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On the foundations of statistics, Ian HACKING.

Long run frequency is here regarded as a physical property. The foundations of statistics must aim at defining this property, and at discovering which statistical inferences are valid. Statistical inferences are of two kinds: from known frequencies, to support for hypotheses about outcomes of particular trials on a chance set-up; and from known outcomes to support for hypotheses about frequencies. This paper offers four postulates. The first three provide the usual probability calculus. The fourth is ultimately taken from R. A. Fisher's conception of likelihood. Together, the postulates entail inferences of both kinds just mentioned. Moreover, they provide for a theory of testing statistical hypotheses. This new theory is compared with that of Neyman and Pearson, which is shown, on independent grounds, to have a narrower domain than in commonly thought; when it is valid, it is contained in the likelihood theory described in this paper.

The inference of function from structure in fossils, M. J. S. RUDWICK.

The evaluation of rival evolutionary theories (Synthetic or Neo-Darwinian against Typostrophism, Orthogenesis, etc.) depends, in part, on determining the adaptive status of certain organisms whose critical significance can only be recognised in retrospect. Hence the problem is to discover whether the features of certain fossil organisms were or were not adaptive. The only method by which the function of a fossil structure can be detected, critically tested and confirmed is by a "teleological" analysis of its fitness to perform a postulated function. But since there is no comparable way of demonstrating that a fossil structure was non-adaptive, the Synthetic theory is, in this respect, strictly unfalsifiable.

Reason and experiment in relation to the special relativity theory, Herbert DINGLE.

The special relativity theory is shown to be untenable because it implies a multi-valued ratio for two clock-rates which are, by hypothesis, single-valued. This has been overlooked because of the implicit assumption that a mathematically self-consistent theory is not disprovable except by experiment, whereas it may be invalidated through imposing impossible behaviour on instruments. The relation of mathematics to physics in a physical theory is discussed. A brief history of the confusion between Lorentz's and Einstein's "relativity" theories is given, and many experimental tests of Einstein's second postulate are shown to involve circular arguments. On the other hand, there is some experimental evidence against Einstein's theory.

Value Judgments in Economics, Ronald L. MEEK.

When the new science of political economy emerged in the eighteenth century, it seemed to have largely divorced itself from value-judgments. Economists gradually began to concentrate on analysing the objective laws governing the working of the economic machine. Nevertheless, value-judgments have been imported into economic analysis, largely because the machine which the economist studies is an incredibly complex one, so that alternative explanations of certain economic phenomena can be put forward and it becomes possible for ideological considerations to motivate the choice of one or other of them. At the present time, however, as a result of the

widespread weakening, breakdown and deliberate destruction of the economic machine, economics is being gradually transformed into a science (or art) of economic management, or social engineering. If this trend continues, the scope for the intrusion of value-judgments into "positive" economics is likely to become relatively small, although there will still be considerable scope for ideological bias in the formulation of appropriate criteria of economic efficiency.

Value judgments and economics, Kurt KLAPPHOLZ.

The predominant, "orthodox" view among English economists has been that economics can be just as ethically neutral or value-free (wertfrei) as the natural sciences. Over the last 15 years or so, however, various purported criticisms of this view have been advanced. After restating the "orthodox" view this paper examines some of these criticisms and shows that, while they are relevant as criticisms of, e.g., an inductivist approach to economics, they miss their apparent target and leave the principle of *Wertfreiheit* untouched. The paper also examines the logical requirements for "scientific" or value-free advice, and the role of value judgments in this context, and also the question whether inter-personal comparisons of utility are to be regarded as value judgments. It concludes by advancing some tentative suggestions which may help to explain the curious persistence of the misdirected debate about *Wertfreiheit*.

The a priori and the empirical in economics, Richard STONE.

The paper asserts the complete intertwining of the *a priori* and the empirical in the development of economics. Some input of factual knowledge is unavoidable in building even very simple theories relating to the real world; some input of theory is unavoidable in making observations and measurements useful in analysis. No matter how we start, advances in knowledge come from an iteration between the two. This point of view is illustrated with the example of the theory of consumers' behaviour.

Empirical and a priori in economics, Anne MARTIN.

Economics has suffered from a recurring tendency of economists to treat analytic propositions (e.g. about "rational entrepreneurs") as synthetic, and to rescue synthetic propositions from falsification by making them analytic (e.g. laws of Supply and Demand). They have also tended to confuse rules guiding the construction of economic *theory* with rules guiding economic *policy*. These various confusions have lent plausibility to Von Mises's view of economics as essentially *a priori*, a view which derives from a mistaken equation of knowledge derived from introspection with *a priori* knowledge in the Kantian sense. This view has put economists off doing empirical work that needs to be done. "As far as the theorems of economics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality."

Confirmation Without Paradoxes, William H. BAUMER.

The central intent of this paper is presentation of a resolution of the various paradoxes of confirmation by means of a metricized eliminative confirmation theory using G. H. von Wright's principal theorem of confirmation. Due to notable differences between this solution and that of J. Hosiasson-Lindenbaum, her metricized approach is examined and held unsuccessful. Abandonment of the metricization, for which there are good reasons, is shown to make no difference here; eliminative confirmation does, while simple enumeration does not, escape the paradoxes and this is grounds for rejecting the latter altogether. The approaches of H. G.

