History of Logic from Aristotle to Gödel (www.historyoflogic.com)

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Introduction

"Preliminary definition of the subject matter of the history of logic is hard to come by. For apart from 'philosophy' there is perhaps no name of a branch of knowledge that has been given so many meanings as 'logic'. Sometimes the whole of philosophy, and even knowledge in general, has been thus named, from metaphysics on the one hand, cf. Hegel, to aesthetics ('logic of beauty') on the other, with psychology, epistemology, mathematics etc. in between. With such a wide choice it is quite impossible to include in a history of logical problems all that has been termed 'logic' in the course of western thought. To do so would practically involve writing a general history of philosophy. But it does not follow that the use of the name 'logic' must be quite arbitrary, for history provides several clues to guide a choice between its many meanings.

This choice can be arrived at by the following stages.

1. First let us discard whatever most authors either expressly ascribe to some other discipline, or call 'logic' with the addition of an adjective, as for example epistemology, transcendental logic, ontology etc.

2. When we examine what remains, we find that there is one thinker who so distinctly marked out the basic problems of this residual domain that all later western inquirers trace their descent from him: Aristotle. Admittedly, in the course of centuries very many of these inquirers -- among them even his principal pupil and successor Theophrastus -- have altered Aristotelian positions and replaced them with others. But the essential problematic of their work was, so far as we know, in constant dependence in one way or another on that of Aristotle *Organon*. Consequently we shall denote as 'logic' primarily those problems which have developed from that problematic.

3. When we come to the post-Aristotelian history of logic, we can easily see that one part of the *Organon* has exercised the most decisive influence, namely the Prior Analytics. At some periods other parts too, such as the Topics or the Posterior Analytics, have indeed been keenly investigated and developed. But it is generally true of all periods marked by an active interest in the *Organon* that the problems mainly discussed are of the kind already to hand in the Prior Analytics. So the third step brings us to the point of describing as 'logic' in the stricter sense that kind of problematic presented in the Prior Analytics.

4. The Prior Analytics treats of the so-called syllogism, this being defined as logos in which if something is posited, something else necessarily follows. Moreover such *logoi* are there treated as formulas which exhibit variables in place of words with constant meaning; an example is 'B belongs to all A'. The problem evidently, though not explicitly, presented by Aristotle in this epoch-making work, could be formulated as follows. What formulas of the prescribed type, when their variables

are replaced by constants, yield conditional statements such that when the antecedent is accepted, the consequent must be admitted? Such formulas are called 'logical sentences'. We shall accordingly treat sentences of this kind as a principal subject of logic." (pp. 2-3)

From: Joseph Bochenski, *A History of Formal Logic*, New York: Chelsea Publishing Co. 1961.

Logic and Ontology

The question "how are logic and ontology interrelated?" is an ambiguous question, that is, it can refer either to logic and ontology themselves or to the metatheories of logic and ontology (that is, to the views about them). Furthermore, in the first case, both logic and ontology may be considered either objectively or subjectively.

(1) If the question refers to logic and ontology themselves considered objectively (that is, in their content), the disciplines are seen as sets of laws and/or rules, and so the problem is purely logical. It will be clear that its solution depends largely on the content of logic and of ontology as they were constructed at a given time.

(2) If the question refers to the same, but as seen subjectively (that is, in as far as they were conceived by some thinkers or groups of thinkers), then it is about empirical facts and is then a historical question: how did the fact that x held the ontology O influence the fact that he also held the logic L or inversely?

(3) Finally, if the question is concerned not with the two systems as they are but rather with the metatheoretical views about them (that is, with the corresponding philosophies of logic), the question is a quite different one. That this is so is indicated by the fact that often the same type of logic was philosophically interpreted in a different manner by two different schools. This question, in turn, can be considered either logically or historically. It should be clear that the first question is fundamental. Therefore, the principal focus of this presentation will be upon it. The philosophy of logic and ontology will be treated only secondarily, while the historical question of the mutual factual influences of doctrines about them will be only marginally noted.

