ATTACHMENT #4

Prior to this translation, the reader had access to the world of the young Schelling only through the bare text of these abrupt and dense essays printed in Gothic script. Marti's volume contains some translations which are questionable from the point of view of philosophical sobriety or American English, but good translations always have an idiosyncratic tone to them. Sometimes the explanatory material is too dense, but this very uncontrolled richness makes the book a rich source of information on early transcendental and idealist philosophy. —T.F.O'M.

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X SEIDENFELD, T. *Philosophical Problems of Statistical Inference: Learning from R. A. Fisher.* Dordrecht, Boston, and London: D. Reidel Publishing Co., 1979. xiii + 245 pp. n.p.—The present work is an expansion of the author's doctoral dissertation, entitled "The Fiducial Argument," completed at Columbia University in 1975. Seidenfeld's principal objective, as stated in the Preface, is to "reconstruct and evaluate Fisherian statistics, with special attention to Fisher's idea of fiducial probability as it pertains to inverse inference."

In his address to the Royal Statistical Society (1935) Fisher remarks that "the general body of researches in mathematical statistics during the last fifteen years is fundamentally a reconstruction of logical rather than mathematical ideas." Although one may disagree with Seidenfeld's decision to analyze Fisher's program exclusively within the framework of inductive logic, one must admit that Fisher himself invites such an analysis.

Modern statistics is a motley collection of mathematical formulae and sampling rituals with roots in such places as seventeenth century gambling manuals, eighteenth century theological tracts, Victorian pamphlets on social engineering and eugenics, statistical mechanics, modern-day information theory, the mathematical theory of errors and "the art of reasoning by figures upon things relating to government." As may seem natural, several competing approaches have developed, divided chiefly over such questions as the nature of probability, the adequacy of the probability calculus as a model for states of ignorance, and the scientific objectivity of any theory based on such a model. For the philosopher the most important debate is perhaps the one concerning inverse inference: statistical inference from an observed sample to an unobserved population.

Typically, inverse inference involves statements of probability concerning non-random but unknown population parameters. If the bias of a coin is not known but a record of the past n flips is available, can we duplicate the force of direct inference in making statements concerning the probability, say, of a head on the next toss or that the unknown bias lies within certain bounds? Those falling into the rather broad category of Bayesians would hold that such inverse inference is possible, while Frequentists would claim that, unless the bias of the coin is itself a stochastic quantity, no such inference is allowed. The fiducial argument, introduced about 1930 by the British statistician

R. A. Fisher as a Frequentist alternative to the Bayesian inverse inference, is the subject of the present work.

It is clear that Fisher recognized the inadequacy of the probability calculus as a rigorous expression of uncertain inference in all cases. Indeed, his concept of "likelihood" and his method of parameter estimation based upon this notion were developed to avoid the use of additional postulates as would be required before direct inference within the calculus of probability could be made. It was his discovery of "sufficient" statistics in estimation, coupled with exact tests for significance, such as those involving "Student's" distribution, that led Fisher to the concept of fiducial probability. In those special cases in which an "exhaustive mobilization of the relevant information latent in the experiment" is possible, one can, he believed, make statements of (fiducial) probability equal in strength to those one would have were direct inference permitted, but differing in logical content from those arrived at by Bayesian techniques. Unfortunately Fisher gave no precise statement of what he considered "exhaustive mobilization" of information. It was left to exegetes of the next generation to reconstruct an axiomatic statement of his fiducial argument and to evaluate its adequacy as a theory of logical inference.

Seidenfeld proposes to test his reconstruction against five postulates which serve for him as conditions of adequacy. He combines with the essentially Carnapian principles of coherence, conditionalization and total evidence a fourth Frequency Principle (essentially due to Hacking) and a requirement of objectivity or "uniqueness of confirmational relations between hypotheses and their evidential basis." Fisherian inference, in the author's view, is related to significance tests in much the same way that confidence intervals are related to hypothesis-testing in the Neyman-Pearson theory. To strengthen the analogy, as well as to illustrate the content of his five postulates, Seidenfeld prefaces his development of Fisherian inference with a detailed analysis of the N-P theory as a method of logical inference.

The inadequacies of the N-P theory as a Frequentist answer to the problem of inverse inference are well-known. Neyman and Pearson stressed instead the "decision-theoretic" nature of their methods. Seidenfeld essentially concurs in Hacking's criticism of the N-P theory but emphasizes the value of attacking the confidence interval theory directly.

The reconstruction of fiducial probability presented here involves, as does Hacking's, a direct inference with respect to a pivotal variable before the data is available, such that the strength of the probability statement is retained after the observations are made. The discussion focuses naturally on suitable conditions of irrelevance for the pivotal variable. Tukey's "smooth invertibility" is adopted as necessary for irrelevance while the requirement of a sufficient statistic is weakened to permit conditioning on ancillary statistics. The notion of "canonical" pivotal variable is used to overcome difficulties posed by well-known counter-examples. However, in considering the case of two independent observations for which no common sufficient statistic exists, the author reveals, through a modification of an example by I. J. Good, the essential weakness of the reconstructed argument. In-

compatible sequential methods, while supporting Fisher's original intuition that a sufficient statistic is required, reveal the limitations of the program; unless we know a priori that the data will admit a suitably exhaustive summary our use of the fiducial argument on any initial segment of the data could lead to inconsistencies.

This is not an introductory text. The interested nonexpert would do well to begin with Hacking's *Logic of Statistical Inference*, a broader and more readable work. Seidenfeld gives us a carefully developed argument, extended over two hundred pages. Important and interesting chapters in the development of statistical inference are reduced to a couple of lines if the argument is not served by a more exhaustive treatment. Recent efforts by Jaynes and others to base the Bayesian program of Laplace and Jeffreys on the notion of entropy borrowed from statistical mechanics has been completely ignored, as has Fisher's anticipation of this idea in his "The Logic of Inductive Inference" (1935).

Missing also is an acknowledgement that the logical analysis of the inferences being made may only be part of the story. Statistical analysis is frequently only part of a process of mathematical modeling. As the mathematician Mark Kac reminds us, the value of such a model lies not so much in its explanatory and predictive powers, as important as these are for science, as in the penetrating questions it permits us to ask. When statistical techniques are seen as part of such a process criteria such as objectivity becomes less meaningful.

It would be unfair, though, for the last word to concern the unkept promises of the title. The important role played by R. A. Fisher in the development of modern statistics has attracted to his fiducial argument many of the better minds of this generation of mathematicians and logicians. Seidenfeld's efforts may well be the final chapter in its brief but stormy history.—C.B.

SEIGFRIED, C. H. *Chaos And Context: A Study in William James.* Athens, Ohio: Ohio University Press, 1978. 137 pp. $10.00—This is, it appears, the first full-length discussion of William James's doctrine of relations. The author traces the development of James's doctrine of relations from *The Principles of Psychology* through *Essays in Radical Empiricism* and discusses the relations between James and Hume, and James and Bradley, on this topic. Seigfried does not attempt to reconcile all that James says on the topic of relations but she does provide us with a plausible reconstruction of the main direction of James's thinking on the subject.

Although James usually sided with the empiricists against the rationalists, he argued against Hume and Locke that persons are conscious of a multiplicity of objects and relations, and not merely simple impressions. He insisted that we experience the bright "next to" the dull and that such relations are not merely the result of reflection after the experience. That we tend to speak of the substantive and not the