This Colloquium examines the field of the Einstein, Podolsky, and Rosen (EPR) gedanken experiment, from the original paper of Einstein, Podolsky, and Rosen, through to modern theoretical proposals of how to realize both the continuous-variable and discrete versions of the EPR paradox. The relationship with entanglement and Bell's theorem are analyzed, and the progress to date towards experimental confirmation of the EPR paradox is summarized, with a detailed treatment of the continuous-variable paradox in laser-based experiments. Practical techniques covered include continuous-wave parametric amplifier and optical fiber quantum soliton experiments. Current proposals for extending EPR experiments to massive-particle systems are discussed, including spin squeezing, atomic position entanglement, and quadrature entanglement in ultracold atoms. Finally, applications of this technology to quantum key distribution, quantum teleportation, and entanglement swapping are examined.