ARISTOTLE ON LOGICAL CONSEQUENCE

The model-theoretic definition of logical consequence provides an account of a modal conception of logical consequence in terms of a topic-neutral conception of consequence as truth preservation in all models. I argue that Aristotle also provides an account of a modal conception of consequence in terms of the semantic and metaphysical facts that validate the moods, and so is engaged in a project comparable to the model-theoretic project. There are however notable differences between the two projects. Aristotle's modal conception of logical consequence is not our notion of classical validity. His conception of topic-neutrality does not employ notions of formality or independence from worldly features but rather relies on highly general features of the world. And finally, Aristotle's account of logical consequence is plausible only in the presence of views in semantics, the theory of relations, and mereology, which might strike us as foreign.

Compare two conceptions of validity: under an example of a *modal* conception, an argument is valid just in case it is impossible for the premises to be true and the conclusion false; under an example of a *topic-neutral* conception, an argument is valid just in case there are no arguments of the same logical form with true premises and a false conclusion. This taxonomy of positions suggests a project in the philosophy of logic: the reductive analysis of the modal conception of logical consequence to the topic-neutral conception. Such a project would dispel the alleged obscurity of the notion of necessity employed in the modal conception in favour of the clarity of an account of logical consequence given in terms of tractable notions of logical form, universal generalization and truth *simpliciter*. Etchemendy (2008), for example, has characterized the model-theoretic definition of logical consequence as truth preservation in all models as intended to provide just such an analysis.

In this paper, I argue that Aristotle provides an account of a modal conception of logical consequence in topic-neutral terms and so appears to be engaged in a project

comparable to the one described above. There are, however, significant differences between the model-theoretic project and Aristotle's apparent purpose in the *Prior Analytics*. For example, the consequence relation Aristotle aims to explicate is distinct from our notion of classical validity. His view of topic-neutrality also is different from our own. I argue, moreover, that Aristotle does not attempt an *analysis* of logical consequence—that is to say, an explication which is true solely in virtue of language—but provides an *account* which relies on substantive metaphysical claims. And there are, as I also discuss, reasons to doubt the success of this account. But the account is not implausible given certain theses Aristotle holds in semantics and metaphysics.

That Aristotle would be engaged in this sort of project is controversial. There are two main rivals to the view I am putting forward. Under one interpretation of the *Prior Analytics*, Aristotle does not and cannot provide an account of logical consequence at all. Rather, he must take the validity of the first figure syllogisms as obvious and not needing justification; he then establishes the validity of the other syllogisms by showing that they stand in a suitable relation to the first figure syllogisms. This line of interpretation was once common, and it retains some lingering currency. Under a second interpretation, Aristotle justifies the validity of the first figure syllogisms by appealing to brute semantic facts, expressed by the traditional *dictum de omni et nullo*, and thereby providing an analysis of logical consequence. This second line of interpretation has a long history and has been gaining renewed momentum in recent years. In what follows, I will unpack these two views in more detail. But my primary goal is to open up a third line of interpretation, under which (*contra* the first rival) Aristotle justifies the syllogisms but (*contra* the second) this justification is not an analysis.

Here is the plan for the paper. First, I will discuss Aristotle's modal conception of logical consequence and note its similarities and dissimilarities to our notion of classical validity (§1). Next, I will discuss in what sense Aristotle might hold that logic is topic-neutral (§2). I will then argue against the rival interpretations I sketched above—first the view that Aristotle does not offer a justification of the syllogisms at all, and next the view that Aristotle justifies the syllogisms solely by appeal to the *dictum de omni et nullo*, read as expressing brute semantic facts (§3). I will examine evidence that Aristotle intends to provide a full account of a modal conception of logical consequence by appeal to notions of topic-neutrality. I will also assess the success of this account (§4) and conclude by drawing a few cautious comparisons with contemporary philosophy of logic (§5).

1

I begin with Aristotle's modal conception of logical consequence. One of my aims here is to bring out both some of the similarities and some of the differences between Aristotelian philosophy of logic and the contemporary model theoretic project. And I also hope to motivate my contention that Aristotle may recognize the need to provide an account of logical consequence. Aristotle introduces syllogisms in the following passage in *APr* 1.1:

T1 A *syllogism* is an argument in which, some things having been supposed, something other than what has been supposed *results of necessity* from their being so. I mean by "from their being so" resulting through them, and by "resulting through them," needing no term from outside for the necessity to arise. (24^b18-22)[1]

[1] Translations mine, based on Smith (1989).

> συλλογισμὸς δέ ἐστι λόγος ἐν ᾧι τεθέντων τινῶν ἕτερόν τι τῶν κειμένων ἐξ ἀνάγκης συμβαίνει τῶι ταῦτα εἶναι. λέγω δὲ τῶι ταῦτα εἶναι τὸ διὰ ταῦτα συμβαίνειν, τὸ δὲ διὰ ταῦτα συμβαίνειν τὸ μηδενὸς ἔξωθεν ὅρου προσδεῖν πρὸς τὸ γενέσθαι τὸ ἀναγκαῖον.

Some preliminary terminological remarks may prove helpful. In what follows, I will treat consequence as a relation between a premise-set and a conclusion. I will call the relation that satisfies the characterization in **T1** *syllogisity*. I will also distinguish between syllogisms and moods. A *syllogism* is any argument which satisfies the **T1** characterization and so exhibits syllogisity; following Barnes (1981), I will sometimes call these *broad syllogisms*. A *mood* is any one of the arguments of the three figures explicitly discussed in the *Prior Analytics*. The moods known by their medieval mnenomics, Barbara and Celarent, are two examples of moods. I will restrict my attention in this paper to the assertoric syllogistic. And we will discuss the classification of assertoric moods in the *Prior Analytics* in more detail in the next section.

