

Synopsis

The following brief summaries, arranged here alphabetically by author, provide an introduction to each of the papers in this volume.

1. *Confirming Inexact Generalizations*. **Ernest W. Adams**. I suppose that 'ravens are black' is an inexact generalization having a degree of truth measured by the proportion of ravens that are black, and a probability measured by its expected degree of truth in different 'possible worlds.' Given this, 'ravens are black' differs in truth, probability, and confirmation from 'non-black things are not ravens', and this suggests a new approach to Hempel's Paradox as well as to other aspects of confirmation. Basic concepts of a formal theory developing this approach are described, and some of its fundamental laws are given, together with sketches of applications.

2. *Impartiality and Causal Decision Theory*. **Brad Armendt**. Defenders of sophisticated evidential decision theory (EDT) have argued (1) that its failure to provide correct recommendations in problems where the agent believes himself asymmetrically fallible in executing his choices is no flaw of the theory, and (2) that causal decision theory gives incorrect recommendations in certain examples unless it is supplemented with an additional metatrickle or ratifiability deliberation mechanism. In the first part of this paper, I argue that both positions are incorrect. In the second part of the paper, I show how the agent's preferences involved in standard counterexamples to EDT, such as Newcomb's problem, violate the Jeffrey/Bolker preference axioms, specifically the Impartiality axiom.

3. *Testing for Convergent Realism*. **Jerrold L. Aronson**. Larry Laudan has challenged the realist to come up with a program that submits realism to "those stringent empirical demands which the realist himself minimally insists on when appraising scientific theories." This paper shows how the realist can go about taking up Laudan on this challenge; and, in such a way that the realist hypothesis actually ends up being confirmed, by any empirical standards. In other words, it is shown that we can test for convergent realism, just as readily as Laudan can test for a connection between theories that are controlled by the canons of science and their subsequent reliability.

4. *Five Theses on Instrumental Realism*. **Davis Baird**. I present five theses to characterize and argue for "Instrumental Realism," a realism wedded to what we *do* with instruments, and not what our theories *say*: The Independence Thesis: Questions about realism are independent of questions about meaning. The Intervening Thesis: Our ability to produce consistent effects with our instruments provides one guarantee that we are engaged with the real world. The Historical Thesis: If the descriptions of what we know and do are of something real, then it will be possible to trace a history from earlier antiquated names and actions to current usages. The Instruments-Do-Not-Always-Work-Right Thesis: Since instruments do not always work right, a successful instrumental intervention cannot be a social construct. The Tinkering Thesis: Since instruments are created by tinkering, we should not take any claim that generalizes away from our instrumental practice realistically.

5. *General Causation*. **John W. Carroll**. The traditional model and the contextual unanimity model are two probabilistic accounts of general causation subject to many well-known problems; e.g. cases of epiphenomena, causes raising their own probability,

effects raising the probability of the cause, *et cetera*. After reviewing these problems and raising a new problem for the two models, I suggest the beginnings of an alternative probabilistic account. My suggestion avoids the problems encountered by earlier models, in large part, by an appeal to singular causation.

6. *Reconstruction of the Optical Revolution: Lakatos vs. Laudan.* **Xiang Chen.** According to Lakatos's theory of scientific change, the victory of the wave theory in the nineteenth-century optical revolution was due to its empirical successes. However, historical facts do not support this opinion. Based on Laudan's theory of scientific change, this paper presents a different orientation to reconstruct the optical revolution. By comparing the conceptual problems that both optical theories had, this paper argues that it was the inferior status of the corpuscular theory in dealing with conceptual problems that constituted the primary cause of the optical revolution.

7. *Fitness and Explanation.* **Gregory Cooper.** Although consensus appears to be on the horizon, the foundations of the theory of natural selection remain a matter of controversy. This paper looks at two recent challenges to the emerging "received view" of this theory. It argues that different views of the nature of scientific explanation are playing a pivotal role in the debates. Do explanations in biology fit the covering-law paradigm? What are the explanatory laws of biology like? Until agreement is reached on these fundamental questions, there is little prospect for consensus on the foundations of the theory of natural selection. Furthermore, the three alternative positions identified in this paper each face serious challenges.

