

[History of Logic from Aristotle to Gödel \(www.historyoflogic.com\)](http://www.historyoflogic.com)

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## Bibliography of Ancient Logic in the Hellenistic Period

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### Selected bibliography on Hellenistic logic

#### Studies in English (G - Z)

1. Gabbay, Dov, and Woods, John, eds. 2004. *Greek, Indian and Arabic Logic* . Amsterdam: Elsevier.  
*Handbook of the History of Logic* : vol. 1.  
 Contents: Dov Gabbay and John Woods: Preface VII; List of contributors IX; Julius Moravcsik: Logic Before Aristotle: Development or Birth? 1; John Woods and Andrew Irvine: Aristotle's Early Logic 27; George Boger: Aristotle's Underlying Logic 101; Fred Johnson: Aristotle's Modal Syllogism 247; Jonardon Ganeri: Indian Logic 309; Robert R. O'Toole and Raymond E. Jennings: The Megarians and the Stoics 397; Tony Street: Arabic Logic 523; Charles Burnett: The Translation of Arabic Works on Logic into Latin in the Middle Ages and Renaissance 597; Index 607-628.  
 "With the present volume, the *Handbook of the History of Logic* makes its first appearance.  
 Members of the research communities in logic, history of logic and philosophy of logic, as well as those in kindred areas such as computer science, artificial intelligence, cognitive psychology, argumentation theory and history of ideas, have long felt the lack of a large and comprehensive history of logic. They have been well-served since the early sixties by William and Martha Kneale's single volume *The Development of Logic* , published by Oxford University Press. But what such a work cannot hope to do, and does not try to do, is provide the depth and detail, as well as the interpretive coverage, that a multi-volume approach makes possible. This is the driving impetus of the Handbook, currently projected to run to several large volumes, which the publisher will issue when ready, rather than in strict chronological order.  
 (,,)  
 As with the present volume, the *Handbook* 's authors have been chosen for their capacity to write authoritative and very substantial chapters on their assigned

- topics; and they have been given the freedom to develop their own interpretations of things. In a number of cases, chapters are the equivalents of small monographs, and thus offer researchers and other interested readers advantages that only a multi-volume treatment can sustain." (*Preface*, , p. VII)
2. Graeser, Andreas. 1977. "On Language, Thought, and Reality in Ancient Greek Philosophy." *Dialectica* no. 31:359-388.  
Reprinted in A. Graeser, *Issues in the Philosophy of Language Past and Present: Selected Papers*, Bern: Peter Lang, 1999, pp. 9-41.  
Summary: "The common ground out of which the problem of "Language versus Reality" was to arise in ancient Greek philosophy may be characterized by the fact that words in general were thought of as names and thus considered to get their meaning accordingly.  
However, while Parmenides was actually committing himself to the position that language was altogether meaningless, Heraclitus seems to have believed that name and meaning are unrelated or even opposite to each other. Plato's *Forms* are clearly meant to serve as objects of linguistic meaning and reference. Aristotle retained the fundamentally realist theory of meaning which he inherited from Plato and thus became liable to the criticism advanced by the Stoics, who insisted that there is no isomorphic correlation between thought on the one hand and things-that-are on the other."
  3. Hadgopoulos, Demetrius J. 1979. "The Principle of the Division into Four Figures in Traditional Logic." *Notre Dame Journal of Formal Logic* no. 20:92-94.  
"The purpose of this note is to show that the traditional account of the division of syllogisms into four figures confuses two different principles which can be used to that purpose, and which give different results. Thus, it is either mistaken or redundant. According to the traditional account of Aristotle's syllogistic, syllogisms are divided into four figures according to the position of the middle term in the premisses." (p. 92)  
(...)  
"But it is not really the position of the middle term that gives us four figures. For the above account makes reference to the major and minor premiss. Since the major premiss, according to the traditional account of the syllogism, is that which contains the major term, and the minor premiss is that which contains the minor term, the principle of the distinction of syllogism into four figures presupposes the distinction between major term and minor term.  
But if we already have this distinction, then it is not true to say that the distinction into four figures is due to the position of the middle term in the premisses, but we must say that the distinction is due to the position of the middle term in the premisses which have already been differentiated into major and minor. But if this (the differentiation) is taken into account, then reference to the position of the middle term is no longer necessary. For we can get four figures by distinguishing between major term and minor term only." (p. 93)
  4. Hankinson, Robert James. 2007. "Self-refutation and the "sorites"." In *Maieusis. Essays on Ancient Philosophy in Honour of Myles Burnyeat* , edited by Scott, Dominic, 351-373. New York: Oxford University Press.  
"More than twenty years ago, Myles Burnyeat (1982) published an important article on the sorites;(3) a few years earlier he had written two ground-breaking pieces on Protagorean self-refutation.(4) So, if nothing else, at least the title of this article is an appropriate one for something written in honour of and out of admiration for my former graduate supervisor.  
My aim is relatively modest. I do not seek to discern a generalized ancient 'solution' to the 'paradox',(5) or to offer one in my own voice (although I will make one or two tentative suggestions). My main purpose is to take seriously a passing hint of Cicero's, one which has generally been either ignored or treated simply as a joke,(6) that the sorites may be applied to itself, or to the more general notion of coherent argument, with potentially devastating results. I say 'potentially

devastating', since it is unclear whether the threatened disaster must occur, and if it does, which of the opposing sides in the dispute it is potentially disastrous for. As such, the debate as I shall reconstruct it mirrors that between Sceptics and Dogmatists as to the question of whether sceptical arguments against argument are self-refuting, and if so, what the appropriate upshot of that ought to be.(7)" (pp. 351-352)

(3) 'Gods and Heaps'.

(4) 'Protagoras and Self-Refutation in Later Greek Philosophy' (1976a); 'Protagoras and Self-Refutation in Plato' (1976b).

(5) 'Paradox' in scare-quotes since the puzzle does not have the logical form of a true paradox: viz. of a sentence that is true if and only if it is false (rather, it has the form of an apparently sound argument with an apparently false conclusion: of course that's bad enough); 'solution' similarly flagged because I am doubtful whether the puzzle—or puzzles—as such can yield to a single authoritative diagnosis. But these issues are largely irrelevant to the concerns of the present paper.

(6) A partial exception to this general neglect is Myles himself (Burnyeat 1982: 327 n. 33). It was thinking about this footnote (and that of Barnes (1982: 57 n. 60)) that first started me down the road followed by this paper more than twenty years ago.

(7) See Sext. *Pyr.* 2. 185–92; *Math.* 8. 465–80; and see McPherran 1987.

#### References

Barnes, J. (1982), 'Medicine, Experience and Logic', in Barnes et al. (1982), 24–68.

Barnes, J. Brunschwig, J., Burnyeat, M. F., and Schofield, M. (1982) (eds.), *Science and Speculation: Studies in Hellenistic Theory and Practice*. Cambridge.

Burnyeat, M. F. (1976a), 'Protagoras and Self-Refutation in Later Greek Philosophy', *Philosophical Review*, 85: 44–69.

