History of Logic from Aristotle to Gödel by Raul Corazzon | e-mail: rc@ontology.co

Selected Bibliography on Aristotle's Theory of Categorical Syllogism

BIBLIOGRAPHY

1. Angelelli, Ignacio. 1978. "*Analytica priora*, I, 38 and Reduplication." *Notre Dame Journal of Formal Logic* no. 19:295-296.
"Although many commentators have summarized chapter 38 of *Analytica Priora I* as if it was perfectly clear to them, I have not found their explanations satisfactory enough. In fact, I think Aristotle's text needs badly some sort of clarification that makes it meaningful to modern logicians. In this note I wish to propose one such reconstruction."

2. Bäck, Allan. 1982. "Syllogisms with reduplication in Aristotle." *Notre Dame Journal of Formal Logic* no. 23:453-458.
"*Prior Analytics* 1.38 is a difficult text that offers a way of handling qua propositions in formal syllogistic. By 'qua proposition' I mean a proposition that contains a qualifying term, phrase, or clause. Many such propositions have a qua connector like 'qua', 'insofar as', 'in virtue of the fact that', 'with respect to', although in some cases a construction like an accusative of respect occurs
instead of an explicit connective.(1) Still, all qua propositions may be paraphrased by explicit qua connectives. So the class of qua propositions is a grammatical class of propositions of the form *'S* is *P* qua *M'* The *Prior Analytics* chapter deals with a specific logical type of qua propositions, and its syllogistic properties.(2)"
(1) Alexander of Aphrodisias, *In Aristotelis Analyticorum Priorum Librum I Commentaria,* ed., Wallies, Berlin, 1883.
(2) Alexander of Aphrodisias, *Themistius, Quae Fertur In Analyticorum Priorum Librum I Paraphrasis,* ed., Wallies, Berlin, 1883.

3. ———. 1996. *On Reduplication. Logical Theories of Qualification*. Leiden: Brill.
"This work deals with the logical properties of the *'qua'* connective, "that treacherous little word 'as'." This connective is represented by many expressions in ordinary language, such as 'insofar as', 'in virtue of, and 'in the sense that'. Traditionally, a use of this connective was called a reduplication. I shall trace the development of the theory of reduplication. As I shall show, this theory has its roots in various passages where Aristotle discusses 'qua' propositions. Islamic and Latin medieval philosophers then contributed to the topic. From all this there arose a theory of *'qua'* propositions, or a theory of reduplication, in the high medieval period (1250-1350). Although there are of course different philosophers with different views on reduplication in that period, it will become clear that their views are extremely similar, and that it makes sense to talk of the rise of a single theory' of reduplication. Indeed, the similarity of their views is due to their using Aristotle's works as a common reference point: They all heed what Aristotle says about *'qua'* propositions, and attempt to offer analyses that demonstrate the truth of those *'qua'* propositions that Aristotle (as well as others in the Aristotelian tradition) asserts and the validity of inferences involving 'qua' propositions that he maintains.
So I shall be dealing with propositions of form 'S is P *qua* M', which, dropping the

italics and the single quotes, I shall henceforth call 'qua propositions'. 'Qua' will represent the type of the connective, which has different grammatical forms. When 'qua' appears in italics, it is meant to be the particular connective, *'qua'*.
The program that I shall follow is this: First, I shall consider those passages in which Aristotle discusses the use of qua phrases and propositions. Next, I shall discuss Islamic philosophers, who wrote about qua propositions while commenting on those passages in Aristotle. Then I shall consider Latin medieval philosophers of the period of the old logic, when the Analytics and the *Sophistical Refutations,* which contain important passages on qua propositions, were at best not well known. Next, I shall discuss various versions of what may be loosely called the theory of reduplication. I shall consider various philosophers of the High Middle Ages on the following topics: determination, or the qualification of a sentence by a modifier; the fallacy of *secundum quid es simpliciter;* the exposition of reduplicative propositions; the conversion of reduplicative propositions; the reduplicative syllogistic; the supposition of terms in qua propositions. I shall also discuss certain uses to which the theory of reduplication was put: notably, the Incarnation, the nominalist reduction of abstract terms, and supposition theory. Next, I shall discuss the post-medieval period, where the medieval theory of reduplication was codified and developed further. I shall consider there the classifications and analysis of qua propositions, the formal features of the logical types distinguished, and applications, including Leibniz's extensive use of qua propositions in his writings. I shall conclude with a survey of current work on qua propositions. Finally, I shall summarize the historical development of the theory of reduplication, offer what I consider to be the best version of that theory, and note some applications of it." (pp. XV-XVI)

4. Barker, Evelyn M. 1984. "Unneeded Surgery on Aristotle's "Prior Analytics"." *Notre Dame Journal of Formal Logic* no. 25:323-331.
"The article takes issue with Ross's bracketing of lines 45a9-16 of Aristotle's "Prior Analytics" I 28 because they involve Aristotle in an "elementary logical error." Describing Aristotle's "method of identities" for finding syllogistic premises, I point out the lines contain an essential leg of Aristotle's argument that this method handles all cases in which the incompatibility between the attributes of a subject e and a predicate a generates a syllogistic conclusion that A does not belong to some E. Also, Aristotle's claim that incompatibility of attributes in such cases always resolves into identity of attributes is valid."

5. Barnes, Jonathan. 1981. "Proof and the Syllogism." In *Aristotle on Science. The "Posterior Analytics". Proceedings of the eighth Symposium Aristotelicum held in Padua from September 7 to 15, 1978*, edited by Berti, Enrico, 17-59. Padova: Antenore.

6. ———. 1999. "Grammar on Aristotle's Terms." In *Rationality in Greek Thought*, edited by Frede, Michael and Striker, Gisela, 175-202. Oxford: Clarendon Press.
"However that may be, Aristotelian syllogistic concerned itself exclusively with monadic predicates. Hence it could not begin to investigate multiple quantification. And that is why it never got
very far. None the less, the underlying grammar of Aristotle's logic did not in itself block the path to polyadicity. The later Peripatetics were conservative creatures and they lacked logical imagination.
Moreover, Aristotle himself had assured them that his syllogistic was adequate for all serious scientific needs. As for Aristotle, his service to logic is nonpareil, and it would be grotesque to hide him for lack of inventiveness. It is true that, in logical grammar, he did not climb above the level which he attained in the *de*

Interpretatione. But the *Analytics* does not represent a fatal, or even a new, grammatical excursion. And the story of Aristotle's fall, like the story of the fall of Adam, is a myth."

7. Berka, Karel. 1991. "La syllogistique aristotélicienne, reconstruction historico-logique." In *Penser avec Aristote*, edited by Sinaceur, Mohammed Allal, 429-432. Paris: Éditions érès.

