depreciation is 20% a year, or $320. The cost of setting up and taking down the snow fence is about 20c a panel, or $128 a mile. Interest at 6% makes $96 a year, or a total of $544 as the annual cost per mile for the common snow fence. When the snow fence proves ineffective, as is often the case in winter of heavy snow, the loss in traffic may be more than that, to say nothing of the loss due to the name the railway gets for being blockaded. Planting eight rows on one side of the track and six on the other, will require 25,000 trees for a mile. These at $5 a thousand will cost $125. The cost of planting will be less than $50. These trees will be set out on 15 acres; if the cost of preparation is $15 an acre it will amount to $225, or a total of $400. There will have to be some replanting, and the trees will need to be cultivated for three or four years and from then on there will need to be some cutting back of them. But such a plantation will offer protection in a winter of the heaviest snow, as well as in a winter of light snow. It will be a permanent affair.

In the prairie regions, tree planting along the right of way furnishes a good demonstration to the farmers as to what can be done in tree growing. Many are planting trees as a result. The tree planting machine is one of the big factors in the success of tree planting. It has cut out the need of big crews, cutting the cost to less than one tenth what it cost to do it by hand. It insures planting the trees the proper depth, and it puts the roots in contact with moist soil and the soil is packed firm about the roots. The machine is not patented, so that anyone can make it. Tree planting when properly done is one of the cheapest and most effective means of protecting railway cuts from snow

[EDITOR'S NOTE. Canadian Railway and Marine World would like to obtain particulars of tree planting for snow protection on Canadian railways. Conditions on railways in Manitoba, Saskatchewan, and Alberta are very similar to those in Dakota and Minnesota, and it is hoped that some of our readers will send in particulars of anything that has been done. Some facts about tree snow fences on C.P.R. western lines were published in Canadian Railway and Marine World in Sept., 1913, and June, 1917. Later information is now desired. At one time some tree planting for snow fences was done on the Intercolonial Ry. Particulars in regard to this, or to similar work on any other railways, would be acceptable.]

Progress in Locomotive Building and Repairing.

By I. C. NEWMARCH, Superintendent of Shops, New York Central Railroad, Col lingwood, Ohio.

In thinking over the progress made in locomotive repairing and machine shop practice, I am carried back to my boyhood days, when I started to serve my apprenticeship in the Grand Trunk shops at Montreal. The experience that I received then has been beneficial to me throughout my railway career. When I think of the crude methods and means we employed for handling the different classes of work at that time, I realize the wonderful improvements we have made in machinery of all kinds and in all departments used for manufacturing and repairing locomotives.

In 1885, the majority of our machine shops knew but little about high speed steel, consequently carbon steel was used throughout the world on all machines that required cutting tools. From this it can be realized that the output of the shops was limited to a considerable extent. Tungsten, as an alloy of steel, had been known and used for a long period of time, it having been employed in the Damascus steel, but its actual effect was not known until Robert Mushet, after much experimenting, brought out the Mushet high speed steel. This caused radical changes in treating the crucible steel, and much progress and great improvement has been made along this line up to the present time. Prior to the use of high speed steel, it would take on an average of 18 to 20 hours to turn one pair of locomotive driving wheel tires. In 1885, in some shops, they were able to turn out one pair of driving wheels in nine hours. This gain in time was also true with other machines used in the general machine shop.

In 1900, with high speed steel much improved, the machines in operation were found to be almost useless. The machine builders realized what was required, and consequently, they at once began the building of machines to meet the requirements made necessary by the use of high-speed steel. Wheel lathes, engine lathes, boring mills, planing machines, etc., came on the market and greatly accelerated the output of the shop throughout the different departments. In 1909, we ran a test on a new wheel lathe that we received from the Niles people, and turned 14 pairs of driving wheel tires in 10½ hours. On other improved machines, the output has more than doubled. This is true in the average machine shop. This was all brought about by the use of high speed steel and improved machinery, without which it would be impossible to build or take care of the heavy motive power that we have in this day and age.

About 1885, air drills, air hammers and air compressors were made and being experimented upon. A comparatively limited number of the drills and hammers were placed in shipyards and boiler shops, but their introduction to railway shops did not occur until some years later. In 1893 a pneumatic tool company was organized and began actively to introduce its hammer in railway shops. The air drills on the market at that time were made in Philadelphia and called the Phoenix rotary air drill. They were light in construction and did not have much power. However, a piston drill was brought out, and at that time was considered almost perfect.

Several companies have come to the front with piston air drills having roller bearings, which are considered strong and durable, and which will meet the requirements of any department. They revolutionized drilling, reaming and tapping in locomotive shops. Previous to the use of air drills, ratchets were used. In many instances flues were rolled by hand. The flue holes were reamed by hand, and in a great many cases all work had to be done by hand. This has all been eliminated by the use of air drills or motors. The pneumatic tools have been the means of reducing the number of men that were usually required to do certain kinds of work to about one third.

The bulldozer and forging machines in our blacksmith department are great labor savers in the way of producing forgings of all kinds. Before these tools came on the market, forgings of all descriptions were made on the anvil. Today, it is only a question of the making and manufacturing of dies to take care of the various kinds of work in our blacksmith shop. In fact, hundreds of forgings, usually made by hand, are turned out on this machine, and the output has been increased one half.

In 1885 the work in our boiler shop was crude compared with the improvements of the present day. At that time, the boilermaker was obliged to do all of his work by hand, such as the removing of side sheets, staybolts, etc. They were cut out with the hammer and chisel. The holes were drilled in the fire box, with ratchets and flat drills. The tapping of staybolts holes and similar work was done by hand. Later on, I recollect that we had what was known as a flexible shaft which was used for the tapping of staybolts. This has all been changed in every sense of the word. Removing of firebox sheets today is done by the use of the torch, whic his also used for cutting off staybolts in quite a number of shops.

The locomotives were being built larger from time to time to the present day, and consequently new methods of handling work became necessary and have been adopted. As the material in boilers is getting heavier, it is necessary to have up to date machinery, such as shears, punches, and rolls. The flanging of today in quite a number of our shops is done by hydraulic pressure. All rivets are driven by hydraulic pressure or with air hammers. This has increased the output in the boiler shop to a great extent.

At one time the welding of flues was done with a charcoal fire. As the flue was heated a man tapped the flue end with a tapper, and when brought to a welding heat, it was welded in a roller machine. The flue was then put back into the fire and swaged with a hand-swaging tool. Today, in quite a number of our shops, flues are welded with electricity, and in other shops they are welded by the use of oil furnaces, and under what is known as a Draper hammer.

In 1908 and 1909, oxweld acetylene welding was adopted for boiler work. This brought about a complete revolution in the method of boiler repairing. By the oxweld acetylene method we are welding all horizontal seams in the fireboxes, doing away with the troublesome leaky seams. Patches of all kinds in the fireboxes are also welded. I believe today that the welding process has been adopted all through the country for many different classes of work throughout the locomotive departments. About the same time electric welding came into vogue This was used extensively for the same class of work as the oxweld acetylene welding, it being used extensively in the way of flue work, the welding of flues, beads and back flue sheets. By doing this, we get two or three times the amount of mileage from them over the old method of merely prossering and beading flues.

There has also been a radical change in the brake equipment on locomotives. In 1885 we had a vacuum brake. Today, we have a Westinghouse air brake. The makers adopted the 6-in. air pump and with the ET equipment.