## POPULAR ERRORS ABOUT FRICTION.

It is seldom that the path to truth lies through error; yet probably many more have been led astray by the truism that "friction is independent of velocity" than would have been by the incorrect statement that "friction varies directly as velocity." The popular error on this point arises from confounding *force* with *power*—two entirely distinct ideas. A simple illustration will render the whole subject clear.

Suppose an iron sledge, without wheels, weighing 1,000 pounds, resting upon a railroad track, to be directly attached to the piston rod of a cylinder having an indefinite length. Let the area of the piston be 10 square inches. Experiment shows that when dry iron rubs on dry iron, every 1,000 lbs. weight requires a force of 150 lbs. to keep it in motion. Admit into the cylinder steam having a tension exceeding 15 lbs. per square inch; the pressure on the piston now exceeds 150 lbs. (the resisting force of the friction of the sledge), and the latter will begin to move with an increasing velocity. When the velocity of two feet per second is obtained, reduce the tension of the steam to just 15 lbs. per square inch, and the pressure on the piston just equaling the resistance arising from friction, the sledge will continue to move with a uniform velocity of two feet per second. The *force* constantly acting will be the pressure on the piston of 155 lbs.; the *power* expended per second will be 150 lbs. moved 2 feet or 150 × 2=300 "feet-pounds" per second, corresponding to a consumption of 10 × 2 × 12 = 240 cubic inches of steam of 15 lbs. tension. Next increase the tension of the steam; this will cause an increase of velocity of the piston and sledge. When the velocity reaches four feet per second, again reduce the tension of the steam to 15 lbs. per square inch; the pressure of the steam on the piston then just equals the resistance arising from friction, and the sledge will continue to move with an uniform volocity of four feet per second. In this case the *force* constantly acting will be the pressure on the piston of 150 lbs.; the *power* expended per second will be 150 lbs. moved four feet, or 150 × 4 = 600 feet-pounds, correspond ing to a consumption of 10 × 4 × 12 = 480 cubic inches of steam of 15 lbs. tension.

Now, compare the two cases. While the *velocity* is doubled, the *force* remains constant, but the *power* expended per second is doubled. Thus, it is evident that, while the resisting *force* exercised by friction is independent of velocity, the *power* requisite per second to overcome the resisting force of friction varies directly as the velocity. As, however, when the velocity is doubled, the time required to pass over a given space is reduced to one half, we have for the passage over any given *space* a double power exercised during a halved time; the increase of power just canceling the diminution of time. This is true for all variations of velocity; hence, though the power expended *per second* in overcoming friction varies directly as the velocity, the power expended in overcoming friction for any definite *space* is independent of the velocity.

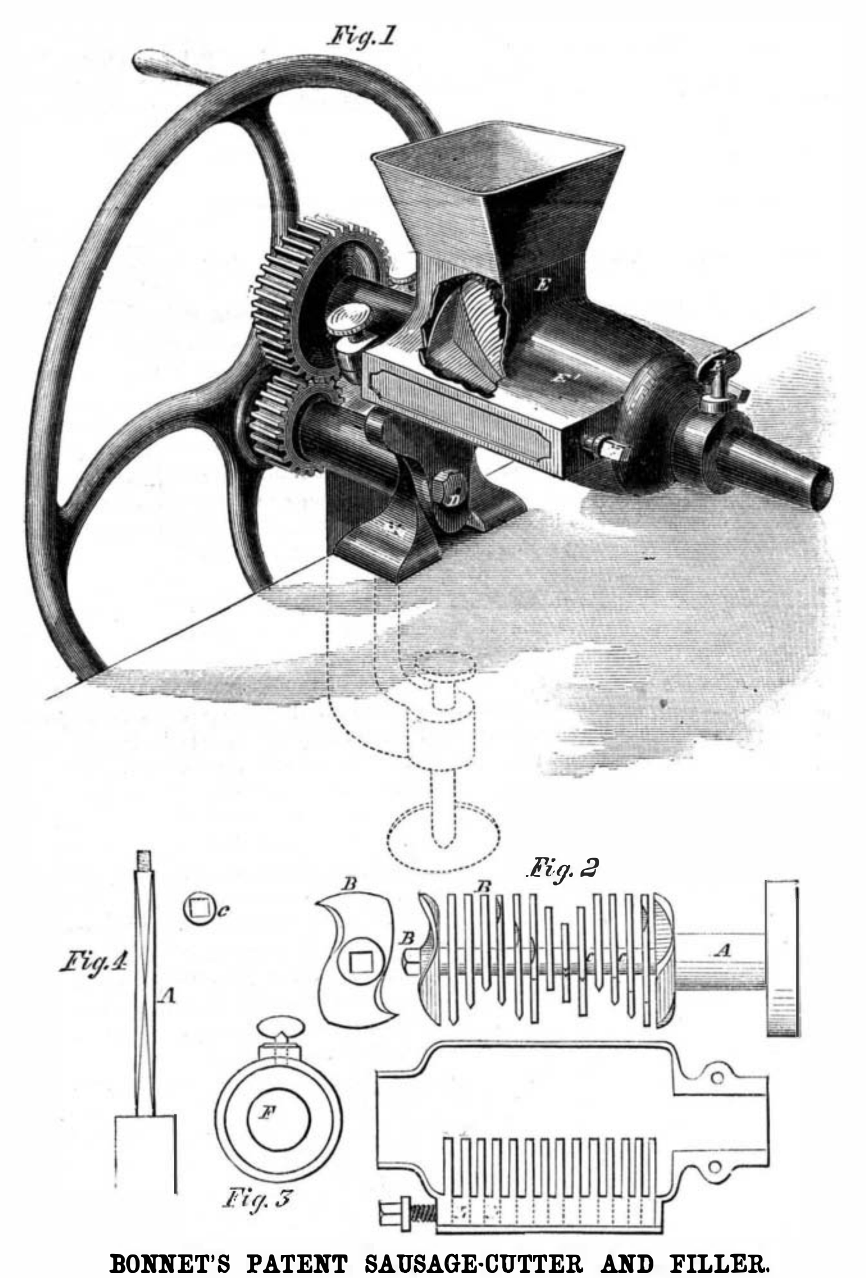
As a general rule, then, in determining the cost of transportation from one place to another, so far as friction alone is concerned, we can neglect the velocity; but in determining the power requisite to drive machinery, we must regard the power necessary to overcome friction as varying directly with the velocity.

