FORESTRY IN SOME OF ITS APPLICATIONS TO AGRICULTURE.*

IT is not possible in a short article to say very much on this subject, but it is proposed to explain in so far as space permits, to some extent, what forestry is, and what bearing it often has on the rural economy of a country; that is, how it can directly affect the lives of the people and particularly those of the agricultural community.

Forestry is the science of growing trees in crops; trees are grown in just such crops as sugar-cane or rice is, but the methods of establishing and growing the crop trees differ very widely from the methods adopted for growing agricultural produce, and the difference in method is due to a fundamental difference in the value of the crop, the nature of the capital involved, and the methods possible in establishing the crop. These differences are principally due to the fact that in agriculture ordinarily a short interval elapses between the sowing and the reaping of the crop; often a few months, seldom much more than a year, whilst even with such crops as coffee, cacao, coconuts or rubber it is only a few years before the crop is in full bearing. It is consequently a comparatively easy matter to work out the returns and value of the crops. The capital involved is usually the land, which forms a high proportion of the capital, seed grain, agricultural implements, some animals to drag the plough, etc. The farmer can easily work out his expenses. He has the rent to pay, the cost of tillage, cost of reaping, threshing, taking his crops to market, etc., and those costs are easily known. When he sells his crop he can count his money and, subtracting his costs, can reckon his profit, all in the course of a few months. The forester has an altogether more complex problem to face than that, because when he plants crop trees, he knows he cannot reap them for a very long time, seldom less than a period of 70 to 80 years, and sometimes very much longer. If he plants an acre of trees, therefore, he cannot count the cost of that planting and subtract it from the final return he gets to show his profit; he must take a current rate of interest and he must allow his cost of planting to accumulate at *compound* interest for a very large number of years before he can make any fair comparison. If the agriculturist spends $50:00 in producing his crops and gets $100:00 at the end of the year he has a profit of $50:00. If the forester spends a like $50:00 planting an acre of trees which he will reap 75 years hence, the original $50:00 at 5% compound interest will have mounted up in 75 years to approximately $1,600., and he must obtain more than that for his crop if he is to show a profit. This means that he *cannot afford to till his land;* he must establish his crop extremely cheaply, because every cent he spends at the outset he has mounting up against him. It also means he must look for intermediate returns, because, whilst his costs each year amount up against him at compound interest, his returns each year are also compounding in his favour. One of the most important functions of the forester is, therefore, to find out how to establish his crops of trees at the minimum possible cost, and, as he cannot afford to till his land, he has to work out the intricate reactions of factors on plant communities which will cause nature to sow and grow for him those kinds of trees which he

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wants, and then by the simplest possible acts upset the balance of nature in his favour, and get her to grow for him, cheaply and effectively, the trees which he wants, in the form in which he wants them. That is the first big difference. The second big difference is in the nature of the capital involved. In agriculture the value of the land is a large proportion of the capital. Agricultural land is usually the richer, better land, near means of communication; it has been cleared, tilled and got into good condition. It is, therefore, of high value. Forest land, on the other hand, is generally more remote, the soil is poorer, much work and clearing has not been done on it, and it consequently has a less value. In addition to that it is necessary to consider another fact, and that is that the agriculturist can, generally speaking, apart from a proportion of fallow, till and sow and reap all his land every year. The forester cannot do this, because if he did he would have a vast quantity of wood to sell once every 70 or 80 years, and would have nothing in between. He has to get returns every year, and to do this he has to cut a certain proportion of his forest every year. To cut the trees when they are of the proper age and size he must have a succession of crops of trees of different ages coming on, and his forest, therefore, must consist of a number of plantations of different ages, so that one is coming on as another is cut down. The simplest possible case is a forest of 100 acres, the trees to be mature when they are 100 years old; in this case the forester wants to have 100 different crops of trees each one acre in extent, and each one year older than the one behind. In this way he cuts down and replants one acre each year, and can go on getting regular returns for ever. It is now necessary to consider how timber is made. In many kinds of wood, if a cut is made transversely, rings are seen in the timber; these rings show the amount of timber put on each tree each year, so that *timber is made by the trees themselves,* and the trees are therefore *capital* and the interest each tree earns on its capital is the layer of wood put on in the year. When therefore we have our 100 acres of trees of all ages, the interest is the sum-total of the layers of wood put on each tree each year, and all the rest of the wood is capital. We, therefore have, the proposition that the land in forestry is a relatively small proportion of the capital, and the principal capital involved is the trees themselves. If the trees are 100 years old when felled, then the wood capital involved is roughly equal to 50 years' growth of the whole forest.

In the example given above the matter is simple because the case is taken of 100 different crops each one year older than the last, but the usual case, and with virgin forest the invariable case, is that all the trees of all ages are inextricably mixed up in the forest, and then the distinction between the wood capital and the interest becomes very complex and involves much calculation which it is necessary to work out in order not to destroy capital on one hand nor leave interest on the other.

Forests can affect the lives of the people and particularly of the agricultural community in many ways. There is one popular belief which is almost invariably held which is that forests increase rainfall. The belief is not strictly accurate or correct. It is certainly true that forests often do increase rainfall to a slight extent, particularly in the near neighbourhood of the trees, but the effect is so slight in comparison with the outline of the country in relief, the hills and valleys, that as an actual increaser of rainfall the forest has hardly sufficient effect to modify to a serious extent the climate of the country. The great effect the forest has is to conserve and to moderate extremes. Forests are rather cooler in summer and warmer in winter than outside; they shade the ground in the day from the sun and keep it cooler, they prevent radiation at night and keep it warmer, but the great effect they exercise is to conserve moisture.

