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The Shape of a Ponytail and the Statistical Physics of Hair Fiber Bundles RAYMOND E. GOLDSTEIN, University of Cambridge, PATRICK B. WARREN, Unilever R&D Port Sunlight, ROBIN C. BALL, University of Warwick — From Leonardo to the Brothers Grimm our fascination with hair has endured in art and science. Yet, a quantitative understanding of the shapes of a hair bundles has been lacking. Here we combine experiment and theory to propose an answer to the most basic question: What is the shape of a ponytail? A model for the shape of hair bundles is developed from the perspective of statistical physics, treating individual fibers as elastic filaments with random intrinsic curvatures. The combined effects of bending elasticity, gravity, and bundle compressibility are recast as a differential equation for the envelope of a bundle, in which the compressibility enters through an "equation of state." From this, we identify the balance of forces in various regions of the ponytail, extract the equation of state from analysis of ponytail shapes, and relate the observed pressure to the measured random curvatures of individual hairs.

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