

Max Cresswell, Edwin Mares, and Adriane Rini, eds. *Logical Modalities from Aristotle to Carnap: The Story of Necessity*. Cambridge University Press 2016. 366 pp. \$99.99 USD (Hardcover ISBN 9781107077881).

This collection will become an indispensable resource for anyone who is interested in the history of modalities. It comprises 15 essays that were specifically written for this volume. The essays are arranged in chronological order, which helps to see how earlier ideas reappear in the work of later philosophers. It also shows the way that the treatment of negation and modalities changed from modifiers to sentential operators, and eventually, freed logic from metaphysical perplexities. Although one can certainly find philosophers who have not been included in this collection (despite having written something about modalities), the selection of the philosophers whose views are scrutinized is well-rounded, considering the Western philosophical tradition. From the point of view of contemporary logic, one might wish that Łukasiewicz were included, but of course, L_3 is not a prominent modal logic.

The first three chapters are devoted to aspects of the concepts of necessity and possibility in Aristotle's works. Rini's article gives an excellent exposition of Aristotle's assertoric syllogisms, then goes on to discuss Aristotle's notions of necessity and possibility. While necessity may enter into a logic as a component of the premises and the conclusion, necessity is a fixture in the notion of a logically correct inference. Given Aristotle's status ('the father of logic') in the history of logic, it is an intriguing question whether he had a notion of logical necessity in the latter sense. An alternative assessment would be that Aristotle merely gave lists of sample (correct) inferences. Rini argues that Aristotle must have had a notion of logical consequence and counterfactual reasoning.

In chapter 2, Malink clarifies Aristotle's two notions of 'possibility.' The scare quotes are justified, because we would not call two-sided possibility 'possibility,' but rather, contingency. Malink focuses on one-sided possibility, which is possibility. Using careful exegesis, he shows how difficult it is to interpret Aristotle's writings—full of changing arguments, self-corrections, and most likely, not completely worked out ideas. The chapter by Smith, on the other hand, emphasizes the role of the two-sided possibility. Smith argues that Aristotle's true scientific method is his assertoric syllogisms, and his modal syllogisms are not completely developed (and perhaps inconsistent). However, we are reminded that the development of a theory of modality was entangled with the difficulties that pertain to unraveling the meaning of natural language sentences—even the structure of those sentences—and their relation to reality. Smith argues that Aristotle needed the notion of two-sided possibility to deny—contra the Megarians—that necessity and actuality coincide.

Chapter 4 turns to other ancient Greek philosophers: the Stoics. De Harven uses a text by Diogenes Laërtius to shed light on three senses of necessity and possibility: logical, metaphysical, and providential. The Stoics are well-known for their truth-functional view on conditionals, which might make us wonder whether they could entertain a deep theory of modalities. De Harven argues that the three-way ambiguity allows the Stoics to maintain a two-valued view of sentences, including modal sentences (unlike Diogenes's view of necessity as truth with a temporal parameter). The distinction between metaphysical and providential necessities circumvents determinism.

In chapter 5, Thom describes Avicenna's views about modality, together with those of Averroes and Razi. The Arabic tradition—juxtaposed with the Stoics—is a drastic change in how modalities are understood. The emphasis shifts to the analysis of essences and the justification of a necessary being. Thom mentions recent attempts to formalize Avicenna's views in first-order modal logic, which are often frustrated by inconsistencies in Avicenna's work. Chapter 6, by Martin, looks at roughly the same period. However, it scrutinizes the Latin tradition. While the idea that possibility

comprises current occurrence, future occurrence, and what has no occurrence at all is not original with Abelard (Martin shows this by appeal to the Orléans treatises), he significantly advanced the understanding of sentences by distinguishing grammatical and semantical structures, and by treating negation as a sentential operator.

Chapter 7, by Normore, highlights Ockham's views on logic and modality. By the 14th century, Aristotle's logical work was recapitulated in the Latin tradition, and so was the logic of the Stoics. According to Ockham, possibility is logical (=consistency) or metaphysical (=the power of God). Ockham formulated inference rules for modalized sentences, though he did not formulate an axiomatic system (unlike Aristotle). Normore gives a reconstruction (a list of rules), and discusses the connection of (what is nowadays called) axiom (5) to the principle that the past is necessary, because it's unchangeable.

