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Reviews

Beginning with the second volume, *Logic and Logical Philosophy* reviews the publications related to the scope of interest of this journal. We will publish rather brief descriptions of the books submitted to us by publishers or authors. Occasionally, we shall make use of excerpts from the authors' introduction or publishers' notes. Authors and publishers are kindly invited to provide us with the books they would like to have mentioned in the section.

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Jan Faye, Uwe Scheffler, Max Urchs (eds.), ***Logic and Causal Reasoning***, Akademie Verlag Berlin 1994.

It is not difficult to see that in recent years there has been a growing interest in applying the apparatus of formal logic to various forms of causal reasoning. The book under review is a result of the intensive work on the problems of causality from a logical point of view, but not exclusively from the point of view of logicians. *Logic and Causal Reasoning* contains 14 contributions from logicians, philosophers, statisticians, and computer scientists living in Denmark, Germany, Poland, Sweden and the Ukraine. All of the papers are previously unpublished, and most of them are a result of a workshop held in May 1993.

The editors of the book start their collection of articles with a highly informative introduction, which contains a rich overview of different attempts to analyse causal reasoning by logical means. The reader can find information about various accounts proposed by A. Burks, D. Lewis, R. Stalnaker, S. Jaśkowski, J. Mackie, M. May, A. Prior, N. Belnap, F. von Kutschera, H. Reichenbach, P. Suppes, W. Spohn and H. Greniewski, but also about the philosophical interpretation of causation putted forward by authors from D. Hume to G. H. von Wright. The papers included in this book can be divided into three main groups: *Logical analysis of causality, Philosophical explication of causality* and *Application of causal analysis or causal logic in empirical disciplines*, though most of the contributors are concerned with more than one of the above mentioned topics.

The first section starts with Ingolf Max' *Way's of Representing Scheffler's Causal Relation between Event Tokens in Multi-dimensional Logics*. The author uses a list of 18 properties given by Uwe Scheffler which every acceptable causal relation should possess. Taking that list for granted, Max investigates the expressive power of extended multi-dimensional classical logic, obtaining a purely syntactical model of Scheffler's list. Uwe Meixner's approach to causality developed in his *Propensity Theory of Causality* breaks with a widely accepted tradition. Instead of using possible worlds, it presents an interesting alternative based on the concept of *propensity* (from one moment of time to another), which in turn is definable by the concept of *difficulty of realisation* (from one moment to another). His approach it distinguished by the advantage of referring to no unactualised possibilities ("counterfactualities"). In the next paper, *The Causal Connective* written by Paul Needham, the author discusses many problems connected with the causal operator. His considerations lead to a basic system of modal conditional logic. According to the title of his article, *Token versus Type Causation*, Uwe Scheffler distinguishes two types of causation: singular and general. Investigating the relationship between these two types he seeks to support the point of view that token and token causation have to be methodologically and ontologically prior to types and type causation. The motive for his efforts is the wish to avoid platonism and analyticity with respect to causality. The aim of Yaroslav Shramko's paper, *Applying Relevant Logic to the Analysis of some Problems of Causality*, is to demonstrate that relevant logic can be used in the analysis of some problems in the methodology of science which are related to the notion of causality, such as: the problem of explicating the concept of "law of nature", the problem of defining dispositional predicates, the problem of counterfactuals. As a result of

his discussion Shramko constructs a logic of counterfactuals on the basis of relevant logic. Werner Stelzner reports in *Hugh MacColl's Explication of Causation and Logical Analysis of Non-logical Causation* about the historic roots of the logical analysis of causation. In his opinion, the significant novelty in MacColl's logical work on causality consists in the use of modal logic tools developed by him in order to express the necessity operator and strict implication. This enables MacColl to give a formulation of causality, which avoids the analogues of paradoxes of material and strict implication as well as the unwelcome consequence that any two sentences cause each other. Stelzner reformulates MacColl's ideas in possible world terminology and examines the validity of these statements. In Heinrich Wansing's paper *Actions and Preventions* a decidable constructive system, *CAL*, of unsorted action logic is introduced. *CAL* is a system of substructural propositional logic, i.e. a logic without all or some of the (hitherto) standard structural inference rules. Since the implicational connectives of *CAL* fail to be pre-causal connectives in the sense of Urchs, according to Wansing there is no much reason to believe that they are causal connectives.

