

Dialectic and logic in Aristotle and his tradition. Introduction

Sweet Analytics, 'tis thou hast ravish'd me,

Bene disserere est finis logices.

Is to dispute well logic's chiefest end?

Affords this art no greater miracle?

Christopher Marlow, *Doctor Faustus*, Act 1, Scene 1

Anyone who has made her way through Aristotle's *Analytics* will sympathise with Faustus' exhaustion in the first line. But after that initial recognition, Faustus' two questions might strike modern philosophers as unusual, even eccentric. Disputation is *obviously* not the chief end of Aristotle's logic in the *Analytics*, much less logic in general. And *of course* logic affords many greater miracles than giving you the edge in a dialectical dispute. But what exactly is the relationship between Aristotle's logic and dialectic, if any?

This special issue aims to take Faustus' questions a bit more seriously. It is composed of three of the papers presented at a conference held in Groningen in September 2013, whose theme was specifically the relationship of dialectic to logic in the Aristotelian logical tradition, which begins, of course, with Aristotle himself. For reasons of space, we were able to include only three of the many insightful papers presented at the conference in this issue. However, and thanks to the flexibility and good will of the

editors of *History and Philosophy of Logic*, three other papers presented at the conference will also be published in different issues of this journal: B. Castelnérac's 'Impossibility in the *Prior Analytics* and Plato's Dialectic'; M. Marion and H. Rückert's 'Aristotle on Universal Quantification: A Study from the Point of View of Game Semantics'; and P. Thom's 'Robert Kilwardby's disputational logic'. The three papers in this special issue have in common the fact that they all focus on the relationship between logic (as presented in particular in the *Prior Analytics*) and Aristotle's *Topics* and/or *Sophistical Refutations*, thus displaying a nice thematic coherence.

In this introduction, we explain some of the intellectual context into which such recent research falls, and then offer a brief map of the papers themselves. We begin by disarming a booby-trap. The key terms in the title, 'dialectic' and 'logic', have their etymological roots in Ancient Greek. However, the English expressions 'dialectic' and 'logic' do not mean the same as their Greek ancestors, '*dialektikê*' and '*logikê*'. For one thing, the Greek terms are not nouns all by themselves. Rather they are adjectives, closer to 'dialectical' and 'logical', which abbreviate an expression meaning 'the dialectical art' and 'the logical art' or maybe 'the dialectical capacity' and 'the logical capacity'. The expressions '*dialektikê*' and '*logikê*' communicate a sense of being a practical skill or ability (Barnes 2007, 361).

The second point to note here is that '*dialektikê*' and '*logikê*' themselves do not have a stable meaning in Greek philosophy. *Logikê* does not appear with a technical meaning in Aristotle (where it does appear it means 'intellectual' or 'rational' e.g. at *Nichomachean Ethics* 1108b). In Hellenistic philosophy, '*logikê*' does have technical meaning, referring to one of the three canonical branches of philosophy. But, when

contrasted with the study of nature (*phusikê*) and the study of value (*ethikê*), *logikê* includes all of what we call logic, but also large swathes of epistemology, philosophy of science and philosophy of language (Barnes 2007, 453).¹ Philosophical Greek has a narrower term available, namely *sullogistikê*, which picks out the study of deductive reasoning, both formal (*Prior Analytics* 24a28) and informal (*Topics* 100a18-19). But, before you think that ‘logic’ in our title serves as literal translation of *sullogistikê*, be warned that *sullogistikê* in at least some contexts, picks out a capacity or method (*Soph. Elech.* 183a37-38), which is not conveyed by our word ‘logic’.

What about the meaning of ‘*dialektikê*’? At its most literal, ‘*dialektikê*’ simply means ‘the art of conversing’, but in Plato ‘*dialektikê*’ often refers to the philosophical method (*Rep.* 533c; *Rep.* 534e; *Soph.* 253e). What that method is notoriously shifts from attempting to reach definitions by question and answer (*Rep.* 534b) to something more technical, and not necessarily multi-agent, the method of division and collection (*Phaedrus* 266b). Cut to Plotinus, a Platonist writing with a close eye on Plato’s texts, and we find *dialektikê* again given an overarching role in philosophy. *Dialektikê* is an ability to give definitions of a certain sort (*Enneads* I iii 4, 2-4) but *dialektikê* is also a method for evaluating other methods of inquiry, in particular *logikê* and *sullogistikê* (*Enneads* I iii, 18-23) (Barnes 2007, 449-50). In fact, by the time we reach Plotinus, the multi-agent, conversational force of ‘*dialektikê*’ is all but absent. One, broadly Platonic, sense of *dialektikê* is as a method of philosophical inquiry, conversational or not. Clearly, this is not what we mean by ‘dialectic’ in our title.

