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The laws of resistance in transitional pipe flows[1] RORY CERBUS, CHIEN-CHIA LIU, GUSTAVO GIOIA, PINAKI CHAKRABORTY, Okinawa Institute of Science and Technology — As everyone knows who has opened a kitchen faucet, pipe flow is laminar at low flow velocities and turbulent at high flow velocities. At intermediate velocities there is a transition wherein plugs of laminar flow alternate along the pipe with "flashes" of a type of fluctuating, non-laminar flow which remains poorly understood. In the 19th century, Osborne Reynolds, who first reported flashes, sought to connect these states of flow with quantitative "laws of resistance" whereby the fluid friction is determined as a function of the Reynolds number. While he succeeded for laminar and turbulent flows, the laws for transitional flows eluded him and remain unknown to this day. By properly distinguishing between flashes and laminar plugs in the transitional regime, we show experimentally and numerically that the law of resistance for laminar plugs corresponds to the laminar law and the law of resistance for flashes is identical to that of turbulence.

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