can do is to give general information in these particulars.

Before determining the size of wheel to use, the condition of the stream at all seasons of the year must be taken into account. The installation is for continuous use and average conditions must be figured on for, if the head of water is real variable, a wheel too large for all but the highest heads will operate at a very low efficiency when the head is low. On the other hand, a wheel too small for any but the very low heads will have low efficiency on the high heads. In almost every case the wheel is chosen to run at a certain fixed speed. This speed cannot be maintained under wide variations in head without affecting the efficiency of the plant. The usual solution is to arrange the plant so that the head will remain as nearly constant as possible and any surplus water go to waste. As has been stated in a previous article low heads are best developed by turbines and high heads by Pelton wheels. These two types are practically the only ones which can be readily purchased for small installations and are used extensively. The speed of the turbine is fast; that of the Pelton wheel is slow. The turbine uses a great quantity of water; the Pelton uses comparatively little.

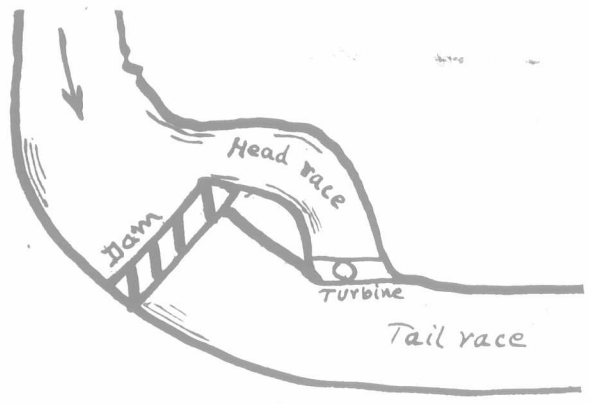
For turbine installations the natural head is usually enlarged sometimes doubled, by building a dam across the stream at some convenient spot. Off to one side of the dam, as illustrated in the sketch, the raised water enters the head race, goes through the turbine, and then goes out through the tail race. The short length of pipe or open channel from the head race to the wheel is called the penstock or flume. The portion of the water course in which the wheel is situated is called the wheel pit.

The following table gives some figures about successful farm installations of water power in various parts of the country. All of these are turbine plants.

TABLE 1.

Power developed	Head of water	Length of dam	Cost of power plant	Cost of plant, transmission line and equipment	Symbol for future reference
15 ft.	5 h.p.	(old dam)	$ 220	$ 518	A
6 ft.	17 h.p.	36 ft.	1,000	1,800	B
17 ft.	15 h.p.	200 ft.	700	1,200	C
11 ft.	8 h.p.	350 ft.	693	1,022	D

These cases indicate how wide a variation in cost there may be in such installations, even of approximately the same power development. As a general guide, however, in rough estimation of costs one may be reasonably sure that $100 per horsepower will cover the complete equipment unless there is some unusual condition of affairs.



A Dam for Turbine Installation.

The higher the head the less the cost, other things being the same. The larger the plant, the less the cost per horsepower. In case C above, for example, the power developed is three times that of case A with but twice the cost, and is twice that of case D with but little additional cost. These are hardly fair comparisons, however, because conditions are quite different.

In case C above the dam was of concrete and raised the available head fifty per cent. to the figure given. The transmission line is about 2,000 feet long from power-house at the stream to the farmer's house. The cost of operation is the interest and depreciation on the plant, amounting to about eight dollars per month. The actual cash outlay for oil and repairs will not exceed one or two dollars per month.

In case D the dam was of earth. It cost nearly $400. The transmission and house wiring cost $350. The remainder was paid for the wheel and installation.

The turbine wheel must be installed pretty close to the dam. On the other hand, the Pelton wheel is very frequently far from the point where the water is available. In the first case the power is transmitted electrically from power-house to place where it is used. In the latter case the water is transmitted from the stream through pipes to the Pelton wheel. As a rule there is no dam nor other construction necessary if a Pelton wheel is used. There need be no running water. A pond elevated above the wheel is ideal. The expense consists of the pipe line to the wheel, the wheel itself, the pipe line or other arrangement to conduct the waste water away. In particular this style of plant lends itself to ready use in connection with irrigation projects. The water is then brought to the wheel, and the waste water from the wheel used for irrigation purposes. The expense incurred may then be divided between the two projects, power and irrigation.

The cost of the Pelton wheel depends upon the size. A 3-foot wheel costs from $220 up to $450, depending upon the head under which it is to operate; a 4-foot wheel from $285 to $675; a 5-foot wheel from $350 to $625; a 6-foot wheel from $400 to $800. The following table gives the horsepower developed by these standard wheels under the various heads. The amount of water needed in each case can be figured by the methods already given.

TABLE II.

Head in feet.	3-ft. wheel.	4-ft. wheel.	5-ft. wheel.	6-ft. wheel.
50	5.98	10.60	16.63	23.93
100	16.84	29.93	46.85	67.36
150	31.01	55.08	86.22	124.04

Smaller wheels may be purchased for smaller heads and less water supply.

Nova Scotia. R. P. CLARKSON.

Growing Forest Trees for Generations to Come.

Four hundred and ten thousand trees to the average man would seem a great forest, and yet, distributed over the wide Province of Ontario, they would only make a wind break if planted eight feet apart in a single row across the north side of this Province. But this in itself is no small matter—it is one of the big things of the day this reforestation. When it is known that from a small farm, as farms go in Norfolk county, this number of forest trees were sent out by a few men this spring to be planted here and there over the entire Province, as a start in reforestation it must be considered one of the largest undertakings, and shows during the last four or five years, which the Norfolk Forest Station has been in existence, most remarkable development. Just think what these 410,000, now very small trees, will be worth to this country forty years hence; and this is only a beginning. As years go by thousands upon thousands of trees will go forward from this farm, which was some four years ago a heap of drifting sand.