8. Boger, George. 2001. "The Modernity of Aristotle's Logic." In *Aristotle and Contemporary Science. Vol. II*, edited by Sfendoni-Mentzou, Demetra, Hattiangadi, Jagdish and Johnson, David M., 97-112. Bern: Peter Lang.
"Summary.
We have identified five aspects of Aristotle's syllogistic to highlight the remarkable modernity of his logical investigations: (1) Aristotle took logic to be a formal part of epistemology. A logic is an instrument for establishing knowledge of logical consequence; this is a principal concern of the science of logic. (2) *Prior Analytics* is a metalogical treatise on the syllogistic deduction system. Aristotle exhaustively treated all possible combinations of elemental "syllogistic" argument patterns to determine which have only valid argument instances. (3) Aristotle recognised the epistemic efficacy of certain elemental argument patterns having only valid instances, and he explicitly formulated them as rules of natural deduction in corresponding sentences. (4) *Prior Analytics* is a proof-theoretic treatise in which Aristotle described a natural deduction system and demonstrated certain of the logical relationships among syllogistic rules. In fact, Aristotle modelled his syllogistic in a rudimentary way for this purpose. One important metasystematic result is to have established the independence of a set of deduction rules. Finally, (5) Aristotle worked with a notion of substitution sufficient for distinguishing logical syntax and semantics. In this connection he also distinguished validity from deducibility sufficiently well to note the completeness of his logic.
Our reading of *Prior Analytics* takes Aristotle to have treated the process of deduction much as modern mathematical logicians do and not to have been confused about some fundamental matters of logic. Least of all was he confused, as some commentators believe, about a distinction between "following necessarily" and "being necessary," both in respect of the distinction between a *syllogismos* or a deduction and a demonstration and of the distinction between assertoric logic and modal logic. Aristotle clearly distinguished between (1) a given sentence's following necessarily from other given sentences and (2) a given sentence denoting a state of affairs to be necessary (or possible). Seeing that he was concerned with the deduction process helps us to avoid such an error. In any case, Aristotle recognised that, while the conclusion of a given argument follows necessarily from its premises, this necessity might not be evident to a participant. He knew that the epistemic process of deduction produces knowledge, or makes evident, that a given sentence follows necessarily from other given sentences. He considered the product of this epistemic process to be an argumentation that includes a deductive chain of reasoning in addition to the premises and conclusion. He recognised using deduction rules in the epistemic process for establishing validity, and that this process can be applied in a purely mechanical and computational way. Furthermore, Aristotle distinguished (1) the subject matter of a given argument from (2) the use to which a given argument might be put from (3) the varying expertise of a participant. All these matters are distinct from (4) the formal matters underlying any of them. And precisely to examine these formal matters was his project in *Prior Analytics.* In this connection, then, we understand Aristotle to have distinguished two kinds of

knowledge that cannot be otherwise: (1) knowledge of what is true or false, which pertains to sentences, and (2) knowledge of what valid or invalid, which pertains to arguments." pp. 110-111

9. Clark, Michael. 1980. *The Place of Syllogistic in Logical Theory*. Nottingham: University of Nottingham Press.

10. Corcoran, John. 1972. "Completeness of an Ancient Logic." *Journal of Symbolic Logic* no. 37:696-702.
"In previous articles ([4], [5]) it has been shown that the deductive system developed by Aristotle in his "second logic" (cf. Bochenski [2, p. 43]) is a natural deduction system and not an axiomatic system as previously had been thought [6].
It was also pointed out that Aristotle's logic is self-sufficient in two senses: First, that it presupposed no other logical concepts, not even those of propositional logic; second, that it is (strongly) complete in the sense that every valid argument formable in the language of the system is demonstrable by means of a formal deduction in the system. Review of the system makes the first point obvious. The purpose of the present article is to prove the second. Strong completeness is demonstrated for the Aristotelian system." (p. 696)
[2] I. M. BOCHENSKI, A history of formal logic (translated by Ivo Thomas), Chelsea, New York, 1970.
[4] JOHN CORCORAN, Aristotle's natural deduction system, this JOURNAL, vol. 37 (1972), 437. Abstract.
[5] __, A mathematical model of Aristotle's syllogistic, Archiv für Geschichte der Philosophie vol. 55 (1973), 191-219.
[6] JAN LUKASlEWICZ, Aristotle's syllogistic from the standpoint of modern formal logic, Press, Oxford, 1951.

11. ———. 1973. "A Mathematical Model of Aristotle's Syllogistic." *Archiv für Geschichte der Philosophie* no. 55:191-219.
"Our purpose in the present article is to present a mathematical model designed to reflect certain structural aspects of Aristotle's logic. Accompanying the presentation of the model is an interpretation of certain scattered parts of the Prior and *Posterior Analytics.* Although our interpretation does not agree in all respects with those previously put forth, the present work would have been impossible without the enormous ground work of previous scholars - especially Jenkinson, Łukasiewicz and W. D. Ross - to whom we are deeply grateful.
Our interpretation restores Aristotle's reputation as a logician of consumate imagination and skill. Several attributions of shortcomings and logical errors to Aristotle are seen to be without merit. Aristotle's logic is found to be self-sufficient in several senses. In the first place, his theory of deduction is logically sound in every detail. (His indirect deductions' have been criticized, but incorrectly on our account.) In the second place, Aristotle's logic presupposes no other logical concepts, not even those of propositional logic. In the third place, the Aristotelian system is seen to be complete in the sense that every valid argument statable in his system admits of a deduction within his deductive system, I. e. every semantically valid argument is deducible.
In the present paper we consider only Aristotle's theory of non-modal logic which has been called "the theory of the assertoric syllogism" and "Aristotle's syllogistic." Aristotle presents the theory almost completely in Chapters 1, 2, 4, 5 and 6 of the first book of *Prior Analytics,* although it presupposes certain developments in previous works - especially the following two : first, a theory of form and meaning of propositions having an essential component in *Categories* (Ch. 5, esp. 2a 34- 2b

7) ; second, a doctrine of opposition (contradiction) more fully explained in *De Interpretatione* (Ch. 7, and cf. Ross, p. 3)." p. 191

12. ———. 1974. "Aristotelian Syllogisms: Valid Arguments or True Universalized Conditionals?" *Mind* no. 83:278-281.

