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THE ROOTS OF LOGICAL HYLOMORPHISM

BASIC RESEARCH PROGRAM

WORKING PAPERS

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THE ROOTS OF LOGICAL HYLOMORPHISM[2]

The purpose of this paper is four-fold. Firstly, various explications of the logical hylomorphism will be sketched. Secondly, I propose to revisit certain interpretations of Aristotle's syllogistic. I attempt to answer the question why Aristotle was not the founder of logical hylomorphism. Thirdly, I try to qualify the logical hylomorphism of Alexander of Aphrodisias. Finally, I focus on the medieval discussions on syncategoremata and consequences. My larger aim is to discuss the origin of formality criterion for the demarcation of logic.

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Introduction

The intuition of formality is a principle traditionally used to demarcate the boundaries of logic. However, the question of what is logical hylomorphism is a difficult one to answer since we have to distinguish between different models of the matter versus form dichotomy in logic.

As Jean-Yves Béziau put it, "form is like a multi-headed dragon: cut one head, three more heads grow" (Béziau, 2008: 20). While a variety of definitions of the formal have been suggested, this paper will use the dichotomy first suggested by Edmund Husserl who characterizes formal logic as both *apophantic analytics* and *formal ontology* (Husserl, 1969). According to John Corcoran, logic as *formal ontology* investigates general aspects of reality while logic as *formal epistemology* describes the process of deduction (Corcoran, 1994). Catarina Dutilh Novaes distinguishes the formal as pertaining to *forms* from the formal as pertaining to *rules* (Dutilh Novaes, 2011). However, 'the formal as pertaining to *forms*' seems tautological and 'the formal as pertaining to *rules*' appears too narrow. Therefore, my approach is based on the distinction between substantial and dynamic models of formality (Dragalina-Chernaya, 2014). Dynamic formality pertains not only to rules, but also to purposes of actions, so the dominant idea of this model stresses the dynamics of goal-directed activities. In a nutshell, the distinction between the two models of the formal is based on the dynamic (of an action) versus static (of a substance) dichotomy rather than on the form versus rules opposition.

The substantial hylomorphism presupposes the interpretation of the formal as an abstraction from matter. Alonzo Church writes: "Traditionally, (formal) logic is concerned with the analysis of sentences or of propositions and of proof with attention to the form in abstraction from the matter. This distinction between form and matter is not easy to make precise immediately" (Church, 1996: 1). The variability of matter may concern terms or models (Dutilh Novaes, 2011). Thus, various modifications of the substantial formality may be classified into two clusters, i.e. the formal as schematic (Corcoran, 2008, MacFarlane, 2000) and the formal as model-theoretic invariance (Sher, 2013, Feferman, 2010, MacFarlane, 2000, Bonnay, 2008, Dutilh Novaes, 2014). Schematically, the form of argument represents a scheme, in other words, a result of the substitution of all the non-logical terms with variables of the corresponding categories.

My main concern in this paper is to discuss the origin and the bounds of the schematic hylomorphism in ancient and medieval logic. The overall structure of the study takes the form of four sections. The first section deals with the present interpretations of Aristotle's assertoric syllogistic (as carried out in *Prior Analytics*). The second section includes a survey of the origin of schematic hylomorphism in the comments of Alexander of Aphrodisias to *Prior Analytics*. The third section is concerned with some aspects of two crucial medieval dichotomies, i.e.

categorematic versus syncategorematic terms and formal versus material consequences. The fourth section contains the conclusions.