Now to state at once one of the principal conclusions of the present investigation, it must be confessed that there is considerable confusion about that basic question. Almost any imaginable answer has been proposed by one or another philosopher. To mention only two of the extreme views, respectable logicians have maintained that there is a complete identity of both disciplines (thus, Scholz) and that there is no relation whatsoever between them (thus, Nagel). The very fact that this is so requires an explanation. As is always so in such cases, this explanation must be historical.

One reason for the unfortunate state prevailing in investigations of this problem can readily be identified: ignorance. Most ontologists do not know even the ABC's of logic. But the inverse is also true: most logicians do not have the least idea what ontology might be. These deficiencies are often combined, on both sides, with value judgments of an unkind sort. Thus, to most ontologists, logic does not seem to be a serious discipline, although they concede that it provides (hélas!) some practical results for computer science. On the other hand, ontology is merely nonsense in the estimation of many logicians. It is little wonder that such scholars produce few worthwhile contributions regarding the relations of the two disciplines.

But this is not the whole answer. The present bifurcation did not always prevail. There have been ontologists who were well instructed in logic and who were even creative logicians in their own right ; Thomas Aquinas and Uddyotakâra (seventh century) are examples. There were also logicians who knew a good deal about ontology; one need think only of Leibniz and of Whitehead. Nevertheless, confusion about our problem is widespread across the ages. Some explanation must be offered for this fact, and once again it has to explained historically. (pp. 274-275)

(...)

The history begins with Aristotle, as so many philosophical questions do. Nor is it a question of that history merely beginning with him. For in many cases one gets the impression that where "the Master of those who know" (Dante) failed to perceive or to formulate a problem, his successors had a difficult time at formulating or solving it. Among these problems is that of the relations between logic and ontology.

The following is a brief description of both disciplines as they appear to the unbiased reader in the Aristotelian corpus. There is a book, or rather a collection of writings, called "*Metaphysics*" by Andronikos Rhodes. There is also a collection of works which received the name "*Organon*" from the commentators. None of these names derive from Aristotle himself. There can be no doubt, however, that we find in his writings a considerable number of doctrines belonging to what will subsequently be called 'logic" and "ontology" respectively.

As regards ontology, Aristotle talks about a "first philosophy" and a "divine science." He says that they are about being as being; what we see here is an attempt to define this discipline. But as far as logic is concerned, we find no name for it in his writings. (...) Still less is there any attempt to define the subject matter of logic.

If, however, we turn from his philosophy of logic and of ontology to the theories themselves (that is, to the systems Aristotle developed), it is relatively easy to describe what he would have meant by "ontology" and "logic" respectively, if he had such terms.

Regarding ontology, we should first note that Aristotle, unlike many later thinkers, did not believe that there is an entity or even a meaning unambiguously associated with the term "being." In one of those passages which can certainly be esteemed as a stroke of genius, Aristotle explicitly states that "being" is an ambiguous term; he justifies this assertion by a sort of embryonic theory of types. And yet, we find extensive discussions of the characteristics of entities in general in the *Metaphysics* and elsewhere. On closer inspection, we discover that his ontological doctrines can be divided into two classes.

First of all, in the fourth book of his Metaphysics, Aristotle undertakes to state and discuss the "principles" -- namely, non-contradiction and the excluded middle. (Aristotle made explicit use of the principle of identity in his logic, but never made it the object of a similar study.) Next we have a number of analyses of concrete entities. Of these the most conspicuous are the doctrine of act and potency and the table of the categories (also studied in the *Organon*, but obviously belonging to the "first philosophy"). The last named could be and has often been viewed as a classification of entities. But it seems more consistent with Aristotle's thought to consider it as a sort of analysis of a concrete entity into its various aspects. (...)

In summary, the Aristotelian ontology appears to be a study (1) of (isomorphically, we would say) common properties of all entities and (2) of the aspects into which they can be analyzed. Both sorts of studies are about *real objects*. One distinctive characteristic of this ontology is its conspicuous lack of existential statements, which is contrary to what we find in what is now commonly called "metaphysics". (pp. 279-281)

(...)