13. ———. 1974. "Aristotle's Natural Deduction System." In *Ancient Logic and Its Modern Interpretations. Proceedings of the Buffalo Symposium on Modernist Interpretations of Ancient Logic, 21 and 22 April, 1972*, edited by Corcoran, John, 85-131. Dordrecht: Reidel.
"In the present article we attempt to show that Aristotle's syllogistic is an underlying logic which includes a natural deductive system and that it is not an axiomatic theory as had previously been thought. We construct a mathematical model which reflects certain structural aspects of Aristotle's logic and we examine both the mathematical properties of the model and the relation of the model to the system of logic envisaged in certain scattered parts of *Prior* and *Posterior Analytics*.
Our interpretation restores Aristotle's reputation as a logician of consummate imagination and skill. Several attributions of shortcomings and logical errors to Aristotle are shown to be without merit. Aristotle's logic is found to be self-sufficient in several senses. In the first place, his theory of deduction is logically sound in every detail. (His indirect deductions have been criticized, but incorrectly on our account.) In the second place, Aristotle's logic presupposes no other logical concepts, not even those of propositional logic. In the third place, the Aristotelian system is seen to be complete in the sense that every valid argument expressible in his system admits of a deduction within his deductive system; i.e., every semantically valid argument is deducible.
There are six sections in this article. The first section includes methodological remarks, a preliminary survey of the present interpretation and a discussion of the differences between our interpretation and that of Łukasiewicz. The next three sections develop the three parts of the mathematical model. The fifth section deals with general properties of the model and its relation to the Aristotelian system. The final section contains conclusions." p. 85
"As a kind of summary of our research we present a review of what we take to be the fundamental achievements of Aristotle's logical theory. In the first place, he clearly distinguished the role of deduction from the role of experience (or intuition) in the development of scientific theories. This is revealed by his distinction between the axioms of a science and the logical apparatus used in deducing the theorems. Today this would imply a distinction between logical and nonlogical axioms; but Aristotle had no idea of logical axioms (but cf. 77a22-25). Indeed, he gave no systematic discussion of logical truth *(Axx* is not even mentioned once). In the second place, Aristotle developed a natural deduction system which he exemplified and discussed at great length. Moreover, he formulated fairly intricate metamathematical results relating his central system to a simpler one. It is also important to notice that Aristotle's system is sound and strongly complete. In the third place, Aristotle was clear enough about logical consequence so that he was able to discover the method of counter instances for establishing invalidity. This method is the cornerstone of all independence (or invalidity) results, though it probably had to be rediscovered in modern times (cf. Cohen and Hersh). In the fourth place, his distinction between perfect and imperfect syllogisms suggests a clear understanding of the difference between deducibility and implication -- a distinction which modern logicians believe to be their own (cf. Church, p. 323, fn. 529). In the fifth place, Aristotle used principles concerning form repeatedly and accurately, although it is not possible to

establish that he was able to state them nor is even clear that he was consciously aware of them as logical principles.

The above are all highly theoretical points -- but Aristotle did not merely theorize; he carried out his ideas and programs in amazing detail despite the handicap of inadequate notation. In the course of pursuing details Aristotle originated many important discoveries and devices. He described indirect proof. He used syntactical variables (alpha, beta, etc.) to stand for content words -- a device whose importance in modern logic has not been underestimated. He formulated several rules of inference and discussed their interrelations.

Philosophers sometimes say that Aristotle is the best introduction to philosophy. This is perhaps an exaggeration. One of the Polish logicians once said that the *Analytics* is the best introduction to logic. My own reaction to this remark was unambiguously negative -- the severe difficulties in reading the *Analytics* form one obstacle and I felt then that the meager results did not warrant so much study. After carrying out the above research I can compromise to the following extent. I now believe that Aristotle's logic is rich enough, detailed enough, and sufficiently representative of modern logics that a useful set of introductory lectures on mathematical logic could be organized around what I have called the main Aristotelian system.

From a modern point of view, there is only one mistake which can sensibly be charged to Aristotle: his theory of propositional forms is very seriously inadequate. It is remarkable that he did not come to discover this for himself, especially since he mentions specific proofs from arithmetic and geometry. If he had tried to reduce these to his system he may have seen the problem (cf. Mueller, pp. 174-177). But, once the theory of propositional forms is taken for granted, there are no important inadequacies attributable to Aristotle, given the historical context. Indeed, his work is comparable in completeness and accuracy to that of Boole and seems incomparably more comprehensive than the Stoic or medieval efforts. It is tempting to speculate that it was the oversimplified theory of propositional forms that made possible the otherwise comprehensive system. A more adequate theory of propositional forms would have required a much more complicated theory of deduction -- indeed, one which was not developed until the present era." p. 130-131

14. ———. 1989. "Argumentations and Logic." *Argumentation* no. 3:17-43.

15. ———. 1994. "The Founding of Logic. Modern Interpretations of Aristotle's Logic." *Ancient Philosophy* no. 14:9-24.

"Conclusion.

The tendency of interpreters to find an epistemically-oriented theory in Aristotle has been overwhelming. With the exception of James Wilkinson Miller’s 1938 book and the writings of Jan Łukasiewicz and those directly influenced by these two, few interpreters have found a theory of formal ontology in Aristotle’s Prior Analytics. Down through the ages, with these exceptions, interpreters have agreed that Prior Analytics is about methods of determining validity and invalidity of arguments. People studied Prior Analytics in order to learn more about deductive reasoning and in order to improve their own reasoning skills.

Despite the overwhelming tendency to interpret the syllogistic epistemically it wasn’t until the early 1970s that it occurred to anyone to wonder whether Aristotle had a developed theory of deductive reasoning with a well worked-out system of deductions comparable in rigor and precision with the systems then familiar from mathematical logic. Of the logicians that studied Prior Analytics from this point of view, two of them published articles in same twelve-month period with remarkably similar systems affirming in clear and unequivocal terms the epistemic nature of

Prior Analytics: Corcoran 1972 and Smiley 1973.
The simpler of the two articles holds that Aristotle's theory of deductions recognizes two kinds of extended deductions of conclusions from arbitrarily large premise sets: direct deductions and indirect deductions. A direct deduction of a conclusion from given premises begins with the premises and proceeds by chaining together simple one-premise and two-premise inferences until the conclusion is reached. An indirect deduction of a given conclusion from given premises is in effect a direct deduction of a pair of contradictory opposites from the premises augmented by the contradictory opposite of the conclusion. This view is spelled out in more detail in the introduction to Smith's 1989 translation of Aristotle's Prior Analytics.
According to the ontic interpretation the syllogistic is a system of true propositions about inclusional relations among classes. It is a system which is organized deductively, axioms followed by deduced theorems, by employment of an underlying logic never explicitly mentioned by Aristotle. It is a system whose place in the Organon, in Greek philosophy, and in the history of philosophy raises many problems. When we turn to the epistemic interpretation the changes are dramatic. From the epistemic perspective the syllogistic is a system of deductions or chains-of-reasoning. It is organized according to an initial-versus-derivative structure with the derivative components as chainings of initial components. It is a system which can be seen to explain epistemic processes of deduction presupposed by the Socratic hypothetical method, by the so-called method of analysis, by the axiomatic method and even by dialectic itself. According to the epistemic interpretation, the focus of the syllogistic is on methods as opposed to results; it concerns the process of deduction rather than conclusions per se. One might say that it concerns how to think rather than what to think. And it is a step toward understanding the nature of proof as opposed to persuasion and toward fulfilling the demand made by Socrates in the Phaedo for a techné logiké. This step made by Aristotle was so firm, so detailed, and so well-developed that it warrants the title of THE FOUNDING OF LOGIC." (pp. 19-20)

16. ———. 2003. "Aristotle's *Prior Analytics* and Boole's *Laws of Thought*." *History and Philosophy of Logic* no. 24:261-288.
"*Prior Analytics* by the Greek philosopher Aristotle (384 - 322 BCE) and *Laws of Thought* by the English mathematician George Boole (1815 - 1864) are the two most important surviving original logical works from before the advent of modern logic. This article has a single goal: to compare Aristotle's system with the system that Boole constructed over twenty-two centuries later intending to extend and perfect what Aristotle had started. This comparison merits an article itself. Accordingly, this article does not discuss many other historically and philosophically important aspects of Boole's book, e.g. his confused attempt to apply differential calculus to logic, his misguided effort to make his system of 'class logic' serve as a kind of 'truth-functional logic', his now almost forgotten foray into probability theory, or his blindness to the fact that a truth-functional combination of equations that follows from a given truth-functional combination of equations need not follow truth-functionally. One of the main conclusions is that Boole's contribution widened logic and changed its nature to such an extent that he fully deserves to share with Aristotle the status of being a founding figure in logic. By setting forth in clear and systematic fashion the basic methods for establishing validity and for establishing invalidity, Aristotle became the founder of logic as formal epistemology. By making the first unmistakable steps toward opening logic to the study of 'laws of thought' -- tautologies and laws such as excluded middle and non-contradiction -- Boole became the founder of logic as formal ontology."

