

But not only does the rate of flow of a river vary at different parts of its course, it is not the same in every part of the cross-section of the river taken at any given point. A river channel (Fig. 114) supports a succession of layers of water (*a, b, c, d*), moving with different velocities, the greatest movement being at the centre (*d*), and the least in the layer which lies directly on the channel. At the same vertical depth, therefore, the velocity is greater in proportion as the point approaches the centre of the stream. The water next the sides and bottom (*a a*), being retarded by friction against the channel, moves less rapidly than the layers (*b b, c c*) toward the centre (*d*).

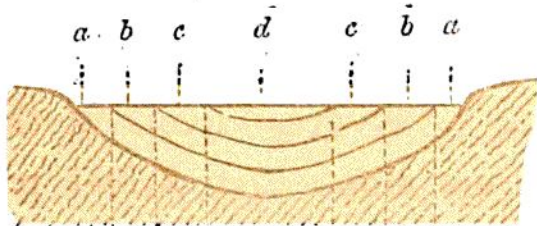


Fig. 114.—Cross-section of a River.

The central piers of a bridge have consequently a greater velocity of river-current to bear than those at the banks. The motion of the surface-water, however, is retarded, on the other hand, by upward currents, generated chiefly by irregularities of the bottom.<sup>119</sup> It follows that whatever tends to diminish the friction of the moving current will increase its rate of flow. The same body of water, other conditions being equal, will move faster through a narrow gorge with steep smooth walls than over a broad rough rocky bed. For the same reason, when two streams join, their united current, having in many cases a channel not much larger than that of one of the single streams, flows faster, because the water encounters now the friction of only one channel. The average rate of flow is much less than might be supposed even in what are termed swift rivers. A moderate current is about  $1\frac{1}{4}$  miles in the

<sup>119</sup> J. Thomson, Proc. Roy. Soc. xxviii., 1878, p. 114. Comp. Collignon, "Cours d'Hydraulique," p. 301.