¹ Incidentally, this tripartition of philosophy arguably stems from Aristotle himself when he divides discursive problems into three sorts: the *ethikê*, the *phusikê* and the *logikê* (*Topics* I 14 105b19-25).

Sextus Empiricus, an excellent source for the Hellenistic schools, as well as an important sceptical philosopher in his own right, uses *dialektikê* in a broad sense that almost has the extension of our English word ‘logic’ and includes both formal (*PH* I 69; *PH* II 146) and informal reasoning (*PH* I 234; *PH* II 94) (*Barnes 2007*, 454). Moreover, logic, like Sextus’ *dialektikê* but unlike Platonic *dialektikê*, can be used to reason about any domain. Of the ancient terminology, this sceptical use of *dialektikê* comes closest to the way we use ‘logic’ in the title of this issue. But that cannot be the whole story. Sextus’ notion of *dialektikê* is not Aristotle’s.

Aristotle’s use of ‘*dialektikê*’ has become the fulcrum around which a key interpretive issue turns. We will say more on this below, but for now, it is worth noting that Aristotle typically uses ‘*dialektikê*’ to mean ‘the method or practice of arguing on the basis of reputable opinions’ (*Barnes 2007*, 454),² for example, at *Topics* 100a30 and *Topics* 100b22. What makes Aristotle’s *dialektikê* distinctive is the (social) epistemic status of the premises. The premises are reputable to everyone, or the majority or the wise (*Topics* 104a9). Of course, there is a formal aspect to Aristotle’s *dialektikê*. *Dialektikê* includes the skill of being able to expose a contradiction within a set of commitments (*Sophistical Refutations* 165b3-4). But clearly, ‘dialectic’ in the title of our issue does not mean something as narrow as this.

In short, ‘logic’ and ‘dialectic’ are not translations, much less transliterations, of any Ancient Greek philosophical expression. Just as well, since the Greek ancestors of ‘logic’ and ‘dialectic’ (*logikê* and *dialektikê*) have their own histories and are by no means univocal. But what, then, do we take these English expressions to mean? ‘Logic’,

² Barnes, as here, typically translates ‘*endoxa*’ as ‘reputable opinions’. For reservations about this translation, see *Berti 1996*, 107n4.

for the purposes of this issue, means the systematic investigation of the relation of consequence; that is, what conclusions validly follow from a premise or set of premises. For our purposes, the noun ‘dialectic’ means a rational multi-agent debate. Dialectic, in our sense, is a practice which involves discussion with an interlocutor following a certain format (thus excluding more mundane, everyday dialogical interactions). Like other recent studies, we understand dialectic to be a debating practice that takes places in a concrete, multi-agent setting.³

What was such a concrete practice like, in Aristotle’s time? Our evidence comes mostly from Plato’s writing and Aristotle’s treatises, especially the *Topics* and *Sophistical Refutations*. We will give here just the barest sketch of what these debates might have been like, but even this template may not capture all of what we find, for example in Plato. What we give here reflects the practice as described in Aristotle’s *Topics*, which is arguably a *regimentation* of the practice documented in Plato’s dialogues, with stricter rules of engagement.⁴ First of all there are the agents: the questioner and the answerer. There may also have been an audience (*Sophistical Refutations* 16 175a20-30). The questioner has two main jobs: First, to extract a thesis, the ‘starting point’ for the debate from the answerer; second, to try to force the answerer to admit the contradictory of that starting point, by getting the answerer to agree to certain premises. Alternatively, the questioner can try to reduce the thesis to absurdity. In either case, the questioner aims to refute the answerer. Crucially, the starting point should be something that can be affirmed or denied (*Topics* 8.2. 158a14-22). For example, ‘what

³ Fink 2012.