The locution 'results of necessity' in **T1** resembles some modern characterizations of a modal conception of logical consequence, such as our example from the first paragraph, under which an argument is valid just in case it is impossible for the premises to be true and the conclusion false. And so **T1** suggests that Aristotle is targeting a notion of validity which would be familiar to us. And indeed, some have held that **T1** is a definition of a widely applicable notion of deduction or valid argument. The view that Aristotle intends the notion of a broad syllogism as the notion of valid inference is explicit in much of the relatively recent secondary literature and is implicit in the tendency over the last fifty years towards translating the Greek *syllogismos* with the English 'deduction'. For example, Rose (1968: 10-11, nb 27) writes that Aristotle's "definition of 'syllogism' (at 24^b18-20) seems so broad as to include any valid

inference…. This definition seems inconsistent with Aristotle's restriction of 'syllogism' to categorical syllogisms in the first, second, and third figures." And Smith (2011) describes the definition of a broad syllogism as "a general definition of 'valid argument'," although he (2011) later notes that the definition "is not a precise match for the modern definition of validity."[2]

However, if Aristotle means to capture a notion of classical validity, then we must conclude that the syllogistic dramatically fails to achieve Aristotle's intended goal. For much inferential reasoning is recalcitrant to syllogistic representation as moods. Among non-syllogistic inferences are the most common derivation rules of classical propositional logic, including repetition, conjunction introduction and elimination, disjunction introduction and elimination, *modus ponens* and *modus tollens*.[3] Moreover, the syllogistic is ill-suited to represent the mathematical reasoning which is characteristic of Euclidean geometry. Aristotle was surely aware of many of these argument forms.[4] So, on this view,

[2] Thanks to an anonymous referee, who asks if we are appealing to Aristotle's notion of necessity and, if so, how this makes a difference to syllogistic consequence. The phrase 'results of necessity' in **T1** leaves the modality underspecified. In this respect, **T1** is not different from many informal modal characterizations of logical consequence: 'impossible for the premises to be true and the conclusion false' also leaves the modality underspecified. Aristotle's views on necessity raise many interpretive difficulties which need not detain us. To argue that Aristotle provides an account of a modal conception of consequence in terms of topic neutrality, with similarities and dissimilarities to a contemporary project, it suffices to note that syllogisity is a modal characterization of consequence, distinct from classical validity.

[3] Some have attempted to adapt the syllogistic so to represent such inferences. See, for example, Sommers (1982) and Englebretsen (1981) who, following Leibniz, attempt to include singular terms by assigning them 'wild' quantity. Whatever the success of such projects, they cannot be taken as clear vindications of Aristotle's intentions.

[4] For the difficulty of representing mathematical reasoning solely with syllogisms, see Mueller (1974). Mendell (1998) persuasively argues that the 'belongs to' terminology which Aristotle uses to characterize categorical propositions, is sufficiently malleable to allow for mathematical theorems to be expressed in the object language of the syllogistic. However, Mendell notes that geometric constructions resist syllogistic representation.

he is guilty of a rather obvious mistake: he intends to represent all validities but fails to notice that arguments, of which he is himself well aware, resist syllogistic representation.

This assessment well might be too quick. For there is little evidence that Aristotle intends to represent all validities. To bring this out, first consider the observation that the characterization in **T1** constrains syllogisity by several conditions. Syllogisms are *non-circular*: the conclusion must be "something other than what has been supposed." And they are *multi-premissed*: the premise set contains "some things." Although **T1** underdetermines what consequence relation syllogisity is, these constraints suffice to show that syllogisity is not classical validity. Classical validity is a consequence relation which is reflexive; syllogisity is irreflexive.[5] According to reflexivity, we can infer any proposition from itself. Reflexivity is explicitly excluded from syllogisity by the condition in **T1** that the conclusion be a different proposition from any premise. And moods also fail to exhibit reflexivity. For example, an instance of repetition such as

> Mortality belongs to all men
> So mortality belongs to all men

is not taken to be one of the arguments classified in the syllogistic, and so a mood, although it is of course a classically valid argument. One might wonder whether Aristotle

[5] For the characterization of classical validity see, for example, Scott (1971). For the observation that syllogisity is not reflexive, see Irvine and Woods (2004), Vlasits (2019), Dutilh Novaes (2017), Duncombe (2014). Reflexivity is a necessary but insufficient condition for a consequence relation to be classical validity. For example, classical validity is also transitive and systems targeting classical validity typically have cut as a primitive inference rule. Syllogisity is not a transitive relation, although it adheres to an inference schema akin to cut. If {A, B} entails C and {C, D} entails E then {A, D} entails E.

failed to realize that there are valid arguments expressible in the object language of the syllogistic but which are neither moods nor broad syllogisms.

Moreover, Aristotle appears explicitly to accept that not all inferences exhibit syllogisity, and this gives further reason to doubt that he intends to represent all validities with the syllogistic. Consider the conversion rules. As I will discuss in more detail below, Aristotle establishes the validity of some second- and third-figure moods by showing that they stand in the relation of convertibility to one of the first-figure moods. Aristotle recognizes three conversion rules:

> From 'A belongs to no B' infer 'B belongs to no A'.
> From 'A belongs to some B' infer 'B belongs to some A'.
> From 'A belongs to all B' infer 'B belongs to some A'.

