R.H. Goddard: A Method of Reaching Extreme Altitudes

[[underline]]CALCULATION OF MINIMUM MASS TO RAISE ONE POUND TO VARIOUS ALTITUDES IN THE ATMOSPHERE[[/underline]].

The "total initial masses" required to raise one pound from sea-level to the upper end of intervals [[underline]]s[[/underline]][[subscript]]6[[/subscript]], [[underline]]s[[/underline]][[subscript]]7[[/subscript]], and [[underline]]s[[/underline]][[subscript]]8[[/subscript]] are given in Table VII. They are obtained by multiplying together the minimum masses (marked by stars in Table V), from [[underline]]s[[/underline]][[subscript]]1[[/subscript]] up to and including the interval in question; and represent, as already explained, the mass in pounds of a rocket which, starting at sea-level would become reduced to one pound at the altitude given.

The highest altitude attained by the one pound mass is not, however, the upper end of the interval in question, but is a very considerable distance higher. This, of course, follows from the fact that the one pound reaches the upper end of each interval with a considerable velocity, and will continue to rise after propulsion has ceased until this velocity is reduced to zero, by gravity and air resistance.

If we call [[underline]]v[[/underline]][[subscript]]1[[/subscript]], the velocity with which the pound mass reaches the upper end of the particular interval where propulsion ceases, [[underline]]h[[/underline]] the distance beyond which the one pound will rise (the cross-section still being one square inch), and [[underline]]p[[/underline]] the mean air resistance in poundals over the distance [[underline]]h[[/underline]], we have by the Principle of Work and Energy, ^[[h = v[[subscript]]1[[/subscript]][[superscript]]2[[/superscript]] over 2 (g + p).]] The values of [[underline]]p[[/underline]] are small, owing to small atmospheric density; being 1.59 poundals for the [[underline]]h[[/underline]] beyond [[underline]]s[[/underline]][[subscript]]6[[/subscript]]; 0.28 beyond [[underline]]s[[/underline]][[subscript]]7[[/subscript]] (a = 50); and 0.465 beyond [[underline]]s[[/underline]][[subscript]]7[[/subscript]] (a = 150). For [[underline]]s[[/underline]][[subscript]]8[[/subscript]] the low density makes this quantity negligible.

The altitudes obtained by adding to the interval the corresponding [[underline]]h[[/underline]], are called the "Greatest altitude attained" in Table VII.