⁴ Here we rely on Fink 2012, 2–15 who in turn draws on Brunschwig 1967, xxix–xlv; Moraux 1968, 277–90; Slomkowski 1997, 9–42 and Rapp and Wagner 2004, 11–18).

is knowledge?’ would not be allowed as a starting point, as the answerer cannot reply ‘yes’ or ‘no’. The answerer, on the other hand, has only one task, which is to remain unrefuted within a fixed time (*Topics* 8. 10. 161a1-15). If the answerer is refuted, then the answer should make clear that it is not their fault, but is due solely the starting point (*Topics* 8 4 159a18-22).

In sum, carefully decoupling ‘logic’ from ‘*logikê*’ and ‘dialectic’ from ‘*dialektikê*’ enables us to articulate, with this special issue, a question that would not have occurred to ancient logicians. What is the relationship of multi-agent debate, roughly as described above, to the systematic investigation of consequence in Aristotle and his tradition?

One answer to this question is ‘there is no relationship’ or maybe, ‘there is no special relationship’. An influential reading of Aristotle focuses on dialectic in his science, rather than his logic. The reading is based on the following quotation from the *Topics*:

And [*dialektikê*] is useful for <finding> the first principles of the science in question since the first principles are prior to everything else. Hence it is necessary to discuss them through the common beliefs on each subject. And this is proper to dialectic alone, or to it more than anything else; for since it examines, it has a road towards the first principles of all disciplines (*Topics* 101b1-4, trans. Irwin 1988, 37).

An Aristotelian science begins with first principles and demonstrates conclusions from them, roughly in the manner of Euclid’s *Elements*. *Dialektikê*, at this point in the *Topics*,

seems to pave us a road to those first principles. On this view, one might say that dialectic would not have much to do with logic. Dialectic generates starting points for science while logic is the study of consequence. If dialectic did have something to do with logic, it would only be in so far as syllogistic, say, is a science. In that case, dialectic may have a role to play in establishing the first principles.⁵ But this is a quite uninteresting answer to our question. Dialectic has precisely the same relationship to logic as dialectic does to geometry, arithmetic or biology. Such an answer would leave our special issue with very little that is special.

One response to this would deny that *dialektikê* really can deliver first principles, whatever Aristotle thinks. This would potentially make room for a more interesting relationship between logic and dialectic. And Aristotle seems over-optimistic about the prospects for *dialektikê* delivering objective first principles for science. *Dialektikê* begins from the reputable opinions and can show that some set of reputable opinions is inconsistent. At best, then, this approach will deliver a maximally consistent set of beliefs. But being a member of such a set is neither necessary nor sufficient for being an objective first principle of science. It is not necessary because the first principles of a science may be unknown, so the first principle would be outside the set. It is not sufficient because there may be many beliefs within a maximally consistent set of reputable beliefs that are not first principles of any science.

⁵ There was some debate in antiquity over whether logic was indeed an Aristotelian science with Alexander denying it (*in Topica* 3, 28-4.2), in particular because syllogistic does not have the right sort of first principles. Barnes argues that the syllogistic could be an Aristotelian science, but to do so tries to side-step Alexander's worry (*Barnes 2007*, 362-368).

There is a famous family of responses to this problem. Roughly, scholars distinguish two sorts of ‘dialectic’ in Aristotle. ‘Pure dialectic’ is the sort of activity described above. But Aristotle makes room for a ‘methodological’ dialectic, which operates on a subset of the reputable opinions, namely the expert opinions, and can deliver respectable first principles.⁶ It can do so precisely because ‘our practices and language embody a reliance on such experts, frequently making such their judgements constitutive of truth’ (Nussbaum 1982, 280). That is, using dialectic to ‘harmonize’ opinion can get us access to first principles because those expert opinions already embody those principles. Hence we may be able to give a reading which makes sense of Aristotle’s insistence that *dialektikê* has a special relationship to science. If so, we might think that dialectic does not have any special relationship to logic. This conclusion, we think, would be hasty. Suppose Nussbaum and Irwin are right and methodological dialectic has a special relationship to science. This does not prevent ‘pure’ dialectic from having an interesting, indeed, special relationship to the investigation of consequence. Nor would it prevent multi-agent debate from having an interesting relationship to such investigations in Aristotle.