Form and matter in Aristotle's syllogistic

Logic is about the form, not the matter. Aristotle is the father of logic as formal discipline. These axioms are veridical, but they are vague. It is generally accepted that the logical hylomorphism goes back to the Aristotelian form (*morphe*) versus matter (*hyle*) dichotomy. As Edmund Husserl tells us, "Aristotle substituted algebraic letters for the words (terms) indicating the material: that which is spoken about in the statements, that which determines judgments as judgments relating to divers material provinces or single matters" (Husserl, 1969: 48). Furthermore, according to Timothy Smiley, "Aristotle created mathematical logic by inventing its distinctive object of study, the formalized language" (Smiley, 1982-3: 1). However, the role of Aristotle as the founder of logical hylomorphism may be challenged. Although formal logic is traditionally traced back to Aristotle, he did not apply formality as a criterion for logicality. It was Immanuel Kant who first offered the formality criterion for the demarcation of logic (MacFarlane, 2000). Moreover, Aristotelian form versus matter distinction is absent from the *Organon* (see Barnes 1990: 39–40; Burnyeat 2001: 8). Aristotle applies this distinction to logic only twice: in *Physics* (195a18–19) and in *Metaphysics* (1013b19–20). The two passages are almost identical. Aristotle observes that the premises of an inference (hypotheses) are matter for the conclusion. These passages do not imply the logical hylomorphism because they say nothing about the logical form or the formal structure of the premises and the conclusion. Surprisingly, as John MacFarlane pointed out, "the father of both formal logic and hylomorphism was not the father of logical hylomorphism" (MacFarlane, 2000: 255). The aim of this section is to clear the ground of this puzzle.

The Aristotle's matter versus form dichotomy has a whole literature devoted to it. However, Elizabeth Anscombe and Peter Geach write: "There is hardly a statement about form in the Metaphysics that is not (at least verbally) contradicted by some other statement" (Anscombe & Geach, 1961: 75). First, Aristotle was clear about the dichotomy between the matter and form of primary substances, but not of language entities. Second, he was not a mereological hylomorphist, that is, he did not take matter and form to be themselves parts of the whole they compose. For Aristotle the form is not a part of a whole conjoined with its material parts but the essence of a being, the dynamic principle of its organization. As it was shown by Myles Burnyeat, in *Metaphysics* Aristotle distinguishes between logical (*logikōs*) and physical

analyses. While logical analyses are abstract, the physical studies address to the concepts of matter and form as principles appropriate to the subject (Burnyeat, 2001).

One immediate and obvious difficulty which we meet is that it is not easy to explain why Aristotle uses letters of the alphabet, like 'A', 'B', 'C', instead of concrete terms if he did not distinguish between logical form and logical matter. Here is an exemplary formulation for the first syllogism in the first figure (*Barbara*) from the *Prior Analytics*: "if A belongs to every B and B belongs to every C, it is necessary for A to belong to every C" (*Pr. An.,* 25b37-9). According to Jan Łukasiewicz, Aristotle's syllogisms are not inference schemata but conditional propositions. He understands Aristotelian 'schematic letters' as object language variables. Łukasiewicz writes: "The introduction of variables into logic is one of the Aristotle's greatest inventions" (Łukasiewicz, 1957: 7). Similarly, the editor of the *Prior Analytics* Gisela Striker notes that "the crucial innovation ... that makes syllogistic a formal system is the introduction of letters as placeholders for the terms" (Striker, 2009: xii).

In contrast, Arthur Prior was the first who claims that Aristotle's syllogisms are meta-theoretical statements about inferences (Prior, 1962: 116, see also Rose, 1968; Boger, 2004). From this perspective syllogisms are not conditional propositions (p & q) ⊃ r but meta-statements (p & q) □ r, where p, q, and r are categorical propositions (see Bocharov and Markin, 2010). According to Corcoran, "there is no need to postulate object language variables for Aristotle's system" (Corcoran 1974: 98). For Corcoran, Aristotle's syllogistic is a theory concerned with the structure of inference, i.e. syllogistic proofs. He writes: "Aristotle nowhere refers to argument forms or propositional functions. All apparent exceptions are best understood as metalinguistic reference to 'concrete syllogisms' " (Corcoran 1974:126). Aristotelian grammar, as Corcoran tells us, is too trivial while his semantics, however, is complex enough to admit of analogues to modern syntactic or semantic results. As he put it, "most of Aristotle's metasystematic results are proof-theoretic: they concern the relationship between the deductive system *D* and various subsystems of it" (Corcoran 1974:113).