(1976b), 'Protagoras and Self-Refutation in Plato's Theaetetus', *Philosophical Review*, 85: 172–95; repr. in Everson (1990), 39–59.

(1982), 'Gods and Heaps', in Schofield and Nussbaum (1982), 315–38.

Everson, S. (1990) (ed.), *Epistemology, Companions to Ancient Thought, I*. Cambridge.

McPherran, M. L. (1987), 'Skeptical Homeopathy and Self-Refutation', *Phronesis*, 32: 290–328.

5. Henle, Paul. 1949. "On the Fourth Figure of the Syllogism." *Philosophy of Science* no. 16:94-104.

"Perhaps the strangest controversy in the history of logic is that over the fourth figure of the syllogism. There was never any argument as to what syllogisms are valid, but merely as to how they should be arranged. Aristotle had divided syllogisms into figures according to whether the middle term was subject of one premiss and predicate of the other, or predicate of both premisses, or subject of both.(1) Theophrastus and Eudemus subdivided the first figure into those moods in which the middle term was subject of the major premiss (and predicate of the minor) and those moods in which the middle was predicate of the major premiss (and subject of the minor).(2) The latter moods were termed indirect. Galen said they constituted a separate figure;(3) and so the controversy started.

(...)

Galen received a somewhat different technical problem and his division represents the best solution to his problem. In neither case is there any interest in tracing the course of thought. The question as to what forms of reasoning are most natural is, to be sure, a genuine problem, but this is a psychological rather than a logical problem and one which-if I am right-did not concern the founder of logic in working out his theory of the syllogism." (p. 94)

(1) *Anal. Pr.* I, 25b 35, 26b 36, 28a 12.

(2) Prantl. C, *Geschichte der Logik im Abendlande I*, 365. The principal source is Alexander of Aphrodisias *ad. An. pr.* f. 27b, 42b.

(3) Prantl. *Op. Cit.* I, 570-74.

6. Huby, Pamela M. 2004. "Elementary Logic in the Ancient World." *Bulletin of the Institute of Classical Studies* no. 47:119-128.  
 Abstract: "In the ancient world most educated people, including medical men and lawyers, studied some elementary logic. The formal study began in Plato's Academy, and can be traced through to Boethius, and so into the Middle Ages. Many works seem to have been written to be memorized by students. Evidence comes, among others, from Aristotle, Apuleius, and Galen, and from a variety of anonymous sources, including some papyri. The views of the Peripatetics and the Stoics, originally different, coalesced, and later handbooks covered both at an elementary level. The origin of the concept of a syllogistic mood is obscure: it may have existed for some time before appearing first in Apuleius."
7. Hurst, Martha. 1935. "Implication in the Fourth Century B.C." *Mind* no. 44:484-495.  
 "Modern analyses of the nature of necessary connection have given rise to more paradoxes than they have solved. A familiarity with the controversy between Diodorus and Philo which took place in the Fourth Century B.C. might perhaps have made unnecessary the anguish which modern logicians have suffered. (1) The dispute is mentioned in passing by Cicero (2) and is discussed in two places by Sextus Empiricus (3). The persons concerned in the dispute are named Diodorus and Philo, and are, I think, to be identified as the Megarians, Diodorus Cronus and his pupil Philo." (p. 484)  
 (1) My attention was first called to this dispute by a notice in C. S. Peirce, *Collected Papers* 3, 441. In being aware of this dispute Peirce is an exception among modern logicians. But he failed to grasp its full significance; so that his knowledge did not save him from the mistakes which they have made.  
 (2) *Academica Priora*, II, 143.  
 (3) *Pyrrhoneion Hypotyposeon* II, 110, *Adversus Mathematicos* VIII, 113 ff.
8. Kapp, Ernst. 1942. *Greek Foundations of Traditional Logic*. New York: Columbia University Press.  
 Contents: Preface V-VIII; I. The origin of logic as a science 5; II. Concepts, terms, definitions, ideas, categories 20; III. Judgments, subject and predicate 43; IV. Syllogisms 60; V. Induction: ancient and modern logic 75; Books cited 89; Index 91-95.  
 "We are concerned with the origin of the science of logic, and I think we have seen that the contents of the first systematic work on the subject have a claim to be considered first not merely for chronological reasons. Perhaps Aristotle was not so wrong in quoting a Greek saying equivalent to "the first start is the main part," although one may have one's doubts with regard to the amount of gratitude we owe him for this start. In any case the start itself demands a historical explanation, for the existence of such a game of mental gymnastics as we had to accept in order to understand the first textbook of logic, the *Topics*, seems even more puzzling than certain features of the developed Aristotelian logic in the *Analytics*.  
 There can be no doubt that in Aristotle's school such a mental game was taken rather seriously. Otherwise Aristotle would not have spent so much time and hard work in preparing the *Topics* as the book shows he must have spent and as according to his own testimony he did spend. We feel puzzled and perhaps a little embarrassed, for Aristotle's sake; but the explanation of the phenomenon is not so difficult as it might seem. The only thing needed is to recall a few well-known facts of the history of science and philosophy in Greece." (pp. 16-17)
9. Kneale, William, and Kneale, Martha. 1962. *The Development of Logic*. Oxford: Clarendon Press.  
 Reprinted 1975 with corrections.  
 "As its name indicates, this book is an account of the growth of logic, rather than an attempt to chronicle all that past scholars, good and bad, have said about the science. For the sake of continuity, and in order to give historical perspective to our

story, my wife and I have included some references to work which does not deserve to be remembered for its own sake; and occasionally we have allowed ourselves to indulge an antiquarian curiosity, when we thought that the result might be of some interest to others. But our primary purpose has been to record the first appearances of those ideas which seem to us most important in the logic of our own day. Such a programme is based on judgements of value, and we realize that our selection of material and still more our comments, especially in the later chapters, may seem eccentric to some readers. In defence of our undertaking we can only say that we have followed the plan which our interests suggested, and that we could not have written in any other way." (*Preface*, , p. V)

10. ———. 1972. "Prosleptic propositions and arguments." In *Islamic Philosophy and the Classical Tradition. Essays Presented by His Friends and Pupils to Richard Walzer on His Seventieth Birthday*, edited by Stern, S.M., Hourani, Albert and Brown, Vivian, 189-207. London: Bruno Cassirer.

"In some ancient writers on logic we find mention of propositions and syllogisms κατά πρόσληψιν. We shall attempt in this paper to determine the nature and logical relations of these propositions and arguments, which we call for brevity prosleptic. It will be convenient first to set out the evidence, which is rather tantalizingly exiguous. The quoted passages are numbered for ease of reference. In probable order of date and authority they are as follows."

(...)

"Although these sources are meagre, it is not difficult to discern the main outlines of the doctrine to which they refer. Either Aristotle or his pupil Theophrastus—and probably it was Theophrastus, since he gets the credit in passages 3 and 4 above—invented the description κατά πρόσληψιν for arguments of such forms as "Whatever  $x$ -ness may be, if every  $x$  thing is  $\alpha$ , then every  $x$  thing is  $\beta$ ; but every  $\beta$ ; thing is  $x$ ; therefore every  $y$  thing is B." The description was intended to draw attention to the fact that these arguments proceed by specification of what was at first left indeterminate.