The conversion rules do not exhibit syllogisity for they fail to satisfy the requirement of a multiplicity of premises.[6,7]

Syllogisity is arguably a consequence relation at least as strong as relevant entailment. Contemporary relevance logicians find the relation of classical validity excessively permissive for, they claim, there are arguments which are valid according to the classical relation but which intuitively are not entailments. For example, classical logic allows explosions: according to the standard account of validity, under which an

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[6] An anonymous referee notes that in 47^{a}31-35, Aristotle distinguishes, as they put it, what follows necessarily and what follows in a syllogism. It is controversial, however, whether 47^{a}31-35 shows that Aristotle recognizes nonsyllogistic validities; for example, both Smith (1989) and Striker (2009) reject this reading.

[7] An anonymous referee objects that the claim that **T1** isn't intended to apply to all validities flies in the face of Aristotle's own argument in *APr* I.23. However, in this chapter Aristotle does not show the definition of a syllogism applies to all validities but argues that all arguments satisfying the **T1** characterization can be represented by one of the moods. See the discussion of **T7** in section 4.

argument is valid just in case it is impossible for the premises to be true and the conclusion is false, an argument with contradictory premises is valid regardless of its conclusion. Relevance logicians claim that it is counterintuitive to hold that a conclusion follows from an unrelated contradiction. They propose to capture this intuitive notion of entailment by imposing a condition of relevance: put roughly, any premise of the argument must be used in the derivation of the conclusion.

As several scholars have noted, the syllogistic is a logical system which satisfies a constraint similar to relevance.[8] Aristotle never canvasses moods corresponding to the so-called paradoxes of strict implication, such as the observations that everything strictly implies a tautology or a contradiction strictly implies everything. Yet to formulate such arguments is well within the expressive power of the syllogistic's object language. Indeed, moods are constrained by a condition more stringent than relevance: not only must each term of the conclusion occur in just one premiss, each pair of adjacent premisses must share a term.

Unfortunately, it is unclear whether syllogisity is entailment for it is difficult to determine whether a broad syllogism is monotonic or non-monotonic. Monotonic logics allow weakening: adding premises does not make a valid argument valid. Relevance logics are typically non-monotonic. The interpretive issue is controversial. Irvine and Woods (2004) read into Aristotle's definition of a syllogism not only multiplicity of premisses and non-identity of the conclusion to any premise but also a condition of counter-monotonicity: the addition of any premise to a syllogism transforms it into a non-

[8] See, for example, Smith (1989: 210-11), Priest (1998: 411), Woods and Irvine (2004, 65).

syllogism. However, Aristotle's requirement in **T1** that the conclusion needs no term from outside implies merely that the premisses are jointly *sufficient*, not that each premise of a syllogism in *necessary* for the conclusion to follow. On the other hand, Hitchcock (ms.) argues that there is evidence that Aristotle is committed to monotonicity:

> in his discussion in the *Sophistical Refutations* of the fallacy of using *reductio ad absurdum* to refute a proposition that was not in fact used in generating the absurdity, Aristotle says, 'Such arguments are not absolutely unsyllogistic, but are unsyllogistic in relation to the proposition.'(167^{b}34-35) Thus Aristotle allows that a syllogism can have an irrelevant or redundant premiss, and *a fortiori* that the relation of resulting of necessity is at least not counter-monotonic.

However, in 167^{b}34-35 Aristotle allows only that the premises of such an argument may form the premises of a deduction to some other conclusion. He is not committed to allowing irrelevant or redundant premises. So the evidence considered by Irvine and Woods, and Hitchcock, fails to determine whether syllogisity is monotonic.

Aristotle's concept of syllogisity is then underdetermined by any of the passages we have considered in this section of the paper. Indeed, Aristotle himself may not have a precise grasp of the relation, and may have intended **T1** to be a gloss or rough characterization, and not a definition of, or necessary and sufficient conditions for, syllogisity—all the more reason to believe that Aristotle aims to explicate a modal conception of logical consequence by appeal to notions that are more tractable than necessity. However, it is clear that syllogisity is a modal consequence relation distinct from classical validity. This characterization, although incomplete, suffices for our present purposes. In particular, we will see that the observation that syllogisity is not classical validity plays a role in tracking the similarities and dissimilarities between the model theoretic and Aristotelian projects in the philosophy of logic.

2

I turn to moods. Readers might appreciate a brief overview; but those familiar with the syllogistic could skip to the next paragraph. Moods are widely accepted today to be two-premise arguments with categorical propositions as the premises and conclusion. An assertoric categorical proposition has one of the following forms:

Universal affirmation: 'BaA' read as B belongs to every A.

Universal negation: 'BeA' read as B belongs to no A.

Particular affirmation: 'BiA' read as B belongs to some A.

Particular negation: 'BoA' read as B does not belong to some A.

I will sometimes call the predications expressing these propositions as a-, e-, i- and o-predications, respectively. The moods are classified into three figures, which have the following format. The premises contain the two terms of the conclusion respectively and a common or middle term: in the first figure, the middle term is in the predicate position of the first premise and in the subject position of the second premise; in the second and third figures, the middle is the predicate or the subject, respectively, of both premises. In *Prior Analytics* 1.4-7, Aristotle considers various combinations for the three figures of moods and shows which are valid and which invalid. The validity of the valid moods of the second or third figures is established by showing that these moods stand in a certain relation to one of the moods of the first figure—often, that of convertibility. That is to say, Aristotle takes such moods as (one of the first figure moods) Celarent:

A belongs to no B; B belongs to all C; so A belongs to no C

as obviously valid. He then establishes the validity of such moods as Cesare

M belongs to no N; M belongs to all O; so N belongs to no O

by converting the first premise to

N belongs to no M

by means of the conversion rule *e-conversion* and then using Celarent to infer the conclusion. For our present purposes, we can ignore the other methods used to establish the validity of second and third figure syllogisms, indirect proof and exposition. Conversion proofs rest on just a few logical tools. Aristotle establishes e-conversion at $25^{a}5$-17 by employing a reductio principle and the contradictory opposition between e- and i-propositions. He goes on to establish the other conversion rules by reductio proofs that employ the established e-conversion.