17. ———. 2009. "Aristotle's Demonstrative Logic." *History and Philosophy of Logic* no. 30:1-20.
"Demonstrative logic, the study of *demonstration* as opposed to persuasion, is the subject of Aristotle's two volume *Analytics*. Many examples are geometrical. Demonstration produces *knowledge* (of the truth of propositions). Persuasion merely produces *opinion*. Aristotle presented a general *truth-and-consequence conception of demonstration* meant to apply to all demonstrations. According to him, a demonstration, which normally proves a conclusion not previously known to be true, is an extended argumentation beginning with premises known to be *truths* and containing a chain of reasoning *showing* by deductively evident steps that its conclusion is a *consequence* of its premises. In particular, a demonstration is a *deduction* whose premises are known to be true. Aristotle's *general* theory of demonstration required a prior *general* theory of deduction presented in the *Prior Analytics*. His general *immediate-deduction chaining conception* of deduction was meant to apply to all deductions. According to him, any deduction that is not immediately evident is an extended argumentation that involves a chaining of intermediate immediately evident steps that *shows* its final conclusion to follow logically from its premises. To illustrate his general theory of deduction, he presented an ingeniously simple and mathematically precise *special* case traditionally known as the *categorical syllogistic*."

18. Crivelli, Paolo. 2001. "Empty terms in Aristotle's logic." *Boston Area Colloquium in Ancient Philosophy* no. 17:237-269.
"Aristotle's logic can accommodate non-referring terms. Genuine affirmations must contain both a referring subject and a referring predicate; sentences that contain non-referring subjects or non-referring predicates are not genuine assertions. In appendix : The translation of *De interpretatione* 8. 18A23."

19. Cutler, Darcy Allen. 2005. "Aristotle and Modern Logic." In *Mistakes of Reason. Essays in Honour of John Woods*, edited by Peacock, Kent A. and Irvine, Andrew D., 207-223. Toronto: University of Toronto Press.

20. Ebbinghaus, Kurt. 1964. *Ein formales Modell der Syllogistik des Aristoteles*. Göttingen: Vandenhoeck & Ruprecht.

21. Ebert, Theodor. 1977. "Zur Formulierung prädikativer Aussagen in den logischen Schriften des Aristoteles." *Phronesis* no. 22:123-145.

22. ———. 1980. "Warum fehlt bei Aristoteles die 4. Figur?" *Archiv für Geschichte der Philosophie* no. 62:13-31.

23. Englebretsen, George. 1978. "Aristotle on the Subject of Predication." *Notre Dame Journal of Formal Logic* no. 19:614-616.
Reprinted in: A. Menne and G. Offenberger (eds.), *Zur Modernen Deutung der Aristotelischen Logik,* vol. II, Hildesheim: Georg Olms, 1985, pp. 128-130.
"Aristotle's thesis that universals must always inhere in a primary substance, a particular, has been used recently as evidence that he, like many contemporary logicians, rejected the predication of terms to universal, i.e., nonsingular, subjects. Yet this would force Aristotle to treat quantifiers as ranging over bare, unsorted, particulars. But Aristotle took the notion of an unsorted particular as nonsense. His thesis about the status of universals can no more serve as evidence that he took all subjects as particulars than can his thesis that every particular satisfies some universal serve as evidence that he took no subjects as particular."

24. Frede, Michael. 1974. "Stoic vs. Aristotelian Syllogistic." *Archiv für Geschichte der*

Philosophie no. 56:1-32.
Reprinted in: M. Frede, *Essays in Ancient Philosophy,* Minneapolis: University of Minnesota Press, 1987 pp. 99-124.

25. Galvan, Sergio. 1995. "A formalization of elenctic argumentation." *Erkenntnis* no. 43:111-126.
"In the Aristotelean philosophical tradition, elenctic argumentation *(Elenchos)* is conceived as a form of dialectical foundation of a thesis.
It takes place in the context of discussion for and against a given thesis and consists in showing that, as the denier of this thesis argues against the opponent, he is unable to maintain his position unless he presupposes the thesis itself, which thus prevails and is consequently proven. As is well known, Aristotle used this form of argumentation in many areas of his inquiry, since he regarded it as an extremely effective technique not only in the speculative sciences but in the physical and practical sciences as well. Particularly fortunate - because of its subsequent widespread use and because of the broad reflection that it stimulated - was Aristotle's application of this form of dialectical argumentation in Book Four of the *Metaphysics* in order to justify the principle of non-contradiction. Apart from its historical influence, this application is of especial importance because it evidences Aristotle's intention to prove, not any thesis whatsoever, but a logical principle, and this expresses his claim for an epistemically absolute proof - in the form of self-proof - of the principle itself.
It does not appear, however, that elenctic proof of the non-contradiction principle can be accomplished successfully. In fact, demonstration that this proof is impossible is the purpose of the present essay, in which I propose a formalization of the argument - i.e. a formal reconstruction of the argument intended to give it a sufficiently precise specification - which highlights the conceptual difficulties that lie at its root." p. 111

26. Gili, Luca. 2010. *La sillogistica di Aristotele. La riduzione di tutte le deduzioni valide al sillogismo*. Milano: Lampi di stampa.

27. Glashoff, Klaus. 2005. "Aristotelian syntax from a computational-combinatorial point of view." *Journal of Logic and Computation* no. 15:949-973.

28. Goddard, Len. 2000. "The inconsistency of Aristotelian logic?" *Australasian Journal of Philosophy* no. 78:434-437.

29. Granger, Gilles Gaston. 1970. "Le syllogisme catégorique d'Aristote." *L'Age de la Science* no. 3:281-310.

30. Gyekie, Kwame. 1974. "Aristotle and a Modern Notion of Predication." *Notre Dame Journal of Formal Logic* no. 15:615-618.

31. Hintikka, Jaakko. 1988. "Le logicien incontinent d'Aristote." In *Aristote aujourd'hui*, edited by Sinaceur, Mohammed Allal, 94-112. Paris: Éditions érès.

32. Ierodiakonou, Katerina. 2002. "Aristotle's use of examples in the *Prior Analytics*." *Phronesis* no. 47:127-152.

33. Jacobs, William. 1979. "The existential presuppositions of Aristotle's logic." *Philosophical Studies* no. 37:419-428.

34. Jehamy, Aïda Chehadé. 1997. *Essais de formalisation de la logique d'Aristote*. Beyrouth: Département des Publications de l'Université Libanaise.

35. Johnson, Fred. 1991. "Three-membered domains for Aristotle's syllogistic." *Studia Logica* no. 50:181-187.

"The paper shows that for any invalid polysyllogism there is a procedure for constructing a model with a domain with exactly three members and an interpretation that assigns non-empty, non-universal subsets of the domain to terms such that the model invalidates the polysyllogism."