In modern terminology they are arguments by substitution and detachment, where the variable for which we make substitution is general rather than individual. Since, however, the pattern of each such argument is fully determined by the nature of its leading premiss, this also is called prosleptic by a very natural extension of usage and assigned to the same figure as its argument.

In working out their account of the various figures of prosleptic argument the Peripatetics seem to have been influenced by a misleading analogy with the theory of the categorical syllogism which was the pride of their school. Assuming wrongly that the indeterminate term of the leading premiss (i.e. What we now call the term-variable) was to be compared with the middle term of a categorical syllogism, they assigned to the first figure those prosleptic premisses in which the indeterminate term occurred as predicate of the antecedent clause and subject of the consequent clause (e.g. "Whatever  $x$ -ness may be, if every  $\beta$  thing is  $x$ , then every  $x$  thing is  $\beta$ "), to the second figure those in which the indeterminate term occurred as predicate of both clauses, and to the third figure those in which it occurred as subject in both clauses. This classification is explained by the anonymous scholiast in quotation 4 above and again by members of the school of Ammonius in passages 6, 7, and 8. Some gratuitous puzzles into which it led them are indicated in passage 7. In the quotation 9 (i) there is to be found a prosleptic proposition which might be assigned on the same principles to a fourth figure in which the indeterminate term occurs as subject of the first clause and predicate of the second. But apparently the Peripatetics recognized no such figure, and on this point at least they were not misled by their analogy between prosleptic arguments and categorical syllogisms. For just as any fourth figure syllogism can be presented as an indirect mood of the first figure, so any fourth figure prosleptic argument can be reduced to the first figure by contraposition. From "Whatever  $x$ -ness may be, if every  $x$  thing is  $\alpha$ , then every  $\beta$  thing is  $x$ " we can easily derive "Whatever  $x$ -ness may be, if some  $\beta$  thing is not  $x$ , then some  $x$  thing is not  $\beta$ , and *vice versa*. Such transformations

involve use of categorical forms other than the universal affirmative in the two clauses of a prosleptic premiss, but it is clear from the various quotations listed above under 9 that this possibility was recognized by the Peripatetics."

11. Knuuttila, Simo. 2012. "A History of Modalities." In *Logic: A History of Its Central Concepts*, edited by Gabbay, Dov M., Pelletier, Francis Jeffrey and Woods, John, 309-339. Amsterdam: North-Holland.  
Volume 11 of the *Handbok of te History of Logic*.  
"My aim is to shed light on long-lived assumptions in Western modal conceptions as well as some clashes between them. In the first section, I shall deal with those trends in ancient and medieval modal thought which were inclined to codify the meaning of modal notions in frequency terms. The second section concentrates on the emergence of a different paradigm in which the analysis of necessity and possibility is separated from a one world model, and which considerably modified late medieval modal logic. The third section is about the interplay of these traditions in the early modern period and their influence up to the nineteenth century." (p. 309)
  
12. Lloyd, Antony C. 1955. "Neoplatonic Logic and Aristotelian Logic: I." *Phronesis. A Journal for Ancient Philosophy* :58-72.  
"It is well known that *Ennead* VI contains an onslaught by Plotinus on Aristotle's *Categories*, but that his pupil, Porphyry, established both the *Categories* and *Predicables* as part of the Neoplatonic and eventually the Scholastic philosophical curriculum. So far as this situation has been studied, it has been for the most part from the standpoint of its external history. Philology has traced many of Plotinus's criticisms to the commentaries of the Middle Academy, and many of Porphyry's expressions to Stoic logicians; historical enquiry has found motives in the social position of the Schools for the Neoplatonic acceptance of Aristotle's logic. This valuable work, however, tends at best to ignore the philosophical understanding of both the criticism and the reinstatement of Aristotle, and at worst to give an erroneous account of the place of Neoplatonism in the history of logic. First, the criticism is of intrinsic philosophical interest, because it aims to shew that 'inseparable' universals, and the whole theory of genus and species, are unable to do the task required of them. Secondly, the logic which Porphyry and his successors reinstate resembles that of the Stoics in being stripped of certain metaphysical implications. The reason for this is not corruption of Platonism by the Stoa, but the inevitable effect of wanting Aristotle the elementary logician without Aristotle the metaphysician.  
And the result is that a good deal of credit has gone to the Stoics which was due to the Neoplatonists. Useful as it is, Prantl's work needs rewriting." (p. 58)
  
13. ———. 1955. "Neoplatonic Logic and Aristotelian Logic: II." *Phronesis. A Journal for Ancient Philosophy* :146-160.  
"Plotinus's criticism of definition by genus and differentia committed him to providing, by means of his new δύναις-concept, an alternative version of the genus-species relation. In *Ennead* VI 2, 9 the aporia is raised, How do the five genera of Being make species? Characteristically he answers it in terms of Nous. (This prevents us from having a direct description of the structure of the Ideas, which are the species of the genera severally, not of the totality of these, which is Nous.) Later he will have to qualify his answer by describing the genus and species as a prior and a posterior Nous and pointing out the dependence of both on a higher hypostasis. This addition is of great importance to Neoplatonic logic, because it includes the notion of a 'giver of form' that splits the generic cause into two, and because (contrary to common belief) it already displays substantially the schematism to be used in the Athenian School. I now proceed to summarise the logic of *Enn.* VI 2, 20, of which the Greek text, divided into sections, has been printed as an Appendix (*infra*, p. 160)." (pp. 147-148)

