INTRODUCTION

The breadth and depth of Patrick Suppes's work and intellectual interests are extraordinary. There are two easy ways by which one can convey this. To gain a grasp on the breadth of Suppes's work, a careful perusal of his bibliography contained at the end of Volume 3 of this collection will suffice. It reveals papers on topics ranging from historical work on Descartes and Aristotle through work in empirical psychology, computer assisted instruction, and robotics, to foundational work in measurement theory, probability, and theory structure, with a host of other subjects in between. Mere breadth is, of course, in itself an indicator of a first-class intellect. It is the extent to which Suppes's work has influenced the direction of research in so many of these areas that is the truest measure of its depth and permanent influence. The best way to demonstrate the extent of that influence is to provide a (non-exhaustive) list of honors and awards he has received: Professor of Philosophy, of Statistics, of Psychology, and of Education at Stanford University; President of the American Philosophical Association, of the International Union of History and Philosophy of Science (twice), of the National Academy of Education, and of the American Educational Research Association; Member of the National Academy of Sciences, of the Finnish Academy of Sciences and Letters, of the Académie Internationale de Philosophie des Sciences, of the National Academy of Education, of the Société Française de Psychologie, of the Yugoslav Academy of Sciences and Arts, and of the USSR Academy of Pedagogical Sciences; Fellow of the American Academy of Arts and Sciences, of the American Psychological Association and of the American Association for the Advancement of Science. Other awards and honors have been plentiful, culminating in 1990 when Suppes was awarded the National Medal of Science by President Bush. This level of intellectual achievement and scholarly productivity is all the more impressive when one realizes that, since 1959, Suppes has been director of the Institute for Mathematical Studies in the Social Sciences (an institute that he co-founded with the economist Kenneth Arrow) and for a period of approximately twenty years, of a highly successful com-
puter company, Computer Curriculum Corporation that he co-founded in 1967. The chairmanship of the Stanford Philosophy Department for six years, and a short stint as Acting Dean of the School of Humanities and Sciences ran concurrently with these other onerous duties. Most ordinary academics would be content with any one of these activities. Taken together they represent an unparalleled level of intellectual and administrative energy. Pat nominally retired from Stanford University, which he had joined in 1950, in 1992, but true to form, has continued to contribute to research in as active a way as ever.

For those of us who have been students of Pat, his influence as an educator has been equally influential. Perhaps surprisingly for someone who has been as strong an advocate of computer assisted instruction as has Suppes, his personal pedagogical skills are considerable. A unique mixture of clarity, focus on the essentials, love of dialectical argument, personal charm, and ruthless exposure of deficiencies in student preparation and rigor has left its work on generations of students in many disciplines.

Despite the catholicity of Suppes’s interests, there is an underlying cohesiveness to his thought, due in large part to the methods he has developed and deployed over his career. One continuous thread running through Suppes’s work has been an emphasis on the importance of probability and probabilistic theories, and that aspect of his work is amply represented in this collection. In the first paper of Part I, Karl Popper and David Miller extend Popper’s well-known axiomatic treatment of probability (Popper, 1959, appendices *iv, *v)) to subtheories of probability that determine lower semilattices and distributive lattices as the domain of interpretation, while also commenting on the implications of their approach for the deducibility relation in logic. In the next contribution, the economist Peter Hammond displays some deep connections between measurement theory and probability in the course of developing a version of non-Archimedean decision and game theories. This is a sophisticated treatment that repays close study.

