of the momentum flux through the jet. It follows from equation (8) that

$$\frac{p_s - p_v}{\frac{1}{2}\rho u^2} \approx 2\,\frac{d}{R} \;,$$

where p_a and p_v have been regarded as negligible compared with p_s. The cavitation number is therefore small under the basic approximation (5) of this theory, and a small cavitation number means that cavity bubbles trail behind the grains. The cutting surface appears to the water flow as an intricate patchwork of grains and vapor cavities. As the radius of curvature R increases, the level of cavitation increases, and the water loses contact with the grains. As the radius of curvature decreases, the surface pressure p_s increases and collapses the cavity bubbles, thereby exposing more grains to direct impact of the water. The interfacial shear stress should therefore be written as

$$\tau = \frac{1}{2}\rho u^2\, c_f\left(\frac{p_s - p_v}{\frac{1}{2}\rho u^2}\right) , \qquad (11)$$

where the skin-friction coefficient c_f is some increasing function of the cavitation number.

Further progress requires that (11) be reduced to an explicit form. Consider the model sketched in Fig. 5. One grain taking the full impact of the water shields some of its neighbors downstream. If ℓ is the streamwise separation between fully exposed grains, then each exposure blanks an area $g\ell$. If f is the drag of an exposed grain, then

$$\tau = \frac{f}{g\ell} \;.$$

But

$$f = C_D(\pi g^2/8)\,\frac{1}{2}\rho u^2 \;,$$

where C_D is the drag coefficient of a grain, and $(\pi g^2/8)$ is half its cross-sectional area, presumed to be the amount of area exposed above the rocky matrix. The separation ℓ is the sum of the grain diameter and the length of the cavity bubble. To a reasonable approximation, the length of a cavity bubble is found to vary inversely as the cavitation number [8], so one can write

$$\ell = g + gB\left(\frac{\frac{1}{2}\rho u^2}{p_s - p_v}\right) .$$