FRICTION OF BELTS.

The friction of belts upon pulleys depends upon the extent to which they are tightened, the extent of circumference with which they are in contact, and their breadth. It is commonly believed that the greater diameter of pulley the more surely does the belt cause it to revolve without slipping. Theoretically, however, and we believe practically, says a writer in the *Circle of the Science*, it will be found that, with equal degrees of tightness, equal breadth of belt and equal circumference as to perfection of contact, the friction of a belt on the circumference of a pulley is the same, whatever be its diameter. The only circumference that can effect the constancy of the result, is that belts, not being perfctly flexible, lie more closely to surfaces curved to a large radius than to those of a smaller radius. When a certain amount of power has to be communicated through a belt, the speed at which the belt moves has to be taken into account, because, power being pressure multiplied by velocity, the greater the velocity with which the power is transmitted the less the pressure that has to be communicated at that speed. In this sense then, it appears that the larger the pulley the less the slip of the belt, because the greater the circumference of the pulley, revolving at a given angular velocity, the greater is the absolute velocity through space, and, therefore, the less the pressure required to communicate a given power. It is found, practically, that a leather belt eight inches wide, embracing half the circumference of a smoothly turned iron pulley, and travelling at the rate of 100 feet per minute, can communicate one horse power. When less than half the circumference of the pulley is embraced the strap must be proportionately wider; and when more than half the circumference is embraced its width might be less. The law according to which the friction of belt increases with an increased arc of contact is of a peculiar character, but may be readily understood by comparing the friction on arcs of different lengths. If a pulley (of any diameter whatever) were prevented from revolving, and a belt passing over part of its circumference were stretched by a certain weight at each end, additions might be made to the weight at one end until the belt began to slip over the pulley. The ratio which the weight so increased might bear to the weight at the other end would measure the amount of friction. For example, in experiments made to test a theortical investigation on the subject, a belt passing over a pulley in contact with 60° of its circumference was stretched by a weight of 10 pounds at each end; one of the weights was increased until it amounted to 16 pounds, when the belt began to slip. The ratio of 16 to 10, or 16 divided by 10, equals 1.6, was then the measure of the friction. When 20 pounds at each end were used to stretch the belt, the one weight was increased to 32 pounds, giving the ratio of 32 divided by 20 equals 1.6, the same as before; and likewise, when five pound were used for stretching, the weight at one end was increased to 8 pounds, giving still the same ratio, 8 divided by 5 equals 1 6.

So far, then, the friction was precisely proportional to the stretching weight, as might have been expected from the ordinarily received doctrine on the subject of friction. On extending the arc of contact to 120°, the ratio was found to be 2 56, or 1.6-2. And, again, on embracing 180°, the ratio was found to be 4.1, or very nearly 1.6-2, the theoretical investigation brought out this result independently, and the following law may, therefore, be taken as established: If for any given arc of contact the one weight bears to the other at the point of slipping a certain ratio for double the arc, the ratio will be squared; for triple the arc, it will be cubed; for four times the arc, it will be raised to the fourth power, and so on. In all cases, however, much depends on the tightness of the belt, the limits to the force with which it is strained being, first, the tensil strength of the belt itself; and, secondly, the amount of pressure that it may be convenient to throw upon the shaft and its bearings. New belts become extended by use, and it is, therefore, frequently necessary to shorten them. Before use they should be strained for some time by weights suspended from them, so as to leave less room for extension while in use. Wherever belts are employed they should be of the greatest breadth and travel at the greatest speed consistent with convenience, as it is most important to have the requisite strength in the form best suited to flexure, and the least possible strain on the shafts and bearings. When ropes or chains are employed, as in cranes, capstans, windlasses or the like, for raising heavy weights or resisting great stains, the requisite amount of friction is obtained by coiling them more than once around the barrel of the apparatus. It is found that one complete coil of rope produces a friction equivalent to nine times the tension on the rope, the barrel being fixed. Two complete coils of the rope produce a friction equivalent to nine multiplied by nine times the tension, and so on. The diameter of the barrel does not effect the result. Having regard to these facts, we may readily understand the force which a knot on a cord or rope resists the slip of the coils of which it consists, for the several parts of the coil act as small barrels, around which the other parts are coiled; and the yielding nature of the material of which the barrels are composed permits the coil to become impressed into their substance on the application of force, and prevents them from slipping more effectually than if they were coiled on a hard and resisting barrel.