This classification of moods is topic-neutral. To get a historically accurate picture of Aristotle's philosophy of logic, however, we first need to draw a distinction between two conceptions of topic-neutrality. This requires a bit of set-up. To take a well-worn example, the mood loosely expressed by 'All Greeks are human; all humans are mortal; so all Greeks are mortal' is a valid inference but it's validity does not depend on the meaning of the nonlogical words, 'Greek', 'human' or 'mortal'. The inference would be licensed regardless of what these words meant. The inference from 'John is a bachelor' to 'John is unmarried', on the other hand, is also a permissible inference but it's permissibility depends on the meanings of the nonlogical words. If 'bachelor' meant Canadian, then the conclusion would not follow from the premise.

Topic-neutrality, so characterized, can be read in one of two distinct ways. Under one conception, logic is characterized by its indifference to all worldly facts or its abstraction from any semantic content whatsoever. Under this conception, the above mood is valid regardless of any worldly facts: whether Greeks are humans, whether

humans are mortal, and so on. This conception is often drawn on in contemporary characterizations of logic; it underlies, for example, Ernest Nagel's (1956: 66) claim that logical laws are empty: they do not tell us anything about the world. To give just one more example: the conception underlies the view Quine (1970: 95) ascribes to Carnap: that "it is language that makes logical truths true—purely language, and nothing to do with the nature of the world." Call this the Formal conception of topic-neutrality.

According to another conception of topic-neutrality, to claim that logic is topic-neutral is not to characterize logic by its abstraction from all content whatsoever but rather to characterize logic by its abstraction from the *specific* identities of things. Under this conception, the above mood is valid regardless of the specific identities of the referents of 'Greek', 'man' and so on. Such a conception of logic, unlike the Formal conception, is compatible with the claim that logical truths hold, and inferences are valid, in virtue of highly *general* features of the world. So call this the General conception of topic-neutrality. Such a conception underlies Russell's (1919: 169) oft-quoted claim that "logic is concerned with the real world just as truly as zoology, though with its more abstract and general features." I'm thinking of *worldly features*[9] in Quine's (1970: 95) sense when he writes:

> A logical truth, staying true as it does under all lexical substitutions, admittedly depends upon none of those features of the world that are reflected in lexical distinctions; but may it not depend on other features of the world, features that our language reflects in its grammatical constructions rather than it's lexicon?

To summarize, I'm contrasting two conceptions of topic-neutrality:

[9] There is an alternative sense of 'worldly', under which something is properly worldly only if varies among the worlds of possible worlds semantics. Of course, the fact that logic is not worldly in *this* sense is almost immediate. For the claim that logic is not worldly in this sense *just is* the unobjectionable claim that logical truths are closed under permutation of the nonlogical constants.

> *Formal Conception*: topic-neutral truths obtain, and topic-neutral inferences are valid, independently of the way the world is;
>
> *General Conception*: topic-neutral truths obtain, and topic-neutral inferences are valid, independently of the particular identities of things.

These conceptions are typically affiliated with other claims, such as claims about what it is in virtue of which logical truths do obtain: the Formal conception is often affiliated with the claim that logical truths obtain in virtue of language alone or in virtue of logical form alone; the General conception may be affiliated with the claim that logical truths obtain in virtue of highly general features of the world. But, for our purposes, I'll keep the terminology of Formal and General restricted to the above claims about that from which logical truths are independent.[10]

Aristotle would hold that logic is at least General. There's good reason to think that Aristotle believes that an argument is valid only if every argument in the same form is valid. This claim is only tacit in the *Prior Analytics* but it plays two roles there. First, to establish validity of all arguments in the same form as a given argument, he establishes the validity of an *arbitrary* argument in the same form—that is to say, leaving its content words unspecified. As we've seen, he uses letters for the terms when stating moods and when proving the second- and third-figure moods valid by conversion.

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[10] The terminology is inspired by, but distinct from, MacFarlane (2000 and 2002), who distinguishes the Formality of logic, as abstracting entirely from the objective content of thought, from the Generality of logic, as providing universally applicable norms for thought as such. MacFarlane argues that Kant and Frege agree on the Generality of logic but disagree on its Formality. The distinction between the Formal and General conceptions of topic-neutrality are arguably equivalent to MacFarlane's distinction, under the assumption that logic provides norms for thought. Thanks to an anonymous referee, who notes that the contrast between general and formal conceptions of topic-neutrality does not exhaust the possibilities. This is certainly true, although the two options suffice for the thesis of the paper, which contrasts the formal conception with the weaker general conception, and ascribes the latter to Aristotle. See Dutilh Novaes (2011) for further discussion.