Alexander and D. F. Pears are shown to fail as Hosiasson-Lindenbaum's does; attention is also given to J. W. N. Watkins's views of the paradoxes. In closing, any attempt to give an explicit definition of "confirming instance" is rejected, such attempts being shown to be a major source of the paradoxes.

On the Conrfimation Paradox, P. R. Wilson.

The propositions

"all ravens are black"   (1)
"all non-black are non-raven",   (2)

together with the following statements constitute the confirmation paradox. These are:

(a) observations of black ravens confirm (1)

(b) observations of black shoes, white swans, etc., are neutral to (1)

(c) if observations confirm one formulation of a hypothesis, they confirm any logically equivalent formulation

(d) (1) and (2) are logically equivalent.

The paradox has been generally solved by denying statement (a) or (b) or both. Here however statement (d) is shown to be irrelevant. While (d) is certainly true for universal logical propositions, it is argued that, if propositions (1) and (2) are considered as scientific hypotheses which are subject to confirmation, then they are not necessarily equivalent. Two examples are given in support of this assertion. It is concluded that, only if (1) and (2) are universally true statements, can (d) be asserted as true à priori. Since universally true statements are not subject to confirmation, there is no paradox at all unless (1) and (2) are considered as scientific hypotheses subject to test. The paradox is resolved because in this case statement (d) does not apply.

Confirmation by observation and the paradox of the ravens, Judith SCHOENBERG.

The paradox of confirmation may be resolved on other grounds than those so far discussed. The problem of the confirming power of enumerated observations as opposed to that of test cases is not entered into. The view expounded is that a prior condition must be fulfilled for observations to have any power at all to confirm an hypothesis. This condition, which is rarely made explicit, pertains to the relation between the observational data and the permissible inductive inferences from the data; it is such that observations which confirm one hypothesis may be entirely incapable of confirming certain logically equivalent hypotheses. Hence the paradox can be resolved by rejecting the proposition that if observations confirm one formulation of an hypothesis, they confirm any logically equivalent formulation.

A new approach to the theory of fundamental processes, Mendel SACHS, Department of Physics, Boston University, Boston, Mass.

The essential aspects of a new approach to the theory of fundamental processes are discussed. The theory is in accord with Einstein's deterministic epistemological approach (6), rather than with the approach of the Copenhagen School. The view of the elementary particle, however, deviates from Einstein's view as well as from that of the quantum theory. The logical development of this theory is based on two axioms. First, the laws of Nature are assumed to obey the restrictions that are imposed by the principle of relativity. The second axiom, which represents the new feature of this theory, asserts that the interaction between particles, rather than the free (noninteracting) particle, must be considered as the elementary entity. Thus, instead of refering to inherent properties of free particles, the variables of this approach relate only to the influence that particles have on each other and to a weighting of their mutual interaction through-

out one space-time. In this way, a theory of fundamental processes is formulated with a complete, deterministic description and is in accord with the principle of continuity. The formalism is nonlinear, but is structured to take on the mathematical form of ordinary quantum mechanics in the nonrelativistic limit.

The direction of time, J. V. NARLIKAR.

This is an attempt to look at the problem of the direction of time from the point of view of a physicist. Although physical laws are time symmetric, a distinction between "past" and "future" is felt because of certain irreversible phenomena in Nature. These can be broadly classified under three groups: thermodynamics, electrodynamics and cosmology. There is a way of connecting the second and the third by means of the time symmetric electrodynamics of Wheeler and Feynman. According to this approach the time-asymmetric phenomena of electrodynamics—such as the radiating charge—can be related to the expansion of the universe. A similar connection between all the three arrows of time would take us much further in our understanding of why time goes only one way.

Origin and concept of relativity (1), G. H. KESWANI.

This is the first part of a two-part paper in which the relative contributions to the (special) theory of relativity by Poincaré, Lorentz and Einstein are assessed with reference to their original contributions and to the ideas they employed. The opinions of the three as to the discovery of the theory are quoted. Evidence is given to show that Einstein was definitely aware of Poincaré's pioneering ideas. The probable connection between Einstein's paper of 1905 and Lorentz's memoir of 1904 is traced. Einstein's original paper is critically studied to see the extent to which Einstein carried out his own programme consistently.
The second part appears in *B.J.P.S.*, *16* (6) May 1965, pp. 19-32.

Why do quantum theorists ignore the quantum theory? Alfred LANDÉ.

Objections by philosophers of science against the doctrine of picture dualism have not been heeded by physicists who are convinced that electronic diffraction experiments yield uncontrovertible evidence for dual manifestations of matter. Their argument rests on a misinterpretation of experiments in disregard of their own quantum mechanical theory. Rectification of the mistake leads to a scientific rather than Copenhagen language solution of the dualistic dilemma and leaves little room for the Bohn-Heisenberg quantum philosophy.

*"The Effect of Essentialism on Taxonomy—Two Thousand Years of Stazis (I)"**, David L. HULL.

Quite often when a scientific problem remains unsolved for a long time in spite of repeated attempts at solution, the problem turns out not to be strictly empirical but involves a basic philosophical presupposition which has remained unchallenged. Such is the case with the species problem. The philosophical presupposition is that definition means Aristotelian necessary and sufficient condition definition. In recent years taxonomists have abandoned Aristotelian definition for cluster concept analysis for the names of taxa. The solution to the species problem (if species are to be units of evolution) lies in extending this type of analysis to "species" itself.

*This is the first part of a two-part article. The second part appears in *B.J.P.S.*, *16* (61) May 1965, pp. 1-18.