History of Logic from Aristotle to Gödel

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History of Medieval Logic: A General Overview

INTRODUCTION

"The role of logic in the Middle Ages.

Regarding the role of logic within the framework of arts and sciences during the Middle Ages, we have to distinguish two related aspects, one institutional and the other scientific. As to the first aspect, we have to remember that the medieval educational system was based on the seven liberal arts, which were divided into the *trivium*, i.e., three arts of language, and the *quadrivium*, i.e., four mathematical arts. The so-called trivial arts were grammar, rhetoric, and logic, and during a period of several centuries virtually every educated person, at least every university graduate, received a training in these matters, especially in logic. Students in the medieval faculty of arts probably spent more time studying logic than any other discipline. This first -- institutional -- aspect concerning the role of logic is explained by the second -- scientific -- aspect. The trivial disciplines provided techniques of analysis and a technical vocabulary that permeate philosophical, scientific and theological writings. Logic, as mentioned before, was referred to and was generally regarded as the art of arts and the science of sciences. The increasing cultural dominance of the universities with their obligatory *disputationes* and their hierarchy of examinations on the one hand and the outstanding status of logic on the other were corresponding features of the educational world of the 13th century.
The core of the logic curriculum from the 12th century onwards was provided by the logical works of Aristotle. These represented the material for the study of types of predication, the analysis of simple propositions or statements (2) and their relations of inference and equivalence, the analysis of modal propositions, of the structure and the types of the syllogism, dialectical topics, fallacies and scientific reasoning as based on the demonstrative syllogism. Medieval logicians, however, realized that there were other, non-Aristotelian, approaches to logical subjects, questions and methods that could be investigated. The new approaches primarily included works on the signification and the supposition of terms -- a distinction showing some similarity to the modern distinction between meaning and reference. The theory of signification deals with the capability of descriptive terms to function as signs, i.e., their property of being meaningful. The theory of supposition was concerned with the types of reference that terms in their function as subject and predicate obtain in the context of different propositions. Another emphasis was put on consequences or valid inference forms. These innovations were by no means regarded as an alternative to tradition, but supplemented the Aristotelian *logica antiqua* under the heading of *logica moderna* or *logica modernorum*.
The medieval logicians themselves did not classify their discipline as a *scientia formalis* -- to my knowledge the expression was not used in the Middle Ages -- but as a *scientia sermocinali*s, i.e., a science of argumentative speech, which was the overarching framework of the trivial arts. The *scientia sermocinalis* itself is one of three types into which science was divided, e.g., by Peter of Spain in his well-known [Lambertus Marie de Rijk (ed.), Petrus Hispanus: *Tractatus* called afterwards *Summule logicales*, Van Gorcum 1972, p. 29, 14-16]. The differences (*differentiae*) of science, as Peter states, are *naturale, morale*, and *sermocinale*, a division which resembles the Stoic division into natural philosophy, ethics, and logic.(3) William of Sherwood, another important logician of the 13th century, offers the same scientific differences, but -- in contrast to Peter of Spain -- as the result of a twofold division:(4) Since there are two sources (*principia*) of things, nature and the soul, there will accordingly also be two kinds (*genera*) of things. The things whose source or principle is nature are the concern of natural science. The others, whose source or principle is the soul, are again divided into two types. Since according to Sherwood the soul is created without virtues or knowledge, it performs certain operations by means of which it attains to the virtues, and

these are the concern of ethics or *scientia moralis*. The soul performs different operations by means of which it attains to knowledge, and these are the concern of the science of argumentative speech or *scientia sermocinali*s. At this point we meet the same threefold division of science that occurs in Peter of Spain. It is worth mentioning that the first division regarding the nature of things is metaphysical while the second division regarding the different sorts of things whose source is the soul is epistemological. The sciences whose principle is the human soul are understood as concerning basic human activities or operations, and the specific differences among them are obtained from the goals of these activities, namely virtues on the one hand and science on the other.

The term "scientia sermocinalis" which stands for the subtle analysis of ordinary language came into use in the late 12th or early 13th century. The designation of logic as a *scientia sermocinalis* was commonly accepted during the 13th century, but it was not the only one. The term "logica" as derived from the Greek "logos" can mean both "sermo" and "ratio". Accordingly, logic was regarded either as a *scientia sermocinalis* or as a *scientia rationalis*. The medieval authors offer considerations supporting both titles. While logicians like William of Sherwood and Peter of Spain stressed the feature of logic as a linguistic science as mentioned above, other authors in the 13th century like Robert Kilwardy and St. Bonaventure called it linguistic and rational alike. In the 14th century the notion of logic as a rational science became predominant. An important reason lies in the fact that logic was about second intentions, which were higher-level concepts like "genus", "species", "predicate", etc. We make use of second intentions to classify our concepts or first intentions of things in the world. Second intentions reveal both universals and logical structures and were regarded as mental constructs or rational objects reached through abstraction, which means reflection on general features and relations of things and on actual pieces of discourse."

