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EUCLIDES AB OMNI NAEVO VINDICATUS

J. R. LUCAS

RAMIFICATIONS OF GRUE

MARY HESSE

The article investigates certain forms of Goodman's "grue" paradox. Two principles for setting up the paradox are adopted: that it is essentially a paradox about prediction, and that needless asymmetries must be eliminated from its initial statement. It is argued that Goodman is correct in holding that no syntactic or semantic asymmetries can be appealed to in choosing between the predictions of "green" and "grue," but wrong in looking to entrenchment to determine this choice. Instead the required asymmetry is to be found in the possibility of stating a total and simple physical theory involving these predicates.

THE RELEVANCE CRITERION OF CONFIRMATION

J. L. MACKIE

This criterion in its basic form says that an hypothesis is confirmed by an observation if and only if the adding of the hypothesis to the background knowledge raises the probability of what is observed. There are also two comparative forms of the criterion, and several proposed measures of the degree of confirmation incorporate it. Though it is plausible and widely accepted, Hooker and Stove have said that arguments for it are lacking. The criterion is defended *a posteriori* by showing that it agrees with otherwise acceptable judgments; arguments against it are examined; it is concluded that it is a sound criterion of the direct confirmation of explanatory hypotheses, but not of nondeductive support in general. Several kinds of nondeductive support are distinguished; it is argued that no one criterion or measure applies to them all. Finally an *a priori* justification is sketched for this as a criterion of direct confirmation.

THAT CONFIRMATION MAY YET BE A PROBABILITY

PATRICIA BAILLIE

In an example discussed in *Appendix 9 of "Logic of Scientific Discovery," Popper takes as given, a certain criterion of classificatory confirmation, the Relevance Criterion, and the direct interpretation of probability as degree of confirmation. The direct interpretation is then supposedly refuted by a reductio ad absurdum argument. But the reductio can be shown to depend on a premise which is not entailed by the direct interpretation, or by the Relevance Criterion, or by their conjunction. This hidden premise is the explication of a concept of comparative confirmation. Clarification of the use of this premise shows that the contentious conclusion is either derivable and not self-contradictory, or self-contradictory, but not derivable. So we can quite comfortably hold both the direct interpretation and the Relevance Criterion, simply by defining a comparison of confirmation relations, which is applicable to the case in question, and is in general a useful concept.

ANOTHER LOOK AT THE DOCTRINE OF VERSTEHEN

JANE R. MARTIN

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DEFINITIONS OF SPECIES IN BIOLOGY

M. RUSE

Two different definitions have been proposed for species in biology, one based on inter-breeding and reproductive isolation, and the other on morphological characteristics. Various arguments purporting to show the superiority of the former definition are examined and found wanting. It is argued that the solution to a problem is to be found by considering why scientists are prepared to call concepts "real"; this being that they can provide alternative, logically independent definitions of the concepts, and that these definitions can be linked by laws. Such alternative definitions can be given for species defined by reproductive criteria, but are lacking for most other cases.

PHENOMENAL GEOMETRY

E. J. CRAIG

MODEL-STRUCTURES AND MODEL-OBJECTS

HENRY BYERLY

Two aspects of talk about models in science are examined: reference to mathematical structures and reference to objects which exhibit those structures. Extension of knowledge by imputation of structure is distinguished from analogical extension in terms of similarities of descriptive properties and relations. The terms "model-structure" and "model-object" are used to bring into focus the role in scientific theories of the descriptive content of model-objects as a ground for causal relationships over and above the logical-mathematical structures.

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THE SORITES PARADOX

JAMES CARGILE

The Sorites Paradox involves the application of reasoning by mathematical induction to ordinary language predicates. One response would be to reject these applications. I argue that this is unacceptable, on the grounds that very basic logical assumptions which are plausible even for the loosest and most informal ordinary language sentences are enough to entail the objectionable inductive arguments. I suggest two ways of accepting the paradoxical results, one involving the assumption that vague terms have boundaries which are just unknown, the other based on the idea that we may, in applying logic to language, have to arbitrarily set boundaries for vague terms.

CAN AN INFINITUDE OF OPERATIONS BE PERFORMED IN A FINITE TIME?

ADOLF GRUNBAUM

An affirmative but multiply qualified answer is given to the question "Is it *kinematically* possible for a classically moving body to perform an infinite sequence of operations in a finite time?" A run made intermittent by a denumerable infinity of suitably decreasing pauses of rest serves as the prototype of such a sequence. This *staccato* run is claimed to be of *finite* duration, being such that *all* of its time-derivatives vary continuously throughout its performance. And it is argued that kinematically such a denumerable infinity of distinct operations is *not* beset by Zeno's paradoxes, any more than the corresponding uninterrupted run of Achilles.

