into lumber there, and this will necessitate the construction of new saw mills and starting into life many mills now idle at Midland and other places. In fact I know of parties now who are figuring on starting up certain mills and building a new one to cut in 1895. In proportion as lumber is sold to go south or to Lake Erie and Lake Ontario ports, or the English market, in that same ratio it will be an advantage to have the logs manufactured into lumber in Canada in preference to towing to Michigan by at least one dollar and fifty cents per M, which on 200,000,000 feet means $300,000, while an outlay for a two band saw mill and plant would not exceed $45,000 to $50,000. As a matter of fact, the whole profit is confined within a two dollar margin, which would be consumed in towing and risk, and lumber can be manufactured fifty to seventy-five cents per M cheaper in Canada than in Michigan or this part of the country.

(4). Is it probable that under the new conditions we shall witness an expansion of the planing mill business in Canada?

The success of a planing mill business in Canada for export depends largely upon the railroad companies; the keystone of the arch is in their hand, which is often held with an iron grasp. They can and often do run the country, but they cannot run a planing or saw mill; neither do they want to. All they ask is to own the other 'fellers' and let them run the planing mill output, the same as they allow manufacturers of lumber, shingles, lath, pulp wood, railroad ties, telegraph poles, cordwood, the farmer's oats, wheat, and agricultural crop, and miner's product generally, to pay the heavy shot. Now, a planing mill will not survive long under this kind of treatment, hence the necessity of securing rates that will enable them to meet competition. All things being nearly fair or equal, as far as railroad companies are concerned, there is no reason why planing mills should not be started and successfully run at Owen Sound, Collingwood, Midland, Victoria Harbor, Waubaushene, Parry Sound (if they can get a railroad), Peterborough, Lindsay, Brockville, Hull, Trenton, Deseronto, and many other places in Ontario and Quebec generally. The nearer the planing mill is to where the lumber is cut the better; dressed and finished lumber from most of the above places can be shipped in cars to the State of Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New Jersey, Rhode Island, Pennsylvania, New York, and other places—the field is unlimited. But you will find some other gentlemen there. It is only a question of understanding the business—money, low railroad rates, and pluck—you must have this combination or bust.

(5). Is our planing mill equipment and capacity sufficient to cover any considerable expansion of business?

I do not think the planing mills generally in Canada, from what I have seen, are as fully equipped and of the capacity necessary for an extensive volume of American trade. As they have not had any export trade, it is not reasonable to suppose that they should be fully prepared for it. Still, with the quietness of the times, the planing mills would be able to turn out millions of dressed and finished lumber for export, provided they are advantageously situated.

(6). In what position do we stand as to planing mills' equipment and methods to compete with the planing mills of Michigan and the Eastern States? (and I will add Wisconsin, Minnesota, and Chicago).

From all of the above States and Chicago, planed and finished lumber is sent—north, west, south and east, as far as Boston. I have seen many of the large, as well as smaller planing mills in Michigan, Wisconsin, Minnesota, and other places within the last five months. The capacity of some of the larger mills runs from 100,000 to 200,000 feet per day, or three to six million feet a year, and they do extra smooth, true, good work. Some have store room for dressed and finished lumber 100 feet wide by 600 feet long, with plenty of room for 30 cars to be loaded. At the same time the sheds extend to car track both sides, which protects the lumber from rain and storm. In all the well organized mills the machinery is strong, large and heavy, and in many cases have three to nine dry kilns. This enables them to fill orders with dispatch, which is a great secret of success in planing mill car trade. They employ first-class men and pay good wages, paying special attention to the grading of the lumber from the time it is sorted in the yard until it enters the car. As a rule it is intended to give to the buyer as good lumber as he ordered, if not a little better. No attempt is made to slide in an inferior piece by any responsible house. In no case do you purchase a "pig in the poke." They take great pride from the manager all along the line, until the lumber is in the car and shipped, in doing their work good, and a little better than any other mill. They do business to keep their customers, and Canada will have to work hard to take them away. I might mention some of the planing mills that do good work: The Penokee Lumber Co., Morse, Wis., one of the finest and most complete in the United States; Montreal Lumber Co., Gile, Wis., near Hurley; Oskosh Log and Lumber Co., Coate, Mich.; Peyters, Kimball & Baker, West Superior, Wis.; Cranbury Lumber Co., Duluth; Scott & Holston, Duluth; N. Nelson, Cloquet, Minn., extra large; J. R. Davison, Phillips, Wis., extra large; Knox Lumber Co., Ely, Minn. From what I have seen of the planing mills in Canada, they are generally constructed too light and cheap, the machinery not large and heavy enough to stop the vibration when running fast, and two or three machines intended to do all kinds of work; shafting and hangers too light, and belting too thin and narrow. The result of this is, you cannot produce first-class work, true, smooth and even finish, presuming knives and other parts are in order. There is no reason why as good planing mills and as many of them as wanted cannot be constructed and operated successfully in Canada as the United States, and as good men to run them; though it would be advisable to engage inspectors of lumber who are accustomed to grading for the market the lumber is intended for.

(7). What importance do you attach to the statement positively made by Michigan and Tonawanda lumber manufacturers, that the effect of the new tariff will be to force American planing mill men and box manufacturers to transfer their business to Canada?

