over which it is rolled, constituting fulcrums, by which, on the principle of the lever, the rolling body is continually lifted against gravity and pried over the inequalities of the surface. Thus, the driving-wheel of a locomotive may be considered as an infinite number of levers, of which the fulcrums are the successive resistances of friction between the points of contact of the wheel and rail, and the weight to be overcome, the sum of the sliding frictions between the journals and their bearings. When the friction at the circumference of the wheel exceeds the friction at the axles, the power of steam being sufficiently great, the train will move forward; otherwise the driving-wheels will revolve, and the train will not advance, the so-called rolling friction being, in this instance, only sliding friction overcome by power. When, therefore, sliding friction is changed into so-called rolling friction, the advantage gained is partly in the application of the power through a lever. It will be observed that when the surface of the wheel meets with an obstruction or a grade, gravity acts against the sliding friction of the rail, and that an obstruction is more easily surmounted when the radius of the wheel is the longer. It is obvious that the longer the long arm of the lever, the more easily the centre of gravity of the wheel is lifted over the obstruction.

LEADING PRINCIPLES.

The most essential facts which experiment has shown concerning resistance, some of which, as before stated, would, hardly, have been expected prior to experiment, are, that it bears to the pressure upon the surfaces, in contact, a ratio which is constant for the same materials and condition of surfaces, and that while the character and condition of the surfaces are unchanged, friction is independent of the extent of those surfaces. The second of these facts may be illustrated in the following manner: A block of wood or iron of any given weight, having faces of different dimensions, will require the same power to move it upon a surface of the same kind, whether the block rests upon its larger or smaller face; the apparent exception in the case where one of the surfaces is being very much reduced, as a skate or an edged