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Dancing Discs: Bending and Twisting of Soft Materials by Anisotropic Swelling DOUGLAS HOLMES, MATTHIEU ROCHÉ, TARUN SINHA, HOWARD STONE, Princeton University — Soft materials, e.g. biological tissues and gels, undergo morphological changes, motion, and instabilities when subjected to external stimuli. Tissues can exhibit residual internal stresses induced by growth, and generate elastic deformations to move in response to light or touch, curl articular cartilage, aid in seed dispersal, and actuate hygromorphs, such as pine cones. Understanding the dynamics of such osmotically driven movements, in the influence of geometry and boundary conditions, is crucial to the controlled deformation of soft materials. We examine how thin elastic plates undergo rapid bending and buckling instabilities after anisotropic exposure to a favorable solvent that swells the network. An unconstrained beam bends along its length, while a circular disc bends and buckles with multiple curvatures. In the case of a disc, a large-amplitude transverse travelling wave rotates azimuthally around the disc. Theoretical interpretations inspired by the complementary thermal expansion problem of transient shape changes triggered by time-dependent heating are presented and allow collapse of time-dependent data on universal curves. Understanding the dynamics of strain-driven shape changes provides new insight into natural systems and control of advanced functional materials.

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