tained outside of schools. What they have gained in the schools is the ability to better think for themselves and better appreciate and weigh the experience that must come later, and this ability is worth all the time and hard work it has cost. Work alone makes the really good engineer; but if a man has to waste his time in picking up in twenty years or more of self-tuition what he might have gained in a four or five years' course of technical training, when his brain was yet young and receptive, he will rarely pass beyond the middle stage of professional rapk.

PHENOMENAL FRICTION. BY JOHN H. COOPER.*

When making experiments during the month of February, 1891, with the Thurston railroad testing machine, I noticed the ease with which the axle box could be made to slide longitudinally upon the axle when the same was in motion.

The several boxes tried had about fourteen square inches of surface in contact with the axle; they were variously loaded, with weight from 262 pounds upwards, and the axle was running at speeds varying from 160 to 400 revolutions per minute.

One box could be moved by a pressure of one ounce when the axle was running, but required thirty-two pounds to move it when the axle was still.

Another box was moved by four ounces with motion, but required forty pounds without motion of the axle.

A third box under considerable pressure could be moved readily by a pull of six ounces, but fifty pounds would not start it when the axle was still, and, indeed, on trial, all the muscular force I could apply to it by my hands, with my foot against the machine, failed to start it.

A spring balance was used in these experiments, for pulling the box in a line parallel to the axle.

Here we employ forces anywhere from 160 to one, up to perhaps 1,000 to one, for moving the same body, under the same load and conditions, except that of the revolving or standing shaft beneath it.

This phenomenon of friction proved a marvel to all who witnessed it. The temptation was great to theorize upon the extraordinary performance, but no theory was offered in explanation of it. A practical suggestion was made, however, in reference to planer-bed motions, and the like, which drag so heavily upon their fixed ways. If, as then proposed, revolving shafts were placed in the bed-ways, and the table fitted to them, a pound pressure would move the table and its load back and forth on the revolving ways, where 1,000 pounds or more would be required to do this work upon the usual fixed V's of planers, as they are generally built.

Numerous applications of this principle will readily suggest themselves to the ingenious reader, when considering the necessity and the difficulties of moving dead loads, especially where ease and celerity of the movement may be required.

To the writer, this unique action, as if the loaded box were floating, was an instructive object lesson in mechanics.

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INVENTORS OF PERPETUAL MOTION MACHINES.

Some of the most ingenious and persistent men are laboring on the hopeless task of devising perpetual motion appliances. Our educational system is in many respects responsible for so much mental energy being wasted upon fallacies. If natural

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philosophy and elementary mechanics received the attention in common schools that their importance demands, there would be fewer persons pestering their friends to supply funds for the development of apparatus intended to cheat 'nature's laws. Ignorance of the laws of nature is, no doubt, responsible for the majority of perpetual motion devotees, yet some men who are well educated become pursuers of the chimera. It is frequently difficult to understand the mechanical fallacies that creep over what are otherwise bright intellects. Electricity seems to be deceiving many men and leading them into the belief that by means of this mysterious force more power can be received than what is given. Since the electric lighting and electric transmission of power era began, there has been a great increase in the applications to the Patent Office for protection of what are electrical perpetual motion machines. For years the Patent Office income was considerably augmented annually by the receipt of fees from inventors of perpetual motion machines, but no fees are now accepted from men working on that kind of apparatus. A printed circular is sent to applicants saying that nothing short of a working mode would be received, and as the inventor never gets a model of this kind to work, he can do no more with the Patent Office. A correspondent of the St. Louis Globe-Democrat gives particulars of some curious recent perpetual motion cases. Mr. Keely has a good many imitators in a small way. A few months ago a New York lawyer went to Washington with parts of a machine, and had quite a controversy with the office because the patent was refused. He insisted that he had seen the machine in operation, that it was running day after day, and keeping a cider press going to boot. There was no deviating from the rule. The lawyer went back to New York, saying that he would produce the machine. He was not seen again until the centennial celebration lately, when he reminded the examiner of the case and told him how he had been fooled. At the time of making application the lawyer really believed that his client had discovered the long-sought principle. But when he got back to New York and told that the patent had been refused, the client confessed. The perpetual motion was no motion at all. Power was concealed in the cider press. It ran the press, and the press made the perpetual motion machine go too. The inventor had been charging 10 cents admission to see perpetual motion. He had fooled the public and his lawyer, and he hoped to slip through a claim. -- National Car and Locomotive Builder.

THE SYSTEM OF MILITARY DOVE COTES IN EUROPE.*

France. -The history of the aerial postal service and of the carrier pigeons of the siege of Paris has been thoroughly written, and is so well known that it is useless to recapitulate it in this place. It will suffice to say that sixty-four balloons crossed the Prussian lines during the war of 1870-1871, carrying with them 360 pigeons, 302 of which were afterward sent back to Paris, during a terrible winter, without previous training, and from localities often situated at a distance of over 120 miles. Despite the shooting at them by the enemy, 98 returned to their cotes, 75 of them carrying microscopic despatches. They thus introduced into the capital 150,000 official despatches and a million private ones reduced by photo-micrographic processes. The whole, printed in ordinary characters, would have formed a library of 500 volumes. One of these 1 2 . . .

* Continued from Scientific American of July 11, p. 23.