In fact, Aristotle is not interested in the syntactic structure or in the regimentations of the arguments. Aristotle does not employ a canonical language in his syllogistics (see Morison, 2012). The *Prior Analytics* contains different expressions for arguments, i.e. 'A is predicated of all B', 'A belongs to all B', 'A is in the whole of B' and 'A follows all of B'. Aristotle does not prescribe which expression to use. Any expression is allowable as long as it has the same meaning. For example, when Aristotle demonstrates that two premises 'M holds of every N' and 'M does not hold of some O' yields a conclusion 'N does not hold of some O' (*Baroco),* he adds: "And if M holds of every N but not of every X, then there will be a deduction that N does not

hold of every X. (The demonstration is the same.)" (*Pr. An.,* 27b1–3). Since the Hellenistic times this small but often quoted fragment from the *Prior Analytics* drew a special attention of commentators. Alexander of Aphrodisias (born at the end of the 2nd century A.D.), arguing against 'the moderns' ('the more recent thinkers', i.e. Stoics), asserts: "This is an argument of the sort which the more recent thinkers call subsyllogistic: it takes something equivalent to the syllogistic premiss and deduces the same thing from it. ('Does not hold of some' has been transformed into 'does not hold of every', which is equivalent to it.) The more recent thinkers deny that such arguments are syllogisms, since they look to the words and the expression. Aristotle, however, looks to the meanings (when the same things are meant) rather than to the words, and says that the same syllogism is deduced when the expression of the conclusion is transformed in this way - granted that the conjunction is in general syllogistic" (Alexander of Aphrodisias, *In. An. Pr.,* 84, 11–19). As Corcoran writes, "it is doubtful that Aristotle ever conceived of a language apart from its intended interpretation. In other words, it seems that Aristotle did not separate logical syntax from semantics" (Corcoran 1974:104).

The freedom of paraphrase which Aristotle allows himself in representing and interchanging syntactically different arguments with the same meaning implies Łukasiewicz's verdict: "Aristotelian logic is formal without being formalistic" (Łukasiewicz, 1957: 15). But logic cannot be *schematically* formal without being formalistic. Thus, the Aristotelian schematic hylomorphism is a mirage. Aristotle's letters are not schematic, that is to say, they are not object language variables waiting to be filled by concrete terms but 'dummy letters' which might be given a meaning (see Corcoran, 1974; Kirwan, 1978; Flannery, 1995). As Katerina Ierodiakonou pointed out, "the only difference between examples with letters and examples with terms such as 'animal', 'man', 'horse' lies in the fact that, obviously, only in the case of letters is it irrelevant what they actually stand for. That is to say, although propositions with letters are either true or false, propositions with terms such as 'animal', 'man', 'horse' have an identifiable truth-value" (Ierodiakonou, 2002: 137). Although 'dummy letters' have meanings their use indicates that the truth-values of propositions do not affect the validity of syllogistic inference rules.

The Aristotelian syllogistic concerned rather with the formal relations between perfect and imperfect rules of inference than with the canonical structures of categorical statements. According to Aristotle, "all the imperfect syllogisms are made perfect by means of the first figure" (*Pr. An.,* 29a30). His aim is not to create a formalized language as a canon for syllogistic reasoning but rather to provide a formal criterion for determining when no assumption of syllogisms is missing. All the perfect syllogisms of the first figure "are completed through themselves" (*Pr. An.,* 29b6-8) while all the imperfect syllogisms of the second and the third

figures "are completed by taking in addition certain things" (*Pr. An.,* 28a5-6, see also *Pr. An.,* 29a15-16). To sum up, the Aristotelian reductive approach to patterns of inference (i.e. to syllogistic moods in the three figures) shifts focus from the schematic towards the dynamic model of formality.