8. *The Pragmatics of Observation.* **Richard Creath.** To assess van Fraassen's anti-realism, I examine observation and its relation to judging. I argue that the boundary of observability is determined pragmatically, because observing depends on the context of inquiry and because the 'able' in 'observable' implicitly involves human interests and concerns. Thus, observability is like van Fraassen's notions of simplicity and explanation. While a non-pragmatic notion of observability can be devised, then virtually any event is potentially observable. Consequently, van Fraassen's attempt to divide empirical adequacy from the pragmatic features of theories loses much of its plausibility, and his anti-realism loses a potential motivation. Indeed, his anti-realism begins to look rather arbitrary.

9. *Individuality and Macroevolutionary Theory.* **Marc Ereshefsky.** A number of authors have argued that the thesis that species are individuals has important implications for macroevolutionary theory. More specifically, some authors claim that the thesis lends support to the Theory of Punctuated Equilibrium and indicates the existence of species selection. In this paper, I argue that the alleged individuality of species is neither necessary nor sufficient for the truth of that theory or for the existence of species selection. I also argue, contrary to the claims of some, that the individuality of a group is not a necessary requirement for a group to be a unit of selection.

10. *The Confirmation of Common Component Causes.* **Malcolm R. Forster.** This paper aims to show how Whewell's notions of consilience and unification—explicated in more modern probabilistic terms provide a satisfying treatment of cases of scientific discovery which require the postulation *component* causes to explain complex events. The results of this analysis support the received view that the increased *unification* and generality of theories leads to greater testability, and confirmation if the observations are favorable. This solves a puzzle raised by Cartwright in *How the Laws of Physics Lie* about the nature of explanation by the composition of causes.

11. *Simplicity and Observability: When are Particles Elementary?* **Kostas Gavroglu.** The atomistic paradigm of high energy physics cannot anymore be dismissed because the proposed elementary particles are too many (and, hence, it is claimed, they do not provide a simple account of nature) or because it is not possible to

observe quarks in an isolated manner. The developments in particle physics have brought about radical changes to our notions of simplicity and observability, and in this paper we elaborate on these changes. It is as a result of these changes that the present situation in elementary particle physics justifies our claim that we have indeed reached a level of explanation where the constituent particles (quarks, leptons, gluons and intermediate bosons) used for the explanation of the various phenomena considered to be delineating a particular level in the descriptive framework of the physical phenomena and a specific stratum in the organization of nature, can be regarded as elementary.

12. *Causal Explanation in Laboratory Ecology: The Case of Competitive Indeterminacy.* James R. Griesemer. This paper characterizes the role of the experimenter in causal explanations of laboratory phenomena. Causal explanation rests on appeals to the experimenter's efficacy as a causal agent. I contrast "demographic" and "genetic" explanations of stochastic outcomes in a set of competition experiments in ecology. The demographic view ascribes causes to the experimenter's agency in setting up the experiment and to events within the experimental set-up. The genetic view ascribes causes to an unrecognized effect of the experimenter's sampling process prior to the experimental set-up.

13. *Was There a Crisis Before the Copernican Revolution? A Reappraisal of Gingerich's Criticisms of Kuhn.* Robert I. Griffiths. I discuss and appraise two conflicting answers to the question of whether there was a crisis in Ptolemaic astronomy prior to the Copernican revolution: Kuhn, who claims that Ptolemaic astronomy was anomaly-ridden at the time of Copernicus, and Gingerich, who claims that the supposed anomalies are fictitious. I conclude that Gingerich's arguments against a technical crisis in Ptolemaic astronomy prior to Copernicus appear to be either arguments against the efficacy of the Copernican system or arguments based on definitions of complexity which are not directly attributable to Kuhn.

14. *Philosophy Versus Science: The Species Debate and the Practice of Taxonomy.* Alan G. Gross. A reading of a sample of taxonomical papers leads to the conclusion that new species identification is both taxonomically plausible and philosophically incoherent. As a result, taxonomy becomes a science that apparently violates a necessary condition of its rationality. It is this apparent violation that is the focus of the philosophical debate, a debate whose goal for taxonomy is theoretical coherence at a global level. In this paper, I assess the appropriateness of this goal.