14. Lloyd, Anthony C. 2006. "Definite Propositions and the Concept of Reference." In *Les Stoïciens et leur logique*, edited by Brunschwig, Jacques, 223-234. Paris: Vrin. "The Stoic position about the reference of tenses and names reflects their metaphysics. For it depends, as I have said, on the interpretation or pre-systematic assumptions of their logic. In this logic, if I am right about its interpretation, every expression which is read as a verb, including the existence sign, but barring of course an initial tense operator if there is one, is in the present tense. But did not grammarians say that the Stoics recognised only two tenses, past and future(27)? Yes, but so far from this being inconsistent with such a logic it is implied by it. Where everything is present, nothing is *present*, as the night in which all cats are grey, Columns C and D are both ways of translating column A. But their interpretation (or pre-systematic assumptions) is their metaphysics; and in Stoics metaphysics neither past nor future are real(28). Tenses belong to a logic, a *lekton* n, which is superimposed on the material reality. One might truthfully combine the grammarian's with the metaphysician's view of the logic by saying that the Stoics recognised only two tenses because they recognised only one time." (p. 231)  
(27) See *Scholias in Dionys. Thrac. Artem gramm.*, 248-251 Hilgard.  
(28) Cp. SVF II, 509,518 ;V. Goldschmidt, *Le système stoïcien et L'idée de temps*, 2e éd., Paris, 1969, § 18, 83-87; A. C. Lloyd, *Proc. Brit. Acad.*, 56,1970, p. 232-240.
15. Longo, Angela. 2009. "The Principle of Contradiction: an Ancient Interpretation (Syrianus, AD Vth cent.) and a Modern Interpretation (J. Lukasiewicz, 1878-1956): a Comparison." In *Syrianus et la métaphysique de l'Antiquité tardive*, edited by Longo, Angela, 383-397. Napoli: Bibliopolis.  
"Introduction  
In this paper, I will draw a comparison between an ancient and a contemporary interpretation of the Principle of Contradiction, as formulated by Aristotle in his *Metaphysics*. My aim here is not to discuss the Aristotelian text(1), neither is it to criticize Lukasiewicz' interpretation. Rather, it is to do something new, namely, (a) to present Syrianus' interpretation of the Aristotelian Principle of Contradiction, and (b) to compare this original, but usually ignored, interpretation with that of Lukasiewicz. This is worth doing because, while Syrianus speaks of several principles of contradiction in his commentary on Aristotle's *Metaphysics*, the Polish scholar also seems to do the same; at the very least, the latter uses three formulations of such a principle(2)." (p. 383)  
(1) I have previously produced a detailed analysis of the very varied way in which both Aristotle, in his *Metaphysics* Γ, and Syrianus, in his commentary on this work, express the Principle of Contradiction (cfr. A. Longo, *Siriano e i principi della scienza*. Prefazione di J. Barnes, Napoli 2005, cap. III, pp. 83-140).  
(2) It is not always clear whether Lukasiewicz intended to speak of three substantially different Principles of Contradiction, or only of three different formulations of the same principle. Arianna Betti has been so kind as to verify for me that this ambiguity is indeed present in the original Polish. In any case, I will proceed on the minimal assumption that Lukasiewicz worked with three formulations of a single principle, since this, at any rate is certain, and also because this position is much less exposed to criticism.
16. Lukasiewicz, Jan. 1967. "On the History of the Logic of Propositions." In *Polish Logic 1920-1939*, edited by McCall, Storrs, 66-87. Oxford: Oxford University Press.  
Originally published in Polish as *Z historii logiki zdań*, *Przegląd 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. Lukasiewicz, *Selected Works*, Ludwik Borowski (ed.), Amsterdam: North-Holland, 1970 pp. 197-217.

"This fundamental difference between the logic of propositions and the logic of terms was unknown to any of the older historians of logic.

It explains why there has been, up to the present day, no history of the logic of propositions, and, consequently, no correct picture of the history of formal logic as a whole. Indispensable as Prantl's(3) work is,

even today, as a collection of sources and material, it has scarcely any value as an historical presentation of logical problems and theories.

The history of logic must be written anew, and by an historian who has fully mastered mathematical logic. I shall in this short paper touch upon only three main points in the history of propositional logic.

Firstly I wish to show that the Stoic dialectic, in contrast to the Aristotelian syllogistic, is the ancient form of propositional logic; and, accordingly, that the hitherto wholly misunderstood and wrongly judged accomplishments of the Stoics should be restored their due honour. Secondly I shall try to show, by means of several examples, that the Stoic propositional logic lived on and was further developed in medieval times, particularly in the theory of "consequence". Thirdly I think it important to establish something that does not seem to be commonly known even in Germany, namely that the founder of *modern* propositional logic is Gottlob Frege." (Lukasiewicz, *Selected Works*, , p. 198)

(3) 3) K. Prantl, *Geschichte der Logik im Abendlande*, vols. i-iv, Leipzig, 1855-1870; vol. ii, 2nd edition, Leipzig, 1885.

17. ———. 1967. "Philosophical Remarks on Many-Valued Systems of Propositional Logic." In *Polish Logic 1920-1939* , edited by McCall, Storrs, 40-65. 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. Lukasiewicz, *Selected Works*, Ludwik Borowski (ed.), Amsterdam: North-Holland, 1970 pp. 153-178.

"1. Modal propositions. -2. Theorems concerning modal propositions. -3.

Consequences of the first two theorems concerning modal propositions. -4.

Consequences of the third theorem on modal propositions. -5. Incompatibility of the theorems on modal propositions in the two-valued propositional calculus. -6. Modal propositions and the three-valued propositional calculus. -7. Definition of the

concept of possibility. -8. Consequences of the definition of the concept of possibility. -9. Philosophical significance of many-valued systems of propositional logic.

*Appendix* . On -the history of the law of bivalence.

In the communication "Untersuchungen Uber den Aussagenkalkül" (Investigations into the Sentential Calculus) which appeared in this issue under Tarski's and my name, Section 3 is devoted to the "many-valued" systems of propositional logic established by myself. Referring the reader to this communication as far as logical questions are concerned, I here propose to clarify the origin and significance of those systems from a philosophical point of view." (Lukasiewicz, *Selected Works*, p. 153)

(...)

"I have compiled thus many quotations on purpose, for, although they illuminate one of the most important problems of logic, it nevertheless appears that many of them were either unknown to the historians of logic, or at least not sufficiently appreciated. The reason for this is in my opinion that the history of logic has thus far been treated by philosophers with insufficient training in logic. The older authors cannot be blamed for this, as a scientific logic has existed only for a few decades. *The history of logic must be written anew* , and by an historian who has a thorough command of modern mathematical logic. Valuable as Prantl's work is as a compilation of sources and materials, from a logical point of view it is practically worthless. To give only one illustration of this, Prantl, as well as all the later authors



who have written about the logic of the Stoa, such as Zeller and Brochard, have entirely misunderstood this logic. For anybody familiar with mathematical logic it is self-evident *that the Stoic dialectic is the ancient form of modern propositional logic*.

Propositional logic, which contains only propositional variables, is as distinct from the Aristotelian syllogistic, which operates only with name variables, as arithmetic is from geometry. The Stoic dialectic is not a development or supplementation of Aristotelian logic, but an achievement of equal rank with that of Aristotle. In view of this it seems only fair to demand of an historian of logic that he know something about logic. Nowadays it does not suffice to be merely a philosopher in order to voice one's opinion on logic." (Lukasiewicz, *Selected Works*, p. 178, a note omitted)

18. Maconi, Henry. 1985. "Late Greek Syllogistic." *Phronesis. A Journal for Ancient Philosophy* no. 30:92-98.

Critical review of Tae-Soo Lee: *Die griechische Tradition der aristotelischen Syllogistik in der Spätantike* (Hypomnemata 79). Göttingen, Vandenhoeck & Ruprecht, 1984.

The history of logic in late antiquity has not been a favourite subject of scholarly inquiry. The texts are imagined to be long, dull, and repetitive: they are perhaps quarries for information about earlier logicians, but their own content is unoriginal and unexciting. Anyone who holds that view should read Tae-Soo Lee's monograph on *Die griechische Tradition der aristotelischen Syllogistik in der Spätantike*. Late Greek syllogistic emerges from Lee's study as a subject well worth examination. Admittedly, it is not original in any strong sense. But it does offer numerous clarifications, developments, and modifications in Aristotle's doctrines, many of which are intelligent and some of which are remarkably subtle. Lee takes as his primary texts the three surviving commentaries on the *Prior Analytics* - the commentaries of Alexander, of Ammonius, of Philoponus." (p. 92)

(...)