36. ———. 1994. "Syllogisms with fractional quantifiers." *Journal of Philosophical Logic* no. 23:401-422.
"Aristotle's syllogistic is extended to include denumerably many quantifiers such as more than 2/3' and exactly 2/3.' Syntactic and semantic decision procedures determine the validity, or invalidity, of syllogisms with any finite number of premises. One of the syntactic procedures uses a natural deduction account of deducibility, which is sound and complete. The semantics for the system is non-classical since sentences may be assigned a value other than true or false. Results about symmetric systems are given. And reasons are given for claiming that syllogistic validity is relevant validity."

37. ———. 1994. "Apodictic syllogisms: deductions and decision procedures." *History and Philosophy of Logic* no. 16:1-18.
"One semantic and two syntactic decision procedures are given for determining the validity of Aristotelian assertoric and apodeictic syllogisms. Results are obtained by using the Aristotelian deductions that necessarily have an even number of premises."

38. ———. 1999. "Parry Syllogisms." *Notre Dame Journal of Formal Logic* no. 40:414-419.
"Parry discusses an extension of Aristotle's syllogistic that uses four nontraditional quantifiers. We show that his conjectured decision procedure for validity for the extended syllogistic is correct even if syllogisms have more than two premises. And we axiomatize this extension of the syllogistic. "

39. Kapp, Ernest. 1975. "Syllogistic." In *Articles on Aristotle. Vol. 1 Science*, edited by Barnes, Jonathan, Schofield, Malcolm and Sorabji, Richard, 35-49. London: Duckworth.
Originally published in German as 'Syllogistik' in: Pauly-Wissowa's *Real-Encyclopädie der classischen Altertumwissenschaft,* IV A, 1931 cols. 1046-1067. Reprinted in E. Kapp, *Ausgewählte Schriften,* Hrsg. von Hans und Inez Diller, Berlin: Walter de Gruyter, 1968, pp. 254-277.

40. Kelly, Charles J. 1991. "The logic of the Liar from the standpoint of the Aristotelian syllogistic." *Notre Dame Journal of Formal Logic* no. 32:129-146.

41. Keyt, David. 2009. "Deductive Logic." In *A Companion to Aristotle*, edited by Anagnostopoulos, Georgios, 31-50. Malden: Wiley-Blackwell.

42. Lejewski, Czeslaw. 1963. "Aristotle's syllogistic and its extensions." *Synthese* no. 15:125-154.
"The task I have set myself in this paper can be described as bridging the gap between Aristotle’s syllogistic and Lesniewski’s ontology. I propose to suggest a number of successive extensions of syllogistic culminating in a system of what may be regarded as basic ontology. In this way I hope to throw new light on the significance of the Aristotelian logic. At the same time I hope to add a little to the understanding of Lesniewski’s ontology, which interestingly enough was conceived by its originator as a modernised continuation of the ancient and medieval tradition."

43. Łukasiewicz, Jan. 1951. *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic*. Oxford: Oxford University Press.
Second edition 1957 with a new chapter on Aristotle's modal logic.

Critical notice by J. L. Austin, *Mind*, 61, 1952, pp. 395-404.

44. ———. 1963. *Elements of Mathematical Logic*. Oxford: Pergamon Press.
Translated from Polish by Olgierd Wojtasiewicz.
Original edition: *Elementy logiki matematycznej*, Warszawa, 1929.

45. ———. 1967. "On the History of the Logic of Propositions." In *Polish Logic 1920-1939*, edited by Storrs, McCall, 66-87. Oxford: Oxford University Press.
Originally published in Polish as: *Z historii logiki zdan*, Przeglad Filozoficzny, 37, 1934; translated by the author in German as: *Zur Geschichte der Aussagenlogik*, Erkenntnis, 5, 1935, pp. 111-131.
Translated in English in: Storrs McCall (ed.), *Polish Logic 1920-1939,* Oxford, Clarendon Press, 1967 pp. 66-87 and also in: J. Łukasiewicz, *Selected Works* - Edited by Ludwik Borowski, Amsterdam, North-Holland, 1970 pp. 197-217.

46. ———. 1967. "Philosophical Remarks on Many-Valued Systems of Propositional Logic." In *Polish Logic 1920-1939*, edited by Storrs, McCall. Oxford: Oxford University Press.
Originally published in German as: *Philosophische Bemerkungen zu mehrwertighen Systemen des Aussagenkalküls*, Comptes rendus des séances de la Société des Sciences et des Lettres de Varsovie 23, 1930.
Translated in English in: Storrs McCall (ed.) *Polish Logic 1920-1939,* Oxford, Clarendon Press, 1967, pp. 40-65 and also in: J. Łukasiewicz, *Selected Works*, Edited by Ludwik Borowski, Amsterdam, North-Holland, 1970, pp. 153-178.

47. ———. 1968. *La sillogistica di Aristotele*.
Traduzione di Camillo Negro.
Contenuto: Presentazione dell'edizione italiana 9; Prefazione di J. Łukasiewicz alla prima edizione 13; Indice e sommario 19; Introduzione storica: Jan Łukasiewicz e la Scuola di Logica di Varsavia, di Czeslaw Lejewski 23; Parte I. Il sillogismo in Aristotele, di C. Negro 43; Parte II. La sillogistica di Aristotele dal punto di vista della logica formale moderna, di Jan Łukasiewicz 107; Note del traduttore 245; Conclusione 269; Nota bibliografica 275; Indice delle cose 281; Indice dei luoghi di Aristotele 285; Indice dei nomi 291-292.

48. Marshall Jr., David. 1977. "Łukasiewicz, Leibniz and the arithmetization of the syllogism." *Notre Dame Journal of Formal Logic* no. 18:235-242.
"Łukasiewicz' second axiomatization of the assertoric syllogism ("Aristotle's syllogistic", 1957) consists of four axioms of assertion and one of rejection. n arithmetic interpretation is presented proving the independence of the latter. Łukasiewicz himself demonstrated all five consistent by means of an arithmetization due to Leibniz. This arithmetization, we are told by Louis Couturat ("La logique de Leibniz", 1901) was thought by Leibniz himself to have been invalid. Whether and why Leibniz in fact took this (mistaken) view, is discussed briefly."

49. Martin, John N. 1997. "Aristotle's Natural Deduction Reconsidered." *History and Philosophy of Logic* no. 18:1-15.
"John Corcoran's natural deduction system for Aristotle's syllogistic is reconsidered. Though Corcoran is no doubt right in interpreting Aristotle as viewing syllogisms as arguments and in rejecting Lukasiecwicz's treatment in terms of conditional sentences, it is argued that Corcoran is wrong in thinking that the only alternative is to construe Barbara and Celarent as deduction rules in a natural deduction system. An alternative is presented that is technically more elegant and equally compatible with the texts. The abstract role assigned by tradition and Łukasiewicz to Barbara and Celarent is retained. The two 'perfect syllogisms' serve as ` basic elements' in the

construction of an inductively defined set of valid syllogisms. The proposal departs from Łukasiewicz, and follows Corcoran, however, in construing the construction as one in natural deduction. The result is a sequent system with fewer rules and in which Barbara and Celarent serve as basic deductions. To compare the theory to Corcoran's, his original is reformulated in current terms and generalized. It is shown to be equivalent to the proposed sequent system, and several variations are discussed. For all systems mentioned, a method of Henkin-style completeness proofs is given that is more direct and intuitive than Corcoran's original."