(2) In medieval logic "propositio" and "enuntiatio" both stand for a sentence signifying something true or false and are mostly used as interchangeable terms. However, using the term "propositio" we have to avoid the modern understanding of proposition, or content, as what is asserted or what is expressed by a sentence.

(3) The *scientiae morale*s and *naturales* as the counterpart to the *scientiae sermocinales* were sometimes brought together under the integrating concept of *scientiae reales*; cf. [Jakob Hans Josef Schneider, *Scientia sermocinalis / realis,* in: Joachim Ritter and Karlfried Gründer (eds.) Historische Wörterbuch der Philosophie 8, Wissenschaftliche Buchgesellaschaft Darmstadt 1992, col. 1508].

(4) Cf. [William of Sherwood, *Introductiones in logicam,* in: J. Reginald O'Donnell, The *Syncategoremata* of William of Sherwood,* Medieval Studies 3 (1941), p. 46-93, p. 2, 1-12].

From: Christoph Kann. Medieval Logic as a Formal Science. In *Foundations of the Formal Sciences IV. The History of the Concept of the Formal Sciences.* Edited by Benedikt Löwe, Volker Peckhaus, and Thomas Räsch. London: College Publications 2006. pp. 103-123.

"The specific contribution of mediaeval logicians.
The new elements which the mediaeval logicians have added to the logical theories which had been handed down to them via Boethius, are found embodied in a number of treatises which mainly discourse upon the field of semantics.(5) To define the exact place of these new elements in mediaeval logic from the twelfth to the fifteenth century, we must recall to mind the mediaeval terminology: *logica vetus*, *logica nova*, *logica antiqua*, and *logica moderna*.

(a) *Logica vetus*. It is a matter of common knowledge, that up to and including the first few decades of the twelfth century the Latin West knew from Aristotle's *Organon* only the *Categories* and *De Interpretatione*. These two works formed, together with the I*sagoge* of Porphyrius, Boethius' commentaries on these three writings as well as his logical monographs, the works of the *ars vetus* or l*ogica vetus*. From c. 1200 the work *De Sex Principiis*, attributed to Gilbert de la Porrée, also belonged to this group.
(b) *Logica nova*. This comprised Aristotle's two *Analytics*, *Topic*s and *Sophistici Elenchi*.
(c) *Logica antiqua* (or *antiquorum*). This name is the generic term for the a*rs vetus* and *ars nova* together.
(d) *Logica moderna* (or *modernorum*). This term is the pendant of the preceding and comprises those elements in mediaeval logic which cannot be simply traced back to the writings of the *logica antiquorum*."

(5) The treatise *De Consequentiis* can be said to be nearer to the logic of propositions.

From: L. M. de Rjik, *Logica Modernorum*. A Contribution to the History of Early Terminist Logic, Assen, Van Gorcum, 1962, Vol. I *On the Twelfth Century Rgeories of Fallacy*, pp. 14-15.

"It was argued in Trentman [5] that, in spite of the important and obvious differences of opinion that divided them, the medieval logicians were in general agreement on the nature of their task and the way to carry it out. For them logic was analytic and, one might say, reconstructionistic. This character of their

discipline was well expressed by St. Anselm in a passage Henry has used to good advantage: *Non tantum debemus inhaerere improprietati verborum veritatem tegenti quantum inhiare proprietati veritatis sub multimodo genere locutionum latenti* (*). (*De casu diaboli*; cf. Henry [4, 6].) Truth lies hidden under the surface structure of everyday speech. The job of the logician is to bring out in a systematic way what lies thus hidden. What is hidden is logical form; we might say that it is the form of thought, and Ockham identifies it with the structure of mental language (Trentman [7]). But we could also say that it is the form of the world; hence, describing it means stating the most general truths about reality. Ockham's mental language is also intended to satisfy this requirement in that it is supposed to be a kind of ideal language directly picturing the world. But logicians sceptical of "Mental" also held firmly to this point of view (Trentman [8]) ; thus a study of logic taught men to speak truly (*vere loqui*). Nor did the dispute about whether logic is *scientia sermocinalis* or a *scientia rationalis* (cf. Kretzmann [9, 10]) really touch this point of fundamental agreement. Medieval logic, therefore, was not formalistic in the sense of a study of uninterpreted calculi. It studied very general truths about reality, reflected in the form of thought and expressed in language. It proceeded by systematic reconstruction, but the "system" that emerged thereby must be viewed as an interpreted system. Of course, contrary to what people sometimes seem to believe, by no means all twentieth-century logicians have been formalists. Indeed, the points of view of Frege and Russell were not unlike that of the medievals, and such otherwise disparate recent logicians as Lesniewski and Bergmann have maintained essentially the same view of logic as an interpreted system.

