

About the Cover

Parallel transport by Schild's ladder

Reading through the article by Jason Osborne in this issue, we wondered whether there existed an intuitive explanation of parallel transport along an arbitrary path on a Riemannian manifold. Professor Google came up with two.

The first, and simplest, is the one illustrated on the cover. It constructs a series of approximations to parallel vectors by constructing approximate parallelograms along the path, essentially by laying off measuring rods along geodesics in the style of Einstein's popular accounts of relativity. This is a straightforward idea attributed to the physicist A. Schild and explained succinctly in the classic book *Gravitation* by Misner, Thorne, and Wheeler. This scheme is first order in the size of the approximating parallelograms, and is used by these authors to prove, with more or less rigor and more or less clarity, basic properties of covariant differentiation.

The second and more interesting is by means of a modern version of the ancient Chinese machine called the "south-seeking chariot". Unfortunately there are no extant models from old times, but in theory this machine maintains a pointer to a fixed direction no matter what path the chariot follows. The basic principle at work is an ingenious mechanism involving differential gears (among the oldest known) that keeps track of the difference in angle of rotation of the chariot's two wheels. There is a large literature on this device, including much advice on how to build a working model. One good reference, containing a useful bibliography, is "The south-pointing chariot on a surface" by Bernard Linet. It can be found among the physics articles on the [arxiv](https://arxiv.org/).

—Bill Casselman, Graphics Editor
(notices-covers@ams.org)