What interesting relationships are there, then, between multi-agent debate and Aristotle’s investigations of consequence? One perennial answer is that there is a historical relationship between dialectic and logic, syllogistic logic in particular. It is widely held, if not always articulated these days, that the dialectical practices that

⁶ Nussbaum 1982, 275-283 and Nussbaum 1986, chap. 8. There are differences within this family: Irwin 1988, 14–15. For criticism of Irwin and an alternative approach to some of these questions see Berti 1996.

Aristotle describes, and which were no doubt taught in the Academy, are the historical antecedent of the formal logic of the syllogistic.⁷

However, scholars often do not clearly distinguish the historical question of the relationship of dialectic to logic from the developmental question of whether Aristotle wrote the *Topics* before the *Prior Analytics*. Scholars usually hold that the *Topics*, at least most of it, antedates the *Prior Analytics*.⁸ But this claim about the relative dating of two of Aristotle's works neither entails, nor is entailed by, the claim that dialectic is the historical antecedent of syllogistic. None of our papers address themselves to the question of dating Aristotle's treatises, so having made this clarification, we can set the developmental question aside.

To return to the historical question: what considerations might be brought to bear to show that Aristotle's logic originates in dialectical practice, in particular, the practice Aristotle knew from the Academy? Kapp cites one sort of evidence, namely, terminology. For example, the Greek word, '*protasis*', translated as 'premise', as it appears in the *Prior Analytics*, literally means something offered, especially in a dialectical debate. Moreover, Aristotle sometimes uses verbs like '*erôtân*' ('to question') to mean 'lay down a premise' (Kapp 1975, 43). That is, logic uses some of the same technical terminology as dialectic. However, there is a problem with simplistically taking terminology as evidence for a dialectical history to logic. The bulk of the technical terminology in Aristotle's logical works has a *mathematical* origin and not a dialectical

⁷ On dialectic in the Academy, see Ryle 1968 and Castelnérac and Marion 2009. For this historical claim, see Kapp 1975, 41 and Kapp 1942. Kapp credits Brandis 1833 with the first articulation of this view.

⁸ Since Brandis 1833, 252–9; Ross 1939, 251–2; Kneale and Kneale 1962, 23–4; Allen 1995, 179; Brunschwig 1967, lxxxvi–lxxxix; Striker 2009, xii cited, amongst others, in Malink 2015, 267n2. For a response to Ross, see Solmsen 1941.

one.⁹ Even a term like ‘*protasis*’ begins as a mathematical term of art (*Einarson 1936*, 34). The evidence of terminology is at best inconclusive and at worst points to a non-dialectical origin of Aristotle’s logic.

Philology, then, does not straightforwardly prove the historical relationship between dialectic and logic in Aristotle. Can philosophy help? Another sort of historical argument runs like this: (1) Dialectic has some feature, *F*. (2) Logic shares *F*. (3) The best explanation for dialectic and logic sharing *F* is that logic develops from dialectic (C). So, logic develops from dialectic. This argument form is an inference to the best explanation and so it is hard to say anything conclusive at this level of generality. Whether such arguments are persuasive really depends on whether there really are some features that dialectic and logic share and whether the development from one to the other really is the best explanation for the shared features.

So far we have mentioned two sorts of answer to the question ‘what has dialectic to do with logic in Aristotle?’. The first answer is that there is no special relationship. The second answer is that there is a historical relationship: Aristotle’s logic developed from dialectical practice. Both types of answer have venerable proponents and extensive discussion in the secondary literature. But more recently, a third sort of answer has begun to distinguish itself, according to which there is a special relationship between dialectic and logic in Aristotle: a conceptual one. Thinking about dialectical contexts conditions Aristotle’s thinking about logic. This position is nicely summed up by Hintikka: ‘the

⁹ *Einarson 1936*. Warning: mathematics and dialectic may not be exclusive at this time. *Netz 1999* argues that there are important dialectical features of ancient mathematical practice from around this period.

theory of the two *Analytiks* presupposes in certain fundamental respects a dialectical framework not unlike that of the *Top[ics]*' (Hintikka 1995, 206).