50. Menne, Albert, ed. 1962. *Logico-Philosophical Studies*. Dordrecht: Reidel.

51. Mignucci, Mario. 1991. "Expository Proof in Aristotle's Syllogistic." In *Aristotle and the Later Tradition*, edited by Blumenthal, Henry and Robinson, Howard, 9-28. Oxford: Clarendon Press.
Oxford Studies in Ancient Philosophy. Supplementary volume.

52. ———. 1996. "Aristotle's Theory of Predication." In *Studies on the History of Logic. Proceedings of the Third Symposium on the History of Logic*, edited by Angelelli, Ignacio and Cerezo, Maria, 1-20. Berlin: Walter de Gruyter.

53. ———. 1996. "Che cos'è un sillogismo aristotelico?" In *Momenti di storia della logica e di storia della filosofia*, edited by Guetti, Carla and Puja, Roberto, 39-58. Roma: Aracne Editrice.

54. Miller, James W. 1938. *The Structure of Aristotelian Logic*. London: Kegan Paul, Trench, Trubner and Co.

55. Morgenstern, Amy S. 2001. "Commentary to Paolo Crivelli: *Empty terms in Aristotle's logic*." *Boston Area Colloquium in Ancient Philosophy* no. 17:270-281.

56. Morrison, John J. 1955. "The existential import of a proposition in Aristotelian logic." *Philosophy and Phenomenological Research* no. 15:386-393.

57. Mulhern, Mary. 1974. "Corcoran on Aristotle's Logical Theory." In *Ancient Logic and Its Modern Interpretations. Proceedings of the Buffalo Symposium on Modernist Interpretations of Ancient Logic, 21 and 22 April, 1972*, edited by Corcoran, John, 133-148. Dordrecht: Reidel.
"Corcoran, it seems to me, has made a very important contribution to our understanding of Aristotle's logic, and the suggestions offered in what follows should not be construed as impugning in any substantive way the value of that contribution. Of the many points Corcoran raises, I intend to take up four: (1) whether syllogistic is a science; (2) whether the theory of propositional forms presupposed by syllogistic is adequate; (3) whether Aristotle had a doctrine of logical truth; and (4) whether Aristotle considered reasoning natural or conventional." p. 136

58. Nasti de Vincentis, Mauro. 1981. "L'affermazione da trasposizione in *De Int*. 10 e *A. Pr.* A 46." In *Atti del Congresso nazionale di logica. Montecatini Terme, 1-5 ottobre 1979*, edited by Bernini, Sergio, 617-645. Napoli: Bibliopolis.

59. ———. 2010. "Forme della contraddizione e sillogistica aristotelica." In *La Contradizion che nol Consente*, edited by Puppo, Federico, 67-84. Milano: Angeli.

60. Negro, Camillo. 1967. "La sillogistica di Aristotele come metodo della conoscenza scientifica." In. Bologna: Patron.

61. Novak, Joseph A. 1980. "Some recent work on the assertoric syllogistic." *Notre Dame Journal of Formal Logic* no. 21:229-242.
"Over the last few decades there have been many attempts to approach the

Aristotelian syllogistic by utilizing the techniques of contemporary formal logic. The aim of this paper is to examine the most significant of these attempts and evaluate their fidelity to and consistency with Aristotle's own basic exposition of the syllogistic as expressed in the *Prior Analytics* (Book I, 1-2; 4-6).
Two major approaches to the formalization of the assertoric syllogistic can be distinguished in the literature. The first and older approach construes the syllogistic as an axiomatic system, while the second and more recent approach considers the syllogistic as a natural deduction system. Since many of the attempts of the first sort fail to be mentioned in current discussion, this paper will try to summarize them and only make a concluding reference to the second approach which is readily accessible in the more recent publications.
There are two main issues which must be confronted in the case of each attempt to present Aristotle's assertoric syllogistic as an axiomatic system: first, whether the method of representation, i.e., the logical alphabet and the well-formed formulas of the system, conforms to Aristotle's own approach; second, whether the specific formulas chosen as axioms and definitions, the rules of inference, and the manner of proof, etc., are faithful to or at least consistent with Aristotle's writings. Although it might appear that the first issue, a discussion of the logical symbols employed, is not of any real value, one must remember that Aristotle's logic seems tied to some basic philosophical or, better, metaphysical presuppositions. That there can be a close link between certain symbolical representations and some ontological positions is clear in the case of some other philosophers.
One instance in the twentieth century is Gustav Bergmann whose espousal of a bare particularist theory of individuation is linked to his employment of a type of Russelian formal language (Bergmann, G., *Meaning and Existence,* University of Wisconsin Press, Madison, 1960).
Attempts at presenting the syllogistic in a formal way have proceeded along four lines: first, the attempt to present the syllogistic by means of the first-order predicate calculus; second, the classic attempt of Łukasiewicz to develop the syllogistic; third, the attempt to present the syllogistic as a theory of classes; fourth, Lejewski's attempt to relate the syllogistic to Lesniewski's ontology. Each of these attempts will be treated below in light of the two issues raised above."

62. Parry, William T., and Hacker, Edward A. 1991. *Aristotelian Logic*. Albany: State University of New York Press.

63. Patterson, Richard. 1989. "The case of the two Barbaras: basic approaches to Aristotle's modal logic." *Oxford Studies in Ancient Philosophy* no. 7:1-40.
" Aristotle's modal propositions use modal copulae rather than modal predicates or modally qualified *dicta*; the familiar contrast between predication of *dicta* and of things is inappropriate to the Aristotelian modalities. Despite what may appear to be vacillation on Aristotle's part between *de re* and *de dicto* modality, the copulae interpretation can serve to unify the two types."

64. ———. 1990. "Conversion principles and the basis of Aristotle's modal logic." *History and Philosophy of Logic* no. 11:151-172.
"Aristotle founds his modal syllogistic, like his plain syllogistic, on a small set of 'perfect' or obviously valid syllogisms. The rest he reduces to those, usually by means of modal conversion principles. These principles are open to more than one reading, however, and they are in fact invalid on one traditional reading (*de re*), valid on the other (*de dicto*). It is argued here that this way of framing the contrast is not Aristotelian, and that an interpretation involving modal copulae allows us to see how these principles, and the modal system as a whole, are to be understood in light of

close and precise connections to Aristotle's essentialist metaphysics."

65. ———. 1993. "Aristotle's perfect syllogisms, predication, and the *dictum de omni*." *Synthese* no. 96:359-378.

66. Patzig, Günther. 1959. "Aristotle and Syllogisms from False Premisses." *Mind* no. 68:186-192.

67. ———. 1959. *Die aristotelische Syllogistik. Logisch-philologische Untersuchungen über das Buch A der Ersten Analytiken*. Göttingen: Vandenhoeck & Ruprecht.
Critical notice by J. L. Ackrill, *Mind*, 71, 1962, pp. 107-117.