Alexander of Aphrodisias on logical form and logical matter

One can find schematic interpretation of formality in the insightful comments to *Prior Analytics* by Alexander of Aphrodisias, known as the *Exegetist.* Alexander's commentaries show that by his time the logical matter versus logical form dichotomy was already thoroughly familiar (see Barnes, 1990). Starting from the Aristotle's mold analogy, he writes: "The figures of the syllogism are like a sort of common matrix. You may fit matter into them and mould the same form for different matters. Just as, in the case of matrixes, the matters fitted into them differ not in respect of form or figure but in respect of matter, so too is it with the syllogistic figures" (Alexander of Aphrodisias, *In. An. Pr.*, 6.16-21).   According to Alexander, Aristotelian schematic letters stand for the matter of the argument: "He uses letters in his exposition in order to indicate to us that the conclusions do not depend on the matter but on the figure, on the conjunction of the premises and on the moods. For so-and-so is deduced syllogistically not because the matter is of such-and-such a kind but because the combination is so-and-so. The letters, then, show that the conclusion will be such-and-such universally, always, and for every assumption" (Alexander of Aphrodisias, *In. An. Pr.*, 53.28 – 54.26).

The Exegetist attributes to Aristotle the logically significant distinction between the variable matter and invariable form: "Combinations are called syllogistic and reliable if they do not alter together with differences in the matter - i.e. if they do not deduce and prove different things at different times, but always and in every material instance preserve one and the same form in the conclusion. Combinations which change and alter configuration together with the matter and acquire different and conflicting conclusions at different times, are non-syllogistic and unreliable" (Alexander of Aphrodisias, *In. An. Pr.,* 52.20–24).   Thus, it was Alexander of Aphrodisias who first offered the invariance criterion for the logical form. However, much uncertainty still exists about the Alexander's theory of logical matter. Definitely, he wanted to connect logical form and logical matter with metaphysical form and matter. But since form is inseparable from matter logical form is also inseparable from logical matter. As it was shown by Kevin Flannery, Alexander treated the logical matter as occupying an intermediate position between things and form.   For Alexander, the logical matter of a syllogism is determined by the

scientific or dialectical discourse in which the syllogistical inference scheme is embedded (see Flannery, 1995).

Syncategoremata and the formal consequence in medieval logic

Logic was treated by the medievals as a *scientia sermocinalis* whose function is to describe the formal structure of language. The explicit schematic hylomorphism in medieval logic rests on two famous dichotomies: (1) categorematic terms (*categoremata)* versus syncategorematic terms (*syncategoremata*); and (2) material versus formal consequences.

The medieval distinction between categoremata and syncategoremata goes back to Priscian (fl. 500 AD) who attributes the dichotomy to Peripatetic 'dialecticians'. Norman Kretzmann suggests that the career of the syncategoremata within the *logica moderna* falls into three stages: (1) their emergence (in the twelfth century, especially the latter half); (2) their identification as a separate treatises (from the last quarter of the twelfth century to the last quarter of the thirteenth); (3a) their assimilation into general treatises on logic; and (3b) their absorption into the sophisma-literature (from the first quarter of the fourteenth century to the disintegration of scholastic logic) (see Kretzmann, 1982: 215). According to Ernest Moody, in the 14th century it became customary to call the categorematic terms the matter and the syncategorematic signs the form of propositions (see Moody, 1953: 16-17). Dutilh Novaes suggests, in turn, that "there were sporadic applications of the form vs. matter distinction to arguments in the medieval Latin tradition already in the twelfth century; but later, the thirteenth century witnessed something of an explosion of uses of hylomorphism in logic" (Dutilh Novaes, 2012: 345).

In any case, for the fourteenth-century logician John Buridan (d. c. 1358), categorematic terms refer to the matter of a proposition or consequence whereas all the rest, i.e. syncategorematic terms, refers to form (see Buridan 1976: I.7.2). He writes: "A formal consequence is one that holds for all terms retaining the same form, or if you wish to speak carefully … for which any equiform proposition which might be formed would be an acceptable consequence. For example, 'That which is A is B, so that which is B is A'… A material consequence is where not every proposition of the same form is valid …, e.g., 'A man runs, so an animal runs', because it is not valid with these terms: 'A horse walks, so wood walks' … No material consequence is evident except by reduction to a formal consequence by the addition of some necessary proposition" (Buridan, 1976: I.4). By consequence Buridan meant not the relations between propositions but implied proposition, i.e. implication: "Now a consequence is a molecular proposition, for it is composed from several propositions conjoined by the expression 'if' or by the expression 'therefore' or something similar" (Buridan 1976: I.3).