For example, in the *Prior Analytics* at 24b18–20, Aristotle defines a *syllogismos* such that the conclusion must differ from each premise and any conjunction of premises. Philosophers of logic usually reject an irreflexive consequence relation. But it turns out that such a consequence relation makes sense for Aristotle, when we consider the dialectical contexts he (presumably) has in mind.¹⁰ Other recent studies have tended to emphasise the relationship between Aristotle's conceptualization of logic and his conceptualization of dialectic, in a way that is more detached from the narrowly historical concerns of which came first. This includes the papers in this issue.

The conceptual approach differs from the historical one. Claims about conceptual relationships are independent of claims about historical relationships. This has some significant scholarly advantages. For instance, it allows us to bring investigations of dialectic from the later Aristotelian logical tradition into conversation with philosophical treatments of the earlier material, without worrying that such an approach is automatically anachronistic.¹¹ But at the same time, conceptual work can be useful for those who wish to make the historical claim that dialectic is the antecedent of Aristotle's logic. After all, perhaps the best explanation of a conceptual connection between dialectic and logic may well be that the latter developed from the former.¹²

¹⁰ For further discussion of this see *Duncombe 2014*.

¹¹ Thom's 'Robert Kilwardby's disputational logic', for example, exploits this idea.

¹² In fact *Kapp 1975*, 38–41 gives several arguments, of, it must be said, variable quality that share this basic strategy. Castelnérac's 'Impossibility in the *Prior Analytics* and Plato's Dialectic' also offers an argument of this sort.

One specific sort of conceptual approach deserves a mention, as it is perhaps the most developed of such approaches.¹³ In general, conceptual approaches say that Aristotle's thinking about dialectic conditions Aristotle's thinking about logic. But what if we take a specific view of dialectic in Aristotle? Aristotle's dialectic, on some readings, is a *dialogic game*.¹⁴ The practice that Aristotle describes in the *Topics*, sketched above, looks like a dialogic game in the strict sense. The questioner and the answerer can be understood as 'players'. There is a starting condition. There are rules by which the 'players' take turns and rule governing the 'moves' the players can make. Apparently there are winning conditions for each player and at most one player can win.

All this tempts us to construe Aristotle's dialectic game-theoretically, for example in terms of Lorenzen and Lorenz's dialogic logic.¹⁵ In this case, Aristotle's logic would be based on a dialogical game and could be explained game-theoretically. What this means for the philosophy of logic is debated.¹⁶ But those who study Aristotle can exploit the relation between his logic and the game reading of dialectic. Some features of Aristotle's logic, such as his idiosyncratic views on the universal quantifier, can be explained by connecting his logic to his dialectic, understood as a dialogic game.¹⁷

We have distinguished three approaches to the relation of dialectic and logic in Aristotle: nothing special, historical, conceptual. But one final point to make in this part of the introduction concerns what we mean by 'logic'. Above, we roughly characterised 'logic' as the study of consequence and use the ideas of 'formal' and 'informal' logic.

¹³ Hintikka 1987; Hintikka 1995; Hintikka 1997; Castelnérac and Marion 2009.

¹⁴ Hintikka 1995, 207; Hintikka 1997.

¹⁵ Lorenzen and Lorenz 1978.

¹⁶ Hodges 2013; Marion 2009; Woods 2013.

¹⁷ This is precisely what Marion and Rückert do in their 'Aristotle on Universal Quantification: A Study from the Point of View of Game Semantics'.

There is a tendency in the literature on Aristotle to think that the *Topics* and *Sophistical Refutations* are concerned with informal logic while the *Prior Analytics* is concerned with formal logic.¹⁸ Some scholars then go even further and hold that the logic of the *Prior Analytics* is formal because it is concerned with logical form.¹⁹

Fortunately, for our present purposes, we need not settle the question of whether the logic of the *Prior Analytics* is ‘formal’ and whether this contrasts with the ‘informal’ logic of the *Topics* and *Sophistical Refutations*. It is clear that all three works, broadly speaking, are investigations of consequence, each giving, as they do, a definition of ‘*syllogismos*’ (*Prior Analytics* I.2, 24b18–20; *Topics* I 1 100a25–26; *Sophistical Refutations* 167a23–27). While, strictly speaking, Aristotle’s definitions pick out a class of arguments, the *syllogismoi*, rather than a consequence relation, it is easy to see that all *syllogismoi* are such that a consequence relation holds between the premises and conclusion. Whether we are in the context of ‘formal’ or ‘informal’ logic, Aristotle investigates consequence and so, in any of these contexts, we can ask what role dialectic plays.