One is almost amazed who knew the farm before its development commenced, when he now approaches it from the south and beholds on the south-east corner, which some five or six years ago shifted by the wind out into the roadways and men and teams were required to move the sand back, young Jack Pine trees anywhere from eight to fifteen or sixteen feet high, and pushing out new growth which is now sixteen to eighteen inches in extent. Five years ago old timers in the section merely laughed and scoffed when they saw men attempting to grow trees on land which had to be held down by piles of brush, or otherwise it would move over to the next farm. These are now the strongest converts to the possibilities of reforestation, even on the shifting sand.

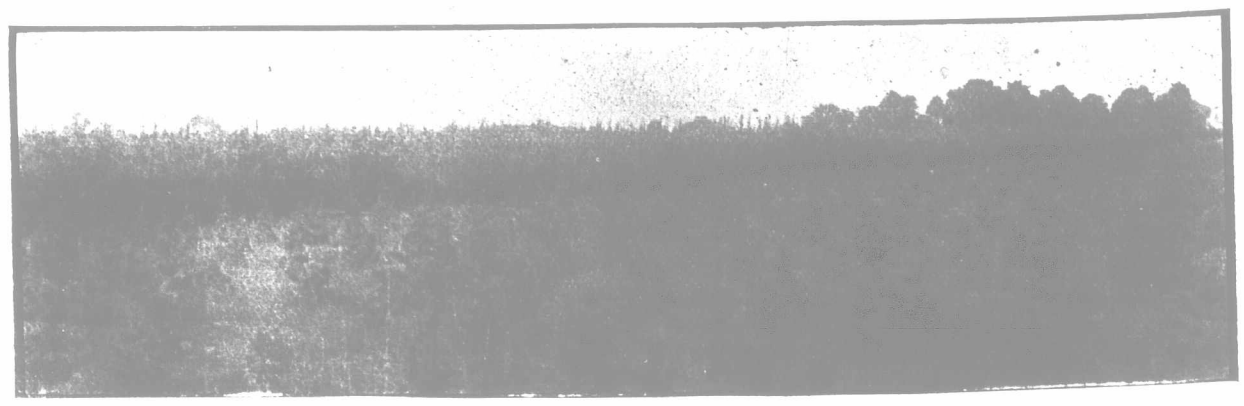
Just back of the five-year-old plantation referred to are two and three-year-old trees making excellent growth. One hundred and twenty acres are now permanently planted to forest. Much more would have been done but the people of the country have been appreciative, and, realizing the need which exists for more forest area, the demands made for trees which are sent out free of charge have been great, so great in fact that this spring not a tree was added to the permanent plantation at the Forest Station. So great was the demand that the station was cleaned out of nut trees entirely, and most of the other common varieties were pretty well gone, although quite a number of Manitoba Maple were noticed in stock. Chief amongst the varieties sent out are Scotch, White, Red and Jack Pine, Black Locust, White Ash, Hard Maple and the nut trees.

From observations made at the Station and in the opinion of some of the experts in charge, the Scotch Pine, especially for light land, seems to be one of the best varieties. On a ridge back toward the centre of the plantation a block of Black Locust had been planted a few years ago. These made almost phenomenal growth, but the hard winter of 1913, which so affected the peach trees, seemed to have a similar effect on the Black Locust plantation. The trees are quite severely frozen back, and it will take them some time to recover from the shock, in fact, many of them will not recover. There is a point in this for those contemplating planting forest trees. Unless favorably situated where there is little danger from freezing, namely close to the lake shores, it would seem that it is not altogether advisable to plant heavily of Black Locust. The Jack Pine makes almost a phenomenal growth on light land, and on this the lightest of blow sand is going ahead at a rapid rate. It is held, though, by experienced foresters that in the end the Scotch and other varieties of Pine will overtake and outgrow the Jack Pine. It is a rapid grower at the start, but does not do so well later on under some conditions.

One of the most interesting departments of the work are the seed beds in which the seed is planted and the young trees propagated. These are situated in very light sand, but irrigation is resorted to to keep the young trees growing. The Skinner system has recently been installed and with it the beds may be moistened every evening, in fact it is not believed that any harm would result if the water were applied during the entire night. The water is supplied from a pond well back on the farm, and from which by wind mill and gasoline engine the water is forced up and into an elevated tank, pipes from which lead to the system of irrigation in the seed beds. This gives pressure enough to make a very fine spray of water from the nozzles which are placed every four feet on the overhead pipes of the irrigating system. It is just about as near natural rain as man can hope to get, and the germinating seed and young trees should do extra well in these warm beds with plenty of added moisture.

A nursery is located about the centre of the main farm, and here we saw some 300,000 White Pines which had just been set this spring. These are grown in rows much as the gardener grows onions, and are shipped out at two years of age. All hard woods and nut trees are ready to ship the next year after planting from the seed beds.

Reforestation is bound to be a paying investment for those who undertake it properly on rough land which is practically worthless for cultivation, and besides this most farmers would benefit by having and keeping a woodlot on their farms. Mr. Lane, who has been in charge at the station since the work began, believes that many of those now planting apple orchards would be better off if they planted instead White Pine forests. This applies, of course, to poor land, and particularly where apples have been planted by careless men who will not look after them. The strong point in the forest work is that forests require very little care after being



Pines on Blow Sand.

A portion of the Forest Station planting at St. Williams. The trees in the background are four years planted, those in the front, two years.