15. *On the Logic of Interrogative Inquiry.* Jaakko Hintikka and Stephen Harris. In Jaakko Hintikka's interrogative model of inquiry, the strategic principles governing empirical inquiry (interrogatively construed) turn out to be closely related to those governing deductive reasoning. Hence it is important to study the precise analogies which obtain between deductive logic and interrogative inquiry. The basic concept of the interrogative model is the relation of model consequence $M:T \vdash C$. It is said to obtain iff C can be derived from T by means of an interrogative process in the model M (in the logicians' sense of model). We prove here a counterpart of Craig's interpolation theorem for the concept of model consequence. The interrogative analogue to definability is a logical generalization of methodologists' concept of identifiability. For this concept, we prove an analogue to Beth's theorem. Some further philosophical consequences of these results are mentioned. For instance, identifiability is a good rational reconstruction of the idea of observability (measurability).

16. *One Epistemological Interfield Relation.* Joyce Kinoshita. In past decades, discussions of scientific unity have been largely directed toward the nature and problems of logical and/or ontological unity. In more recent times, discussions of scientific unity have grown somewhat *passé*. This paper characterizes a distinctly *epistemological* sort of interfield relation, dubbed "cluster relations." Different fields may be related by sharing a

unifying case, a paradigmatic conception of how some of their phenomena are related. These relations have the misleading appearance of a kind of part-whole ontological relation. The examples of "color sciences" and "memory sciences" are used to clarify the nature of cluster relations. Although these relations are piecemeal, they may afford pragmatic benefits as well as understanding through unification.

17. *On the Intertheoretic Competition Hypothesis*. A. David Kline. The intertheoretic competition hypothesis (the rejection of a theory not only requires the comparison of the theory with nature but also the acceptance of an alternative theory) is a dogma of contemporary philosophy of science. I first attempt to reconstruct Thomas Kuhn's argument for the view. A central exegetical claim is that his argument rests on the Duhemian Thesis. I then show that the argument is inconclusive and suggest that there are vivid historical counterexamples to the competition hypothesis.

18. *Regarding the Raven Paradox*. Robert J. Levy. Reflecting the influence of both Bayesian and Popperian methodology, this paper presents an interpersonal view of confirmation which: (i) explains why a non-black non-raven may constitute evidence for and a black non-raven fails to constitute evidence for the hypothesis 'All ravens are black;' (ii) accounts for the common sense belief that black ravens confirm the raven hypothesis more than do non-black non-ravens; and (iii) applies to lawlike sentences understood as subjunctive conditionals as well as to accidental generalizations.

19. *Schlick's Critique of Positivism*. Joia Lewis. It is not well known that Moritz Schlick, whose name is inseparable from the development of logical positivism, was extremely critical of positivism prior to the 1920's. Understanding Schlick's early criticisms of positivism not only puts Schlick's transition from his early realist to his later positivist views in better perspective, but clearly shows the role of relativity theory in turning Schlick's attention to a positivist concern with empirical verification. It also can be seen that Schlick spent the second part of his philosophical career struggling to find solutions to the very problems he had criticized so vehemently in his early work.

20. *Prediction, Accommodation, and the Logic of Discovery*. Patrick Maher. A widely endorsed thesis in the philosophy of science holds that if evidence for a hypothesis was not known when the hypothesis was proposed, then that evidence confirms the hypothesis more strongly than would otherwise be the case. The thesis has been thought to be inconsistent with Bayesian confirmation theory, but the arguments offered for that view are fallacious. This paper shows how the special value of prediction can in fact be given Bayesian explanation. The explanation involves consideration of the reliability of the method by which the hypothesis was discovered, and thus reveals an intimate connection between the 'logic of discovery' and confirmation theory.

21. *Minimal Disturbance in Quantum Logic*. Sergio Martinez. I construct a quantum-logical model of the type of situation that seems to be at the root of the problem of interpreting the projection postulate (Luders' rule) as a criterion of minimal disturbance. It is shown that the most natural way of characterizing minimal disturbance leads to contradictory conclusions concerning the final state.

