dition of rocks, due to decay through chemical methods, and to the superficial riftings and fractures attending chemical changes, organic growths, freezing, and the alternating of cold with heat occasioned by the sun.

The *methods* of denudation are (1) by water-strokes, or the simple *impact* of water; (2) by *abrasion*, which includes (*a*) wear of rocks by means of the stones and earth carried or thrown against rocky surfaces; and (*b*) wear of transported stones or grains by their mutual friction or *corrasion*. By these means much of the shaping of the earth's surface and the trituration of rocks to earth has gone forward. Abrasion becomes a *shearing action* in planation and terrace-making.

1. *Impact of water simply.* — In the flow over a smooth surface of rock pure water has no abrading effect. But when thrown in masses, in the form of plunging waves or torrents, into cavities of rocky bluffs or against bold projections, great results may be produced. Blocks of many tons' weight along a shore, if resting on a surface but slightly inclined toward the deeper water, will slip downward with each stroke.

The force of the impact of flowing water is expressed in pounds, by the general equation $P = 0{\cdot}9702nsv^2$, in which v is the velocity in feet per second, s is the greatest transverse section of the body in square feet, n a coefficient varying with the form of the body, the value being ascertained for any particular form by trials; and 0·9702 is the quotient from dividing the weight of one cubic foot of water (62½ pounds) by 2 g (p. 174). Supposing the greatest transverse area to be 1 foot: for a simple plate the value of n is 1·86; for a cube, 1·46; for a sphere, 0·51; for some rounded forms, only 0·25. If the hemispherical end of a cylinder faces the current, the impact is half less than if the flat end were in front. In accordance with the above, the force of impact against a flat plate a foot square, in a current of 5 miles an hour (or 7⅓ feet per second), will be nearly 100 pounds; in one of 20 miles an hour (4 times 5), 16 times that for 5 miles, and so on. On the other hand, if the surface struck is a hemispherical *concavity*, the impact would be very much greater than for a flat surface, the value of n being about 2 for a hollow hemisphere with the concavity to the current. The principle is illustrated in the connection between form and resistance, or form and velocity, in a boat.

These results of experiment and mathematical calculation show that while it is not possible to measure the force exerted in the movements of a river, the concavities and deep recesses or channels among the rocks along the sides of a rapid stream afford an opportunity for effective blows.

2. *Abrasion; Corrasion.* — The transported sand and gravel which is carried by water against the rocks within reach acts like the emery of an emery wheel, yet only under slight pressure. The particles, and especially the pebbles or stones, that are thrown by violent torrents against the surfaces of the solid rock, work more effectively, but less constantly. In a current of given velocity the larger stones carried abrade more rapidly than the smaller. At the same time the transported particles or stones, whether in rivers or on seashores, are wearing one another, and this *corrasion* tends to reduce the material to that fine impalpable state in which even slow-moving waters will transport them.