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How to keep your pants on: historic metamaterials and elasticity before the invention of elastic ELISABETTA A. MATSUMOTO, School of Engineering and Applied Sciences, Harvard University, L. MAHADEVAN, School of Engineering and Applied Sciences, Wyss Institute, Harvard University — How do you create stretching from an inextensible material? Remarkably, the centuries-old embroidery technique known as smocking accomplishes just this. With the recent explosion of origami-based engineering, the search is on for a set of design principles to generate materials with prescribed mechanical properties. This quickly becomes a complex mathematical question due to the strict constraints of rigid origami imposed by the inextensibility of paper. Softening these constraints by considering woven fabrics, which have two orthogonal inextensible directions and a skewed soft shear mode, opens up a zoo of possible configurations. We explore the emergence of elastic properties in smocked fabrics as functions of both fabric elasticity and smocking pattern.

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