In summary, then, Aristotle left: (1) an ontology conceived as a theory of real entities in general and of their most general aspects; this discipline is defined; (2) two quite different systems of logic: a technology of discussion and an object-linguistic formal logic; (3) a considerable overlapping of both disciplines (for example, the "principles," the categories, etc.) ; (4) not even a hint, direct or indirect, as to what formal logic might be about ; in other words, no philosophy of logic at all.

It should be clear that in that frame of reference, the question of the relations between logic and ontology cannot even be clearly stated. For we do not know what logic is nor which of the two logics has to be considered nor where are the boundaries between it and ontology.

And yet that is the frame of reference within which most of the Western discussions of our problem will develop. That is, so it seems, the explanation of the confusion reigning in our field.

With the Stoics, we find a clear choice between the alternative conceptions of logic: they opt for "dialectics," the art of arguing. This does not mean that they remained at the level of the Topics. On the contrary, their logic of propositions, magnificently developed, is formal logic. But it is conceived as being a set of rules of arguing.

Moreover, the Stoics were the first to formulate a consistent theory of the object of logic. Logic is, according to them, radically different from ontology of the Aristotelian type. There is, it is true, no ontology in their philosophy; and what corresponds to the Aristotelian table of categories is considered to be a part of logic. But the subject matter of logic, the meanings, is sharply distinguished from what is real. For, whereas everything which is real, including mental entities, is a body in the Stoics' view, the meanings are not bodies. They are ideal entities.

Thus the first known philosophy of logic emphasizes the radical difference and independence of logic as regards ontology.

The Scholastics make no use of the term "ontology" and discuss subjects which will subsequently be called "ontological" in the context of their commentaries on Aristotle's Metaphysics. As

compared with the latter, there are some important developments. For example, much consideration is given to the semantic status of "being." We are aware of several positions adopted regarding this problem: while the Thomists considered "being" as analogous (that is, basically a systematically ambiguous term), others, such as the Ockhamists, held that it was purely ambiguous; Scotists, on the other hand, claimed that it is a "genus" (that is, not an ambiguous expression). Depending on the position assumed, some philosophers will develop a general theory of being, while others will not. In addition, we find a few new chapters in ontology: above all, the doctrine of the distinction between essence and existence, the theory of the "transcendental" properties of all entities, and, of course, a rich technical elaboration of every doctrine. With these exceptions, the subject matter of ontology is the same as that found in Aristotle.

When we turn to logic, the situation is quite different. While incorporating and developing a number of Aristotelian doctrines, Scholastic logic is very much un-Aristotelian insofar as its method and approach are concerned, but also, to a large extent, as regards the content. It is completely metalinguistic and consists of rules. But it is unlike Stoic logic as well, for its explicit concern is not with mere meanings but rather with what were called propositions (meaningful sentences). Semantics undergoes tremendous development during this period.

This being so, several important facts which are relevant to our problem emerge. First of all, a sharp distinction between logic and ontology is explicitly established: the former is metalinguistic, the latter, object-linguistic; logic formulates rules, ontology, laws. Secondly, given this distinction and the nature of the Aristotelian corpus, a curious duplication of doctrines appears: problems are treated twice, once in logic and then again in ontology. As Ockham noted, there are two principles of noncontradiction: one ontological, stated in object-language, and another logical, formulated in meta- linguistic terms.

The Scholastics also formulated various philosophies of logic. They had several common views. For one, logic, while being primarily a methodology of reasoning and arguing, is said to be also a theory of certain entities. Second, they all shared the assumption that logic is not about "first intentions," which are dealt with in ontology, but rather about "second intentions." However, these terms assumed very different meanings in the context of different schools. (pp. 282-283)

(...)

The modern era, prior to the rise of mathematical logic, is an alogical and a largely unontological period. It opens with the Humanists; in their view, if logic has any usefulness at all, it is only as a set of rules for everyday arguments: it is an inferior sort of rhetoric, as Valla put it. Later on, when the scientific spirit began to rise, even the most rationalistic thinkers, such as Descartes, would not dare to reconsider the Humanists' total condemnation of "scholastic subtleties," including formal logic. Gradually, the so-called conventional logic was formulated.