## SAUSAGE-CUTTER AND FILLER.

"Killing hogs" is a job which has to be performed yearly in the early winter among our farmers, and a principal portion of the labor connected with it is the chopping of the sausage meat. Some farmers have heavy blocks prepared, with a slight hollow formed in them, and chop the meat on these with either a broad-ax or cleaver. But our inventors are changing the method of doing this, as they are of doing almost everything else, by devising easier and more rapid processes. A large number of machines for cutting sausage-meat have been invented, and we here present an illustration of the very last one which has made its appearance before the public.

This machine is designed to cut the meat and to force it into the skin. A series of cutters, of the form represented at B (Fig. 2), are fastened upon a shaft, A, with a space between them about equal to the thickness of a cutter; rings or washers, c, being employed to separate them. They are so placed upon the shaft that the two hooked edges form spiral grooves around the shaft, and they revolve between fixed cutters, I, permanently secured in the concave case of the machine. The cutters have two cutting edges, as shown, and there are two series of stationary cutters, the edges of one being turned down and the other up, so that the meat is subjected to two cutting operations at each rotation of the shaft. The spiral form of the grooves causes the meat to be forced along from right to left and so discharged from the nozzle of the machine; this lateral movement being still further promoted by the propeller form of the two end pieces upon the shaft. A tin nozzle of proper length is secured to the discharging orifice by means of the ring F (Fig. 3) and screw, so that it may be removed when it is not desired to stuff the meat into skins.

The patent for this invention was granted (through the Scientific American Patent Agency) on July 24, 1860; and further information in relation to it may be obtained by addressing the inventor, Louis Bonnet, at No. 78 Leonard-street, this city.




**BONNET'S PATENT SAUSAGE-CUTTER AND FILLER.**

## GAS TO REPLACE STEAM AS A MOTIVE POWER.

The Paris correspondent of the Boston *Traveler* sends the following account of the new invention (by a Frenchman) of a gas engine, which is now exciting considerable attention in the French metropolis:—

"I believe the machine recently invented by Mons. Denois (a gentleman quite well known by his galvanoplastic copies of alto-relievo sculpture and engraving), I mean his gas engine, which he looks upon as destined to take the place of the steam engine in a great many places where a motive power is required, occupies the chief share of the Academy's attention at this present moment. This gas engine is a good deal like the steam engine in its external appearance. There is the same cylinder with its piston, the same fly-wheel, eccentric and slide-box —but no boiler and no furnace. It has a gas meter and a very small inductive apparatus. There is a tube leading from the gas meter, and conductors leading from the electrical apparatus to the cylinder, or rather to the organs of distribution which immediately precede the cylinder. When the gas enters the slide-box it is mixed with a large proportion of ordinary air, introduced first on one and then on the other side of the piston, and there it meets an electric spark which fires it; the moment this takes place, the aperture through which the gas enters is closed, so that the combustion takes place in a sealed chamber and determines in the mixed gas and air a force of expansion which acts immediately upon the surface of the piston. The motion of the slide-box and electric distributor is so arranged that the moments of introduction, inflammation and expulsion take place in succession and at proper times. When the piston has its motion in one direction, the same phases of the introduction and combustion of the gaseous mixture take place at the other extremity of the cylinder. This machine is 30 per cent more economical than the steam engine, and it only costs $200. and can be used wherever gas is used. I call the attention of your mechanics to it, if they ever stand in need of small motive power. It is cheap, it is convenient, and a it isfree from danger."

[Whatever credit belongs to the above-described invention, France deserves no share in it. Such an engine was exhibited for nearly a year, in full operation, in the Crystal Palace, in this city, in 1855. A full description of it will be found on page 93, Vol. XI. (old series), of the SCIENTIFIC AMERICAN. Its inventor was Dr. Drake, of Philadelphia, now deceased, a very enthusiastic and worthy American inventor. Such an engine possesses inherent defects, and never can supersede the steam motor.—EDS.

THE sewing machine case recently on trial at Cooperstown, N. Y., before Judges Nelson and Smalley, between the Wheeler & Wilson Sewing Machine Co., and G. B. Sloat, on the feed and looping device, had not been decided at the time of our going to press. As soon as we get the decision we shall publish it.

CANNEL coal should be used exclusively for making gas, as it contains little or no sulphur.