22. *Constructive Empiricism and Anti-Realism*. Sam Mitchell. Van Fraassen's constructive empiricism is presently the most influential and well-developed alternative to scientific realism. In this paper I argue that a reasonable condition on the distinction between belief and agnosticism prevents van Fraassen from claiming that we can be agnostic about what a theory says about unobservable entities while simultaneously accepting that theory. The upshot is that we must find some other way to do justice both to the argument for constructive empiricism and to van Fraassen's cogent criticisms of scientific realism. I suggest that a highly attractive alternative is founded upon semantic anti-realism, and that empiricists should develop this alternative.

23. *Reduction and Realism*. Margaret Morrison. In *The Foundations of Space-Time Theories* Friedman argues for a literal realistic interpretation about theoretical structures that participate in theory unification. His account of the relationship between observational and theoretical structure is characterized as that of model to submodel and involves a reductionist strategy that allows for the conjunction of certain theoretical structures with other structures which, taken together, form a truly unified theory. Friedman criticizes the representational account for its failure to allow for a literal interpretation and conjunction of theoretical structure. I argue that *contra* Friedman the representationalist account can sanction a literal interpretation and in fact presents a more accurate account of scientific practice than the model-submodel account. The strict reductionism characteristic of the model submodel approach can in some cases be seen to prevent rather than facilitate a literal account of theoretical structure. Because of the dependence Friedman places on reduction for his account of conjunction, and because the former cannot be sustained, it would appear that Friedman's own account fails to achieve what it was designed to do.

24. *Marr's Theory of Vision and the Argument from Success*. Peter A. Morton. This paper considers the implications of David Marr's computational theory of vision for the issues of individualism and methodological solipsism. A recent argument that the theory is nonindividualistic is shown to be similar to Gibson's arguments for "direct perception." The paper argues that a complete analysis of Marr's theory must take into account Marr's rejection of Gibson's approach, and that such an analysis shows Marr's theory to be consistent with methodological solipsism as a research strategy.

25. *Reasoning From Imagery and Analogy in Scientific Concept Formation*. Nancy J. Nersessian. Concept formation in science is a reasoned process, commensurate with ordinary problem-solving processes. An account of how analogical reasoning and reasoning from imagistic representations generate new scientific concepts is presented. The account derives from case studies of concept formation in science and from computational theories of analogical problem solving in cognitive science. Concept formation by analogy is seen to be a process of increasing abstraction from existing conceptual structures.

26. *A Defense of a Non-Computational, Interactive Model of Visual Observation*. Bonnie Tamarkin Paller. If a computational account of visual perception were correct, then perception would involve at least two sorts of rule-guided inference processes: inference from primitive input to complex perceptual output (constructional inference) and inference from perceptual content to the organism's environment (representational inference). Psychologist J.J. Gibson argues that such accounts are circular. Fodor and Pylyshyn argue that Gibson's alternative account, though intended to be non-inferential, actually requires the above two sorts of inference. But their arguments for the necessity of inference work only if (1) complex properties cannot be transduced, and (2) we assume a signal transmission model of perception. The force of their arguments is weakened once we see that (1) their criterion for non-transducibility is itself problematic, and (2) an interactive model of visual perception does not require signal transmission.

27. *Which Universal?* Philip L. Peterson. My recently developed Fact-Proposition-Event (FPE) Theory can help to begin the clarification of D.A. Armstrong's account of natural laws—that laws are relationships among certain universals. FPE Theory makes careful description of laws possible, distinguishing them from law propositions (or statements), law facts, and states-of-affairs with which they might be confused. Initial inspection of Armstrong's proposal forces a choice between taking a law to be a certain kind of state (an event- or state-kind) and taking it to be a determinate kind of relation (a relation-kind instantiated by ordered pairs of concrete events and/or states). On both alternatives, new kinds of events and states arise (abstract ones and event-pairs, among others).

