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ABDUCTION AND INVERSE PROBLEMS (abstract)

C. S. Peirce introduced in the 1860s his notion of *hypothesis* as “inference of a cause from its effect”. Later he coined the term *abduction* for such an “inference to an explanation”. Its important special case is *retroduction*, or reasoning backward in time on the basis of causal laws of succession. Peirce illustrated retroduction by the inference from present documents to the historical existence of Napoleon Bonaparte. This paper shows that similar examples abound in medicine, biology, and cultural sciences. First, the new growing branch of applied mathematics called “inverse problems” deals successfully with various kinds of abductive inference within a variety of scientific disciplines. The fundamental theorem about the inverse reconstruction of plane functions from their line integrals was proved by Johann Radon already in 1917. The practical applications of Radon’s theorem and its generalizations include computerized tomography which became a routine imaging technique of diagnostic medicine in the 1970s. Secondly, the common task of many biological and cultural sciences is to reconstruct the historically branching development of some types of entities (like animal species, hominids, languages, texts, and poems). The methods of cladistics, textual criticism, and stemmatology thus share a common pattern of abductive inference.