To say that medieval logic was systematic is not, of course, to say that it was constructed like a modern quasi-axiomatic system. There are no axioms and theorems, no formation rules and the like. Medieval logics were generally presented in the form of lists of rules of inference, often with little or no apparent heed for economy. This does not mean, however, that the logicians were unaware of logical relations between rules. Indeed, in some cases they showed a very perceptive appreciation of the ways in which proofs are constructed and the ways in which some rules may be derived from others (Boh [11]). The medieval logicians, unfortunately, lacked a good notation; indeed, they lacked any notation. Even quotation marks would have helped, as some of the complications with material supposition show. But, although they experimented a bit with something like indicators of quotation, and they commonly used letters for abbreviation, on the whole, they had to make do with ordinary or (as Henry has often reminded us) rather extraordinary Latin. None of them, however, was an "ordinary language" philosopher. Contrary to what John of Salisbury had urged, they did not take the idioms of any ordinary language as an arbiter of logical rectitude. No problems are solved simply by citing ordinary usage. Yet, as Boh [11] points out, it was the "formal aspects of ordinary discourse", that is, the syntax of ordinary language, that provided the material for logical analysis. To this material they brought the tools of their trade. They aimed at reconstructions of puzzling syntactical constructions that would perspicuously reveal the logical forms they concealed. The logicians' business, then, was with the perplexities of ordinary language syntax; on them he used his tools of reconstruction; and the arbiter of his success was an ideal syntax, a syntax reflecting the general form of reality.

The theory of supposition was one of the great preoccupations of the later medieval logicians. It was, in fact, at the heart of the studies of *proprietates terminorum* which so characterized their work and led to their being called "terminists". Owing to the important work of de Rijk [12], its origins are no longer veiled in impenetrable obscurity; but, whatever its origins, it has for some time been a subject of much fascination for modern scholars and logicians, although, like so many medieval theories, it seems to aim one stone at too many birds; it has to do equally with matters that we should prefer to distinguish as semantic and syntactic. In any case, there has been considerable recent discussion about whether or not a part of it, in particular the theory of personal supposition, constitutes a kind of analogue to modern quantification theory. This debate is interesting, not only in its own right, but also in exemplifying some of the problems involved in attempted comparisons between modern and medieval logical theories."

(*) [We should not let ourselves be hindered by the improprieties of words which cover up the truth; rather we should seek after the propriety of the truth which is hidden under diverse manners of speaking.]

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(to be continued...)

Latin Logicians before Eleventh Century

Cicero (106 BC 43 BC)

Lucius Apuleius of Madaura (c. 123/125 - 180)

Marius Victorinus (4th century)

Martianus Capella (5th century)

Anicius Manlius Severinus Boethius (c. 480 - 524 or 525)

Byzantine Logicians (from 6th to 12th century)

Alcuin of York (c. 735 - 804)

John Scottus Eriugena (c. 815 - 877)

Logicians of the Eleventh Century

Abbo of Fleury (c. 945 - 1004)

Anselm of Canterbury (1033 - 1109)

Islamic Logicians

Al Kindi (c. 801 - 873)

Al-Farabi (c. 872 - 950/951)

Avicenna (Ibn Sina) (c. 980 - 1037)

Averroes (Ibn Rushd) (1126 - 1198)

Logic and Grammar in Twelfth Century

The anonymous *Glosulae super Priscianum* (written between 1080 and 1150)

Roscelin (c. 1050 - c. 1125)

William of Champeaux (c. 1070 - 1122)

Garlandus Computista [Gerlandus of Besançon] (early 12th century)

Peter Abelard (1079 - 1142)

Adam Parvipontanus (or Adam of Balsham) (? - 1181)

Gilbert of Poitiers (after 1085 - 1154)

John of Salisbury (c. 1120 - 1180)

Logic and Grammar in Thirteenth Century

William of Sherwood (or Shyyreswood) (1200/5 - 1266/71)

Albert the Great (1200 - 1280)

Peter of Spain (d. 1277)

Robert Kilwardby 1215? - 1279)

Roger Bacon (1215 - 1294)

Henry of Ghent (c. 1217 - 1293)

Ramón Llull (c. 1233 - 1316)

Boethius of Dacia (fl. 1260-1270)

William Heytesbury (? - d. 1272/3)

Simon of Faversham (c. 1260 - 1306)

John Duns Scotus (c. 1266 - 1308)

Radulphus Brito (c. 1270 - 1320)

Logic and Grammar in Fourteenth Century

Pseudo-Scotus (14th century)

Thomas of Erfurt (first quarter of the 14th century)

Walter Burley (c. 1275 - 1344)

Peter Aureoli (c. 1280 - 1322)

Siger of Courtrai (c. 1283 - 1341)

William of Ockham (c. 1287 - 1347)

Robert Holkot (c. 1290 - 1349)

Thomas Bradwardine (c. 1290 - 1349)

John Buridan (c. 1300 - after 1358)

Gregory of Rimini (c. 1300 - 1358)

Nicholas of Autrecourt (c. 1300 - after 1358)

Albert of Saxony (c. 1316 - 1390)

John Wyclif (c. 1330 - 1384)

Marsilius of Inghen (c. 1340 - 1396)

Peter of Mantua (? - d. 1400)

Richard Billingham (fl. 1350 - 1360)

Vincent Ferrer (c. 1350 - 1420/1)

Peter of Ailly (c. 1350 - 1420)

Paul of Venice (c. 1369 - 1429)

Paul of Pergola (1380 - 1455)

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