As mentioned above, the three papers contained in this issue focus on the *Topics* and/or *Sophistical Refutations* and their relationships with the ‘formal’ logic of the *Prior Analytics*. L. Castagnoli’s paper focuses on Aristotle’s requirement that there must be some kind of causal connection between the premises and the conclusion in a valid syllogistic argument; failure to comply with this requirement corresponds to the *Non-*

¹⁸ It turns out not to be a simple matter to say in what sense the logic of the *Topics* is ‘informal’ in contrast to that of the ‘formal’ *Prior Analytics*. For a recent discussion see Malink 2015. On the general issue of what it is to be a formal logic, see Dutilh Novaes 2011 and MacFarlane 2000.

¹⁹ Oehler 1962, 13–17 cited in Allen 1995, 183.

cause fallacy. He argues that, in virtue of this essentially dialectical requirement, the consequence relation underlying syllogistic is non-monotonic (basically, a relevant consequence relation), thus illustrating the conceptual connection between dialectical concepts and the very notion of syllogistic consequence. In a similar vein, C. Swanson's paper focuses on another fallacy as discussed in the *Topics* and the *Sophistical Refutations*, namely the *fallacy of begging the question*. She argues that, if begging the question is exposed as "a defect in syllogistic reasoning (as opposed to a mere 'dialectical' foul)", this lends further corroboration to the idea that the conceptual origin of Aristotle's definition of syllogism is to be traced back to the scoring system in the game of dialectic.

D. Merry's paper in turn argues for a very different view, in fact in a sense it argues for a variant of the view that there does not seem to be any privileged relation between dialectic and logic in Aristotle, in particular given "the solitary nature of philosophical inquiry" on Merry's interpretation. His interpretation presents philosophy (and logic) as emerging as a *reaction* against the explicitly multi-agent setting of dialectic. This is in stark contrast with the views of both editors of this special issue, as well as with the two other papers included. However, it is precisely because we, the editors, feel that the dialectical method of confronting opposing views is extremely valuable that we have included this paper in the issue. It is a careful, compelling and insightful defence of an opposing view, and thus a worthy opponent for the continuation of this debate.

We hope that this collection of papers (as well as the sibling papers to be published in other issues of this journal) will represent an important contribution to the ongoing debates on the nature of Aristotle's logic, or even logic in general. In our

opinion, they bring forward the significant conceptual affinities between dialectic and Aristotle's logic, thus offering further (albeit not decisive) evidence for dialogical conceptions of logic.