Second, Aristotle establishes the invalidity of a syllogistic form by a method of "contrasted instances," as Ross (1949: 302) puts it. Consider the following explanation of this method:

T2 If the first [i.e. the major term] belongs[11] to every one of the middle and the middle belongs to none of the last [i.e. the minor term], there will not be a syllogism of the extremes; for nothing necessary results from their being so; for it is possible for the first to belong to every one of the last and possible for it to belong to none of the last, so that neither the particular nor the universal will become necessary; since nothing is necessary through these propositions, there will not be a syllogism. Terms for belonging to every one animal-man-horse, for belonging to none animal-man-stone. (*APr* 1.4, 26^{a}2-9)

εἰ δὲ τὸ μὲν πρῶτον παντὶ τῶι μέσωι ἀκολουθεῖ, τὸ δὲ μέσον μηδενὶ τῶι ἐσχάτωι ὑπάρχει, οὐκ ἔσται συλλογισμὸς τῶν ἄκρων· οὐδὲν γὰρ ἀναγκαῖον συμβαίνει τῶι ταῦτα εἶναι· καὶ γὰρ παντὶ καὶ μηδενὶ ἐνδέχεται τὸ πρῶτον τῶι ἐσχάτωι ὑπάρχειν, ὥστε οὔτε τὸ κατὰ μέρος οὔτε τὸ καθόλου γίνεται ἀναγκαῖον· μηδενὸς δὲ ὄντος ἀναγκαίου διὰ τούτων οὐκ ἔσται συλλογισμός. ὅροι τοῦ παντὶ ὑπάρχειν ζῶιον – ἄνθρωπος – ἵππος, τοῦ μηδενὶ ζῶιον – ἄνθρωπος – λίθος.

Here Aristotle shows that there is no deduction with the premises

A belongs to every B; and

B belongs to no C.

To show that nothing follows of necessity from these premises, Aristotle shows that different assignments of referents to the terms yields different propositions containing the extreme terms. For one assignment of referents to the terms

A: animal

B: man

C: horse

[11] Reading *huparchei* with the manuscripts, as opposed to Alexander's reported *akolouthei*, adopted in the OCT.

has the result that the alleged premises are true and a proposition where the extreme terms form a universal affirmation—namely, 'animal belongs to all horses'—is also true. But another assignment of referents to the terms

A: animal

B: man

C: stone

has the result that the alleged premises are true and a proposition where the extreme terms form a universal negation—namely, 'animal belongs to no stone'—is also true. The former situation shows that no universal negation follows of necessity; the latter situation shows that no universal affirmation follows of necessity.[12]

The General conception of topic-neutrality is arguably consistent with Aristotle's own use of the term 'logical' (*logikôs* and it's cognates). Aristotle's meaning of such terminology is controversial. Ross (1958, 168), in a note on $1029^{b}13$, for example, holds that 'logical' "probably always refers to linguistic inquiries or considerations." Simplicius (in Phys. 440.19-441.2), on the other hand, argues that Aristotle's intention in calling a puzzle 'logical' at Phys. 3.3 ($202^{a}21$-22) is that the puzzle proceeds from generalities rather than from principles peculiar and appropriate to the subject. Burnyeat (2001: 19-23) endorses and defends Simplicius' view of Aristotle's use of this terminology and adopts it as a structural guide to *Metaphysics* Zeta.[13]

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[12] Ross (1949: 302) claims that Aristotle's method of contrasted instances merely cites empirical facts to show that no conclusion results of necessity from a particular combination of premises, but "gives no reason for this, e.g. by pointing out that an undistributed middle or an illicit process is involved." Ross's assumption, that empirical evidence cannot establish invalidity, but that rather a formal explanation ought to be given, perhaps rests on the Formal conception of the topic-neutrality of logic.

[13] An anonymous referee objects: "The remarks about the term *logikos* are not consistent with Aristotle's own uses of this term, which are sometimes deprecatory – something like

These considerations support the ascription to Aristotle of the General conception of logic. But they do not go so far as to support the ascription to Aristotle of the stronger Formal conception. The Simplician reading suggests that Aristotle indeed would deny the Formal conception. And some of the methodology of contemporary commentators might support this interpretation. As I noted in [redacted], it is a commonplace among historians of logic to observe that Aristotle either lacks a clear-cut syntactic/semantic distinction, or does not draw this distinction in terms of interpretation. Modern formal systems are typically treated as uninterpreted. In Aristotle, moods and conversion rules are presented with capitalized letters standing for terms. But these are, in Kirwan's (1978, 1-8, 33) coinage, dummy letters—that is to say, not variables or uninterpreted letters but rather letters the interpretation of which is left unspecified, since the specific referent of the letter is irrelevant. That is, although arguments in the same form are either all valid or all invalid, this does not show that the way the world is a matter of indifference to the question of an argument's validity.[14]

Let us take stock. Since the terms of moods are not uninterpreted but unspecified, moods are valid, but valid independently of the particular identities of the referents of their terms, and so conform to the General conception of topic-neutrality. To show this,

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'void of content' – and often conjoined with 'empty'." The referee gives as examples GA 747^{b}28 and Meta. 1087^{b}20-21. The argument in the body of the paper considers several reasons to hesitate to ascribe the formal conception of topic-neutrality to Aristotle, noting that the interpretation of *logikos* is controversial but under one reading supplies one such reason. The passages suggested by the anonymous referee are consistent with ascribing the general conception but not the formal conception; for example, at GA 747^{b}28 the term denotes the abstract, explicitly contrasted with the less general, not the contentful; and at Meta. 1087^{b}20-21 the term denotes abstract proofs in support of, and objections to, Platonic views of the principles, not arguments or objections devoid of content.

