an extremely fine angular sand consisting almost wholly of quartz, with scarcely any felspar, nearly the whole of the latter mineral having passed into the state of clay. The sand grains, as they are continually pushed onward over each other upon the bottom of a river, become rounded as the larger pebbles do. But a limit is placed to this attrition by the size and specific gravity of the grains.[156] As a rule, the smaller particles suffer proportionately less loss than the larger, since the friction on the bottom varies directly as the weight and therefore as the cube of the diameter, while the surface exposed to attrition varies as the square of the diameter. Mr. Sorby, in calling attention to this relation, remarks that a grain $\frac{1}{10}$ of an inch in diameter would be worn ten times as much as one $\frac{1}{100}$ of an inch in diameter, and a pebble 1 inch in diameter would be worn relatively more by being drifted a few hundred yards than a sand grain $\frac{1}{1000}$ of an inch in diameter would be by being drifted for a hundred miles.[157] So long as the particles are borne along in suspension, they will not abrade each other, but remain angular. Prof. Daubrée found that the milky tint of the Rhine at Strasburg in the months of July and August was due, not to mud, but to a fine angular sand (with grains about $\frac{1}{20}$ millimetre in diameter) which constitutes $\frac{2}{100000}$ of the total weight of water. Yet this sand had travelled in a rapidly flowing tumultuous river from the Swiss mountains, and had been tossed over waterfalls and rapids in its journey. He ascertained also that sand grains with a mean diameter of $\frac{1}{10}$ mm. will float in feebly agitated water; so that all sand of finer grain must remain angular. The same observer has noticed that sand composed of grains with a mean diameter of $\frac{1}{2}$ mm., and carried along by water moving at a rate of 1 metre per second, is rounded, and loses about $\frac{1}{10000}$ of its weight in every kilometre travelled.[158]

The effects of abrasion upon the loose materials on a river-bed are but a minor part of the erosive work performed by the stream. A layer of débris, only the upper portion of which is pushed onward by the normal current, will protect the solid rock of the river-channel which it covers, but

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[156] "Geologie Experimentale," p. 250 *et seq.*
[157] Q. J. Geol. Soc. xxxvi. p. 59.
[158] "Geologie Experimentale," pp. 256, 258.