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Nature's Microfluidic Transporter: Rotational Cytoplasmic Streaming at High Péclet Numbers[1] J.W. VAN DE MEENT, I. TUVAL, R.E. GOLDSTEIN, University of Cambridge — Cytoplasmic streaming circulates the fluid contents of large eukaryotic cells, often with complex flow geometries. A largely unanswered question is the significance of these flows for molecular transport and mixing. Motivated by "rotational streaming" found in Characean algae we solve the Stokesian advection-diffusion dynamics of flow in a cylinder with bi-directional helical forcing at the wall. Transverse to the cylinder's long axis is generated circulatory flow akin to Dean vortices at finite Reynolds numbers. Strongly enhanced lateral transport and longitudinal homogenization occur if the transverse Péclet number is sufficiently large, with scaling laws arising from the effects of boundary layers.

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R.E. Goldstein
University of Cambridge

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