[14] In addition to Kirwan, the point is discussed in Mignucci (1965, 156-58), Frede (1974, 113), Lear (1980, 2), Barnes (1990, 20), and Barnes and Bobzien (1991, 116 n. 71).

however, falls short of showing that Aristotle aims to provide an account of a modal conception of logical consequence in topic-neutral terms. For example, he might take the validity of the first figure moods to be brute, and so ill suited for providing an account. Or he might take syllogisity, the conception of consequence stated in **T1**, to be merely partly captured by the moods. Going forward, I have then incurred two obligations: first, to consider whether and how Aristotle validates the first figure moods; and second, to consider whether Aristotle believes any broad syllogism can be represented by a finite sequence of moods.[15]

[15] An anonymous referee notes that Aristotle "identifies certain 'common' things that are proper to no science and applicable to every subject matter. These include some principles that we would today recognize as logical (non-contradiction and excluded middle are two favourite examples) but also such things as 'things equal to the same thing are equal to each other." The referee objects that I do discuss these principles. In the body of the paper, I discuss the distinction between viewing logic as formal and viewing logic as being grounded on highly general facts. A reader might hold that, since principles such as the law of noncontradiction are highly general, and by our lights logical, the submission should discuss these principles. Common principles are axioms lacking a specific subject matter, but are applicable to all special sciences. Let me take the principle of non-contradiction as an example; similar comments could be made for other common principles. Gottlieb (2023) notes that the principle of non-contradiction is occasionally presented as an ontological claim, for example as "it is impossible for the same thing to belong and not to belong at the same time to the same thing and in the same respect" at *Meta*. 4.3, 1005^{b}19-20, but the principle is not consistently presented as an ontological claim, and is instead sometimes presented as a doxastic claim, for example as "it is impossible to hold (suppose) the same thing to be and not to be" at *Meta*. 4.3, 1005^{b}24, or as a semantic claim, for example as "opposite assertions cannot be true at the same time" at *Meta*. 4.6, 1011^{b}13–20. Since the principle of non-contradiction is not consistently presented as an ontological claim, it does not provide clear evidence on whether common principles express extralogical content, as do propositions that are topic-neutral in the general sense but not in the formal sense. Moreover, although the principle of non-contradiction arguably might be viewed by our lights as a logical principle, the principle is not an inference rule and it is unclear whether Aristotle would view the principle of non-contradiction as a logical principle. For these reasons, common principles such as the principle of non-contradiction give little evidence for whether or in what sense Aristotle views logic as topic-neutral. Indeed, even if common principles had evidential value for general questions over logic and topic-neutrality in Aristotle, a lengthy discussion of such principles would not be relevant to the specific topic of this

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We have been considering whether Aristotle provides an account of logical consequence. But under what was until recently a not uncommonly held view, and a view that still has currency, he must take the first figure moods to be obviously or self-evidently valid. So that in virtue of which the first figure moods are valid—that is to say, that in which their syllogisity consists—is left unaddressed. He then shows that the moods of the second and third figure are valid, only under the unexamined assumption that the first figure moods are valid. On this view, no account of logical consequence is available to Aristotle.

Let me briefly defend my characterization of this view as a once fairly standard and still not uncommon one. The view is sometimes stated explicitly. See, for example, Lear (1980: 3), who writes that Aristotle "simply states that it is evident that the first figure syllogisms are perfect. No argument is given for their validity. For if the syllogisms are perfect, no argument need be given."[16] But the view arguably is also tacitly assumed in much of the recent scholarship on Aristotle's logic. Formal reconstructions of the syllogistic as a modern logical system over the last sixty years have treated the first figure moods as axioms in a theory or as primitive inference rule in a

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paper, since principles such as the law of non-contradiction are of less relevance to the specifics of the syllogistic. The submission concerns generality only insofar as it is relevant to the interpretation of the syllogistic, since the submission argues that Aristotle provides an account of syllogistic inference by appeal to extralogical and general facts about parts and wholes. This restriction to certain general facts suffices for the purposes of the paper.

[16] Compare Rose (1968: 27), who writes that Aristotle's "way of handling validity is to take the valid moods of the first figure as basic and to establish the validity of moods in the remaining figures by reducing them to moods of the first figure."

Fitch-style natural deduction system. For the former representation, see Łukasiewicz (1956) and for the latter, see Corcoran (1974) and Smiley (1973).[17] One might naturally hold that axioms or primitive rules do not need justification. And indeed, these authors do not attempt to justify the choice of first figure moods as axioms or primitive rules. So perhaps the best evidence for the orthodoxy of the view is the paucity of discussion of Aristotle's concept of logical consequence *per se* in the secondary literature.

Is there support for the view that Aristotle does not attempt an account of logical consequence? Those who hold the view typically do not provide an explicit argument. But one might look to Aristotle's characterization of the necessity of a complete syllogism as being self-evident at *APr* 1.1.

T3 I call a syllogism *complete* if it stands in need of nothing else besides the things taken in order for the necessity to be evident. I call it incomplete if it still needs either one or several additional things which are necessary because of the terms assumed, but yet not taken by means of premises. (24^b22-26)

τέλειον μὲν οὖν καλῶ συλλογισμὸν τὸν μηδενὸς ἄλλου προσδεόμενον παρὰ τὰ εἰλημμένα πρὸς τὸ φανῆναι τὸ ἀναγκαῖον, ἀτελῆ δὲ τὸν προσδεόμενον ἢ ἑνὸς ἢ πλειόνων, ἃ ἔστι μὲν ἀναγκαῖα διὰ τῶν ὑποκειμένων ὅρων, οὐ μὴν εἴληπται διὰ προτάσεων.

