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Why the "K41"/Batcher hypothesis of "local equilibrium" is wrong WILLIAM K. GEORGE, Imperial College London and Princeton U. — The foundation of modern turbulence theory since Kolmogorov's pioneering paper in 1941 has been the hypothesis that the small scales of the turbulence were in "local" statistical equilibrium relative to those containing most of the energy. This hypothesis is shown to be fundamentally incorrect and internally inconsistent with deductions based upon it, no matter the Reynolds number. In fact deductions from the local equilibrium hypothesis are valid only in flows in strict statistical equilibrium; i.e., flows that are either already statistically stationary at all scales, or in a convective frame, statistically homogeneous. In other words, only in flows where the "local equilibrium" is in fact exact. Hence experiments in such flows (of which there are many) provide no proof at all, contrary to popular belief that "K41" is "proven." Moreover there are many experiments in non-stationary flows that "disprove" "K41," consistent with the conclusions here. The implications of this for a new theory of turbulence are explored using the material derivative of the dissipation rate.

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