presumably because the sandstone targets were too soft. Recently Powell and Simpson [5] attempted to calculate P_c on the basis of elasticity theory and a fracture criterion. The results proved to be higher than those reported in [3], and Powell and Simpson concluded that "the rock cutting action of a water jet cannot be explained entirely in terms of mechanical fracture due to the stress field induced internally in the rock by impact of the jet."

The English work produced useful correlations but no explanation of the mechanics of hydraulic rock cutting. The explanation had to go beyond a simple fracture criterion, to the interplay between the fluid mechanics of the jet stream and the solid mechanics of the rock.

One reason no explanation was forthcoming may be that penetration of a static target is a difficult conceptual problem. The hole deepens with time, and the interface between water and rock is nonsteady. Olsen and Thomas's continuous-flow pressure intensifier lends itself to the alternative steady-state experiment illustrated in Fig. 1. The jet emerges with diameter d_o and steady total pressure P_o, and the rock feeds under the jet stream at a constant speed v. However complicated the mechanics of cutting may be, the cutting interface is steady in coordinates fixed with respect to the jet, and the cut attains some definite terminal depth h. The problem is to determine h as a function of P_o, d_o, v, and whatever material properties may be pertinent.

Soviet workers developed continuous-flow pressure intensifiers early and have published experimental data on h. Zelenin, Vesselov, and Koniashin [6] cut three kinds of stone — granite, limestone, and marble — at pressures P_o up to 2000 atm. They found that h is directly proportional to $(P_o - P_c)$ and inversely proportional to a measure of rock hardness, which here will be taken as the shear strength τ_o. The critical pressure P_c was found to increase with feed rate v. For each P_o, cutting would cease at a sufficiently high value of v, and the only effect of the jet would be sporadic pitting. Perhaps the most interesting finding was that h is independent of v for feed rates up to about 10 in/sec and thereafter decreases gradually with v until cutting ceases altogether. The results of [6] can be summarized by the formula

$$h = d_o \frac{(P_o - P_c)}{\tau_o} F(v) \quad , \tag{1}$$

where P_c increases with v, and F(v) is constant at low v and decreases at higher v. Zelenin, Vesselov, and Koniashin assert that F(v) falls as $v^{-0.33}$ in the feed-rate interval 20-70 in/sec, though no simple power law will suffice for all v.