THE MATTER OF PRICES.

The statistics show indisputably that prices of all kinds have been steadily sinking for the past four or five years. This decline has been so gradual and so general that it has not attracted as much attention as its importance has warranted and the people are beginning to see in a definite way that the process has method in it, and that the conditions which govern it are of a logical and irresistable character. It is difficult to believe that the general average of prices in this country at the present time is actually 20 per cent less than it was in 1860, and that accordingly the cost of living is one-fifth smaller than the rate which prevailed just before the war; and yet the figures prove such to be the fact beyond question. There it not a single article of ordinary food or clothing which commands as high a price as it did a quarter of a century ago, when we thought things were as cheap as they could possibly be grown or manufactured, and the tendency appears to be towards a still further reduction rather than in the opposite direction.

The situation is due to causes of a permanent kind—to the increased use of machinery, the development of new areas of farm lands, the regular growth and application of capital, and the multiplied facilities of transportation, and of easy and rapid commercial exchange. Our whole system of trade and industry has been revolutionized. We do business according to modes and calculations that were not present, or even dreamed of, twenty-five years ago. The old rules that were once deemed infallible have been trivialized and exploded, and the man who got his education in any pursuit before the war has to requalify himself for successful dealings with the circumstances which now exist. We cannot estimate values any more by certain universal standards. A bushel of wheat is no longer worth a given sum, below which it cannot fall in any event. There is no fixed limit that can be safely counted as to the coming price of pork or beef, regardless of all possible fluctuations. The only certainty in the case is that it is mainly a question of chance, with a probability of lower instead of higher rates than those previously obtained.

We are not differently situated in this respect from the people of other countries. The decline in prices has been general throughout the civilized world. It is an area of cheapness everywhere. The same causes which have steadily lowered the margins in the United States has operated to produce similar results in all other quarters of the globe. We have not constructed all the railroads or employed all the new and improved machinery, or opened up all the increasing areas of cultivation and production. The people of all the other leading nations have been using like energy and enterprise in those directions. We formerly enjoyed a monoply in several brances of trade—as cotton, grain, meat, etc.—but we do not hold it any longer. The markets that we once practically controlled are now filled with competing products, and our right to establish selling rates is disputed at every turn There are new sources of supply being reached and utilized all the time, with an appreciable effect upon the issue of values wherever there is such a thing as commerce; and we may as well open our eyes to the significant truth that a good many advantages which we have heretofore been blessed with have gone never to return.

Our position is still a surprising one in some regards and must always continue to be so; but it is evident we have reached a spirit and encountered a measure of competition that must deprive us of the power to dictate terms and regulate prices to suit ourselves. Like all other nations we are subject to those familiar laws and principles which are the basis of every true system of commerce. The rule of supply and demand extends to all sorts of products and all forms of traffic, and there is no way to subvert or avoid it. We cannot sell our surplus grain and stock and minerals at any higher rate than those at which some other country stands ready to furnish them; and when the world gets as much as it needs of a particular product it will not buy any more at any price. These are simple propositions but very forcible ones, and they have just now a peculiarly distinct and very practical bearing upon our affairs. It is folly to ignore or disparage the fact that we are face to face with influences that must shape our commercial relations and adjust our profits in spite of all resistances on our part, and with doctrines that are as old as civilization itself.—*St. Louis Globe-Democrat.*

COMPARATIVE COST OF FRAME AND BRICK BUILDINGS.

A very interesting article is found in the *National Builder*, giving the comparative cost of frame and brick buildings:

The first idea that naturally suggests itself, after the general plan of arrangements has been perfected, is what material shall mainly enter into the construction of a building, brick, stone, or wood? In nearly every portion of the Eastern, Middle and Western States these three building materials can readily be had, and the cost of production does not vary much in any locality. Assuming, therefore, that the first cost is the same in the above localities, we may easily arrive at the ultimate cost of production. For the purposes of this article we may assume the cost of good, common brick during the summer to be eight dollars per thousand; cost of labor and mortar to lay the same in the wall, $4 per thousand, wall measure. The cost of good quarry stone assumed at $10 per cord; cost of labor and mortar to lay the same in the wall, $8 per cord of 100 feet. The cost of framing lumber, $12 per thousand feet; labor and nails to put the same up $6 per thousand. With these prices as a basis, it is a matter of computation only to arrive at the proportionate cost of each material after it has been worked into the walls. As an example, suppose we have ten feet square of plain wall to build, what will be the comparative cost? Ten feet square equals 100 superficial feet. If to be built of brick, 12 inches thick, estimating 22½ brick to the superficial foot, it would take 2,250 brick; cost in wall, per thousand, $12, equals $27. To lay a good rubble stone wall it should be 18 inches thick; therefore 10 feet square, or 100 superficial feet, of stone wall 18 inches thick, at $18 per cord of 100 feet, would cost $27. In estimating a frame or studded wall, there should be included, 1st, the studding, say 2x8—12-inch centres; 2nd, the outside sheathing of 1-inch surfaced boards; 3rd, the siding of clear pine. For this example we have placed the cost of rough lumber at $18 per thousand feet up. We will assume the cost of the inch surfaced boards for sheathing to be $25 per thousand including labor, nails and waste. Ten feet square, or 100 superficial feet, 2x8 studding at $18 per 1,000, equals $2.43. The same surface covered with surfaced boards at $25 per 1,000, costs $2.50. One hundred and twenty-five superficial feet of siding, at $40 per 1,000 would cost $5, allowing one-quarter for lap and waste. Then we find the total cost of the frame wall to be $9.93. Add to this the cost of painting same, one square at $3, we find the cost to be $12.93. Comparatively, therefore we find the cost of 100 superficial feet of wall, built of the three leading building materials of the country, as follows:—

Common brick, $27.
Rubble stone, $27.
Frame, $12 93.

The cost of window and door frames, cornices, etc., may be estimated about the same in either building. In brick and stone buildings we find the additional cost of cut stone window and door sills, water table, etc, but the cost of these adjuncts does not enter into the first cost of the walls, and should rather be estimated on separately, or considered as additional items of cost that may be dispensed with if necessary.

TREE PLANTING.

E. P. Roe, in *Harper's Magazine* for March, 1886, has the following article in regard to transplanting trees:

"As a rule, I have not much sympathy with the effort to set out large trees in hope of obtaining shade more quickly. The trees have to be trimmed up and cut back so greatly that their symmetry is often destroyed. They are also apt to be checked in their growth so seriously by such removal that a slender sapling, planted at the same time, overtakes and passes them. I prefer a young tree, straight stemmed and healty, and typical of its species or variety. Still, when large trees can be removed in winter with a great ball of frozen earth that insures the preservation of the fibrous roots, much time can be saved. It should ever be remembered that prompt rapid growth of the transplanted tree depends on two things—plenty of small fibrous roots, and a fertile soil to receive them. It usually happens that the purchaser employs a local citizen to aid in putting his ground in order. In every rural neighborhood there are smart men; smart is the proper adjective, for they are neither sagacious or trustworthy, and there is ever a dismal hiatus between their promises and performances. Such men lie in wait for new comers, to take advantage of their inexperience and necessary absence. They will assure their confiding employers that they are beyond learning anything new in the planting of trees—which is true, in a sinister sense. They will leave roots exposed to the sun and wind; in brief pay no more attention to them than a baby-farmer would bestow on an infants appetite, and then, when convenient, thrust them into a hole scarcely large enough for a post. They expect to receive their money long before the dishonest character of their work can be discovered. The number of trees which this class of men have dwarfed or killed outright would make a forest. The result of a well meaning, yet ignorant man's work might be equally unsatisfactory. Therefore the purchaser of the acre should know how the tree should be planted and see to it himself, or he should by careful inquiry select a man for the task who could bring testimonials from those to whom he had rendered like services in the past.

"The hole destined to receive a shade or fruit tree should be at least three feet in diameter and two feet deep. It then should be partially filled with good surface soil, upon which the tree should stand, so that its roots could extend naturally, according to their original growth. Good fine loam, should be sifted or sprinkled through and over them, and they should not be permitted to come in contact with decaying matter or coarse, unfermented manure. The tree should be set as deeply in the soil as it stood when first taken up. As the earth is thrown gently through and over the roots it should be packed lightly against them with the foot, and water, should the season be rather dry and warm, poured in from time to time to settle the fine soil about them. The surface should be leveled at last with a slight dip towards the tree, so that spring and summer rains may be retained directly about the roots. Then a mulch of coarse manure is helpful, for it keeps the surface moist, and its richness will reach the roots gradually in a diluted form. A mulch of straw, leaves, or of coarse hay, is better than none at all. After being planted three stout stakes should be inserted firmly in the ground at the three points of a triangle, the