References

- Allen, J. 1995. 'The development of Aristotle's logic: part of an account in outline', *Proceedings of the Boston Area Colloquium in Ancient Philosophy*, **11**, 177–205.
- Barnes, J. 2007. *Truth, Etc.*, Oxford: Oxford University Press.
- Berti, E. 1996. 'Does Aristotle's conception of dialectic develop?', in W. Wains (ed.) *Aristotle's Philosophical Development: Problems and Prospects*. Lanham, Maryland, USA.: Rowman & Littlefield Publishers, Inc.
- Brandis, C. 1833. *Über die Reihenfolge der Bücher des Aristotelischen Organons und ihre Griechischen Ausleger*, Berlin: Berliner Akademie der Wissenschaften.
- Brunschwig, J. 1967. *Topiques. Tome I: Livres I-IV*, Paris: Les Belles Lettres.
- Castelnérac, B., and Marion, M. 2009. 'Arguing for inconsistency: dialectical games in the academy', in G. Primiero and S. Rahman (eds.) *Acts of Knowledge: History, Philosophy and Logic*. London: College Publications.
- Dutilh Novaes, C. 2011. 'The different ways in which logic is (said to be) formal', *History and Philosophy of Logic*, **32**, 303–32.
- Einarson, B. 1936. 'On certain mathematical terms in Aristotle's logic: Part I', *The American Journal of Philology*, **57**, 33–54.
- Fink, J. 2012. *The Development of Dialectic from Plato to Aristotle*, New York: Cambridge University Press.
- Hintikka, J. 1987. 'The fallacy of fallacies', *Argumentation*, **1**, 211–38.
- . 1995. 'Commentary on Allen', *Proceedings of the Boston Area Colloquium of Ancient Philosophy*, **11**, 206–15.
- . 1997. 'What was Aristotle doing in his early logic, anyway? A reply to Woods and Hansen', *Synthese*, **113**, 241–49.
- Hodges, Wilfrid. 2013. 'Logic and games', in E. Zalta (ed.) *The Stanford Encyclopedia of Philosophy (Spring 2013 Edition)*. URL = <http://plato.stanford.edu/archives/spr2013/entries/logic-games/>.
- Irwin, T. 1988. *Aristotle's First Principles*, Oxford: Clarendon Press.
- Kapp, E. 1942. *Greek Foundations of Traditional Logic*, New York: Columbia University Press.
- . 1975. 'Syllogistic', in J. Barnes, M. Schofield and R. Sorabji (eds.) *Articles on Aristotle*, **1**, 35–49. Originally published as 'Syllogistik' in Paul-Wissowa (ed.) *Real-Encyclopädie der classic den Altertumswissenschaft (1931)*, **4**, cols. 1046–67. Reprinted in E. Kapp. 1968. *Ausgewählte Schriften*, Berlin: Gruyter.

- Kneale, W. and Kneale, M. 1962. *The Development of Logic*, Oxford: Oxford University Press.
- Lorenzen, P. and Lorenz, K. 1978. *Dialogische Logik*, Darmstadt: Wissenschaftliche Buchgesellschaft.
- MacFarlane, J. 2000. *What does it mean to say that logic is formal?*, unpublished PhD dissertation.
- Malink, M. 2015. 'The beginnings of formal logic: deduction in Aristotle's *Topics* vs. *Prior Analytics*', *Phronesis*, **60**, 267–309.
- Marion, M. 2009. 'Why play logical games?', in O. Majer, A.-V. Pietarinen and T. Tulenheimo (eds.) *Games: Unifying Logic, Language, and Philosophy. Logic, Epistemology, and the Unity of Science* **15**. Amsterdam: Springer.
- Morau, P. 1968. 'La joute dialectique d'après le huitième livre des *Topiques*', in G.E.L. Owen (ed.) *Aristotle on Dialectic: The Topics*. Oxford: Clarendon Press.
- Netz, R. 1999. *The Shaping of Deduction in Greek Mathematics*, Cambridge: Cambridge University Press.
- Nussbaum, M. 1982. 'Saving Aristotle's appearances', in M. Schofield and M. Nussbaum (eds.) *Language and Logos: Studies in Ancient Greek Philosophy*. Cambridge: Cambridge University Press.
- . 1986. *The Fragility of Goodness: Luck and Ethics in Greek Tragedy and Philosophy*, Cambridge: Cambridge University Press.
- Oehler, K. 1962. *Die Lehre vom noetischen und dianoetischen Denken bei Platon und Aristoteles*, Munich: C. H. Beck.
- Rapp, C. and Wagner, T. 2004. *Aristoteles Topik*, Stuttgart: Reclam.
- Ross, W. D. 1939. 'The discovery of the syllogism', *The Philosophical Review*, **48**, 251–72.
- Ryle, G. 1968. 'Dialectic in the Academy', in G. E. L. Owen (ed.) *Aristotle on Dialectic: The Topics*, Oxford: Clarendon Press.
- Slomkowski, P. 1997. *Aristotle's Topics*, Leiden: Brill.
- Solmsen, F. 1941. 'The discovery of the syllogism', *The Philosophical Review*, **50**, 410–21.
- Striker, G. 2009. *Aristotle: Prior Analytics, Book I*, Oxford: Clarendon Press.
- Woods, John. 2013. 'Ancestor worship in the logic of games. How foundational were Aristotle's contributions?', *Baltic International Yearbook of Cognition, Logic and Communication*, **8**, 1–38.