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Reimagining the description of the turbulent boundary layer RICHARD DUNCAN, HASSAN NAGIB, Illinois Institute of Technology — The turbulent boundary layer has been described from many different perspectives, drawing on physical inference, mathematical interpretation, and even visual observation. Many descriptions, however, lack complete explanation for the various features of the mean flow, or rely heavily on the description of only the streamwise mean velocity without analogous description of the Reynolds stress profiles. Here, a new description is proposed in which three regions of the turbulent boundary layer are identified, each defined by distinct physical phenomena and distinct mathematical solutions. A viscous region is shown to exist nearest the wall, with an extent further from the wall than previously thought. An inertial region, encompassing the potential region of the solution as well as the outermost part of the boundary layer, is proposed to help clearly and uniquely identify the extent of the boundary layer as well as allow for description of other wall-bounded flows, which possess a different outer boundary condition. Finally, the region in which turbulence is dominant is singled out as a separate region, calling into question the classical inner versus outer scaling while better explaining the presence of intermediate regions such as the classical buffer layer and wake region.

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