn it into a cubic yard or more and watch the effect; while he who ploughs his hundred acres can plough four times instead of once, to a depth of twelve, fourteen, or eighteen inches, with ploughs that cut and aerate the soil while they make no clods.

The one thing needed in this matter is *faith*. When men discover the presence of enormous wealth one thousand yards beneath the surface, they allow no expense to hinder them. They think and plan and invent till they are able to reach their treasure at a reasonable cost. Once we as a people come to believe in the boundless treasure bound up in soil and air, we, too, shall invent machinery to carry out profitably these new ideas. Indeed, this process has begun already. Several machines have been invented. Amongst others, one used last year by the Duke of Bedford, which rips up the land to a depth of thirty inches at a cost of only 30s. per acre, and which pulverizes the top eighteen inches for another 20s., *i.e.* only 50s. in all. Early in July this year, some experts visited the Duke's estate to see the wheat on the land so tilled, and one of them reported to me that it stood about two feet higher than other wheat near by on similar land tilled in the old style.

Sir Arthur Cotton believes that land is one of the best of investments, if not the best, and that it may well be made to yield a forty to fifty per cent. return at present prices. Anyway, the question is a national one, and one of incalculable importance.





## CHAPTER XIX

The Mainspring and Secret of Arthur Cotton's  
Life : Character and Characteristics

MY father was never really happy unless he was in some manner promoting what he believed to be the furtherance of the kingdom of God in the world. He lived as one who served his Divine Master; and thus ordered his life and conversation; while a sense of the importance of religion to every one and the great issues of eternity made him ever zealous for the salvation of the souls of men. His ever-abiding sense of God's presence was the secret and the mainstay of his life of manifold activities.

So long ago as one of his visits to Tasmania, he took great interest in evangelistic work amongst the convicts, the southernmost island of the Australian dominion being then a penal colony.

Wherever he was stationed in India, Christian mission work found in him a ready supporter. More particularly was this the case while the great anicut at Dowlaiswaram was being constructed. Many instances occurred in which this was evidenced. Young officers, sent to assist him in the carrying out of his great enterprise, were particularly influenced by him for good, and not a few were themselves made the occasion of great good to others.

My father's interest in the extension of Christianity throughout the world was evident from a glance at the little pile of missionary reports, quite up to date, which always lay on a small table by his side, ready to be studied





at any leisure moment. To the very last month of his life, he seemed to be cognisant of each fresh effort that was being made to aid the march of Christianity in every part of the world.

A conversation with him would embrace so many different themes and cover such a vast area, that we often used to tell him that we had "heard as much as we could take in for the time being." But his own brain never tired in his search after knowledge, especially in anything that related to the advantage of the British Empire, either spiritually or temporally. Truly, he was a Christian patriot.

When the transcript of the Moabite stone came to light, he used constantly to refer to it. "It seems as if it had been sent to us," he said, "just at a critical moment, when infidelity is trying one of its worst attacks on the inspired Word. This is merely to remind God's believing ones that His Word is true; and that nothing can ever shake the Divine testimony."

In prophecy his interest was unbounded. I can give but a slight sketch of some of his prophetic thoughts:—

"The strange confusion which exists on prophetic subjects surely arises from mixing up things literal, things figurative, and things allegorical. When we read, 'They shall cast lots upon my garment,' we know that this is literal. When, again, we read, 'The man of sin shall be revealed, and he who now lets will let,' we know that it is figurative, because the smallest consideration will satisfy us that it has reference to future events; so that 'he who lets' cannot be a man, and consequently we may say the same of 'the man of sin.' To speak of one person in a certain passage as an individual man and in another a figure of something else is contrary to common sense.

"If we begin by satisfying ourselves whether a passage is literal, figurative, or symbolical, which is easily done, the matter will soon be cleared up to us conclusively. We do this, as a matter of course, when we read *John Bunyan's*, or any other, book. Nobody has any doubt whether his





'Interpreter' is a man who translates one language into another, or whether he is an interpreter of the Word of God.

