

Setting $F_\mu = 1$, $\Phi_\mu = 0$, $\Phi_N = \kappa F_{2N}/4M$, we get the previously mentioned Rosenbluth formula.

In conclusion I express my thanks to I. L. Rozental' for a discussion.

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CONCERNING THE IMPACT OF SOLIDS AT HIGH VELOCITIES

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WHEN a solid body strikes a solid barrier at a speed exceeding several km/sec, a strong shock wave is produced in the body and in the barrier, and destruction of the crystalline lattices of the colliding bodies begins on the front of this wave. At speeds on the order of 10 km/sec and higher, (say when a meteorite strikes the surface of the moon or of an asteroid), the result is evaporation of the striking body and partial evaporation of the struck medium.

The pressure on the front of the shock wave drops sharply with increasing distance to the point of impact, and the evaporation of the medium on its front ceases and is replaced by melting and simple crushing of the medium. Strong crushing stops almost always when the mass energy density on the front of the shock becomes less than a certain value that characterizes the "strength of the medium" ϵ . The evaporated and finely fragmented medium continues to move expands, and exerts an explosion-like effect.

Since the effect of the explosion is analogous in this case to the effect of the well-studied explosion of high explosives, such as TNT, it is advantageous to introduce the so-called TNT equivalent. The

equivalent mass of an explosive substance is determined by the obvious relation

$$m_s = \eta E_0 / Q = \eta M_0 u_0^2 / 2Q,$$

where E_0 is the initial energy, M_0 the mass of the striking body, u_0 the impact velocity, η the efficiency of utilization of the energy, and Q the caloric content per gram of explosive. At high impact velocity ($u_0 > \sqrt{\epsilon}$) the mass M expelled from the medium by the explosive exceeds considerably the incident mass, and therefore the momentum J of the expelled medium (normal projection) also exceeds considerably the initial momentum $J_0 = M_0 u_0 \cos \theta$, where θ is the angle (measured from the normal) at which the impact takes place.

Experiments and corresponding computations have shown that the exploded and expelled mass equals $M \approx E_0 / \epsilon$. Since the momentum of the expelled mass is $J \approx \sqrt{ME_0}$, then obviously

$$J = BE_0 / \sqrt{\epsilon}.$$

Here the coefficient of proportionality B is found essentially by experiment. This coefficient can be easily related with the strength properties of the medium.³

The relation

$$J_0 / J = 2 \cos \theta \sqrt{\epsilon} / Bu_0$$

is small at large initial impact velocities (when $u_0 > \sqrt{\epsilon}$). Consequently, the total momentum acquired by the medium during the impact and subsequent explosion depends essentially on the explosion momentum and is practically independent of the angle of the impact. At cosmic impact velocities, on the order of 30 or 40 km/sec, J exceeds J_0 by one order of magnitude.

The foregoing effects fail to apply only at very large values of the angle of incidence θ , when the normal velocity component is small.

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