The latter consists of extracts from Scholastic logic which omit almost every logical matter not connected with the theory of the assertoric syllogism (thus, the logic of propositions among others) and with the addition of a number of methodological doctrines. Logic is quite clearly conceived of as "dialectics," "the art of thinking," as the authors of the influential *Logique de Port-Royal* titled it. Philosophically, there is a novelty: widespread psychologism, according to which logic has as its object mental entities and activities (concepts, judgments, reasonings).

There is, of course, one great exception -- Leibniz, a logician of genius and an important thinker in the field of ontology. His ontology has been popularized by Wolff; in the latter's work the term "ontology" is clearly defined as designating the most general part of metaphysics, dealing with "being in general" (quite in the Aristotelian spirit). Leibnizian logic is mathematical and should rather be considered together with more recent logics, for its influence on the seventeenth, eighteenth, and nineteenth centuries was almost negligible. Leibniz also established his own philosophy of logic, which can only be understood in light of his logic. Our discussion of this will be deferred as well.

But, apart from Leibniz, the situation of our problem is not much different from that found in the Stoics and Scholastics: as logic is concerned with the mental behavior of men and ontology with being in general, the separation of the two is just as sharp as in the older schools. Indeed, this separation is reinforced by the fact that logic is now thought of as being a purely practical discipline and not as a theoretical one.

The whole course of the evolution between Aristotle and Boole may be summarized as follows. Ontology, whenever present, is on the whole of the Aristotelian type: a general theory of real entities. Regarding logic, the great majority of thinkers opt for the first Aristotelian logic, that of the Topics; they cultivate this discipline as a methodology of thought. While it is true that some

Scholastics admitted a theory founding such a methodology, their logic nevertheless belongs to the type outlined in the Topics, not to that of the Prior Analytics. With such an assumption as a basis, whatever philosophy of logic they developed--whether conceived as a theory of meanings, of second intentions, of syntax or of mental entities, it was always radically different from ontology." (pp. 284-285)

From: Joseph Bochenski, "Logic and Ontology", *Philosophy East and West*, 24, 1974, pp. 275-292.

"Aristotle was the founder not only of logic in western philosophy, but of ontology as well, which he described in his *Metaphysics* and the *Categories* as a study of the common properties of all entities, and of the categorial aspects into which they can be analyzed. The principal method of ontology has been one or another form of categorial analysis, depending on whether the analysis was directed upon the structure of reality, as in Aristotle's case, or upon the structure of thought and reason, as, e.g., in Kant's *Critique of Pure Reason*. Viewed in this way, the two subjects of logic and ontology could hardly be more different, and many schools in the history of philosophy, such as the Stoics, saw no common ground between them. Logic was only a system of rules for how to argue successfully, and ontology, as a categorial analysis and general theory of what there is (in the physical universe), was a system of categories and laws about being.
Scholastic logicians also drew a sharp distinction between logic and ontology, taking the latter to be about 'first intentions' (concepts abstracted directly from physical reality), and the former about 'second intentions' (concepts abstracted wholly from the 'material' content of first intentions, as well as about such categorial concepts as individual, proposition, universal, genus, species, property, etc., and so-called syncategorematic concepts such as negation). According to Aquinas, second intentions have a foundation in real entities, but 'exist' only in knowledge; i.e., they do not exist in the real world but depend on the mind for their existence – which is not say that they are subjective mental entities." (p. 117)

From: Nino Cocchiarella, "Logic and Ontology", *Axiomathes* vol. 12, 2001, pp. 117-150.

A survey of research on the history of logic until 1950

"Ancient and medieval history of ancient logic.

