2. *The amount of work* which a body of water, as that of a lake, can theoretically do, on its descent to the level of the sea, is equal to the product of the height of the lake (h) into the weight (W) of the water; and hence Wh is an expression in foot-pounds for the energy or working-power potentially present in the lake. The amount of energy in a lake a fourth of a square mile in surface, 10 feet in average depth, and 400 feet above the sea level, is 1,742,400,000,000 foot-pounds; — a power sufficient, could it be expended without loss, to raise a mass of stone weighing about 87,000 tons to the top of a mountain 10,000 feet high. If now the water were allowed to flow by a continuous slope to the sea level, without loss from evaporation, or from resistance of any kind (such as friction, etc.), its velocity would increase regularly according to the well-known law of falling bodies; and, in this increase of rate, it would be constantly accumulating *energy of motion*, which would be the exact equivalent of the energy of position it was losing; and when it reached the lower level its velocity would be 160 feet per second (about 109 miles an hour). In the case of falling bodies the relation between the vertical distance fallen through (h) and the acquired velocity (v) is expressed by the formula $v = \sqrt{2gh}$, g being the force of gravity, usually taken at 32·2 (it is 32·165 at New York City); or, approximately (since $2g = 64{\cdot}3$), by the formula $v = 8\sqrt{h}$, or $h = \frac{1}{64}v^2$. In actual experience the theoretical result cannot be realized. On the contrary, the velocity of a stream does not increase uniformly as it descends, and when it reaches the sea, whatever the elevation at first, its velocity is in most cases nearly zero. This is owing to the fact that its energy, instead of being stored up, is being expended against the various resistances encountered, that is: —

(1) In overcoming friction between (a) the molecules of the water itself; (b) the water and the bed of the stream; (c) the surface of the water and the atmosphere.

(2) In impact, or blows against the rocks or earthy material of the bed and banks of the stream; and in pushing sand or gravel along the bed.

(3) In transporting earth, sand, or stones, held in suspension in the water.

(4) In overcoming the friction between the transported particles and the bed of the stream, and the friction between the particles themselves; and also the loss from eddies made by the character or form of the bed or otherwise.

By these means the energy is so far expended that no accumulation can take place except on portions of a stream where the pitch is uniform and considerable, and the bed is hard and smooth. In a waterfall, accumulation goes on during the descent; but the whole energy of the stream is lost in the stroke of the water at the bottom of the fall, where it is converted into heat, — a fall of 772 feet producing heat enough to raise the temperature of the water 1° F.

Owing to the rapid increase of velocity in the descending water of a waterfall, the stream in a high fall of small volume becomes divided up, the

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