GOODMAN'S THEORY OF PROJECTION

Paul Teller

This paper first outlines Goodman's theory of projection emphasizing Goodman's important but often overlooked characterization of projectibility as a matter of degree. Next, the paper presents several difficulties, particularly in Goodman's appeal to overhypotheses as a means of mediating indirect evidence. Finally, it is argued that the tenable residue of Goodman's theory is compatible with a Bayesian version of confirmation theory in which the problem of choosing a prior probability function is identified with the problem of deciding the projectibility of hypotheses.

THE SENSATION OF PLEASURE

Roland Puccetti

Many philosophers have followed Gilbert Ryle in denying pleasure the status of a sensation because, unlike pain, it is not separable from its source, a cause or effect, clockable or locatable or describable. However experiments in psychobiology beginning some 15 years ago show there are specific pleasure centers in the mammalian brain which, when artificially stimulated by electrodes, produce behavior patterns inexplicable except on the interpretation of pleasure sensations occurring to the subject. How these are separable from their source, both cause and effect, clockable and locatable and describable. The extrapolation to humans and reported results with human subjects. How this may be taken as an example of the limitations of ordinary language philosophy.

INDETERMINISM IN CLASSICAL PHYSICS

Walter Hoering

The concepts of indeterminism, which can be extracted from the works of Liapunov 1893, Popper 1950, Born 1955 and Brillouin 1956/34 are made explicit and compared. For each of the concepts obtained it is possible to define, in the framework of classical mechanics, models, which are indeterministic in that sense. The question of indeterminism of a given model depends moreover on the kind of questions admitted. Quite generally: Any mechanics suitable for the description of models of decisions (partitions of a continuum of trajectories into two or more physically distinct classes) is seen to lead to indeterminism for these very models.

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EUCLID'S *ELEMENTS* AND THE AXIOMATIC METHOD

Ian Mueller

Certain historians of mathematics have rejected the nineteenth-century characterization of Euclid's *Elements* as intuitive rather than logical. Building upon this rejection, A. Szabó has speculated concerning the influence of Greek philosophy on the historical development of mathematics. A careful statement of the differences between the *Elements* and its modern successors shows the essential correctness of the nineteenth-century characterization and the superfluity of Szabó's speculations for understanding the history of mathematics. In particular, the evolution of the axiomatic method and the Greek conception of the relationship of arithmetic and geometry are explained without resort to complicated conjectures.

ON THE DESIGN OF INDUCTIVE SYSTEMS: SOME PHILOSOPHICAL PROBLEMS

C. West Churchman and Bruce G. Buchanan

The concept of an inductive system is introduced as that of a teleological entity which formulates and tests explanatory hypotheses. Various philosophical problems arise with the

question of how to design an inductive system that performs this task rationally. When viewing the process of induction in this way the fundamental problems include finding criteria of success for the whole system and for the component parts and finding criteria for deciding between alternative designs. From one example followed in detail it is suggested that it is unlikely that a rational design of an inductive system can be found at all.

THE WATSON-CRICK MODEL AND REDUCTIONISM

KENNETH F. SCHAFFNER

This paper examines some of the issues connected with the problem of reducing biology to physics and chemistry. The approach is made through the history of molecular genetics, in particular focusing on the implications for molecular biology of the Watson-Crick model of DNA. The nature of reduction in the *physical* sciences is reexamined in connection with an optics-electromagnetic theory example, new analyses of "scientific theory" and "correspondence rule" are suggested, and the necessary and sufficient conditions for reduction discoverable here are applied in the context of the molecular genetics of the 1950's and 1960's. Contributions of biologists connected with semi-conservative replication, protein synthesis, genetic fine structure, the genetic code, and cell differentiation are discussed. Finally, some of the problems specific to the reduction of biology are examined, and a general *biological principle of reduction* is stated.

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POWERS

R. HARRÉ

The decline of positivism as a philosophy of the logic and epistemology of science has not yet been matched by a new metaphysics, to replace the substance/attribute metaphysics associated with subject/predicate logic. Developing out of a discussion of two paradigms of action observed in nature, and a critique of dispositionalism, the notion of individuals with powers is introduced. The ascription of a power is shown to be capable of analysis into the ascription of a specific hypothetical together with an unspecific categorical component, the latter tying the powers of individuals to their natures. The truth-conditions for power ascriptions are explored and the connection between the dispositions of things and their natures more exactly specified. The identity of powers is then discussed in terms of dispositions and natures, and various cases distinguished. A realist theory of science is then shown to be rationally grounded both for theory and observation, if powers are everywhere substituted for qualities. It is shown that the incorporation of perceptual predicates into science can proceed rationally, only by a transformation into power predicates, retaining only a metaphorical relation with their original use in the ascription of sensible qualities. Finally a rough analysis is made to show that there is a residual modal element in power ascriptions, but its logic is not explored.