One meets sometimes with the assertion that history of philosophy is an invention of the XVIIIth century. This is in so far correct, that in older times -- in spite of Aristotle's and Thomas Aquinas' explicit teaching -- scholars neglected completely the genetic point of view in history of logic; on the other hand, thorn is no doubt that another aspect of historiography, namely the understanding of doctrines, was much cultivated by ancient and medieval thinkers. A complete account of ancient logic would have to take their results into consideration. Unfortunately, we know practically nothing of all the huge work which was accomplished, especially on Aristotle, by Greek, Syrian, Arabian, Jewish, or, above all, by Latin medieval logicians: as was already stated, the Greek commentators have not yet been studied, while the others are little more than a field for future research. And yet, we know that there were important discoveries during that time. This has been proved at least in one particularly striking instance: Albertus Magnus had a perfect understanding (superior to that of Alexander [of Aphrodisias], not to mention Prantl) of the highly difficult Aristotelian modal logic. This understanding has been nearly completely lost, however, during the modern ages.
State of the history of formal logic during the XIXth century.
Modern history of Logic had been started during the XIXth century, but its state was very bad at that time -- indeed until 1930 approximately -- because of two phenomena. On one hand, most of the historians of logic took for granted what Kant said on it; namely that "formal logic was not able to advance a single step (since Aristotle) and is thus to all appearance a closed and complete body of doctrine" (*); consequently, there was, according to them, no history of logic at all, or at the most, a history of the decay of Aristotelian doctrines. On the other hand, authors writing during that period were not formal logicians and by "logic" they mostly understood methodology, epistemology and ontology. That is why e.g. Robert Adamson could devote 10 pages to such a "logician" as Kant --

but only five to the whole period from the death of Aristotle to Bacon, i.e. to Theophrastus, the Stoic-Megaric School and the Scholastics. In order to realize what this means, it will be enough to remember that from the point of view we assume here, Kant is not a logician at all, while the leading Megaricians and Stoics are among the greatest thinkers in Logic.
The worst mischief was done during that period by the work of Carl Prantl (1855). This is based on an extensive knowledge of sources and constitutes the only all-embracing History of Ancient Logic we have until now. Unfortunately, Prantl suffered most acutely from the two above-mentioned phenomena: he believed firmly in the verdict of Kant and had little understanding of formal logic. Moreover, he had the curious moralizing attitude in history of logic, and, as he disliked both the Stoics and the Scholastics, he joined to incredible misinterpretations of their doctrines, injurious words, treating them as complete fools and morally bad men precisely because of logical doctrines which we believe to be very interesting and original. It is now known that his work -- excepting as a collection of texts (and even this far from being complete) -- is valueless. But it exercised a great influence on practically all writers on our subject until J. Łukasiewicz and H. Scholz drew attention to the enormous number of errors it contains.

Recent research.

We may place the beginning of recent research in our domain in 1896 when Peirce made the discovery that the Megaricians had the truth-value definition of implication. The first important studies belonging to the new period are those of G. Vailati on a theorem of Plato and Euclid (1904), A. Rüstow on the Liar (1908) and J. Łukasiewicz (1927); the Polish logician proposed in it his re-discovery of the logical structure of the Aristotelian syllogism and of Stoic arguments. Four years later appeared the highly suggestive, indeed revolutionary, *History of Logic* by H. Scholz, followed in 1935 by the paper of Łukasiewicz on history of logic of propositions; this is considered until now as the most important recent contribution to our subject. Both scholars -- Łukasiewicz and Scholz -- formed small schools. J. Salamucha, the pupil of the former, wrote on Aristotle's theory of deduction (1930) and the present author on the logic of Theophrastus (1939). Fr. J. W. Stakelum, who studied with the latter, wrote a book on Galen and the logic of propositions. On the other hand, A. Becker, a student of H. Scholz, published an important book on Aristotle's contingent syllogisms (1933). Professor K. Dürr was also influenced by Łukasiewicz in his study on Boethius (1938); his results were somewhat improved by R. van den Driessche (1949). In the English speaking world we may mention the paper of Miss Martha Hurst on implication during the IVth century (1935) -- but above all the already quoted work of Dr. B. Mates on Stoic Logic (in the press [*published 1953*]), which, being inspired by Łukasiewicz and his school may be considered as one of the best achievements of recent research.
Such is, in outline, the work done by logicians. On the other hand philologists had considerable merits in the study of ancient logic. We cannot quote here all their contributions, but at least the important book of Fr. Solmsen (1929) on the evolution of Aristotle's logic and rhetoric must be mentioned, and, above all, the masterly commentary on the Analytics by Sir W. D. Ross (1949). It does not always give full satisfaction to a logician trained on modern methods, but it is, nevertheless, a scholarly work of a philologist who made a considerable effort to grasp the results of logicians." (pp. 4-7, some notes omitted)