"In the course of his discussion Lee incidentally sheds light on a number of obscure parts of the Aristotelian tradition. For example, he has an excellent account of the Greek idea of "form" in logic; he gives a lucid explanation of what is involved in the idea that logic is (only) an instrument or tool of philosophy; he is illuminating on the dark topic of ἀντιστροφή. He also has wise words to say about the nature of his own enterprise: "I think that the main task of an historian is not simply to exclaim: "Look here - they already knew such and such" (usually adding: "but somewhat imperfectly and not with complete clarity"). On the contrary, if an ancient author is worth our attention, that is not only because he already knew something which we too now know, but also - and more importantly - because his mode of thinking was different from ours" (p. 22)." (p. 93)

19. Martin, John N. 2004. *Themes in Neoplatonic and Aristotelian Logic: Order, Negation and Abstraction*. Aldershot: Ashgate.

Contents: Preface VII; Introduction XI; 1. Aristotle's Natural Deduction Reconsidered 1; 2. Ecthesis and Existence in the Syllogistic 19; 3. Existence, Negation, and Abstraction in the Neoplatonic Hierarchy 25; 4. A Tense Logic for Boethius 53; 5. Proclus on the Logic of the Ineffable 65; 6. Proclus and the Neoplatonic Syllogistic 79; 7. Ammonius on the Canons of Proclus 125; 8. All Brutes are Subhuman: Aristotle and Ockham on Privative Negation 139; 9. Lukasiewicz's Many-valued Logic and Neoplatonic Scalar Modality 167; Bibliography 195; Index of Names 201; Index of Topics 203-204.

"The papers in this collection are presented in the historical order of the philosophers they discuss: Aristotle before Plotinus, Plotinus before Proclus, and so on. But that is not the order in which they were written. "A Tense Logic for Boethius" (Chapter 4) was my initial effort at applying the methods of modern logic and formal semantics to ancient logic. It gave me confidence to pursue Plotinus, the patriarch of the tradition. The result was "Existence, Negation, and Abstraction in the Neoplatonic Hierarchy" (Chapter 3). In this paper I argue that the mysticism in the *Enneads* is accompanied by some logically interesting theory. Plotinus exploits

properties of scalar adjectives only recently studied in linguistics, and marshals them in structures of an algebraic character by means of negation operations characteristic of the Neoplatonic tradition. When formulated in this way, the views amount to serious positions in modern logic and the philosophy of language. My excursion into the "logic" of Plotinus made it clear to me that I needed to work out in a satisfactory way Aristotle's syllogistic, the theory that lies at the background of all ancient logic and that was bent to new purposes by Neoplatonists. I found that the standard account of the syllogistic as developed in the 1960s by Smiley and Corcoran could be abstracted to a lattice theoretic semantics and given a more standard Henkin style completeness proof. These results are outlined in "Aristotle's Natural Deduction Reconsidered" (Chapter 1) and "Ecthesis and Existence in the Syllogistic" (Chapter 2).

I was ready then for attempting to understand Proclus, who is without question the most logically sophisticated of Neoplatonic thinkers.

(...)

His logical ideas are explored in "Proclus on the Logic of the Ineffable" (Chapter 5), an introductory essay, and more fully in "Proclus and the Neoplatonic Syllogistic" (Chapter 6).

(...)

The collection concludes with two studies of Neoplatonic ideas in later logic. In "All Brutes are Subhuman: Aristotle and Ockham on Privative Negation" (Chapter 8) two closely related notions of privative negation are distinguished, one Neoplatonic and one more Aristotelian." (Preface, p. VIII)

20. McCall, Storrs. 1967. "Contrariety." *Notre Dame Journal of Formal Logic* no. 8:121-132.

"This paper is an attempt to make philosophical capital out of an important difference between the Aristotelian logic of terms and the Stoic, or 'modern', logic of propositions. This difference is, that although both logics include and give formal recognition to the relation of contradiction, only the former, and not the latter, takes account of the relation of contrariety.

Here I do not refer to the relation of contrariety as extending between terms (thus for example the terms 'pleasure' and 'pain', 'black' and 'white' denote contraries), but as extending between propositions.

The most common definition of contrariety is as follows: two propositions are contraries if they cannot both be true. For comparison, the definition of contradiction states that two propositions are contradictories if they can neither both be true nor both be false, and that of subcontrariety, that they cannot both be false.

(...)

The fact that there is not seems *prima facie* to be a consequence of Stoic logic's being a logic of unanalysed propositions, while Aristotelian logic is not.

Notwithstanding this seemingly irreconcilable difference between the two logics, there may still be ways of introducing the notion of contrariety into propositional logic. For example we might, analogously with  $Np$ , write  $Rp$  for the contrary of  $p$ . This device is adopted by L. Goddard(2) in order to give a satisfactory analysis of exclusive disjunction: he points out that what makes disjunctions exclusive is not use of the exclusive 'or', but an internal opposition between the disjuncts which we can express by saying that they are contraries. The aim of this paper will be to investigate the formal properties of the notion of contrariety: that is, to provide means of introducing the operator  $R$  into the logic of propositions." (pp. 121-122)

(2) 'The Exclusive "Or" ', *Analysis* 1960.

21. ———. 2012. "A History of Connexivity." In *Logic: A History of Its Central Concepts*, edited by Gabbay, Dov M., Pelletier, Francis Jeffrey and Woods, John, 415-449. Amsterdam: North-Holland.

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"Connexive implication is a type of implication first defined in the 4th Century B.C., a time of active debate when it was said that the very crows on the rooftops were croaking about what conditionals were true. In Sextus Empiricus' Outlines of

Pyrrhonism, which discusses four varieties of implication, including [1] material (Philonian) and [2] strict (Diodorean) implication, we read:

"[3] And those who introduce the notion of connection say that a conditional is sound when the contradictory of its consequent is incompatible with its antecedent." [Kneale, 1962, 129]

It follows from this definition that no conditional of the form "If p then not-p" can be true, since the contradictory of not-p, i.e. p, is never incompatible with p.

Accepting this in turn requires that "compatibility" be essentially a relational concept, and that whether or not A is compatible with B cannot be determined by examining A and B separately.

