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The evolution of viscous flow on a cylinder DAISUKE TAKAGI, HERBERT E. HUPPERT, Institute of Theoretical Geophysics, DAMTP, University of Cambridge — The temporal development of a thin viscous layer on a stationary cylinder is investigated both theoretically and experimentally. A constant volume of fluid is released instantaneously at the top of a cylinder, whose axis is horizontal. The resultant flow is confined laterally by vertical plates and propagates down a channel whose slope varies continuously along the flow. The structure of the current is shown using lubrication theory to initially have a uniform thickness. This thickness is independent of the fluid volume per cross-stream width. The thickness and length of the current after time t from initiation are given by $(3\nu R/2g)^{1/2}t^{-1/2}$ and $A(2g/3\nu R)^{1/2}t^{1/2}$ respectively, where g is gravity, A the cross sectional area of fluid, ν its kinematic viscosity and R the radius of the cylinder. These results are in good agreement with experimental data taken on a cylinder of radius 15 cm and width 11 cm. The front of the current, which can produce a series of rivulets after it has propagated a distance proportional to $A^{1/2}$, ultimately detaches from the underside of the cylinder. Video clips of the laboratory experiments highlight some remarkable features at the contact line due to capillary action.

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