In chapter 8, MacIntosh explains four senses of necessity (self-evidence, tensed necessity, absolute necessity, and necessity of existence) based on Aquinas's writings. He explicates how necessity was utilized in demonstrations of the existence of God or in the sciences. MacIntosh remarks that 'logic was in a severe decline in the early modern period' (168). This situation might have been further exacerbated by the philosophical demand that scientists show necessary claims (only) while they also provide a causal explanation. These requirements are problematic, firstly, for mathematics, but secondly, for the empirical sciences. Chapter 9 is a natural continuation of this line of thought—the importance of facts in building up scientific knowledge relocates modalities. Anstey outlines the early modern beliefs in the existence of necessary facts that are inherently connected with essences. Necessary facts are within the reach of cognizing humans. Indeed, they form the foundation of human knowledge, which can be used to produce more knowledge. As an illustration, Anstey considers Locke, and how Locke's acceptance of 'principles' (necessary truths or laws of nature) changed throughout his works.

Chapter 10 deals with Leibniz's views on necessity. If everything has a reason, then it seems that everything must be necessary. Leibniz avoids this undesirable conclusion by distinguishing two senses of necessity—necessity per se and hypothetical necessity. Necessity per se means that the opposite leads to a contradiction, hence, possibility per se means conceivability. Hypothetical necessity is a result of interference between things, that is, the opposite is conceivable. However, other things having been determined, the thing in question cannot be otherwise. Look explains how Leibniz manages to create room for contingency and free will by stipulating infinitely long sequences of steps in inferences (which cannot be carried out by humans). These infinite chains exemplify derivative truths—a category that also includes truths demonstrable in finitely many steps. Leibniz gave a genuinely modal proof of the existence of God using axiom (5) ('if it is possible that God necessarily exists, then God necessarily exists' (214)). Once the antecedent is shown, it follows that God necessarily exists. Leibniz stipulated that there are infinitely many possible worlds, and this idea continues to influence our thinking about modalities. The next chapter by Westphal tackles the problem of whether humans can 'accidentally' establish necessary truths when their analysis of a concept happens to start with the predicate sought after. He argues that the infinity of the predicates that belong to the individual always have to be considered (and a human will fail at that task). Also, unless all the predicates have been considered, the task of individuating an object cannot be successfully carried out.

In chapter 12, Stang focuses on Kant's views, based on transcripts of his lectures. Stang teases out many senses of possibility and necessity, and argues that Kant's notion of real possibility is the same across his two periods. In the next chapter, Legg and Misak describe Peirce's ideas about modality in his philosophical and logical works. Peirce differentiated at least five kinds of modalities including logical, mathematical and physical, and considered a proposition to be necessary or

possible depending on a subject's information state. Legg and Misak give a brief overview of Peirce's α -, β - and γ -graphs, the last of which include steps for modal reasoning. While it is commonly believed that, unfortunately, Peirce had little influence on the development of logic, because many of his writings remained unpublished during his lifetime, in chapter 14, Mares corroborates that C.I. Lewis was directly influenced by Peirce. Strict implication, which was introduced by Lewis, is commonly taken to be the starting point of modern formal modal logic. Mares recounts the story of the invention of the S1–S5 systems, and he also describes how Lewis's ideas evolved from his concern about the 'paradoxes of material implication' toward a fine-grained theory of meaning.

The last chapter, by Cresswell, concludes the volume with Carnap's views on modality. Carnap (being a logical positivist) does not need a metaphysical theory to ground necessity and possibility. Cresswell gives a clear exposition of Carnap's modal predicate logic, and argues that Carnap could have alleviated Quine's worries about modalities using his analysis of *de re* modalities (rather than individual concepts). This well-written and well-edited book is rich in content, and it should be read by anybody who is interested in the intellectual path leading up to the contemporary understanding of necessity and possibility in philosophy, and more narrowly, in logic.

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