The second group of papers consists of three articles, which concentrate on philosophical issues of causality. Jan Faye starts his discussion of *Causal Beliefs and their Justification* with the question about the roots of human belief in causal nexus. His claim that our notion of causation cannot be spelled out in any way by extensional terms seems to me as less convincing as his argumentation in favour of so-called backward causation. Jerzy Perzanowski starts his considerations on *Reasons and Causes* with a few general remarks concerning the ontology of causality. Next, the basic family of relevant onto-logical operators, called *makers*, is introduced. Basic axioms are worked out for a formal setting of the mechanism of causal interactions in his "Ontologic". Perzanowski's paper concludes with the following deep truth: "Anyway, one thing is clear. Determinism needs further, careful and subtle discussion"(188). The third paper on philosophical topics, *Chaos: The Reason for Structural Causation*, is written by Hans Rott. Its purpose is an attempt to reconcile two very different approaches to the concept of causation, which both can be found in Laplace' writings: his doctrine of constant and variable causes on the one hand, and his mechanistic determinism on the other hand. Rott argues that as far as games of chance are concerned, to assign probabilistic laws a fundamental role in scientific explanation does not conflict the assumption of Laplacian determinism. In his opinion there is no contradiction between the views of Laplace and the new chaos-theoretical ideology.

The next article, which opens the contributions to the last section, deals with structural causes, too. Weyma Lübbe is interested in using sharp and detailed arguments brought forward in the modern philosophical analysis of causation to conceptualise some causal problems sociologists have. Her *Structural Causes: On Causal Chains in Social Sciences* concerns questions about the applicability of the concept of a causal chain in social science. Applications of causal logic in medicine and engineering is the subject of *The Structure of Causal Reasoning in Medicine and Engineering* written by Stig Andur Pedersen, Peter Øhrstrøm and Morton Elvang-Görenson. The authors developed a semantical system, in which the counterfactual implications are evaluated in possible histories instead of possible worlds. It is based on the ideas in metrical tense logic combined with an understanding of causality based on Mackie's ideas. Ole Olsen starts his *Probabilistic Causality in Epidemiology* from the fact that similar as in science and philosophy the meaning of the word "cause" in epidemiology is far from being clear, too. The aim of his paper is to help to clarify this situation by formalizing and comparing, in a model-theoretic way, the prevailing concepts of causation in contemporary epidemiology. Olsen argues in favour of a specific probabilistic concept of causality to be used in epidemiology. In *Artificial Causality*, the last work of the book, Max Urchs takes a look "over the fence of logic" at Artificial Intelligence. There he founds that the problem of formalization of the causal nexus plays a distinguished role in the contemporary research of AI. Urchs encourages logicians to consider the results achieved in AI instead of limiting their interest to results obtained in pure logic. The purpose of his article is to present to logicians the specific point of view on causal analysis in AI in order to establish a basis for communication.

Concluding I would like to mention that *Logic and Causal Reasoning* offers a good survey of the work in causal logic and describes interesting applications of this theory in other sciences. The book should find interested readers not only in the circle of logicians and philosophers but among other scientists too. And finally, it should be said that the manuscript was prepared carefully with only few mistakes. One of them consists in giving Faye's article two different titles — one in the list of content and another heading his paper. This does not bother the reader, it was rather a problem for the author of the present review to report the "real" title.

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Gila Sher (eds.), ***The Bounds of Logic: A Generalized Viewpoint***, A Bradford Book, The MIT Press Cambridge Mass. 1991.

Gila Sher's book is both a skilled investigation of the generalized quantifiers perspective in modern logic and an attempt to provide a new, also generalized in a sense, viewpoint of the scope and limits of logic. In the last decades the importance of the notion of generalized quantifiers for mathematics, cognitive sciences and natural language analysis was brought out explicitly in a rich body of literature. Nevertheless, the question of whether generalized quantifiers signify a genuine breakthrough in logic per se is still open. Sher focuses her analysis on the philosophical significance of the generalization of quantifiers for a general characterization of logic and logical constants. The book is divided into a preface and seven chapters. An appendix contains proofs of the main theorems (pp. 141–149), notes (149–157), references (159–167), indexes of notation and terms (169–178).

In Chapter 1 ("New Bounds?", pp. 1–9) Sher gives an outline of her philosophical approach to logic. She does not share the traditional view on logic as something to be discovered once and for all. The construction of new logical structures is a question of invention rather than of discovery. On the other hand, logic is not a merely linguistic convention. Sher claims, that "revision in logic, as in any field of knowledge, should face the 'trial of reason' on both fronts, practice and theory"(p. 7). Her own investigation concerns the theoretical grounds for certain extensions of logic.

Various intuitions about "logicality" lead to more sophisticated hierarchies of logical terms than the usual set. In turn, the actual practice of the generalization of quantifiers gives the old question *What is logic and what is logically?* a new, sharp form.

