MARKO MALINK

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To the memory of my brother,
Jurij

Contents

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Parts of the interpretive framework presented here, especially in Appendix B, were derived from a paper entitled “A Reconstruction of Aristotle’s Modal Syllogistic” (*History and Philosophy of Logic* 2006). In general, this book follows the same approach outlined in the paper, although it deviates from it in a number of ways. Also, Chapters 1–6 of this book are informed by discussions presented in two earlier papers entitled “A Non-Extensional Notion of Conversion in the *Organon*” (*Oxford Studies in Ancient Philosophy* 2009) and “*TΩI* vs *TΩN* in *Prior Analytics* 1.1–22” (*Classical Quarterly* 2008). Chapter 9 relies on “Categories in *Topics* I.9” (*Rhizai* 2007).

I thank my colleague and friend Jacob Rosen for countless hours of enjoyable conversations. They have been a constant source of inspiration and motivation. More specifically, I have greatly benefited from our collaboration on some portions of Aristotle’s modal logic which are not treated in this book (“A Method of Modal Proof in Aristotle,” *Oxford Studies in Ancient Philosophy* 2012; and “Proof by Assumption of the Possible in *Prior Analytics* 1.15,” forthcoming in *Mind*).

Finally, I thank my parents for their support. While I was working on the manuscript, my brother, Jurij, struggled with his health and died in 2010 at the age of 21. This book is dedicated to his memory.

Abbreviations of Aristotle's Works

APost.	*Posterior Analytics*
APr.	*Prior Analytics*
Cael.	*de Caelo*
Cat.	*Categories*
de An.	*de Anima*
EE	*Eudemian Ethics*
EN	*Nicomachean Ethics*
GA	*de Generatione Animalium*
HA	*Historia Animalium*
Int.	*de Interpretatione*
MA	*de Motu Animalium*
Met.	*Metaphysics*
Meteorol.	*Meteorology*
PA	*de Partibus Animalium*
Phys.	*Physics*
Top.	*Topics*

Aristotle's Modal Syllogistic

Introduction

Aristotle was the first to undertake a systematic study of deductive inference. He is therefore considered the founder of logic. At the heart of his mature logical theory lies the assertoric syllogistic, presented in chapters 1.1–2 and 1.4–7 of the *Prior Analytics.* The assertoric syllogistic deals with inferences that consist of nonmodal propositions such as 'A belongs to all B' or 'A does not belong to some B'. Now, Aristotle is the founder not only of logic but also of modal logic. He developed a system of modal syllogistic, presented in *Prior Analytics* 1.3 and 1.8–22. There he is concerned with modalized propositions, that is, with propositions that contain modal qualifiers such as 'necessarily' and 'possibly'. Typical examples would be 'A necessarily belongs to all B' and 'A possibly belongs to no B'. Aristotle examines a large number of inferences involving such modalized propositions and determines which of these inferences are valid and which not.

One of the first things to note about the modal syllogistic is that it is considerably more complex than the assertoric one. It gives rise to a number of interpretive problems and has been the subject of controversy since antiquity. Commentators have identified various mistakes in the modal syllogistic, especially when reading it in the light of modern logic. Thus Łukasiewicz, in his influential 1957 book *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic,* writes, "Aristotle's modal syllogistic is almost incomprehensible because of its many faults and inconsistencies" (133).

In subsequent years, commentators have attempted to challenge Łukasiewicz's verdict and to vindicate the modal syllogistic. However, these attempts have generally not been successful, which has led to some skepticism about the modal syllogistic. Smith aptly writes,

> In recent years, interpreters have expended enormous energy in efforts to find some interpretation of the modal syllogistic that is consistent and nevertheless preserves all (or nearly all) of Aristotle's results; generally, the outcomes of such attempts have been disappointing. I believe this simply confirms that Aristotle's system is incoherent and that no amount of tinkering can rescue it. (Smith 1995: 45)[1]

The view that the modal syllogistic is incoherent is widely shared, for example, by the Kneales, Hintikka, and Striker.[2] Similarly, it is often thought that Aristotle's claims about the validity and invalidity of inferences in the modal syllogistic include substantive mistakes.[3] However, there is no consensus as to exactly where the supposed mistakes or incoherences lie. Depending on the interpretive framework employed, commentators offer different diagnoses of what went wrong and why.

In view of this situation, the aim of this book is to explore the prospects for understanding the modal syllogistic as a coherent and consistent logical system. I argue that the obstacles to such an interpretation can eventually be overcome, albeit at the cost of some interpretive complexity. I develop a model that matches all of Aristotle's claims about the validity and invalidity of inferences in the modal syllogistic. Thus it will be shown that the set of these claims is consistent and that, with respect to the proposed model, these claims do not contain mistakes. Of course, this does not mean that the modal syllogistic is free of problems. Far from it. But the model will help us to see more clearly precisely where the problems lie, and where not.

In addition to proposing a model that matches Aristotle's claims of validity and invalidity, I seek to explain why Aristotle made the claims

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1. Smith makes the same point elsewhere (1989: xxviii and 2011: 240–1).

2. Authors who hold this view include Łukasiewicz (1957: 133, 181, and 198), Kneale & Kneale (1962: 86–91), Hintikka (1973: 140–1), van Rijen (1989: 195–9), Striker (1994: 39; 2009: xv, 115, 146, and 166–7), Thom (1996: 123–49), Mignucci (1998: 52), and Mueller (1999b: 8).