Thus even "p&~ p" is not incompatible with itself, and "If p&~ p, then not-(p&~ p)" is connexively false." (p. 415)

References

W. Kneale and M. Kneale. *The Development of Logic*, 1962.

22. Mueller, Ian. 1974. "Greek Mathematics and Greek Logic." In *Ancient Logic and Its Modern Interpretations*, edited by Corcoran, John, 35-70. Dordrecht: Reidel. "By 'logic' I mean 'the analysis of argument or proof in terms of form'. The two main examples of Greek logic are, then, Aristotle's syllogistic developed in the first twenty-two chapters of the *Prior Analytics* and Stoic propositional logic as reconstructed in the twentieth century. The topic I shall consider in this paper is the relation between Greek logic in this sense and Greek mathematics. I have resolved the topic into two questions: (1) To what extent do the principles of Greek logic derive from the forms of proof characteristic of Greek mathematics? and (2) To what extent do the Greek mathematicians show an awareness of Greek logic? Before answering these questions it is necessary to clear up two preliminaries. The first is chronological. The *Prior Analytics* probably predates any surviving Greek mathematical text. There is, therefore, no possibility of checking Aristotle's syllogistic against the actual mathematics which he knew. On the other hand, there is no reason to suppose that the mathematics which he knew differs in any essential way, at least with respect to proof techniques, from the mathematics which has come down to us." (p. 35)
- "The paper which follows has three main sections. In the first I discuss the character of Euclidean reasoning and its relation to Aristotle's syllogistic. In the second I consider the passages in the *Prior Analytics* in which Aristotle refers to mathematics; my purpose here is to determine whether reflection on mathematics influenced his formulation of syllogistic. In both sections my conclusions are mainly negative. Euclid shows no awareness of syllogistic or even of the basic idea of logic, that validity of an argument depends on its form. And Aristotle's references to mathematics seem to be either supportive of general points about deductive reasoning or, when they relate specifically to syllogistic, false because based on syllogistic itself rather than on an independent analysis of mathematical proof. In the third main section of the paper I consider the influence of mathematics on Stoic logic. As far as Chrysippean propositional logic is concerned, my conclusions are again negative. However, it is clear that at some time logicians, probably Stoic, began to consider mathematical proof on its own terms. Although they never developed what I would call a logic to cover mathematical proof, they at least realized the difference between it and the logical rules formulated in antiquity. Much of the third section is devoted to an attempt to reconstruct in outline the history of logical reflections on mathematics in the last two centuries B.C. In conclusion I recapitulate briefly my conclusions about the relation between Greek mathematics and logic." (p. 37)
23. Mulhern, John. 1974. "Modern notations and ancient logic." In *Ancient Logic and Its Modern Interpretations*, edited by Corcoran, John, 71-82. Dordrecht: Reidel. "To what extent does ancient logic admit of accurate interpretation in modern terms? Blanché [3] and Dürr [14] published general surveys of research on ancient logic in the mid-1950's. My aim in the present paper is to identify studies made available during the quarter-century 1945-1970 that illustrate the influence modern

notations have had on our understanding of ancient logical texts. Accepting Bochenski's division of ancient logic into four temporally distinct stages, I mention research on the Prearistotelian, Aristotelian, Stoic and Commentatorial logics in Sections 1-4. In Section 5, I offer some generalizations on the utility of modern notations in writing the history of ancient logic." p. 71

"At the beginning of this paper, I asked to what extent ancient logic admits of accurate interpretation in modern terms. While no final answer to this question will be available until research in the field has gone a good deal further than it has so far, still the progress since 1945 has been remarkable, and it is not too early to consider its causes. In his history of the history of logic, Bochenski wrote as follows:

The rise of modern history of logic concerning all periods save the mathematical was made possible by the work of historians of philosophy and philologists in the 19th century. These published for the first time a series of correct texts edited with reference to their context in the history of literature. But the majority of ancient philologists, medievalists and Sanskrit scholars had only slight understanding of and little interest in formal logic. History of logic could not be established on the sole basis of their great and laborious work.

For its appearance we have to thank the fact that formal logic took on a new lease of life and was reborn as mathematical. *Nearly all* the more recent researches in this history were carried out by mathematical logicians or by historians trained in mathematical logic. ([5e], pp. 9-10.)

The trained researchers who have worked on the ancient materials have had to do much more than merely transcribe into modern notations logical treatises originally written in ancient natural languages. Just finding suitable transcriptions has had to wait on considerable analysis of the ancient texts. Transcription into modern notations presupposes some community of understanding and purpose with the ancient logicians, and this community is something that needs to be argued for. In general, a department of ancient logic lends itself to being dealt with in notation if and only if its corresponding department of modern logic lends itself to being dealt with in notation. Logistic systems and their interpretations lend themselves to this to a great extent, theoretical syntax and especially semantics to a much lesser extent. Where a modern notation follows or reproduces or elucidates the logical form of a sentence or inference or schema that interests an ancient logician, then its use is in order. The studies discussed in Sections 1-4 of this paper point to the conclusion that the judicious use of modern notations has been one cause of progress -- over the last two decades and a half -- in our understanding of ancient logic." (pp. 81-82)

[3] Blanché, R., Vues nouvelles sur l'ancienne logique', *Les Etudes Philosophiques* 11, 1956, 183-208

[4] Bochenski, I. M., *Ancient Formal Logic*, Amsterdam 1951

[5e] Bochenski, I. M., *A History of Formal Logic* (trans. by I. Thomas), Notre Dame 1961

24. Nuchelmans, Gabriel. 1973. *Theories of Proposition. Ancient and Medieval Conceptions of the Bearers of Truth and Falsity*. Amsterdam: North-Holland. Contents: Preface V; 1. Introduction 1; 2. Plato 13; 3. Aristotle 23; 4. The Stoic *lekton* 45; 5. The Stoic *axioma* 75; 6. Later developments in Greek antiquity 89; 7. The transition to the Latin West 105; 8. Boethius and the beginning of the Middle Ages 123; 9. Abelard 139; 10. The doctrine of the *dictum* in the century after Abelard 165; 11. Preliminaries to the fourteenth century debate 177; 12. The *complexum* theory of Ockham and Holkot 195; 13. Some reist opponents of Ockham and Holkot 209; 14. The theory of the *complexe significabile* 227; 15. The oppositions against the theory of the *complexe significabile* 243; 16. The significate of a true *propositio* 273; Selective bibliography 281; Indices 289-309.
- "This book is intended as the first part of a history of those problems and theories in the domain of philosophical semantics which nowadays are commonly referred to as problems and theories about the nature and the status of propositions. [\*]

Although the conceptual apparatus and the terminology by means of which questions concerning propositions were asked and answered have considerably varied from period to period, the main types of disputes and solutions have remained remarkably constant. One of the aims of this study is precisely to trace the vicissitudes of the vocabulary in which this refractory topic was treated in the remote past. As is evident from the Bibliography, many parts of the field have been explored by predecessors. Guided by their results, I have tried to fill in more details and to design a provisional map of the area as a whole." (from the Preface)

[\*] The two other volumes are: *Late-Scholastic and Humanist Theories of the Proposition* (1980) and *Judgment and Proposition. From Descartes to Kant* (1983).