Notes

(*) *Kritik der reinen Vernunft*. 2d ed. p, VIII (English by N. Kemp Smith)
References (edited by R. Corazzon)
Robert Adamson, *A short History of Logic*, edited by W. R. Sorley, London 1911.
Albrecht Becker, *Die Aristotelische Theorie der Moglichkeitsschlusse. Eine logisch-philologische Untersuchung der Kapitel 13-22 von Aristoteles' Analytica priora I* (Dissertation, University of Munster), Berlin 1933.
Józef M. Bochenski, "La logique de Théophraste", *Collectanea logica*, 1, 1939, pp. 195-304) second edition Fribourg: Librairie del'université 1947 (reprint New York: Garland 1987)
René van den Driessche, "Sur le "De Syllogismo Hypothetico" de Boece", *Methodos*, 1, 1949, pp. 293-307.

Karl Dürr, "Aussagenlogik im Mittelalter", *Erkenntnis* 7, 1938, pp. 160-168.

Martha Hurst, "Implication in the 4th Century B.C.", *Mind* 44, 1935, pp. 484-495.

Jan Łukasiewicz, "O logice Stoików" (On the Logic of the Stoics), *Przeglad Filozoficzny* 30, 1927, pp. 278-279.

Jan Łukasiewicz, "Zur Geschichte der Aussagenlogik" (On the history of the logic of propositions), *Erkenntnis*, 5, 1935, pp. 111-131 (English translation: Storrs McCall (ed.), *Polish Logic 1920-1939*, Oxford: Clarendon Press 1967, pp. 66-87 and L. Borkowski (ed.), *Jan Łukasiewicz. Selected Works*, Amsterdam: North-Holland 1970, pp. 197-217.

Benson Mates, *Stoic Logic* Berkeley: University of California Press 1953 (second edition 1961).

Charles Sanders Peirce, "The regenerated logic", *The Monist*, 7, 1896, pp. 19-40.

Carl Prantl, *Geachichte der Logik im Abendlande* (Manuldruck) 2 vols., Leipzig 1927.

David W. Ross, *Aristotle's Prior and Posterior Analytics... with Introduction and Commentary*, Oxford 1949.

Alexander Rüstow, *Der Lügner. Theorie, Geschichte und Auflösung des Russellschen Paradoxons*, (Dissertation at the University of Erlangen, 1908), Leipzig 1910.

Jan Salamucha, *Pojiecie deduckcji u Aryatotelesa i św. Tomasza z Akwinu* (The Concept of Deduction in Aristotle and St. Thomas Aquinas). Warezawa 1930 (See the review by Józef M. Bochenski (1935), translated in: Kordula Świętorzecka, Jacek Juliusz Jadacki (eds.), *Jan Salamucha. Knowledge and Faith*, Amsterdam: Rodopi, pp. 311-316).

Heinrich Scholz, *Geachichte der Logik.*, Berlin 1931 (English translation: *A Concise History of Logic*, New York, 1961.)

Friedrich Solmsen, *Die Entwicklung der Aristotelischen Logik und Rhetorik*, Berlin 1939.

James W. Stakelum, *Galen and the Logic of Propositions* (Dissertation, Rome, Angelicum), Romae 1940.

Giovanni Vailati, "A proposito d'un passo del Teeteto e di una dimostrazione di Euclide", *Rivista di Filosofia e di scienze affini*, 6, 1904, pp. 378-388.

From: Joseph Bochenski, *Ancient Logic*, Amsterdam: North-Holland 1951.