INDUCTION, REASON, AND CONSISTENCY

KEITH LEHRER

In this paper, I offer a rule of inductive inference which avoids the lottery paradox. The set of statements that may be inductively inferred from evidence by the rule is logically consistent and deductively closed. It is argued that the rule is a principle of rationality and explanation. Formal proofs are provided to establish the logical features of the rule.

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BERTRAND RUSSELL AS A PHILOSOPHER OF SCIENCE

R. B. BRAITHWAITE

CURIE'S PRINCIPLE

A. F. CHALMERS

In 1894 Pierre Curie proposed the principle "When certain causes produce certain effects, the elements of symmetry of the causes must be found in the effects produced." A precise formulation of this principle is presented and its status investigated. It is seen to follow from the invariance properties of physical laws, but this does not render it redundant. Apparent refutations can always be accounted for by postulating some, as yet discovered, asymmetry in the initial conditions. It is in this way that the principle has heuristic value. The use of the principle is illustrated by examples. Situations involving electromagnetism with magnetic monopoles included and weak interactions prove to be of particular interest.

EROTETIC LOGIC AND THE STRUCTURE OF SCIENTIFIC REVOLUTIONS

SCOTT A. KLEINER

An adequate axiomatization of a given physical theory should contain syntactical rules which determine the legitimate questions as well as possible descriptive statements that can be raised or made within the framework of the theory. These rules are repressented as kinematic postulates. The Special Theory of Relativity and the Schrödinger–Born wave mechanics contain departures from classical particle kinematics, whence the problem-fields characteristic and peculiar of these theories differ. This thesis is used to explicate T. S. Kuhn's conception of "normal science" by (1) clarifying the intellectual activities constituting normal science, (2) showing how a change in fundamental theory entails a change in the questions asked in scientific investigation and (3) correcting Kuhn's view that all modifications of prior beliefs regarding theory, achievement, and instrumentation are equally revolutionary.

IS THE OFFICIAL THEORY OF MIND ABSURD?

DAVID BLOOM

It is argued that some of Ryle's most typical arguments do not succeed in furthering his claim that the official theory of mind is absurd. It is central to the defence that the official theory be treated as an embryonic explanatory theory with the mind as a theoretical entity. The argument depends on a move (previously used by Fodor) of transposing Rylean arguments into an area where their shortcomings can be more clearly seen. Parity of reasoning is established with certain nineteenth-century arguments against atomism. The bearing of the theoretical entity view of mind on materialism is also discussed.

EUCLIDEAN SPACE: A LASTING PHILOSOPHICAL OBSESSION

T. G. MCGONIGLE

It is argued that J. R. Lucas ("Euclides ab omni naevo vindicatus," *British Journal for the Philosophy of Science*, vol. 20, 1969, pp. 1–11) fails in his attempt to rehabilitate the Kantian doctrine that space is necessarily Euclidean; and the argument suggests that any such rehabilitation effort must fail.

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CAUSALITY AND STATISTICS IN MODERN PHYSICS

HERBERT DINGLE

The paper discusses causal and statistical regularities in physics against a background of more general considerations, with special reference to the ideas of Professor D. Bohm, as described in his book, *Causality and Chance in Modern Physics*. In the first part, attention is mainly concentrated on the relation between the observable world of ordinary objects on the one hand, and the various conceptual worlds of atoms, molecules, electrons, etc., on the other. Although both causal and statistical relations are appropriate to both, it is held that the discordance between Bohm's views and those of orthodox quantum physicists depends on the relation which is held to exist between those worlds. In the second part the relation between causal and statistical regularities is discussed. It is held that these are essentially independent of one another and that there is no possibility of expressing one in terms of the other.

INSCRIPTIONALISM AND THE OBJECTS OF EXPLANATION

SAMUEL GOROVITZ

I consider what sort of thing it is that an explanation explains, and related ontological issues. Scheffler seeks to provide an account of the objects of explanation that presumes the existence of only such entities as are acceptable to nominalism. Quine's discussion of the objects of propositional attitudes suggests an alternative account. Scheffler takes inscriptions to be the objects; Quine argues for the preferability of sentences. But neither approach provides an adequate account of the objects of propositional attitudes or of explanation. Even in light of these nominalistic efforts to dispel them, the ontological problems associated with talk about explanation remain.

THE PARADOX OF MEANING VARIANCE

JERZY GIEDYMIN

The following premiss of the so called paradox of meaning variance is critically examined:

(1). The meanings of all descriptive terms of a scientific theory depend on the whole theory and change with any change of the postulates of the latter, so that two prima facie conflicting theories, e.g. Newtonian and relativistic mechanics, are incommensurable.

Some of the conclusions of this examination are as follows:

(2). If (1) above implies that the denotations of all descriptive terms of a theory are determined by all the postulates of the theory, then, should (1) be true, there would be no empirical theory, since any one would be an implicit definition of its primitives.

