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**Fluid Mechanics Revisited** HOWARD BRENNER, Massachusetts Institute of Technology — The "velocities" appearing in the respective Eulerian forms of the continuity and linear momentum equations are those of mass and momentum. Despite possessing the units of velocity, neither is really a velocity, the latter notion being reserved exclusively for quantifying the movement of a single immutable material object through space. Rather, the mass velocity appearing in the continuity equation is really the fluid's mass flux divided by its density, whereas the momentum velocity is really the fluid's specific (i.e., per unit mass) momentum density. When founding the subject of rational fluid mechanics in 1755, Euler implicitly assumed these two quantities to be the same by assigning to each the same symbol, namely $\mathbf{v}$, symbolically suggesting (without proof) the notion of velocity. In this talk the standard pre-constitutive equations of irreversible thermodynamics are combined with the Chapman-Enskog-Burnett equations of single-component monatomic gas-kinetic theory jointly with Onsager's reciprocal theorem to negate the general applicability of Euler's 250-year old implicit *constitutive hypothesis*, at least in circumstances where temperature gradients exist.

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