68. ———. 1968. "Aristotle's Theory of Syllogism. A Logico-Philological Study of Book *A* of the *Prior Analytics*." In. Dordrecht: Reidel.
English translation by Jonathan Barnes of *Die aristotelische Syllogistik. Logisch-philologische Untersuchungen über das Buch A der Ersten Analytiken,* Göttingen: Vandenhoeck & Ruprecht, 1959.

69. ———. 1988. "Problèmes actuels de l'interprétation de la syllogistique d'Aristote." In *Aristote aujourd'hui*, edited by Sinaceur, Mohammed Allal, 270-275. Paris: Éditions érès.

70. Rose, Lynn. 1956. "Premise order in Aristotle's syllogistic." *Phronesis* no. 11:154-158.
"Upon examination of all of the syllogisms in the "Prior Analytics," it is found that Aristotle has relatively strong tendencies to write the major premise before the minor premise in the first figure and in the second figure and a considerably weaker tendency to write the major premise first in the third figure. These tendencies are explained in terms of 'left-right' and 'adjacency' factors that are connected with Aristotle's treatment of the syllogism as a rectilinear array of the three terms."

71. ———. 1965. "Aristotle's syllogistic and the Fourth Figure." *Mind* no. 74:382-389.

72. ———. 1968. *Aristotle's Syllogistic*. Springfield: Charles C. Thomas.
Contents: I. Plato's dialectic and Aristotle's syllogistic 3; II. The varieties of predication 13; III: The three figures 16; IV. The non-use of rules 27; V. Validation by reduction 34; VI. Invalidation by counterexample 37; VII. The syllogistic system 53; VIII. The Fourth Figure and the indirect proof 57; IX. Subalternation 80; X. Premise order 81; Appendix. I. The square of opposition 99; II. The mnemonic lines 102; III: The perfection of Aristotle' First Figure 104; IV. Theophrastus and the indirect moods 109; V. The diagrams of the three figures 133; VI. John Locke's criticisms of Aristotle and the syllogism 137; Bibliography 144; Index 147-149.
"Aristotle's work in formal logic has received a great deal of scholarly attention; nevertheless, it remains largely misunderstood. Aristotle's logic has often been equated with traditional "Aristotelian" logic (a usage as unhistorical as "Platonic" love or "Epicurean" tastes), or, which is even worse, judged and evaluated in accordance with how closely it follows or "fails" to follow that traditional logic. Even when efforts have been made to understand Aristotle's logic in its own right, Aristotle has usually been very shabbily treated. He has commonly been accused of errors that he never made at all, such as neglecting or overlooking the fourth figure. Even his way of conceiving the syllogism as a linear array of three terms has been lost on minds handicapped by later, but not thereby better, ways of thinking. Although I hope that this book will contribute towards a better understanding of what Aristotle did and did not accomplish in his syllogistic, I have by no means attempted to treat Aristotle's syllogistic in its entirety. (For one thing, I have confined myself to the assertoric syllogistic and not gone into the modal logic at all.) The principal task

of this book has been to explore the consequences of accepting the Aristotelian syllogism as a linear array of three terms. This approach to Aristotle sheds light on many hitherto mysterious aspects of Aristotle's logic; it provides new insights into what Aristotle was doing in the *Prior Analytics* and enables us to correct numerous misconceptions about his logic.
My treatment of the *Prior Analytics* has been quite sympathetic, and my conclusions are generally favorable; indeed, one of the aims of this book is to exonerate Aristotle's work in formal deductive logic." p. V

73. Ross, William D. 1939. "The Discovery of Syllogism." *Philosophical Review* no. 48:251-271.

74. Shepherdson, John C. 1956. "On the Interpretation of Aristotelian Syllogistic." *Journal of Symbolic Logic* no. 21:137-147.

75. Simons, Peter. 1989. "Tree proofs for syllogistic." *Studia Logica* no. 48:540-554.
"This paper presents a tree method for testing the validity of inferences, including syllogisms, in a simple term logic. The method is given in the form of an algorithm and is shown to be sound and complete with respect to the obvious denotational semantics. The primitive logical constants of the system, which is indebted to the logical works of Jevons, Brentano and Lewis Carroll, are term negation, polyadic term conjunction, and functors affirming and denying existence, and use is also made of a metalinguistic concept of formal synonymy. It is indicated briefly how the method may be extended to other systems."

76. Smiley, Timothy. 1962. "Syllogism and Quantification." *Journal of Symbolic Logic* no. 27:58-72.

77. ———. 1973. "What is a Syllogism?" *Journal of Philosophical Logic* no. 2:136-154.

78. ———. 1994. "Aristotle's Completeness Proof." *Ancient Philosophy* no. 14:25-38.
"In *Prior Analytics* I 23 Aristotle presents a completeness proof for syllogistic logic, or so I maintain. I reconstruct the crucial step, which I take to be his highly condensed argument that every syllogistic-style deduction with more than two premises can be reduced to a series of syllogisms proper. I detect two big holes in the argument, but show that they can be filled without recourse to anachronistically modern methods. I end with a principle about the ordering of terms, and discuss the connections between it, Platonic division and Aristotle's exclusion of the fourth figure." (p. 25)

79. Smith, Robin. 1978. "The mathematical origins of Aristotle's syllogistic." *Archive for History of Exact Sciences* no. 19:201-210.
"Interpretation of the syllogistic theory presented in *Prior Analytics* I.4-7. This syllogistic theory is more properly regarded as mathematics than as logic as understood by most contemporary logicians."

80. ———. 1982. "What is Aristotelian Ecthesis?" *History and Philosophy of Logic* no. 3:113-127.
"I consider the proper interpretation of the process of ecthesis which Aristotle uses several times in the "Prior analytics" for completing a syllogistic mood, i.e., showing how to produce a deduction of a conclusion of a certain form from premisses of certain forms. I consider two interpretations of the process which have been advocated by recent scholars and show that one seems better suited to most passages while the other best fits a single remaining passage. I also argue that "ecthesis" for Aristotle means 'setting out' the case to be proved using letters. Aristotle's remarks about the use of letters in mathematical proofs suggest that he had some

understanding of rules equivalent to universal generalization and existential instantiation; the 'proofs through ecthesis' are so-called because they rest on the latter rule, with which use of letters is involved in a special way." (p. 113)

81. ———. 1982. "The axiomatic method and Aristotle's logical methodology." *Southwest Philosophical Studies* no. 8:49-59.
"I argue that Aristotle developed the syllogistic in the "Prior Analytics" in order to use it in resolving the question, presented in "Posterior Analytics" A 3, whether proof of every proposition is either necessary or possible. His method, which rests on an analysis of the possible structure of proofs derived from the study of syllogisms in the "Prior Analytics", resemble modern proof theory in both style and purpose."

82. ———. 1983. "Completeness of an Ecthetic Syllogistic." *Notre Dame Journal of Formal Logic* no. 24:224-232.
"In this paper I study a formal model for Aristotelian syllogistic which includes deductive procedures designed to model the "proof by ecthesis" that Aristotle sometimes uses and in which all deductions are direct. The resulting system is shown to be contained within another formal model for the syllogistic known to be both sound and complete, and in addition the system is proved to have a certain limited form of completeness."