T3 lays down a sufficient condition for a syllogism to be complete or perfect (*teleion*). It is accepted among commentators that 'the things taken' are the initial premises of the mood;[18] and that the 'necessity' is the logical necessity of the conclusion following from these premises. So a mood is complete if the premises are sufficient for the inference to be self-evident. The Greek *phanênai* is an aorist passive infinitive stemming from *phainô*,

[17] Modern representations of the syllogistic typically do not follow Aristotle's own presentation. For example, Łukasiewicz (1957, 88ff.) takes the syllogistic implications corresponding to Barbara and Datisi as axioms.
[18] See, for example, Ross (1949: 292).

to bring to light. In a complete mood nothing else besides the premises are needed for the fact that the conclusion results of necessity from the premises to be brought to light or made evident. Those who hold that Aristotle does not attempt an account of logical consequence might read *phanênai* as ' to be obvious' or 'to be self-evident', as it is translated here. But it is consistent with holding that a mood is complete if the premises are sufficient for the inference to be made evident, to hold the validity of complete moods are adequately *justified*. The characterization of certain moods as self-evident in this sense does not show that they are obvious and so left unjustified.[19]

How might this contrast between complete and incomplete moods be fleshed out? Morison (2015) argues that a mood is complete if it does not require additional premises, over and above the two premises of the mood itself, for the validity to become apparent; incomplete moods, by contrast, are shown to be valid by additional premises brought in through the methods of conversion, ecthesis or indirect proof. This is consistent with a complete mood being amenable to validation. I turn now to the question how Aristotle might validate the complete moods.

When Aristotle introduces the complete moods Barbara and Celarent, he makes reference to a semantic condition for a- and e-predications:

T4 And we say 'one thing is predicated universally of another' whenever none of [those of] the subject can be taken of which the other cannot be said, and we use 'predicated of none' likewise. (APr 1.1, 24^{b}18-30)

λέγομεν δὲ τὸ κατὰ παντὸς κατηγορεῖσθαι ὅταν μηδὲν ᾖ λαβεῖν [τῶν] τοῦ ὑποκειμένου καθ᾽ οὗ θάτερον οὐ λεχθήσεται· καὶ τὸ κατὰ μηδενὸς ὡσαύτως.

[19] Thanks to an anonymous referee, who notes that another reason to reject the move from the obviousness of the first figure moods to primitivism is that, as the former is an epistemic claim, it does not straightforwardly entail the second, logical, claim.

This passage is the basis for the traditional *dictum de omni et nullo*.[20] Under any plausible interpretation of the *dictum de omni*, as Malink (2013) puts it, an a-predication is true just in case any member of the plurality associated with the subject is a member of the plurality associated with the predicate. This entails that a-predication is transitive, and so validates Barbara. For (reversing the order of the premises for perspicuity) if any member of the plurality associated with C is a member of the plurality associated with B, and any member of the plurality associated with B is a member of the plurality associated with A, then any member of the plurality associated with C is a member of the plurality associated with A. And similarly for Celarent.

Does the *dictum* justify more than Barbara and Celarent? Let us say that a semantic theory *validates* the assertoric syllogistic if the first figure moods, Barbara and Celarent and the three conversion rules can be derived from that semantics, when supplemented by a *reductio* rule. The incomplete moods can be derived from the first figure moods either by conversion or through indirect proof. And as Aristotle himself recognizes at 1.7 (29^b6-11), two first figure moods, Darii and Ferio, are superfluous, and can be themselves derived from Barbara and Celarent. So if Barbara, Celarent and the three conversion rules can be derived from a semantic theory, when supplemented by a *reductio* rule, then that theory might reasonably be said to validate the assertoric syllogistic.

[20] There are interpretive issues that we can set aside. I will assume for this essay the standard view of the *dictum* as a semantic condition, but see Morison (2015) for criticism of this standard view. The *dictum de omni et nullo* is typically supplemented by a *dictum de aliquo et aliquo non*, semantic conditions for i- and o-propositions, but we will not need to broach this complication.

On what Barnes (1981) characterizes as the orthodox reading of the *dictum*, an a-predication AaB is true just in case the extension of the subject B is a subset of the extension of the predicate A. On this reading, the *dictum* fails to validate the syllogistic. But there has been a recent resurgence of interest in the *dictum* as providing a validation of the syllogistic.[21] This reinterest has been partly driven by the case made by Morison (2008) and Malink (2008, 2013) for a heterodox reading, under which for example AaB is true just in case for every item of which the subject B is a-predicated, the predicate A is a-predicated of that item as well. On this reading, the *dictum* indeed validates the syllogistic.

One point of contrast between the two readings concerns the validation of a-conversion, under which recall AaB licences BiA. This is usually taken to imply that universal predication carries existential import, and is equivalent to the contrariety of universal affirmations and negations. But the standard reading of the *dictum* entails that both a- and e-predications can be both vacuously true. For when the subject is an empty term, it is both the case that any member of the plurality associated with the subject is a member of the plurality associated with the predicate (the standard *dictum de omni* truth condition for a-predications) and the case that any member of the plurality associated with the subject is not a member of the plurality associated with the predicate (the standard *dictum de nullo* truth condition for e-predications). By contrast, as Barnes (2007, 409-12) and Malink (2013, 68) observe, the heterodox reading of the *dictum de omni*,

[21] For example, Patterson (1993 and 1995), Morison (2008 and 2015), Malink (2008, 2009, 2013 and 2020), Gili (2015), Marion and Rückert (2016), Crubellier, Marion, McConaughey and Rahman (2019), Ludlow and Živanović (2022), and Corkum (forthcoming).

under which an a-predication is true just in case for every item of which the subject is a-predicated, the predicate is a-predicated of that item as well, does not allow for cases where both a- and e-predications are vacuously true. On this reading, universal predication is reflexive, so any term is a-predicated of itself, and the possibility of empty terms in universal predications does not arise.