On a bare hillside heavy rain hits the ground hard and rushes off. Where heavy rains occur on bare hillsides the soil becomes torn away, the water rushes off and the agricultural lands below are subjected to a savage alternation of droughts and floods. Where the same hillsides are covered with trees, the rain hits the leaves and drips on to the soil and runs down the boles of the trees. The soil is covered by a layer of undergrowth and leaves, and the latter mop up the water like a sponge, and it gradually percolates into the soil. Here the roots of the trees seeking moisture have forced their way deep down, and have opened cracks in the subsoil and the rain sinks right in, to reappear later as springs. The effect is to have streams which rise and fall to a moderate extent, fed by perennial springs, instead of rushing torrents after rain and dry stream beds at other times. The effect of removing the forest cover from hills, without replacing it by terraces or tillage is almost invariably to greatly reduce the value of agricultural land below. The district of Etawah in India used to be a very fertile country. The Emperor Jehangir hunted the rhinoceros in its forests; it was densely cultivated, a land of waving corn and good water. It is a historical fact that 200 years ago when the Mohammedans were fighting the Maharattas, a Rajah was killed in battle and his wife withdrew the people to a strong fort stored with food and the cattle were driven in as well. There they held out for just over a year, and the historian states that the reason was that there was a wonderful well in the fort which never failed to give water. The forests are now all gone, the river Jumna has cut its bed down very deep, draining the water out of the soil, and sharp ravines cut their way further and further into the plain year by year. A few years ago a ravine undercut the wall of the old fort, which fell down and at the end of the rainy season the ravine had cut under the famous old well, which was left in the face of the ravine. The bottom of that well which had kept a small army going for a year was then just over one hundred feet above the subsoil water. The land now has no trees, no crops and few inhabitants. It has been described as a scene of aching desolation; the only animals are some goats. This was caused by the clearing of the hillsides in the Himalayas 200 miles away, causing the Jumna to cut down its bed like a torrent, and by draining down the subsoil water killing the local trees, and so still further intensifying the rate at which the land dried up. The soil is baked and trodden hard and the rains only penetrate four inches into the soil, the ravines eat back every year. By afforesting these areas a complete change takes place. The first year the rain penetrates 4 feet in, the second year 9 feet. Grass comes up between the trees and good grazing is supplied and the population comes back, and tillage re-commences; such instances could be multiplied in many parts of the world.

Another effect forests have on the agricultural community is that it is a first necessity for the people to have wood with which to build and make implements, fuel to burn which is cheap and easily obtained, and larger timber for the maintenance of public works, using the expression in its wide sense, for public utility. Timber and fuel are expensive to transport, and are consequently expensive if the forests are far away. Dear sleepers make for high freight and costly fares on the railway; cheap beams mean more bridges can be built with the money available; cheap poles and rafters mean that the peasant can afford better houses and so keep better health. Cheap fuel above all things in the tropics means that the people use wood fuel, and the cow dung goes back into the field as manure, and not under the cooking pots as fuel. It is impossible to realise in British Guiana as it is now, what rapid disappearance of the forests can occur, and how disastrous that disappearance can be once a wave of settlement sets in. One hundred years ago the Gorakhpur district

in India was completely covered with forest, a few hunters roamed in it, graziers drove their cattle in to graze on the riverside savannahs, but apart from that the forest was unbroken. In 1813 an officer was sent to establish a district and district headquarters. He found a piece of rising ground and pitched his tents; he had to light fires round his camp and keep elephants circling at night to keep off the tigers which "not being familiar with men in these parts were very bold." He records that it required "an odious exertion of power to get a small space cut down to give a kind of breathing hole to the Europeans." The wife of the great John Lawrence of Mutiny fame went into the forests, and described them. Her description tallies to a remarkable extent with that of the Chinese pilgrim Fa Hien who had visited them more than 2,000 years before. Then the tide of settlement set in, the forests were cut down, and it was not known that it is necessary to keep twenty per cent. of the land under trees to supply easily the wants of the population. Where the tent was pitched and ringed with fires to keep off the tigers is now a racquets court. The other side of the road has a court house where three sessions judges sit apart from magistrates. It is the headquarters of a railway operating 2,500 miles of track and the junction of seven lines. Some forests exist which reverted by accident to the Crown, only 70 square miles of trees and 40 of grazing, and inconveniently situated. They bring in a profit now of $400,000 a year. The agricultural population is 1,200 to the square mile, nearly two cultivators per acre. Quite literally every square yard of soil carries two crops a year, the forests are hopelessly inadequate to provide such a population with fuel, and where the fertility of the soil means everything to the people, every stick of fuel, even dry leaves and twigs are eagerly bought, every cow-pat is turned to fuel and burnt; no manure can go on the hard pressed fields, and even then men scrape the dry bark off the road side trees to get a little fuel. This is all due to the early mistake of not reserving enough forest to make it possible to pour out cheap fuel and poles to the people, and, to any one who believes and hopes that British Guiana will one day attract settlers in their thousands, it must be apparent that such a mistake must never be allowed to occur, and that steps must be taken in advance to make sure that forestry will be the essential handmaid of agriculture and that there will in the future be managed forests easily accessible to the people, which can pour out the necessaries of an agricultural population so cheaply and in such volume, that the poorest can have their wants supplied.