Pat has a longstanding interest in the concept of randomness. Within the framework of Martin–Löf’s approach to random sequences there is a natural connection between the computational definition of randomness developed by Kolmogorov and Chaitin, which provides an elegant tool for analyzing finite frequency data, and the classical notion of statistical hypothesis testing. Building on this literature, Rolando Chuaqui’s paper in Part I takes his own recently refined conception of objective
A different aspect of Suppes's interest in probabilistic theories is revealed in the next three papers in Part I. Within broadly subjectivist theories of probability, there are two particularly pressing questions. First, what is the appropriate apparatus for representing the dynamics of belief states? Second, given that point-valued probability functions are frequently an unrealistic idealization of an individual’s degrees of belief, what is the correct generalization of those functions to more realistic representations in terms of upper and lower probabilities? Isaac Levi’s paper explores responses to the first of these questions, while Terrence Fine’s essay focuses on the second. Fine emphasizes the usefulness of upper and lower probabilities in modelling a fascinating class of empirical phenomena (flicker or 1/f noise) which have divergent, long-run relative frequencies. This class of phenomena presents serious problems for empirical interpretations of probability, and deserves to be more widely known in the philosophical community. Finally, Philippe Mongin’s investigation of Dempster–Shafer belief functions develops some important connections between Suppes’s work on upper and lower probabilities and recent work on epistemic statics and dynamics. The axiomatizations given here provide a particularly clear insight into the work of Gärdenfors and his coworkers.

The papers of Wolfgang Spohn and of Zoltan Domotor each reflect in their different ways the power of the axiomatic approaches that Suppes has championed. Spohn surveys recent results in the area of conditional independence, and provides a significant clarification of the concept for epistemic and causal contexts. Measurement theory is put to good effect in Domotor’s extension of earlier results by Scott and Suppes for de Finetti’s qualitative probability relations. Part I concludes with an unusual paper by Jean-Claude Falmagne written in dialog form which brings to bear geometrical models on probabilistic aspects of voting behavior.

Suppes’s 1970 monograph on probabilistic causality has been among the most influential of his works in the philosophy of science. Although Hans Reichenbach and I. J. Good had previously developed theories in this area it is probably true to say that it was Suppes’s contribution that led to this field becoming one of the most active in contemporary philosophy of science. The area is well represented in Part II of this collection. One of the persisting problems in probabilistic causality is
how to integrate it with more traditional accounts based on sufficient, deterministic criteria, or on factors necessary for the outcome. The papers of Holland and of Good deal with this in different ways, with Holland providing a theoretical framework that is independent of the probabilistic or deterministic nature of the underlying phenomena, while Good explores the tendency of a factor to be either a necessary or a sufficient condition within his own theory of probabilistic causality.

Decisions, causation and actions are intimately linked, of course, and it is not surprising that Suppes’s work on the first two of these should have implications for the third. Adams explores some of these consequences in his paper, paying particular attention to the interpretation of probability that is appropriate for probabilistic causal decision making. In an important criticism of multiple regression methods, Glymour, Spirtes and Scheines draw on some of the ideas motivating Suppes’s account of probabilistic causality to argue that where one has correlated regressor variables, variables that are in reality causally independent of the endogenous variable can have significant regression coefficients attributed to them. A substantive connection with statistical practice is also made in Costantini’s paper, where he argues that probabilistic causal claims of the kind advocated by Suppes can be tested only by the use of significance tests. Finally, by drawing on the empirical work of Tversky and others on the psychology of inference and decision, Legrenzi and Sonino argue that both probabilistic causality and decision theory are descriptively inadequate for counterfactual reasoning.

Suppes wrote his Ph.D. dissertation at Columbia University under Ernest Nagel’s direction. Its subject matter was a historical account of the concept of action at a distance, this historical orientation resulting partly from the (still prevalent) attitude of philosophers that a technical treatment of philosophical problems is somehow inherently unphilosophical. Freed from these constraints at Stanford, Suppes has pursued a longstanding interest in the foundations of physics. In the case of quantum mechanics, Pat’s original interest in action at a distance was curiously prescient, as the work on Bell’s Theorem has made abundantly clear. Combined with probabilistic themes, Suppes has written a number of papers, often co-authored with Mario Zanotti, refining and simplifying the probabilistic aspects of Bell’s results. This interest is well represented in Part III by the papers of Barry Loewer and of Arthur Fine. Suppes has frequently argued that the relationship between (non-relativistic) quantum theory and classical probability is a delicate one,
and that in general it is preferable to preserve the latter at the expense of reformulating the former. Loewer argues that this can best be done by the use of David Bohm’s hidden variable version of quantum mechanics. Fine discusses a version of the EPR experiment due to Schrödinger and draws some important conclusions about the difficulty of incorporating probabilistic causality into quantum theory. Part IV continues with the paper by Jules Vuillemin, which shows that classical mechanics poses intriguing philosophical issues concerning the nature and measurement of physical magnitudes, issues that are different in important ways from those that occur in the much more widely discussed arena of quantum measurement. The concept of a physical quantity also serves as one of the focal points of Brent Mundy’s paper, but here within the area of differential geometry. Mundy’s paper also contains a valuable assessment of the relationships between Suppes’s work on measurement theory and his work in philosophy of physics.