28. *Arguing for the Natural Ontological Attitude.* Joseph Rouse. Arthur Fine has recently argued that standard realist and anti-realist interpretations of science should be replaced by "natural ontological attitude" (NOA). I ask whether Fine's own justification for NOA can meet the standards of argument that underlie his criticisms of realism and anti-realism. Fine vacillates between two different ways of advocating NOA. The more minimalist defense ("why not try NOA?") begs the question against both realists and anti-realists. A stronger program, based on Fine's arguments for a "no-theory" of truth, has promise, but the arguments must be developed in a stronger, more general form if they are to justify NOA.

29. *Lorentz's Local Time and the Theorem of Corresponding States.* Robert Rynasiewicz. I address a number of questions concerning the interpretation of local time and the corresponding states theorem (CST) of the *Versuch*, questions which have been addressed either incompletely or inadequately in the secondary literature. In particular: (1) What is the relation between local time and the behavior of moving clocks? (2) What is the relation between the primed field variables and the electric and magnetic fields in a moving system? (3) What is the relation of the CST to the principle of relativity and requirements of covariance? (4) Does the introduction of local time and the primed field variables constitute a hypothesis, i.e., an addition to or a modification of the basic theory?

30. *Explaining the Success of Science.* Rose-Mary Sargent. Various explanations for the success of science have become central to both sides of the philosophical debate over scientific realism. In this paper I argue that the recent attempt by Steven Shapin and Simon Schaffer, in *Leviathan and the Air-Pump*, to provide a sociological explanation for the success of experimental science fails to make any significant contribution to this debate because of (1) the historical prejudgments that they employ and (2) their oversimplification of present-day philosophy of science.

31. *Natural Selection, Hypercycles and the Origin of Life.* Sahotra Sarkar. Two aspects of the Eigen theory of the origin of life are separated: (i) a theory of evolution at the molecular level, and (ii) the special dynamical properties of hypercycles when that theory is applied to them. It is shown that the former can be applied to a variety of molecular systems which then satisfy Lewontin's criteria for evolution by natural selection. This insight is used to show how, at the molecular level, this theory of natural selection can be used to provide physical warrants for functional explanations. The position of hypercycles in this picture and the reasons for their suitability as a model for the origin of life are also discussed.

32. *Scientific Anti-Realism and the Epistemic Community.* William Seager. Bas van Fraassen has presented a most vigorous argument in support of an anti-realist interpretation of science. In defence of his view he revives the seemingly moribund 'observable-unobservable' distinction, and employs it in the attempt to show that science provides no grounds for accepting, as real, entities which it itself classifies as unobservable. Traditional arguments against the observable-unobservable distinction (which van Fraassen successfully counters) can be reinterpreted as arguments for the reality of what is unobservable to humans. The argument is quite straightforward. We could create (or meet) intelligent creatures with a perceptual range of observation superior to that of humans. Granted that they are intelligent, we would accept them into the epistemic community. Once accepted their pronouncements should become belief-worthy for us. The aim of the paper is to defend this argument against van Fraassen's seemingly plausible charge that, roughly, it fallaciously assumes that we ought to admit merely possible evidence rather than actual evidence in the formation of our beliefs.

33. *Scientific Reasoning or Damage Control: Alternative Proposals for Reasoning with Inconsistent Representations of the World.* Joel M. Smith. Inconsistent representations of the world have in fact played and should play a role in scientific inquiry.

However, it would seem that logical analysis of such representations is blocked by the explosive nature of deductive inference from inconsistent premisses. "Paraconsistent logics" have been suggested as the proper way to remove this impediment and to make explication of the logic of inconsistent scientific theories possible. I argue that installing paraconsistent logic as the underlying logic for scientific inquiry is neither a necessary nor a sufficient condition for giving a philosophical alternative. I suggest that identification of heuristic strategies, based on the network of confirming evidence for inconsistent proposals for reasoning from such proposals to their consistent replacements is the proper way to explicate their function in science.