"But I should like to add one or two remarks on particular points.

"One is about Tarshish. It is asked, Where is it? It is perfectly clear that in the Bible the word 'Tarshish' is used just as we have used the word 'India,'—that is, as a general expression for the distant parts of the earth. We had East India, and the West Indies; we call coloured men, Indians, whether negroes or red Indians. We used to call all large ocean vessels, Indiamen, whereas that was not correct; just as they are called in the Bible, ships of Tarshish. Thus ships went to Tarshish from Ezion-geber, and returned after three years' voyage, with ivory, gold, apes and peacocks, the present four marked products of the highlands of Mysore, in India, and those who went from Tyre to Tarshish brought back silver, tin, and lead, the three products of England still. But also Tarshish is mentioned as a particular locality, just as now we designate our Asiatic Empire, India, as if there were no other. Thus, we read in that most remarkable verse, 'Tarshish, and all the young lions thereof,'—the lion being the official symbol of England, the only State that has young ones. There are no young 'eagles.' Canada, Australia, and South Africa are England's real glorious whelps, as superior to all the rest of the world as their mother is. I would like just to add here, that, in the passage in the 38th chap. of Ezekiel, Tarshish is merely represented as looking on, and saying, sarcastically, 'Art thou come to take a prey?' That is spoken by a person taking an intelligent view of the case; and assuredly anticipating what the end of the contest would be."

He held for many years, latterly very strongly, the Anglo-Israelite theory, and certainly many of his statements, which were the result of close investigation, were very convincing.

The relative to whom the following letters are addressed





"I CAN GIVE THE PRINTED WORD" 551

was in Ireland for a time, directing the operations of the Irish Church Missions :—

(1) "There are two marked signs of the times in Ireland, one is the hearty union of different portions of Christian men, one a Plymouth Brother, a sectarian of sectarians, uniting himself with Churchmen, as well as others. The other is the spirit of dissension, that God has sent among the enemies of truth and of His kingdom.

"We cannot mistake these signs that the time has come for the deliverance of Ireland from her papal bondage. I don't understand what you say about the supply of scriptures running short. Will not the Bible Society supply any number of copies? How far this state of things is beyond what was thought of two or three years ago! What encouragement for the prayer meeting! We must not be surprised at the troubles in North Africa. Hudson Taylor has met the difficulty in China by appropriating separate ranges of country for the different churches.

"A large number of the converts from heathenism in Orissa owe very much of their awakening to the printed Word. In various branches of the Indian service Christian officers, who may not be able to preach in the vernacular, gladly engage in tract and scripture distribution. The late lamented General Brown, of the Madras Army, did this, saying, 'If I cannot preach the Word on the line of march, I can give away the printed Word.' Another officer in the Madras service purchased a sufficient number of gospels to send to every town and village, and to every native prince and Government official in the district where he was appointed. Our Lord said, 'So is the kingdom of God, as if a man should cast seed into the ground; and should sleep and rise night and day, and the seed should spring and grow up he knoweth not how.'

"David strengthened himself for his contest with Goliath, by remembering what God had done for him on a former occasion, and this record is exactly calculated to strengthen the hands of every one, whether missionary or otherwise





who shall help in any way to scatter this living seed. We have every day new proofs that it has in good measure already undermined the great fabrics of Hinduism and Mohammedanism; and the working of this leaven is now appearing on the surface; in the little native churches which have sprung up in many places, before any missionary had reached them.

"In one tract of country, on the confines of the native State of Hyderabad, there are now more than twenty-five villages in which there are well-established native churches, the commencement of this movement was entirely from tracts and scriptures, the native catechist who first visited the neighbourhood finding there a number of Indians who regularly met for Christian worship, and were so far instructed as to be in a great measure prepared for baptism. And we may now confidently expect that such cases will rapidly multiply. There is, as it were, the seed of truth under every sod almost throughout India, and all for many years well-watered by the prayers and tears of faithful men. Let this fact encourage every one to help in a work of such unspeakable importance.