Suppes’s early scientific training was in meteorology, a discipline from which he learned that the application of scientific theories to real phenomena is by no means as straightforward as standard philosophical accounts would have it. Humphreys’s paper explores this point in connection with the methodology of computer simulations, within which a new kind of scientific method is employed, intermediate between theory and empirical experimentation.

I mentioned earlier that one of the principal unifying themes in Suppes’s work is probability and probabilistic methods. A second, and perhaps more important theme is the use of the set theoretical apparatus that serves as his preferred mode of representation for theories and measurement. The best introduction to these set-theoretical methods is the (unfortunately still unpublished) mimeo manuscript (Suppes, 1970). These methods, which were inspired by the model theoretical work of Tarski and others, and which were refined by Suppes in collaboration with J. C. C. McKinsey, form a deliberate attempt to demonstrate the advantages of abandoning language-oriented representations, especially those couched in first-order languages, in favor of more abstract set-theoretical models. Its fruitfulness is now widely recognized, and what are now variously called semantic or structuralist approaches to theory structure are direct descendants of Suppes’s innovations. A fine overview of the advantages to be gained here is provided by Wojcicki’s paper which opens Part IV.
Yet the set-theoretical approach is not just a novel way of representing theoretical structure. Its true value is revealed when it is used to axiomatize specific theories, and in proving specific theorems about the class of structures that constitute that theory. Examples of how this powerful apparatus can be deployed to good effect may be found in the paper of da Costa and Doria, within which incompleteness and undecidability results are proved for certain important empirical theories in dynamics and game theory. Concluding Part IV is a paper on structural explanations by Joseph Sneed, who together with Stegmuller, Balzer, Moulines, and others, has done much to develop the structuralist account of theories.

There is a natural affinity between the use of the set theoretical apparatus for representing theories and its use in measurement theory. Suppes’s foundational work in this area is well known, and his collaborative three volume work (Krantz et al. 1971; Suppes et al. 1989; Luce et al. 1990) is a standard reference work for researchers on the topic. The paper by R.D. Luce and Louis Narens that opens Part V beautifully lays out fifteen open problems in the representational theory of measurement, with an assessment of their ease of solvability. Fred Roberts and Zangwill Rosenbaum generalize some earlier results on the invariance of homomorphic representations, whereas C. U. Moulines and Jose Díez demonstrate some of the connections between Suppes’s views on theory structure and on measurement before going on to prove some results in combinatorial measurement theory.

Model theoretical considerations also play a central role in Suppes’s account of the logic of natural languages, a topic that is the subject of three papers in Part VI. This section begins with a paper by one of Pat’s long-time colleagues at Stanford, Dagfinn Follesdal. Follesdal begins by surveying Suppes’s work in the philosophy of language, and then concentrates on Suppes’s notion of congruence of meaning, which is intended to be a generalization of the concept of synonymy. Beginning in the early 1970s Suppes developed an alternative to the then popular Montague semantics. This logic, which is variable-free and stays close to the surface grammar of ordinary English, is employed by Michael Boettner in a treatment of noun, pronoun, and verb phrases and by William Purdy as the basis of a systematic treatment of anaphoric pronouns. Julius Moravcsik’s paper also deals with Tarskian model theoretic semantics, but argues that Tarski’s formal semantics are in fact inadequate for English.
Suppes once remarked that at any university other than Stanford, he would be considered a logician rather than a philosopher of science. He is, of course, the author of two widely used textbooks in logic and axiomatic set theory, and this interest in logic spills over into the much discussed topic of whether quantum mechanics requires a non-standard logic. The papers of Paul Weingartner, of Jaakko Hintikka and Ilpo Halonen, and of Maria Luisa dalla Chiara and Roberto Giuntini all deal with this issue in various ways. While the second of these focuses on identifiability, the first and third papers in this group take interestingly different positions on the question of abandoning classical logic, with Weingartner arguing in detail for Suppes’s cautious approach, and dalla Chiara and Giuntini urging a pluralist approach that exploits some of the insights gained from the relationship between difficulties of applying classical probability theory to quantum mechanics, and the algebraic structure underlying the deviant logics.