I think there is more truth than poetry in their statement, and they will find it more so than they anticipated. One day they did not want free lumber; the next day they purchased a pine tree; the day after they wanted lumber free. And now they are to have it free in all conceivable shapes and they don't want it. The next day they commenced kicking and will continue this exercise until they have elevated all the Democrats out of Congress and Republicans have come in. There can be no doubt that allowing planed and finished lumber to enter the States free will have an injurious effect on the planing mills in some parts of the States, and cause transfer of mills to Canada or building of new ones there. Many of the planing mills here are situated in connection with saw mills and are likely to remain so and take their chances in competition with Canadian planed lumber. They know the market; the Canadians have it to learn. They believe the Republican party at the next Presidential election will be returned and return the duty on dressed and planed lumber. And with this change likely to take place, many who would have built planing mills will wait—hence not as many mills will be constructed as there would be if the free duty was more permanent or definitely settled.

Duluth, Minn., 1894.

THE FATIGUE OF METALS.

THE metallic parts of machines that are in constant use if they are not fully strong enough for the work required of them, undergo what is known scientifically as fatigue. In metals there is a point in their resistance to pulling, bending or crushing which is known as the elastic limit. Beyond this limit, if continued in use, permanent strain begins. When machines are submitted to this limit of strain if it is not kept up too long, they may be restored to normal condition, just as a muscle is by resting. If the strength and power of a machine is fully equal to the task imposed upon it, it does not undergo this fatigue and the use of it may be kept up continuously until impaired by friction. The resemblance in this particular to the muscles of man and other animals is very striking.

A CHAPTER ON FRICTION.

FRICTION is not a force in mechanics, it is a resistance; a passive resistance to motion, writes F. J. Moster, in the Wood Worker. It is the tendency of force to produce motion, whereas the tendency of friction is to destroy motion. Nor is the increase of friction between two surfaces in contact properly the amount of force necessary to produce motion, but the amount of pressure necessary to balance the friction and bring the body to a state of indifference to both rest and motion. Yet we use friction to transmit force, and it is sometimes convenient to speak of it as the force itself.

All surfaces, however highly polished, contain minute projections, hence when pressed together the asperities of the two surfaces become to some extent interlocked with each other and produce resistance to motion—and this is friction. The whole amount of friction stated in pounds of resistance, is the product of two factors. The first of these factors is called the co-efficient of friction. Co-efficient, as an adjective, means operating together; as a noun it implies co-operation—a factor in multiplication. The co-efficient of friction is a constant number which has been determined by experimenting with substances of different kinds and with surfaces in various conditions. Scientific men have made these experiments and tabulated the results of their experiments, so that now, when the practical mechanic has to solve a problem in friction, he refers to one of these tables for the co-efficient to meet the case. Oak against oak has a co-efficient varying from ·975 to ·064, according to exposure of grain and quantity and quality of lubrication. Iron against iron has a variation in like manner from ·314 to ·064. Between these two extremes in the use of iron I find six other co-efficients, so that adding the eight together the average is ·148. This is for sliding surfaces; a revolving shaft requires a different co-efficient.

I want to be sure that I make clear the exact use of this co-efficient of friction. I said it was a constant number and so it is for the same conditions. In casting the interest on $100 at six per cent., we multiply by ·06, and that multiplier is the co-efficient in the problem; it is a constant number for that rate of interest. But if we change the rate of interest to five per cent., then we change our multiplier to ·05, and that becomes the constant number or co-efficient for all sums of money at that rate of interest. So the co-efficient of friction might be called the rate or amount of friction that prevails with certain surfaces under given conditions of smoothness and lubrication. Then multiplying the total pressure by this rate of friction gives the amount of resistance in pounds—pressure being the same factor in computing the effect of friction.

Mill shafting in these days does not often run on iron surfaces, the boxes being lined with babbitt metal, but I have no table at hand that gives the co-efficient for an iron shaft running on babbitt metal; but on bronze I have. The co-efficient is ·251, which will answer our purpose for illustration. Suppose a three inch countershaft with two belts each in the same direction, 1,200 pounds each. This will give 2,400 pounds belt tension. Let the weight of the shaft and pulleys be 200 pounds, making 2,600 pounds pressure on the bearings. Inertia and atmospheric influence have nothing to do with the case, I think. Now co-efficient of friction ·251, pressure 2,600 pounds, what is the resistance in pounds? 2,600 multiplied by ·251 equals 652.6 pounds as the effect of friction. To reduce this to terms of horse power and determine its proportion to the whole of the driving force, we must make further calculation.

Suppose the driven pulley to be two feet in diameter and making 150 revolutions per minute. This will give a belt velocity of 942 feet per minute. Then, 942 multiplied by 1,200 (driving force) equal 1,130,400 dividend by 33,000 equals 34-horse power and an insignificant fraction as the amount of driving force.

The shaft is only three inches diameter and therefore does not move with the velocity of the belt on the pulley. The surface of the shaft moves only 118 feet per minute, hence we have 652.6 pressure multiplied by 118 feet equals 77,006.8, divided by 33,000 equals 2.333-horse power as the effect of friction. This is the theory of friction with all things perfect, but it is quite likely that in practice (fair practice, too) the friction would amount to one-eighth of the driving force.