model the criminal side of Moriarty after Newcomb.

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Gauss on the mountaintops

Michael Marder, Robert Deegan, and Eran Sharon discuss Carl Friedrich Gauss's measurement of the angles of a triangle across mountaintops (PHYSICS TODAY, February 2007, page 33), but their discussion is simply wrong. They write, "Some believe that Gauss performed his mountaintop measurement to check whether three-dimensional space itself is Euclidean, but in the paper he published at the time he did the work he made no reference to any such question."

The theoretical spherical triangles of Gauss and Adrien-Marie Legendre that are discussed in the article have edges that are great circles on the surface of the sphere. They thus obey Euclid's definition of being the "shortest distances" on that surface. But for Gauss's mountaintop measurements, there is no simple way to construct or observe such great circles, because the light rays that were used to make the angle measurements are not constrained to follow Earth's assumedly spherical surface. They are, rather, geodesics within 3D space, if one ignores atmospheric refraction. Gauss's measurement therefore could not have been anything but a test of the Euclidean nature of 3D space. Gauss understood that perfectly well, and his lack of reference to any such test probably simply reflects his well-known reluctance to discuss non-Euclidean geometries.

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Marder, Deegan, and Sharon reply: Many people, including Douglas Robertson, believe that Gauss performed his mountaintop measurement to check whether three-dimensional space itself is Euclidean. Ernst Breitenberger's careful analysis (our reference 1) persuaded us to the contrary. From 1821 to 1825, Gauss spent many months in the field, mapping Hanover with a heliotrope, an instrument he had invented. The mountain peaks forming the corners of his great triangle were base stations; he measured and plotted 26 smaller triangles between them. The edges of all those triangles were assumed to be great circles, projected down to sea level.

Inconsistencies in the measurements were minimized with a global least-squares adjustment, a method Gauss had invented, and he projected them onto flat surfaces with conformal maps, also his invention. The purpose of the great triangle between Hohehagen, Brocken, and Inselberg was to check the results he had obtained by patching together the 26 smaller triangles. He wanted that check both to ensure the map's accuracy and to measure deviations of Earth's shape from a perfect sphere. For the latter task he needed to invent differential geometry. Perhaps amid his phenomenal exhibition of creativity, Gauss also wondered whether space itself is Euclidean, but the great triangle is easily justified without invoking that question, and Breitenberger cites much evidence against it.

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Laws, theories, and the passage of time

I found the Letters Department discussion of laws versus theories (PHYSICS TODAY, July 2007, page 8) quite interesting. I have observed that Boyle's law, Ampère's law, Faraday's law, conservation laws, Newton's laws, and the laws of thermodynamics all precede the Industrial Revolution, whereas relativity theory, evolutionary theory, quantum theory, and such all follow it. The term "law" seems to have fallen out of favor after the Industrial Revolution. I cannot attribute this observation to any cause; perhaps others can.

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