In Chapter 2 ("The Initial Generalization", pp. 10–35) Sher analyzes Mostowski's original generalization of quantifiers, tracing its roots to Frege's interpretation of number statements. She showed that Mostowski's logic is, from a Fregean point of view, a first-level system with an arbitrary number of 1-place second-level cardinality predicates. One immediately arising question is what does cardinality have to do with logicality? Mostowski's answer is that a logical quantifier "does not allow us to distinguish between different elements of [the universe]" (cited after Sher, p. 14) and thus it has to be invariant under permutations of the universe. Is it possible to extend Mostowskian quantifiers without violating the spirit of his approach? To answer this question Sher discusses a proposal by Barwise and Cooper to create a system of nonlogical quantifiers for use in linguistic representation. In her

opinion, "Barwise and Cooper's analysis explains some linguistic regularities, but what it explains is not the structure of *quantifiers*" (pp. 25–26). Sher advocates an extension of logical quantifiers in a way that was first proposed by Lindstrom. In accordance with Lindstrom's proposal, she adds to Mostowskian predicative quantifiers, which semantically are functions on subsets of the universe, the relational quantifiers, i.e. functions on subsets of the Cartesian products of the universe. This is certainly a natural generalization. But when it comes to relational quantifiers one does not seem to have very strong intuitions about the content of the Mostowskian invariance criterion for logical quantifiers. In the reviewer's opinion, the relational perspective on the noun phrases determiners suggests a natural way of distinguishing between quantifiers and other determiners. Such invariance requirements for quantifiers-forming determiners as quantity, conservativity, extension have been discussed in the modern literature on generalized quantifiers in natural language. Sher prefers a more general viewpoint: she uses the relational generalization of quantifiers as a "jumping board" investigating the notion of logicality.

Chapter 3 ("To Be a Logical Term", pp. 36–66) focuses on two general questions. What is it for a term to be logical? What are all the terms of logic? Examining Tarski's foundational ideas in semantics, the author showed that within the framework of model-theoretic semantics the success of logic as an instrument for identifying formal and necessary consequences depends on the choice of logical terms. The task of a logical system is fully accomplished only if all formal and necessary constituents are taken into account by its logical constants are taken into account by its logical constants. According to the central claim of the book, the standard system, with its limited set of logical constants, does not fully achieve the goal. Sher argues that to be formal is to be invariant under all nonstructural variations of models. Thus she generalizes the Mostowskian criterion of logicality as invariance under permutations to invariance under isomorphic structures. A logic based on this generalization is called *Unrestricted Logic*.

In Chapter 4 ("Semantics from the Ground Up", pp. 67–104) the author gives a constructive definition of logical constants within the framework of Unrestricted Logic.

Chapter 5 ("Ways of Branching Quantifiers", pp. 105–129) is devoted to several theories of branching quantifiers. Initially branching quantification was considered as a generalization of the ordering of standard quantifier prefixes and it was interpreted in terms of Skolem functions. Is it possible to explain "branching" when it comes to the generalized quantifiers lacking

Skolem functions? Using Barwise's idea of the definition of monoton-increasing quantifiers on the base of a relational reading of the Skolem functions, Sher proposes her own general definition schema for a pair of branching quantifiers without regard to monotonicity. The obvious challenge here is to extend the schema to arbitrary large partially ordered quantifier prefixes.

In Chapter 6 ("A New Conception of Logic", pp. 130–140) the author returns to her general conception of logic and investigates some of its philosophical consequences. In her opinion, one of such consequences is a revision of the "old" logicism which did not engage in a critical examination of the concept of logical constants. Sher's new version of logicism shifts the perspective, placing the emphasis on logical terms: they are formal in the sense of being essentially mathematical. "Thus if the classical thesis is 'the logicist thesis of mathematics', the new one is 'the mathematical thesis of logic' " (p. 133). It might be of interest tore-examine the old arguments against the classical logicism in the perspective of its new version proposed by Sher.

It comes out that another essential philosophical consequence of the new conception of logic is the relativistic interpretation of Quine's ontological criterion: the ontological commitments of a theory can be weakened if more terms are considered as logical. The choice of a set of logical constants depends on our understanding of what are formal, metaphysically unchanging parameters of reality. Thus ontological considerations become a factor in choosing logical frameworks for formalising theories. It seems worthwhile trying to examine how more sophisticated models of reality can affect on the choice of logical constants. For example, the dynamics semantics, which take into account the binary transition relations over relevant states, nicely corresponds with the interpretation of logical constants as those satisfying certain invariance conditions. Some interesting insights may come to light if we compare dynamic "update conditions" with the logistic concept of universal logic as a study of the most general truths. The justification of the new conception of logic in the book under review is of model-theoretic, but not of proof-theoretic nature. According to Sher, the problem is that "there is no body of mathematical generalization in proof theory directly parallel to 'generalized logic' in contemporary model theory" (p. 140). Even so, the two frameworks are closely related. In particular, relational conditions on quantifiers (transitivity, reflexivity, etc.) may be regarded as expressing patterns of inference (see, e.g. van Benthem's works). Using these techniques, one can classify various sets of quantifiers by their inferential patterns. The shift in perspective may add a new, proof-theoretic dimension to Sher's conception of logic and logicality.

The Bounds of Logic is a book on the interface of mathematics, computer sciences, formal semantics in logic as well as in linguistics. It does not assume the form of a survey. Nevertheless, focussing on the deepest philosophical aspects, the book presents a broader perspective in this heterogeneous area. The emphasis on the theoretical grounds for the generalization of quantifiers leads to genuine logical results belonging to the main themes of modern logic.

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