Needham, VDGF, Chapter 20, Exercise 11, p. 221.
Palmer, February 26, 2022, 1:45 am PT

11. Why Paper Folds into a Straight Line*. We take it for granted that when we fold a piece of paper, the fold automatically forms itself into a straight line, but why does this happen? Show (without any calculation) that this is a direct consequence of the Theorema Egregium!…*

The Theorema Egregium states: The extrinsic curvature $\mathcal{K} = \left(\delta\ \tilde{\mathcal{A}} / \delta\mathcal{A}\right)$ *is invariant under isometries of* $\mathcal{S}$ *and therefore belongs to the intrinsic geometry of* $\mathcal{S}$*. More explicitly, while the principle curvatures individually depend on the shape of the surface in space, their product does not:* $k_1\, k_2$ *is invariant under isometries.*

Wikipedia uses more specific language. The isometries must be local.

In modern mathematical terminology, the theorem may be stated as follows:
The Gaussian curvature of a surface is invariant under ***local*** *isometry.* [emphasis added]
(https://en.wikipedia.org/wiki/Theorema_Egregium)

Answer: Paper is a rigid substance with local isometry. Stretching a paper surface is impossible by construction. In general, stretching in any direction would destroy the local isometry of the surface. Therefore *the fold automatically forms itself into a straight line.* This is the only mathematical fold that doesn't stretch.