On the contrary, Robert Fland, writing in Oxford around 1350, considered all the analytic consequences as formal ones: "General rules are given in order to appreciate when an inference is formally valid. The first is this: where the conclusion is formally understood in the premises. For example, this inference is formally valid: 'There is a man, so there is an animal' because the conclusion 'animal' is formally understood in the premise, namely, 'man' " (Spade, 1976: 57; see also Read, 2012). Presumably, the 'formal understanding' of the conclusion in the premises implies the transcendental relation between the premises and the conclusion. According to scholasticism, the transcendental relation is 'anchored' in the essences of relata. For example, it is impossible for God to create a man without creating an animal. For René Descartes, conversely, eternal truths do not limit God's perfection, but only our ability to understand God's perfection. In his second letter to Mersenne Descartes writes: "The eternal truths … are not known as true by God in any way which would imply that they are true independently of him" (Descartes, 1991: 3:24). Thus, to discuss what is possible or impossible for God is a wrong way of doing logic (see Dragalina-Chernaya, 2013).

The Paris school did not use the vague concept of 'formal understanding' but it is based on the obscure distinction between meaningful categorematic and meaningless syncategorematic terms. More than fifty different words were considered as syncategorematic terms by Latin medieval authors (see Kretzmann, 1982: 212). From the beginning of the centuries-old debate, philosophers who dealt with syncategoremata explicitly offered syntactic account of them. According to syntactic criterion, syncategorematic terms cannot be subjects or predicates of propositions. Thus, the medieval syntactic approach is limited by the non-universal syllogistical assumption that every proposition has one subject and one predicate. Moreover, a syncategorematic term may be a subject when it is used as an autonymous symbol (e.g., 'No is an adverb' or 'And is a copulative conjunction'). The medievals try to get over the difficulty by focusing on the significative (i.e. non autonymous) use of the subject and predicate as the matter of the mental proposition. Albert of Saxony who taught at Paris from 1351 to 1362 writes in his *Perutilis logica*: "A categorematic term is said to be one which, taken significatively, can be a subject or a predicate, or a part of the subject or a part of the distributed predicate, of a categorical proposition. For example, these terms 'man', 'animal', 'stone', are called categorematic terms because they have a definite and determinate signification. A syncategorematic term, however, is said to be one which, taken significatively, cannot be the subject or the predicate, nor a part of the subject nor a part of the distributed predicate, of a categorical proposition" (*Perutilis Logica*, I, ch. 3; Moody, 1953: 16). Therefore, the medieval logicians have to distinguish *semantically* between different uses of terms, i.e. between different

kinds of suppositions (see Klima, 2006). In addition, according to medieval semantic criterion, syncategoremata have no meaning. They signify nothing outside the mind but merely co-signify, that is to say, modify the semantic functions of categorematic terms. For Buridan, a mental proposition is generated by adding a form, i.e. a complexive concept (*conceptus complexiuus*) signified by a copula, to a pair of simple concepts, i.e. to a subject and a predicate. As is the case with physical things, the form of a mental proposition cannot exist without matter (see Thom, 2012). However, in modern model-theoretic semantics, 'syncategorematic' terms receive independent semantic values (e.g., generalized quantifiers are interpreted as sets of subsets of the domains).

Conclusions

Logical hylomorphism is based on the distinction between logical form and logical matter. Curiously enough, the status of logical form was not exactly determined in ancient and medieval logic. On the one hand, the logical form versus matter dichotomy cannot be considered as an extrapolation of metaphysical form versus matter dichotomy. On the other hand, ancient and medieval authors have failed to propose a coherent syntactic or semantic criterion for the demarcation of logical terms and formal consequence. Shifting focus from the static of a substance towards the dynamic of an action offers some important insights into the demarcation of the bounds of logic as a formal art.

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