25. Plochmann, George Kimball. 1952. "Professor Henle on the four figures of syllogism." *Philosophy of Science* no. 19:333-341.  
 "An able piece on the controversy over the fourth syllogistic figure, written by Paul Henle and published by this journal [\*] deserves attention both for its clear argument and for details on which one might take issue. The essay, to renew old acquaintances, consists of two interlocking parts, and a very brief appendix. The two main theses relate, one to the needlessness of the fourth figure both on Aristotelian grounds and in general, the other to the modal syllogism as being the real center of gravity in the *Prior Analytics*. The appendix pronounces a benediction upon the controversy because the syllogism is 'waning' in its importance for formal logic. Where it seems necessary, I should like to refine -or even correct points Dr. Henle has made." (p. 333)  
 [\*] Paul Henle, *On the Fourth Figure of the Syllogism* (1949).
26. Prier, Raymond Adolph. 1976. *Archaic Logic: Symbol and Structure in Heraclitus, Parmenides, and Empedocles* The Hague: Mouton.  
 "The following study represents an attempt not only to explicate in some small way a mode of thought significantly different from much of our own, but also to suggest a new criterion of judgment for Classical Philology. These two purposes merge into one insofar as both come about from my own sharp disagreement with certain prevailing critical attitudes towards the so-called pre-Socratics. These essentially ungrounded attitudes are characterized, as I see them, by strong relativistic and materialistic premises which, although hidden for the most part, result in awkward misunderstandings of the pre-Platonic corpus in general and an uneven, if not castrating, criticism of specific authors in particular. These modern critical stances did not exist in the pre-Aristotelian Greek world in any predominant form, but Classical Philology in the later half of the twentieth century maintains otherwise and has, consequently, severely limited itself and very probably its future by adopting a narrow and unnecessarily rigid criterion of judgment that largely misrepresents the literary evidence at hand. Beyond the by no means unanimous acknowledgment that Aristotle revealed little of the real worth of the pre-Socratics, modern Classical Philology has not even suggested the need of a method — let alone the method itself - that might grasp the period between Homer and the Platonic revolution. I offer this study as an attempt to supply this critical tool." (From the *Preface* )
27. Rescher, Nicholas. 1969. "Three Post-Aristotelian Concepts of Syllogistic Logic." In *Essays in Philosophical Analysis* , 61-71. Pittsburgh: University of Pittsburgh Press.  
 "The aim of this chapter is to consider—primarily on the historical side— three important post-Aristotelian concepts of traditional syllogistic logic: the notions of the *quality* and *quantity* of categorical propositions and that of the *distribution* of terms therein. The history of all three of these key concepts of the traditional theory of the syllogism is still in significant measure obscure, and the remarks of recent scholars has tended (as will be shown) rather to darken than to clarify matters."
28. Smiley, Timothy. 1973. "What is a syllogism?" *Journal of Philosophical Logic* no. 2:136-154.

- "I shall offer my answer to my question in the shape of a formal system in which I shall put into practice the idea of treating syllogisms as deductions, and which is intended to match as closely as possible Aristotle's own axiomatisation of the syllogistic by means of conversion, *reductio ad impossibile*, and the two universal moods of the first figure. The definition of deducibility will ensure that in counting premisses attention is paid to whether and how often they are used in a deduction. This is in order to satisfy the constraints mentioned in the preceding paragraph, and also to harmonise with Aristotle's own remarks about the numbers of premisses (cf. *An. Pr.* 42b1, *An. Post.* 86b13); though it should be stressed that the case for treating syllogisms as deductions is independent of the case for this particular treatment of deducibility. The principal result proved is that the system is complete with respect to the valid moods, where these are defined in the spirit of the Aristotelian figures but without his restriction to the special case of two premisses. I shall also show that the system possesses a simple decision procedure. Finally I shall test the system's harmony with Aristotle's ideas by considering it in relation to his well-known discussion of syllogisms with false premisses." (pp. 140-141)
29. Smith, Robin. 1983. "Completeness of an Ectetic Syllogistic." *Notre Dame Journal of Formal Logic* no. 24:224-232.  
Abstract: "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."
30. ———. 2002. "Ancient Philosophical Logic." In *A Companion to Philosophical Logic*, edited by Jacqueline, Dale, 11-23. Malden: Blackwell.  
"Ancient Greek logic was inseparable from ancient Greek philosophy. The formal theories developed by major logicians such as Aristotle, Diodorus Cronus, and Chrysippus were in large part influenced by metaphysical and epistemological concerns. In this brief essay, I will try to give some picture of this interrelationship. For reasons of space, I make no attempt to cover, or even to mention, every aspect of ancient Greek logic. I have preferred instead to concentrate on illustrating its philosophical aspects." (p. 11)
31. Speranza, J. L., and Horn, Laurence R. 2012. "History of Negation." In *Logic: A History of Its Central Concepts*, edited by Gabbay, Dov M., Pelletier, Francis Jeffrey and Woods, John, 127-174. Amsterdam: North-Holland.  
Volume 11 of the *Handbook of the History of Logic*.  
"In choosing Grice as a catalyst and foundation stone, we open with a discussion of Formalism (or Modernism). This we present as giving a "System" for the logic of negation – notably with a syntactic and a semantic component. In the second part, we briefly discuss Neo-Traditionalism (or Informalism) which Grice saw as presenting a challenge to Formalism. We propose, with Grice, that most of the observations made by the Informalists pertain to the pragmatic component of the System, and characterise pragmatic rather than logical inference. We will try to show that our choice of Grice as a catalyst is general enough to provide a basis for the History of Logic and the treatment of one of its central concepts. We center on the ideas of Grice as an example of a logical treatment of negation, but also as a memorial to a specific chapter in logical historiography. Our focus will be one particular logical feature of negation as it has been conceived in the history of logic as a 'unary' truth-functor." (p. 127)
32. Tracy, Kevin. 2006. *The Development of Dialectic from Aristotle to Chrysippus*. Dissertation presented to the University of Pennsylvania (available on ProQuest).  
Abstract: "From Aristotle onward, formal logic was an element of ancient Greek dialectic (*dialektiké*). Aristotle's *Prior Analytics* (4th century BCE) is the earliest

evidence of a formal logic in antiquity. The evidence for the formal logic of the Stoic philosopher Chrysippus (3rd century BCE) is fragmentary; nonetheless it makes clear that not more than a century or so after *Prior Analytics*, Chrysippus revolutionized formal logic. The scholarship on Stoic logic has not yet presented the history of dialectic from Aristotle to Chrysippus as an intelligible narrative. Without such a narrative, one cannot explain what, in general, motivated the innovations of Chrysippus, what made Stoic logic coherent as a unified project, or what relationship that project had to earlier work in logic. This dissertation approaches the problem through the presentation and interpretation of the ancient source material. First it describes the logical doctrines of Aristotle, Theophrastus, and the 'Megarics' in such a way as to make clear what questions these predecessors left for Chrysippus. It then describes how Chrysippus addressed these questions. Finally, it uses the resulting narrative to give a detailed account of Stoic formal logic. The dissertation yields five principal conclusions. First, neither the Peripatetics or the 'Megarics' described logical forms of propositional logic; Chrysippus was the first to do so. Second, the guiding aim of Chrysippus' logic was to avoid adopting a semantic stance in describing logical forms and explaining logical relationships. Third, the Stoics distinguished 'valid' (*hugies*) from 'true' (*aléthes*), so that *sunartésis* is a standard for the validity rather than the truth of the Stoic conditional (*sunhémmenon*). Fourth, the Stoics produced derivations for categorical arguments in their deduction system. Fifth, the Stoic deduction system is roughly analogous to the first-order fragment of Frege's system, except on two points: it most likely was not designed to accommodate the use of polyadic predicates with multiple quantifiers, although the possibility for doing so inheres in its approach to the analysis of propositions, and it uses the 'natural' approach rather than the 'axiomatic' approach of Frege."

