tool, having reference, in reality, to the effect of abrasion, or to the manner of application of the power, and not to the actual friction between the surfaces. If the ice were, everywhere, equally smooth, it would require the same power to push a man standing erect upon skates, whether the skate blades were 1-16th of an inch or six inches in thickness. But the first of these laws, that friction varies directly as the pressure upon the surfaces in contact, and is the same for the same materials and condition of surfaces, is of the greatest interest, and of the greatest practical importance in mechanics, relating as it does, to the anti-frictional value of various substances, the strength of materials between which friction may take place, and the various expedients, the use of lubricants and alloys by which friction may be lessened.

It is found by experiment that if a block of wood or iron be moved upon a surface of the same material and degree of smoothness, by a force acting parallel with the surfaces in contact, the force, necessary to overcome the friction of the surfaces, will always be a certain fraction of the weight or other pressure which forces the surfaces together; that this power must be increased or diminished with the increase or diminution of the pressure, and that it varies in like manner with the roughness or smoothness of the surfaces, and with the nature of the materials composing them, but, otherwise, remains constant. This necessary power, which is called the co-efficient of friction, to overcome the friction between different surfaces, has not been determined with great exactness, owing to the difficulty of obtaining any fixed standard of smoothness. The co-efficient of friction of iron upon iron has been estimated at about .28 of the vertical pressure; that of iron upon brass, well polished, about .116; when not so smooth about .263; iron upon copper about .17. With the friction of metals upon each other as a general rule with lubrication, the co-efficient of friction is estimated at about one-tenth of the vertical pressure. While experiment thus shows that friction is less between substances of different kinds—steel upon steel being the only exception—it is also by no means a matter of indifference which way motion is applied in those