(3). If (1) implies that the empirical and the analytic components of a scientific theory are in principle indistinguishable, then the problem whether a change in the theory is a change in the meanings of primitives or a change in the empirical content, is in principle insoluble.

(4). Fortunately, any scientific theory can be so reformulated that the empirical and the analytic components are distinguished, the latter alone determining the denotations of primitives and the conjunction of both being equivalent to the original theory. The original theory, however, does not uniquely determine this distinction, so that several alternatives are usually available.

(5). It follows from (4) that not all changes of a theory need be regarded as affecting the meanings of primitives and not every primitive need be affected by the changes in the postulates; furthermore, whether a change is a change in meanings or in empirical content, depends partly on how we choose to distinguish the analytic from the empirical components of a theory, i.e. it depends partly on a convention.

In view of (4) assumption (1) may be rejected and so the paradox of meaning variance disappears.

THE NOTION OF VALIDITY IN LOGICAL SYSTEMS WITH INEXACT PREDICATES

John P. Cleave

Körner defines the notion of logical validity of indefinite sentences in terms of a syntactical operator which deletes in some manner the indefinite atoms from a sentence. This method is generalized to arbitrary deductive systems (in Tarski's sense). If a syntactical operator ∂ is defined on the expressions of a deductive system D than a substructure D' of D can be constructed from D and ∂, which if ∂ satisfies certain very general conditions, is also a deductive system. The notion of logical consequence (and hence logical validity), as proposed by Körner, is therefore well defined.

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THE SCIENTIFIC INTELLIGIBILITY OF ABSOLUTE SPACE: A STUDY OF NEWTONIAN ARGUMENTS

Hugh M. Lacey

First, a number of distinct theses associated with absolute space are clarified, and a number of *a priori* arguments for and against absolute space are surveyed and deemed inconclusive. The bulk of the paper is concerned with a study of Newton's discussion of the bucket-experiment and of related writings of his. It is shown that Newton's arguments refute Descartes and withstand the challenges of Leibniz and Berkeley. They are not conclusive, however, and it is shown what characteristics a relational theory must have so as not to run afoul of Newton's arguments. Finally, the scientific intelligibility of "absolute space" is defended against arguments of Mach and others, it being maintained that the existence or not of absolute space is in principle open to empirical investigation. This final discussion opens up an interesting contrast between Newton and Mach regarding the nature of science.

FREE WILL IN A MECHANISTIC UNIVERSE?

P. T. Landsberg and D. A. Evans

The logical status of human free will in a mechanistic universe is discussed with reference to an experiment in which a scientist S attempts to predict the future brain state of a human subject A, the prediction to be communicated to A before the time to which it refers. Alternative definitions of free will are presented, and the possible outcomes of the experiment are discussed in terms of these definitions. Some of the difficulties of making such predictions are discussed. It is concluded that the existence of free will for all agents in a mechanistic universe can be asserted only if an unreasonably weak definition of free will is used.

IS QUANTIZATION REALLY NECESSARY?

M. Sachs

Discussion is given to the necessity for the mathematical structure and the underlying postulates of the quantum theory to explain the properties of matter in the microscopic domain. It is argued that while the form of the Schrödinger equation and the principle of linear superposition and the Heisenberg uncertainty principle are accurate mathematical approximations in the low energy domain, for some general theory, they have not yet established themselves as valid features of a general theory of matter. The reason has to do with the fact that nonrelativistic quantum mechanics has not yet been successfully extended, in a demonstrably mathematically consistent fashion, so as to be entirely compatible with the theory of special relativity. It is then argued that there is no guarantee at the present stage of physics that the general theory will indeed have the mathematical structure of quantum mechanics or incorporate the principles of Heisenberg and linear superposition. Brief discussion is given to an alternative theory of this author which maintains the Einstein view of a deterministic, nonlinear continuum description of matter, in all domains of interaction, while maintaining a formalism that asymptotically

approaches the linear eigenfunction form of nonrelativistic quantum mechanics in the low energy limit. It is concluded that at the present stage of physics, the assertions of the quantum theory, *as fundamental principles*, are not necessarily true.

LAWS AND INSTANTIAL STATEMENTS

ALEX BLUM

In this paper I argue that: From a set of laws (expressed without individual constants in a standard notation of first order logic with identity) no instantial statement is deducible.

My argument rests on a version of Nagel's account of contrary-to-fact conditionals and on the following three postulates:

(P1) If L is a law, L supports at least one *bona fide* contrary-to-fact conditional;

(P2) If S entails and is in turn entailed by a set of laws, then S itself is either a law or a conjunction of laws; and

(P3) If '$f \supset (g \cdot h)$' is a law (where 'f', 'g', and 'h' are predicate letters representing the atomic sentences in which they occur), so are '$f \supset g$' and '$f \supset h$'.