The three papers in Part VII deal with two early interests of Suppes, and with a quite recent interest. In 1955–56, Suppes spent the year at the Center for Advanced Study in the Behavioral Sciences. It was there that W.K. Estes provoked his interest in stimulus sampling theory, a theory that provided one of Suppes’s first sorties into theoretical and experimental psychology. Estes here describes some of the differences between the linear theories of the early stimulus sampling approaches and the later nonlinear theories of array similarity approaches. In the early nineteen-fifties, Suppes collaborated with two game theorists, David Blackwell and M. A. Girshick, who were at that time writing what was to become a standard work on game theory and statistics. Perhaps a more familiar result of work in this period was Suppes’s experimental research with Donald Davidson and Sidney Siegel with the aim of measuring utility assignments and personal probabilities. Raimo Tuomela and Gabriel Sandu’s paper provides a detailed treatment of intentional actions by developing a game-theoretic semantics for such actions. With the concluding paper of Part VII, Crangle draws on some earlier collaborative work with Suppes to emphasize the central role played by habit in the design of, and semantics for, robots. This is an ingenious approach, and neatly combines the behaviorist and humean strains in Suppes’s methodology.

The volume concludes with a useful survey paper by Maria Carla Galavotti, which ties together many elements of Suppes’s work that I have not had time to touch upon in this brief introduction.
From the inception of this project, Pat insisted that he wanted to write a response to each article. As the number of contributors grew, and the level of technical sophistication of many of the contributions became apparent, this commitment to the spirit of philosophical exchange became an ever more daunting task. Characteristically, Pat came through with detailed comments in a timely fashion. The result is in itself an almost book-length set of responses, and they collectively provide an invaluable clarification of many aspects of Suppes’s work. Volume 3 concludes with a brief Postscript by Suppes explaining the general orientation that he has taken in his comments to each paper.

The quick overview that I have given here can of course provide only a glimpse into the broad sweep of topics covered within this collection. When the authors were invited to contribute, they were specifically asked not to write retrospective analyses, but to submit research papers that maintained a significant level of contact with at least one of Suppes’s principal areas of interest. There was no question but that this was the appropriate goal, and its enthusiastic embracing by the contributors is a testament to the power and continuing fruitfulness of the methods Suppes has introduced into the philosophy of science and made a permanent part of its methodology. The abstracts preceding each paper should aid the reader in orienting himself within the broad organization by subject matter.

All of the papers in this collection appear in print for the first time here. Previous versions of some of them were read at a conference on Probability and Empiricism in the Work of Patrick Suppes held in Venice, Italy in June 1992, the principal organizer of which was Maria Carla Galavotti. Maria Carla graciously agreed to the suggestion that we publish those papers in the present collection.

I conclude by expressing my thanks to all of the contributors for so promptly responding to various deadlines and editorial requests, and I especially want to convey my deep appreciation to Pat Suppes for his help and suggestions at every stage of the endeavor. The volumes were immeasurably improved as a result. I hope they are a fitting tribute to a scientific philosopher who has served as an inspiration to us all.

Fall, 1993

P. W. H.
NOTES

1. An intellectual autobiography entitled ‘Self-Profile’ is included in (Bogdan, 1979), pp. 3–56. This contains a fine survey of Suppes’s research and intellectual influences up to 1978.

2. I note here that this attitude was not one that Nagel himself adopted.

REFERENCES