"How terrible it is that God's people should be spending their energies upon each other, instead of upon the enemy! I am persuaded that as yet the only thing is for each body of Christians to carry on its own work in its own way."

(2) "I am so glad to hear you are so grappling with Popery. It must be a most difficult subject, but the end of the fight is certain. Rome will never revive. And all this childish religion in our own churches is a sign that men's consciences are not so fast asleep as in my boyhood.

"I remember many years ago your quoting that verse in John, that the Word should try us at the last day, and have a thousand times referred to it. It speaks authoritatively to the conscience, and the whole system of training of the Papacy is to overpower and stupefy the conscience, in order to get rid of this authority of the Word, acting most wisely in their own interests.





"And that which carries conviction to the understanding is the argument of justification by faith.

"The whole Bible rests upon this; and who could have invented it? It bears its own proof with it. That there should be some intimation of it in another book proves nothing. Every human system contains some scriptural things, both doctrinal and perceptive. How could God's teaching be utterly obliterated? Some things approve themselves to the natural conscience which the heart and life are still entirely opposed to; and these are found in all false religions. But the clear and full declaration of 'faith being counted for righteousness' is the proof that the Bible, which is pervaded by it, and absolutely dependent upon it, is from God. If the records of the Bible are false, of course our faith is vain.

"Every possible thing that could confirm the miracles of our Lord took place, and friends and enemies are equally witnesses to them. The miracle of Peter's at the Temple was a remarkable one of this type. The man afflicted was forty years old, had been long placed in the porch of the Temple, where certainly almost every man in the land must have seen him, and known him as well as the pillars! so that, in every town and village of the land, there must have been witnesses of the leaping and praising God of this well-known object of apostolic commiseration. I often think of his long, weary suffering as a reminder of that word, 'What I do thou knowest not now.' How little people thought of God's purposes in regard to this sufferer!"

One of my father's strongest characteristics was his admiration and support of women's work! He expressed in very ardent terms his feeling that women were called into the world's great arena of need in order that they might, with a gentle hand and skilful instinct, which, he said, were talents granted to them as a special gift, take their own place in undoing the work of evil.

Many an argument I have heard between him and others





who would rather hold back, than encourage, feminine efforts of the kind that he loved and supported.

He would sometimes say to me: "Do something, my girl; do something. Never be idle for a single moment. Remember, Time is short, Eternity is near!"

Though a firm adherent of the Church of England, and loyally devoted to it to the last day of his life, he felt very strongly that it was a mistake for those who had been learning heavenly truths all their lives to sit in their pews twice every Sunday, whilst thousands around them might be classed amongst the non-church-going masses, and were untouched by spiritual work of any kind. He employed a home missionary, who visited from house to house, and held small cottage meetings for the poor. He would often go and take these meetings himself.

There was at this time a young French lady residing in a village in the neighbourhood. She had an extraordinary gift for reaching and benefiting the working classes. Their love for her was unbounded; many a story reached us of her quiet, gentle, power over the roughest of the navvies who were employed in making the London and Brighton railway line. Many of her richer neighbours objected, however, to her efforts. She was winning and raising, refining and softening, these men by the hundred; the wives and children blessed her very name. Yet she was hindered and opposed in every way by those living around her, and it was in discussion of this strange opposition that she said to my father one day, "If our Father in heaven did not wish that women should carry the message of His Gospel to the poor and needy, why did He tell us, in the 11th chapter of 1st Corinthians, exactly what costume we are to wear when we are doing it?" Her quaint way of expressing her argument as she drew attention to this well-known passage, struck him very much. A Bible was called for and the words looked up. "You are quite right," he said, "You are quite right"; and in the most enthusiastic way he expressed his approval of what she was doing.

This brings me to the commencement of my own work