83. ———. 1986. "Immediate propositions and Aristotle's proof theory." *Ancient Philosophy* no. 6:47-68.
" I argue that Aristotle's main reason for developing the theory of deductions (syllogisms) in the "Prior Analytics" was its use as a proof-theoretic instrument to solve problems about demonstrative sciences. thus, concerning the old problem of the relation of the two "Prior" and "Posterior Analytics", I hold that the "Prior" is "propter", and therefore "post", the "Posterior". This is shown in greater detail through an analysis of the role of 'immediate' propositions in his theory."

84. ———. 1994. "Dialectic and the Syllogism." *Ancient Philosophy* no. 14:133-151.

85. Striker, Gisela. 1985. "Notwendigkeit mit Lücken." *Neue Hefter für Philosophie* no. 24/25:146-164.

86. Thom, Paul. 1976. "Ecthesis." *Logique et Analyse* no. 74-76:299-310.

87. ———. 1979. "Aristotle's Syllogistic." *Notre Dame Journal of Formal Logic* no. 20:751-759.

88. ———. 1981. *The Syllogism*. München: Philosophia Verlag.
Contents: Preface 11; Part One. Aristotle's syllogistic. I. Elementary syntax 19; II. Basis of the system 32; III. Theses 45; IV. Non-theses 56; V. Interpretation an application 69; Part Tow. Syllogistic and its extensions. Introduction 89; VI. System *A* 91; VII: Subsystems 109; VIII. Extensions 119; IX: Rejection 147; X: Echtesis 164; Part Three. The theory of the syllogism. Introduction 179; XI. Syntactic theory 181; XII. Aristotle's syntactic theory 193; XIII. Semantic theory 216; XIV: Epistemological theory 227; Appendix 1. The Gergonne relations 253; Appendix 2. *Termini obliqui* and the logic of relations 255; Appendix 3. Medieval echtetic systems 257; Notes 261; Bibliography 289; Indices. Index 1. Aristotelian passages 299; Index 2. Definitions 306; Index 3. Names 409-312.
"The three Parts of this book deal respectively with the formal analysis of Aristotle's non-modal syllogistic; with the inter-relations between various syllogistic systems, their subsystems and extensions; and with the most fundamental question about the syllogism, *viz.* What is it?
Part One aims to effect a synthesis of recent work (both logical and philological) on

the non-modal sections of the *Prior Analytics,* within the framework of a new formal system which combines features of Łukasiewicz's `axiomatic' approach with features of the 'natural deduction' approach of Corcoran and Smiley.
This system is identified, in Part Two, as one of a family which also includes the semantically complete systems of Łukasiewicz and Corcoran. Extended systems are also considered, in which rejected formulae are axiomatised, and negative or singular terms added. In particular, formal analyses are given of Aristotle's own logics of negative and singular terms, and it is shown that the whole system of categorical syllogisms can be based on a system of singular syllogisms with the Aristotelian rules of *ecthesis.*
The multiplicity of syllogistic systems discussed in Part Two gives rise to the search (carried out in the third Part) for properties *essential* to the syllogism, which would recur in any genuinely syllogistic system. A complex syntactic property of the categorical syllogism is first described, then a semantic one, and finally one which I will term epistemological (without wanting to sink into psychologism). The principal standpoint in this Part is a purely theoretical one - the semantic discussion being within the context of the contemporary debate on entailment, and the epistemological one belonging to the theory of fallacies. But the historical approach of the first two Parts is not wholly abandoned, and a detailed account is given of those parts of the *Prior Analytics* (not often read) which include Aristotle's own attempts at metatheory.
With some reluctance, and in the interests of brevity, I have adopted a style of exposition which is generally dogmatic rather than dialectical, in that it seeks merely to state the truth rather than to allow the true view to emerge in stages from partial truths or mistaken opinions. Also, interpretations or theories which seemed to me *wholly* wrong have in general not been mentioned: there are just too many of them. On the other hand, I have tried to include reference to what seemed to me the most important contributions of the ancient and medieval commentators.
I have proceeded (as Aristotle would have said) from what is best known in itself, to what is best known for us, beginning with the basis of an uninterpreted formal system, and ending with a statement of the function of the syllogism and the use of the system. So, in a sense, the reader will not know why the beginning is as it is, until he has come to the end. For the benefit of readers who can't stand the suspense, I have tried to make the end independently intelligible, so that they can begin there, and then go to the beginning, ending in the middle with a kind of *syllogismus interruptus.*" pp. 11-12

89. ———. 1991. "The Two Barbaras." *History and Philosophy of Logic* no. 12:135-149.
"This paper examines three recent discussions of Aristotle's system of syllogisms with apodeictic and assertoric premisses. Though they contain no cross-references, and though they arrive at disparate interpretations, all three pieces share a common aid. That aim is to construct an intuitively graspable interpretation of Aristotle's modal syllogistic which is based on metaphysical considerations. I argue that none of these authors has succeeded in this; nevertheless, I share their broad aim, and attempt to show that a more satisfactory interpretation can be formulated by combining and developing elements drawn from all three."

90. ———. 1993. "Apodeictic Ecthesis." *Notre Dame Journal of Formal Logic* no. 34:193-208.

91. Thompson, Marley. 1959. "On the Elimination of Singular Terms." *Mind* no. 68:361-376.

92. Weidemann, Hermann. 2004. "Aristotle on the reduciblity of all vald syllogistic moods to the two Universal moods of the First Figure (*Apr* A7, 29b1-25)." *History and Philosophy of Logic* no. 25:73-78.

93. Westerstähl, Dag. 1989. "Aristotelian syllogisms and generalized quantifiers." *Studia Logica* no. 48:577-585.

94. Williams, Mark F. 1984. *Studies in the Manuscript Tradition of Aristotle's Analytica*. Königstein: A. Hain.

95. Williamson, Colwyn. 1972. "Squares of opposition: comparisons between syllogistic and propositional logic." *Notre Dame Journal of Formal Logic* no. 13:497-500.
"It has been pointed out, for example by Bochenski, (1) that the principles of propositional logic now known as DeMorgan's Laws bear a certain resemblance to the laws depicted in the traditional Square of Opposition.
The analogy, however, is not as perfect as it could be. The aim of this paper is to explore some of the consequences of seeking a more exact comparison between syllogistic and propositional logic."
(1) J. M. Bochenski, *A Précis of Mathematical Logic,* Holland (1959), p. 14.

96. ———. 1988. "How many syllogisms are there?" *History and Philosophy of Logic* no. 9:77-85.
"The incompleteness and artificiality of the 'Traditional logic' of the textbooks is reflected in the way that syllogisms are commonly enumerated. The number said to be valid varies, but all the numbers given are of a kind that logicians should find irritating. Even the apparent harmony of what is almost invariably said to be the total number of syllogisms, 256, turns out to be illusory. In the following, it is shown that the concept of a "distribution-value", which is related to the traditional theory of distribution, and the familiar concept of "quantity" together suffice to produce a far better way of enumerating syllogisms and a more complete understanding of the systematic features of syllogistic logic."

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