The amount of mineral matter transported by rivers can be estimated by examining their waters at different periods and places, and determining their solid contents. A complete analysis should take into account what is chemically dissolved, what is mechanically suspended, and what is driven or pushed along the bottom. We have already dealt with the chemically dissolved ingredients. In determinations of the mechanically mixed constituents of river-water, it is most advantageous to obtain the proportion first by weight, and then from its average specific gravity to estimate its bulk as an ingredient in the water. According to experiments made upon the water of the Rhone at Lyons, in 1844, the proportion of earthy matter held in suspension was by weight $\frac{1}{17000}$. Earlier in the century the results of similar experiments at Arles gave $\frac{1}{7000}$ as the proportion when the river was low, $\frac{1}{230}$ during floods, and $\frac{1}{2000}$ in the mean state of the river. The greatest recorded quantity is $\frac{1}{45}$ by weight, which was found "when the river was two-thirds up, with a mean velocity of probably about 8 feet per second."[140] A. Guérard, who has more recently made observations at the mouth of this river, estimates the total annual discharge of sediment to amount to 23,540,000 cubic yards, or $\frac{1}{2166}$ of the volume of the water.[141] Lombardini gives $\frac{1}{300}$ as the proportion by volume of the sediment in the water of the Po. In the Vistula, according to Spittell, the proportion by volume reaches a maximum of $\frac{1}{48}$.[142] The Rhine, according to Hartsoeker, contains $\frac{1}{100}$ by volume as it passes through Holland, while at Bonn the experiments of L. Horner gave a proportion of only $\frac{1}{16000}$ by volume.[143] Stiefensand found that, after a sudden flooding, the water of the Rhine at Uerdingen contained $\frac{1}{1282}$ by weight. Bischof measured the quantity of sediment in the same river at Bonn during a turbid state of the water, and found the proportion to be $\frac{1}{4878}$ by weight, while at another time, after several weeks of continuous dry weather,

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clay. In trying to ford it," he remarks, "I felt thousands of particles of coarse sand striking my legs, which gave me the idea that the amount of matter removed by every freshet must be very great. . . . These sand-rivers remove vast masses of disintegrated rock before it is fine enough to form soil. In most rivers where much wearing is going on, a person diving to the bottom may hear literally thousands of stones knocking against each other."

[140] Surell, "Memoire sur l'amelioration des embouchures du Rhône." Humphreys and Abbot, "Report upon the Physics and Hydraulics of the Mississippi, 1861," p. 147.

[141] Min. Proc. Inst. Civ. Engin. lxxxii., 1884–85, p. 309.

[142] Ibid. p. 148.

[143] Edin. New Phil. Journ. xviii. p. 102.