3. For example, Henle (1949: 99), Brogan (1967: 57–61), Patterson (1995: 171–85 and 194–8), Nortmann (1996: 133, 266–82, and 376), and Ebert & Nortmann (2007: 667–8).

he did make. In some cases, the proposed model itself provides such an explanation, by adequately representing Aristotle's reasons for judging a given inference valid or invalid. I pursue this kind of explanatory project for some central parts of the modal syllogistic, especially for *Prior Analytics* 1.8–12. However, I am not able to do so for the whole modal syllogistic. With regard to chapters 1.13–22, my focus is more narrowly on gathering his claims of validity and invalidity, examining their various consequences, and organizing them into a coherent model. Correspondingly, I do not attempt to analyze and reconstruct all of Aristotle's proofs of these claims. Some of his more complicated proofs remain unaccounted for in this book, due to both limitations of space and specific problems with them.

Before launching into the modal syllogistic, however, it will be helpful to have a look at the assertoric syllogistic. We will do so in Part I of the book. Part II and Part III are then devoted to the modal syllogistic. In the remainder of this introduction, I give an overview of each of the three parts.

THE ASSERTORIC SYLLOGISTIC. The assertoric syllogistic deals with non-modal propositions such as 'Every man is an animal' or 'Not every man is walking'. Aristotle usually represents these propositions by means of a somewhat artificial construction using the verb 'belong to'. For example, he would use the phrase 'A belongs to all B' instead of 'Every B is A', and 'A does not belong to some B' instead of 'Not every B is A'.[4] Aristotle focuses on four kinds of assertoric propositions, which are usually indicated by the letters 'a', 'e', 'i', and 'o'. In the secondary literature on the modal syllogistic, the lack of modal qualifiers in these propositions is often indicated by the letter 'X'. Thus the four common kinds of assertoric propositions can be written as follows:

Aa_XB	A belongs to all B
Ae_XB	A belongs to no B
Ai_XB	A belongs to some B
Ao_XB	A does not belong to some B

4. Thus, 'A does not belong to some B' does not mean 'it is not the case that A belongs to some B', but is equivalent to 'A does not belong to all B'.

If an a_X-proposition 'A belongs to all B' is true, let us say that A is a_X-predicated of B. In the same way, we will speak of e_X-predication, and so on.

In Part I of this book, we briefly consider the syntax of Aristotle's assertoric propositions (Chapter 1), and then examine their semantics (Chapters 2–5). The focus is on the semantics of a_X-propositions. Specifying their semantics means giving an account of the relation of a_X-predication. It is often thought that this relation is determined by the sets of individuals that fall under its argument-terms, as follows: A is a_X-predicated of B if and only if every individual that falls under B falls under A. Thus a_X-predication is taken to be definable by means of the relation of an individual's falling under a term.

I argue that Aristotle did not accept such a definition but that he treated a_X-predication as a primitive and undefined relation. To substantiate this claim, I examine what is known as Aristotle's *dictum de omni et de nullo,* found in the opening chapter of the *Prior Analytics.* As we will see, the *dictum de omni* can be taken to state that the primitive relation of a_X-predication is reflexive and transitive. This relation is then used in the *dictum de nullo* to specify the semantics of assertoric universal negative propositions, as follows: A is e_X-predicated of B just in case A is not a_X-predicated of anything of which B is a_X-predicated. Similar definitions will be given for i_X- and o_X-predication. The result will be an adequate semantics for Aristotle's assertoric syllogistic, based on the primitive relation of a_X-predication. In this semantics, the truth of assertoric propositions is not determined by the sets of individuals that fall under the terms involved.

MODALIZED PROPOSITIONS. As mentioned above, the modal syllogistic deals with propositions that contain modal qualifiers such as 'necessarily' and 'possibly'. In the secondary literature, the former qualifier is usually indicated by the letter 'N'. Propositions that contain this qualifier are called necessity propositions or N-propositions. There are four common kinds of these propositions:

Aa_NB	A necessarily belongs to all B
Ae_NB	A necessarily belongs to no B

$Ai_N B$	A necessarily belongs to some B
$Ao_N B$	A necessarily does not belong to some B

Although the label "necessity proposition" is somewhat artificial, it is preferable to the more natural "necessary proposition," for this latter label suggests that the proposition in question is necessarily true, whereas Aristotle's N-propositions need not be necessarily true. For example, 'Horse necessarily belongs to all man' is an N-proposition, since it contains the qualifier 'necessarily'; but it is not necessarily true (in fact, it is necessarily false). To avoid such potential misunderstandings, I use the label "necessity proposition." Likewise, propositions that contain the modal qualifier 'possibly' are called possibility propositions.

The modal syllogistic is concerned with inferences that consist of assertoric and modalized propositions. Aristotle first considers inferences that consist exclusively of assertoric propositions and necessity propositions (*Prior Analytics* 1.8–12). This portion of the modal syllogistic is traditionally called the apodeictic syllogistic. We will examine it in Part II of this book. Aristotle goes on to treat of inferences that involve possibility propositions (*Prior Analytics* 1.13–22). This portion is called the problematic syllogistic, and we will examine it in Part III.

THE APODEICTIC SYLLOGISTIC. Aristotle begins the apodeictic syllogistic by briefly discussing inferences that consist exclusively of necessity propositions (*Prior Analytics* 1.8). His treatment of these inferences is strictly parallel to that of assertoric inferences in the assertoric syllogistic. Aristotle next considers inferences from mixed premise pairs consisting of an assertoric proposition and a necessity proposition (*Prior Analytics* 1.9–11). In his view, some of these premise pairs yield a necessity proposition as conclusion. For example, he takes the following schema, known as Barbara NXN, to be valid:

Major premise:	$Aa_N B$	A necessarily belongs to all B
Minor premise:	$Ba_X C$	B belongs to all C
Conclusion:	$Aa_N C$	A necessarily belongs to all C

Barbara NXN allows us to infer a necessity proposition from a necessity major premise and an assertoric minor premise. On the other hand,