33. Waszkiewicz, Jan, and Wojciechowska, Agnieszka. 1990. "On the origin of reductio ad absurdum." In *Logic Counts*, edited by Zarnecka-Bialy, Ewa, 87-96. Dordrecht: Kluwer.

"Our particular interest is in the origin of reductio ad absurdum method of theorem proving.(1) It is approached from both - the history of mathematics and history of logic side.(2) We proceed by analysing the cultural context of both sciences. Hence, it is necessary to regard some cultural phenomena much older than logic or even mathematics. The considered problem is well established. It has been widely discussed but no definite conclusions have been reached so far. Existing opinions are summed up by A. Szabó.(3)

An explanation of the origin (and priority in use) of reductio ad absurdum is crucial for the interpretation of the early history of the deductive method in mathematics and also of dialectics in philosophy. As A. Szabó stated (reformulating Proclus' opinion), "mathematics was at least in one respect a branch of dialectics" and it is exactly this respect we are going to investigate." (p. 87)

(1) This is the text of the lecture delivered at the 33rd Conference on the History of Logic, Jagiellonian University, Cracow, October 1987.

(2) Our point of view in these more general problems is presented, e.g., in: A. Wojciechowska, "Geneza matematyki i logiki - przykład wspólnych problemów historii obu nauk" [Genesis of mathematics and logic - an example of parallel problems in history of both sciences], *Ruch Filozoficzny* 1987; J. Waszkiewicz, "The influence of cultural background on the development of mathematics", *Organon* 16-17 (1981), pp. 93-113.;

J. Waszkiewicz, "Korzenie greckiej matematyki. Studium socjokulturowych uwarunkowań genezy matematyki" [Roots of Greek Geometry. Study of Sociocultural Conditions of the Genesis of Mathematics). Prace Naukowe OBP Politechniki Wrocławskiej, Wrocław 1988.

(3) See A. Szabó, "Greek Dialectics and Euclid's Axiomatics", in: I. Lakatos (ed.), *Problems in the Philosophy of Mathematics. Proceedings of the International Colloquium in the Philosophy of Science*, London 1965, vol.I, North Holland, Amsterdam 1967, pp. 1-27 (lecture and discussion).

34. Williamson, Timothy. 1994. "The early history of sorites paradoxes." In *Vagueness*, 8-35. New York: Routledge.  
 "The sorites puzzles can be traced conjecturally forward from Eubulides in the mid fourth century BCE through a chain of teacher–pupil links. One pupil of Eubulides was Apollonius Cronus; one of his pupils was Diodorus Cronus. David Sedley argues that it was Diodorus who gave Eubulides' puzzles wide circulation and intellectual status. According to Sedley, Diodorus inherited from Eubulides 'his sophisticated leanings, his flamboyancy and his love of showmanship'; he could present a puzzle so that it not only caught the imagination but emerged as a serious challenge to philosophical theory.(6) Diodorus taught dialectic, 'the science of discoursing correctly on arguments in question and answer form', the standard medium of philosophical argument and that in which the sorites puzzles were formulated." (p. 10)  
 (6) Sedley 1977: 78.  
 References  
 Sedley,D.N. 1977. 'Diodorus Cronus and Hellenistic philosophy', *Proceedings of the Cambridge Philological Society* 23: 74–120.
35. Wolenski, Jan. 1998. "Scepticism and Logic." *Logical Analysis and History of Philosophy* no. 1:187-194.  
 Abstract: "This paper offers a logical analysis of Scepticism. It is shown that Dogmatism, Academism and Scepticism as characterized by Sextus Empiricus in *Outlines of Pyrronism* form a variety of views which can be ordered by an interpretation of the classical logical square. In particular, Scepticism appears as a conjunction of the negations of Dogmatism and Academism. The next problem concerns the logic proper for Scepticism. Logic based on a dual of the consequence operation is proposed as satisfying intuitive requirements associated with doubting. Finally, the attitude of the sceptic toward logic is discussed. In particular, it is argued that the principle of isosteny trivializes scepticism if it is applied to logic."
36. Woods, John. 2012. "A History of Fallacies." In *Logic: A History of Its Central Concepts*, edited by Gabbay, Dov M., Pelletier, Francis Jeffrey and Woods, John, 513-609. Amsterdam: North-Holland.  
 Volume 11 of the *Handbok of te History of Logic*.  
 "Much of what I shall have to say in the chapter is centred around a concept and a list. The concept is the traditional concept of fallacy, an idea that has come to us over the centuries from its early definition in antiquity. The list is the traditional list, or what I will for light relief call the "gang of eighteen". The gang of eighteen is not a mathematically well-defined set. Its number varies somewhat from writer to writer, and some lists will contain items which other lists omit. But the gang of eighteen is a representative sample of the fallacies that we think of today as exemplars of the traditional concept of fallacy. The gang of eighteen is constituted as follows: *ad baculum*, *ad populum*, *ad verecundiam*, *ad hominem*, *ad ignorantiam*, *ad misericordiam*, affirming the consequent and denying the antecedent, *begging the question*, *many questions*, *hasty generalization*, *equivocation*, *biased statistics*, *gambler's*, *post hoc*, *ergo*, *propter hoc*, *composition and division*, *faulty analogy*, and *ignoratio elenchi* (of which straw man is a special case).  
 The earliest predecessor list was Aristotle's "gang of thirteen" in *On Sophistical Refutations*. It is made up of ambiguity (cf. the modern fallacy of equivocation), amphiboly (cf. equivocation), combination of words (cf. composition), division of words (cf. division), *secundum quid* (cf. hasty generalization), *ignoratio elenchi* (cf. straw man), begging the question (cf. begging the question), many questions (cf. many questions), consequent, non-cause as cause, accident, accent and form of expression.(3)" (p. 514)  
 (3) Not on Aristotle's list are *ad hominem* argument, babbling and solecism. I will come back to these below.



37. Youtie, Herbert, Youtie, Louise, and Kneale, William. 1973. "P. Mich. Inv. 2906, a Fragment of Logic." *Zeitschrift für Papyrologie und Epigraphik* no. 10:175-185. "This papyrus contains a single column from a roll of prose text identified as logic by O. Neugebauer and H. Cherniss, with the concurrence of W. and M. Kneale, F. Solmsen and W. H. Hay, all of whom responded generously to an appeal for help in the elucidation of a difficult text. We are especially indebted to Prof. W. Kneale for expanding our diplomatic transcript into a text with appropriate supplements, which in turn enabled us to improve the transcript in a number of places. His reconstructed text, together with a translation and commentary on the logic of the fragment, follows immediately after our description of Mich. Inv. No. 2906, the diplomatic transcript and palaeographic commentary." (p. 175)

### Études en Français

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2. Bochenski, Joseph. 1937. "Notes historiques sur les propositions modales." *Revue de Sciences Philosophiques et Théologiques* no. 26:673-692.
3. Brunschwig, Jacques. 1986. "Remarques sur la classification des propositions simples dans les logiques hellénistiques." In *Philosophie du langage et grammaire dans l'Antiquité*. Bruxelles: Ousia.  
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