34. *Neo-Skinnerian Psychology: A Non-Radical Behaviorism*. Terry L. Smith. Neo-Skinnerianism differs from Radical Behaviorism in at least three important respects: (1) its willingness to entertain cognitive accounts of the processes underlying behavioral dispositions, (b) its reluctance to assert that the results of animal experiments can be used to predict and control human behavior, and (c) its ability to side step folk psychology's major criticism of operant theory. While eschewing Radical Behaviorism's ambition to transform psychology (and, indeed, human society itself), it nonetheless joins issue with a centuries-old debate over human nature, and may eventually help to resolve it.

35. *Jarrett's Locality Condition and Causal Paradox*. Allen Stairs. Jarrett (1984) and Ballentine and Jarrett (1987) have argued that violations of Jarrett's locality condition are strictly forbidden by the theory of relativity. In Ballentine and Jarrett, this claim is supported by an appeal to the fact that superluminal signalling gives rise to causal paradoxes. In this paper, it is argued that if violations of locality are permitted, certain puzzles indeed arise. The result takes the form of a set of apparent "no go" theorems. However, it is argued that the results may not really show what they seem to, and that contrary to Ballentine and Jarrett, it is by no means clear that relativity forbids violations of Jarrett's locality condition.

36. *The Role of Skill in Experimentation: Reading Ludwik Fleck's Study of the Wasserman Reaction as an Example of Ian Hacking's Experimental Realism*. David Stump. While Ludwik Fleck's *Genesis and Development of a Scientific Fact* is mainly concerned with social elements in science, a central argument depends on his case study of the development of a serum test for syphilis, the Wasserman Reaction, which Fleck argues was the product of skill and of laboratory practice, not a simple discovery. Ian Hacking interprets the creation of new phenomena in science very differently, arguing that it can be seen as an argument for scientific realism. Hacking's argument shows that Fleck's case study does not lead to the conclusion Fleck expects, and may solve one of the main problems in Fleck's work, how to define an objective element of knowledge.

37. *The Explanatory Coherence of Continental Drift*. Paul Thagard and Gregory Nowak. This paper applies a new theory of explanatory coherence to the early history of the idea of continental drift. The new theory consists of seven principles that establish coherence and incoherence relations among propositions. It has been implemented in a connectionist computer program called ECHO. Analysis of the arguments of Alfred Wegener, the first major proponent of continental drift, provided input to ECHO which evaluated the explanatory coherence of his hypotheses. ECHO has also been used to analyze the coherence of the views of Wegener's critics. The paper concludes by contrasting our explanatory coherence account of Wegener and his opposition with a decision-theoretic account recently offered by Ron Giere.

38. *Non-Formal Properties of Real Mathematical Proofs*. Jean Paul Van Bendegem. The heuristics and strategies presented in Lakatos' *Proofs and Refutations* are well-known. However they hardly present the whole story as many authors have shown. In this paper a recent, rather spectacular, event in the history of mathematics is examined to

gather evidence for two new strategies. The first heuristic concerns the expectations mathematicians have that a statement will be proved using given methods. The second heuristic tries to make sense of the mathematicians' notion of the quality of a proof.

39. *Is Our Universe a Mere Fluke? The Cosmological Argument and Spinning the Universes.* **J. van Brakel.** Recent discussions about the anthropic principle and the argument from design can perhaps be summarized as follows (Hacking): (1) The world is very unusual, so it must have been made by an intelligent creator. (2) The world is very unusual, but unusual things *do* occur by chance. Both (1) and (2), in their ordinary interpretations, have been labelled probabilistic fallacies. In my paper I will discuss in particular the following two aspects: (a) The contemporary relevance of Cicero's discussions on chance. (b) The fact that any talk of chance events is only possible subject to the more encompassing idea of "limited belief in chance".

40. *Understanding Regression.* **James Woodward.** This paper explores, in a rather schematic way, some issues having to do with the conception of causation and explanation implicit in regression analysis. I argue that (a) regression analysis does not yield lawlike generalizations but rather claims about causal connections in particular populations and that (b) regression analyses are not plausibly viewed as part of a neo-Humean program of analyzing causal claims in terms of claims about patterns of statistical association. I also argue that (c) the conception of explanation implicit in regression analysis is deductive and involves the exhibition of a pattern of counterfactual dependence between mean values of the independent and dependent variables.