pineries exhausted, the Big Woods pretty well thinned out, the Mississippi drying up, St Paul and Minneapolis 300 or 400 hundred miles above steamboat navigation, mercury 40 degrees below zero, and the wind blowing a hurricane. The remedy for the growing evil is tree planting. Somethine has been done in this direction. The congressional acts of 1873 and 1874, which allows a man who plants and tends a certain number of trees to enter land free, have stimulated individual action. Altogether, nearly 20,000,000 trees have been set out in Minnesota. Of these, 4,000,000 have been planted by the St. Paul and Pacific road, which has found the business a profitable one. Mr. Hodges indeed claims that it is more profitable than grain growing, although it yields small immediate returns. He declares that "the net profits on a quarter- section of prairie, properly prepared, planted, and cultivated with forest trees, will, within ten years, exceed ten quarter-sections of wheat," and that "the genuine white willow, properly handled will increase faster than money at interest at 4 per cent. per month." While these statements may be, and probably are, somewhat exaggerated, they have a solid basis of truth. There can be no doubt that the destruction of forests in the northwest is working a vast injury to the country. The winters are already growing colder, so that we may, ere long, be forced, like New England farmers, to abandon the cultivation of the more delicate northern fruits. The drought which makes the great interior basin worth less is creeping eastward. We need forests to break the violence of freezing gales, to preserve the moisture of the ground, and to serve as the raw material for buildings, fences, fuel, railroad-ties, etc., in the future. The west is begining to appreciate this fact. Congressional action has been wisely taken. Nebraska has established a legal holiday, called, we believe, "Tree-Planting Day." There is a state superintendent of arboriculture, and prizes are given to the men who plant the most trees during the year. The plan is said to work well. It should be tried elsewhere. The northwest, in cutting down its forests at the present rate and making no provisions to replace them, is living on its capital, as Virginia planters did when they ruined the soil of the Old Dominion by growing successive crops of tobacco. The man who makes two trees grow where oge grew before is a public benefactor.—*Chicago Tribune.*

Bearings.

[From the Metal World.]

M. C. Runzel has tabulated the results of experiments made on the effects of friction between various substances. The heat produced, other conditions being equal is in proportion to the hardness of the substances; and, on the other hand, the greater the difference in the hardness of two substances rubbing against each other, the less the heat produced by the friction, and the harder of the two heats more than the other. If friction take place between glass and cork the amount of heat received by the two respectively is as seven to one, and between bronze and cork, four to one.

For durability alone, of course, bearings should be of metal as hard as that of the arbors which they support, but considering the wear of the latter the former should be as soft as possible. In practice, however, certain precautions are to be observed; the bearing must no tcut the arbor, and it must wear as little as possible; it should not get hot even when lubrication fails, and, lastly, it should possess resistance enough to bear all the shocks that fall upon it without being deformed or broken. The alloys of copper and tin generally in use are rarely homogeneous, with the exception of that which contains eighty-two to eighty-three parts of copper to seventeen or eighteen of tin. When there is less tin in the composition granulation takes place during cooling, which alters the homogeneousness of the alloy, and causes the cutting both of bearing and arbor. When an alloy of copper and tin sets slowly the first part consolidated is a very soft alloy not containing more than 7 to 10 per cent. of tin; this forms, as it were, the shell of the bearing, while the hard alloys containing seventeen to eighteen parts of tin, set afterwards and fills up the shell. When a bearing thus formed is in work the soft alloy soon gives way, and the hard grains within attack the arbor and are often torn out and carried away when grease fails.

A good bearing should be the very opposite of the above: its shell should be very hard and durable, and the interior filled up with a softer composition. This result is attempted to be obtained by fusing together several alloys of different compositions and degrees of fusibility, so as to produce by two given alloys, but the operation is delicate and the result uncertain. Phosphorus bronze succeeds best in this way; the shell is then almost entirely formed of very hard broze, and the interior of a soft alloy of copper and tin. The bearing may then be considered as a series of layers of soft metal enclosed in a casing of metal almost as hard as the arbor itself. The microscope reveals this disposition very evident; and if one of these bearings be carefully submitted to heat, so as to cause the soft metal to run, the rest remains in the form of a spongy mass.

