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The Mean-Velocity Profile of Turbulent Wall-Bounded Flows: The Debate Continues M. BUSCHMANN, Institut für Luft- und Kältetechnik Dresden, Germany, M. GAD-EL-HAK, Virginia Commonwealth University — The recent debate concerning the mean-velocity profile of turbulent wall-bounded flows has ruled out neither a log nor power law behavior. Furthermore, a Reynolds number dependence of the mean-velocity profile has not been excluded either. Clearly, a more complex functional form is needed to describe the profile. The generalized log law introduced by Buschmann & Gad-el-Hak in 2002 is re-examined using more recent pipe flow data from McKeon et al. (2004). The zeroth-order solution shows good agreement with the data. However, analyzing the fractional difference of that solution reveals that a previously not considered dependence on both the Reynolds number and wall-normal coordinate still persists. Progressing to the second-order solution resolves both deficits fairly well. The generalized log law is then valid throughout the profile above $y^+ \approx$100–150, in perfect agreement with the data. The Reynolds number dependence of the two main parameters, the Kármán constant and the outer additive constant, are predicted up to fifth order. For moderate Reynolds numbers the parameters calculated with the zeroth-order solution are very close to the values proposed by Zanoun (2003) for channel flows. However, the Kármán constant shows slight Reynolds number dependence, which is in excellent agreement with a function for κ proposed by Tennekes (1968).

Mohamed Gad-el-Hak
Virginia Commonwealth University

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