The results obtained with various kinds of bearings used on the Belgian and German railways are thus givan: Bronze composed of 83 parts of copper and 17 of tin, costs 3 fr. 25 c per kilogramme, and wears at the rate of 11·6 grammes for four bearings per 1,000 kilometres, the cost being 0·37 fr.; bronze containing 32 parts of copper and 18 of tin costs 0·032 fr.; the same applied to carriages with brakes, wears at the rate of 109·5 grammes, and costs 0·335 fr.; white metal, composed of 3 parts of copper, 90 of tin, and 7 of antimony, costs 3 fr. 73 c., wears at the rate of 14·8 grammes, and costs 0·055 fr.; ditto containing copper 5, tin 85, and antimony 10 parts, costs 3 fr. 66 c., wears at the rate of 11·3 grammes, and costs 0 41 fr.; ditto composed of lead 84, and antimony 16 parts costs 1 fr. 84 c., wears at the rate of 12·2 grammes, and the expense is 0·018 fr. per 1,000 kilometres; lastly, phosphorus bronze costs 4 fr. 37 c., wears at the rate of 2·3 grammes, and the expense is 0.010 fr. only, bnt when applied to carriages with brakes, the wear rises to 9·5 grammes, and the expense to 0·041 fr.

Philosophy of the Welding of Metals.

The science of molecular mechanics is is yet in its infancy, and for this very reason it presents a rich field for investigation and experiment. We are already acquainted with iron, for example, in very many physical conditions. We have learned within a few years how te obtain it melted like steel and cast iron. But how numerous are the things which yet remain for us to learn, in order to understand the properties of even these various states of iron, in order to explain the peculiarities which they present when viewed from the standpoint of construction; in order to establish the relation which should subsist between these molecular states and resistance of the metal under various strains, in order to have as difinite a theory for working iron cold as for working it hot. This knowledge which may be called the physics and molecular mechanics of iron, is still very rudimentary.

I will attempt to lay before you a sketch of what I foresee in these molecular studies, at present unfortunately too much neglected. I will enter upon the subject through a phenomenon well known to every one.

It is a matter of common knowledge that iron is capable of being welded; that if two pieces of iron be heated to a temperature called for this very reason a welding heat, and then be pressed together, either by hammering or by energetic presure, the two pieces will be firmly united, i. e., welding tegether. Why is this? The only explanation which we can find in the best works on chemistry or metallurgy is the following:—"At a white heat iron acquires the property of being welded, a property which it shares with the metal platium only." But obviously there is no evidence here of any mysterious and special property called "weldability," there is only the effect of a very general cause, the manifestation of a molecular property elsewhere abundantly active in nature.

Take two pieces of ice, and at a temperature a little below zero, press them very gently together, they become at once welded to each other. This is the phenomenon, first observed by Faraday and subsequently investigated in so fascinating a way by Thompson and Tyndall, which has received the name of "regelation." Thompson explains it in the folloming manner: For all bodies, like water, which have the property of diminishing in volume as they liquefy, pressure, which tends to bring the molecules closer together, lowers the temperature of fusion. Consequently, when two pieces of ice are rubbed against each other, fusion takes place between the surface of contact, at a temperature below zero. Of course, as soon as the pressure ceases, solidification is again produced, and the pieces are welded together.

It seems to me that the welding of iron is a phenomenon exactly similar to regelation. Such cases of actual regelation or welding of iron are sometimes seen in the welding of a spindle to its step when heatted by friction, in the absence of any lubricating fluid. The two pieces of iron are brought to a white heat, that is to say, more or less near to the fusion point. The repeated blows of the hammer, or the pressure of rolls, lowers the point of fusion and causes a superficial liquefication of the parts in contact, and thus welds the masses together; and this because like water, iron dilates in passing from the liquid to the solid state. Many other metals are similarly endowned, they all, therefore, may be welded like iron, if