We do not need to enter further into the details of this issue, since either reading of the *dictum* validates Barbara and Celarent, and the validation of Barbara and Celarent alone suffices to show that Aristotle is providing at least a partial account of logical consequence by appeal to the *dictum*. Moreover, the validation of the syllogistic goes beyond our present interests, since the conversion rules are valid but, as we saw in section 2, do not conform to syllogisity.

There is an interpretive question in the vicinity, however, that pertains to our purposes. If a modal conception of logical consequence is given an account at least partly by appeal to the *dictum*, how ought we to view this account? Malink (2013, 65) views the *dictum* as not providing a definition of a-predication; e-, i- and o-predication can be defined in terms of a-predication, but on the heterodox reading of the *dictum*, a-predication is employed in the truth condition for a-predications, and so a-predication is treated as an undefined primitive. The *dictum de omni* under the heterodox reading expresses the fact that a-predication is transitive and reflexive, but there is no further explanation of this brute fact. For this reason, this line of interpretation might suggest that Aristotle offers an analysis of logical consequence – an account that relies on purely semantic facts such as facts about the meaning of a-predication.

In an alternative reading, we need not take the fact that a-predication is transitive and reflexive to be brute, since Aristotle arguably draws on mereological facts to ground this semantic fact. A mereological interpretation of a-predication immediately preceeds the introduction of the *dictum* in **T5**:[22]

T5 'One thing is wholly in another' means the same as 'one thing is predicated universally of another'. (*APr* 1.4, 24^{b}26-28)

τὸ δὲ ἐν ὅλῳ εἶναι ἕτερον ἑτέρῳ καὶ τὸ κατὰ παντὸς κατηγορεῖσθαι θατέρου θάτερον ταὐτόν ἐστιν.

And Aristotle also appears to justify the validity of Barbara and Celarent directly through the transitivity of mereological containment in **T6** when he first introduces these moods:

T6 Whenever three terms so stand to each other that the last is wholly in the middle and the middle is either wholly in or wholly not in the first, it is necessary for there to be a complete syllogism of the extremes. (*APr* 1.1, 25^{b}32-25)

Ὅταν οὖν ὅροι τρεῖς οὕτως ἔχωσι πρὸς ἀλλήλους ὥστε τὸν ἔσχατον ἐν ὅλῳ εἶναι τῳ μέσῳ καὶ τὸν μέσον ἐν ὅλῳ τῳ πρώτῳ ἢ εἶναι ἢ μὴ εἶναι, ἀνάγκη τῶν ἄκρων εἶναι συλλογισμὸν τέλειον.

Mignucci (1996 and 2000) notes that the reading of the *dictum* as grounded in mereological facts is also a heterodox reading, under which the *dictum de omni* expresses that a-predication is transitive and reflexive, since the reading treats a-predication as mereological containment, and the improper part relation is transitive and reflexive.[23]

[22] Mignucci (1996 and 2000), Corkum (2015) and Vlasits (2019) discuss the mereological semantics suggested by passages such as **T5**.

[23] An anonymous referee asks "Why think that Aristotle's part-whole relation is improper parthood and therefore reflexive? Aristotle is clear in Categories 7 (6^{b}35) that all relatives are irreflexive. So is parthood an exception?" The heterodox reading of the *dictum* takes the relation between the subject and the predicate in a universal affirmation to be reflexive. The mereological reading of the *dictum* is a variant of the heterodox *dictum*. On the specific question of Aristotle's treatment of relatives, Cat. 7 (6^{b}35) notes that correlatives reciprocate, and this is consistent with not every relation being irreflexive.

Corkum (forthcoming) notes that the *dictum* under this reading validates the syllogistic, and argues for certain advantages over the reading of the *dictum* under which the fact that a-predication is transitive and reflexive is taken to be brute.

If this reading is correct, then the account of a modal conception of logical consequence – given by the moods, validated by the *dictum*, itself grounded in mereological facts – would be poorly thought of as an analysis. It is intuitive to view the improper part relation as transitive and reflexive. But it is not forced upon us by the meaning of 'part'. An appeal to mereological facts draws on substantive metaphysics, and to extralogical and extralinguistic facts. Notice also that the mereological interpretation of the *dictum* provides further support for the observation, made in section 2, that Aristotle's view of topic-neutrality conforms to the General conception and not the Formal conception. The validation of the syllogistic through a mereologically grounded *dictum* does not rely on the particular referents of the terms, but is not wholly independent of worldly or extralogical facts. Mereological facts, such as the transitivity of the part relation, are true regardless of the specific identity of the parts and wholes, and are extralogical. We cannot rehearse here the advantages and disadvantages of these two interpretations, under which the fact that a-predication is transitive and reflexive is brute or grounded in mereological facts. But I note the significance of this question of local textual exegesis for our understanding of Aristotle's philosophy of logic.

4

In this section, I discharge the second of the two obligations I incurred back in section 2. I have argued in section 3 that Aristotle provides an account of moods by appeal to semantic or mereological facts. In this section, I will note that Aristotle holds that any broad syllogism can be represented as a finite series of moods. So Aristotle intends to provide an account of syllogisity, a modal conception of logical consequence, by appeal to topic-neutral semantic or mereological facts. I will also tentatively assess the success of this account and draw a few cautious comparisons with contemporary philosophy of logic.

Aristotle asserts in *APr* 1.23 that any broad syllogism can be represented as a finite series of moods:

T7 It is clear from what has been said that the syllogisms in these figures are made perfect by means of the universal syllogisms in the first figure and are reduced to them. That every syllogism without qualification can be so treated, will be clear presently, when it has been proved that every syllogism proceeds though one of these figures. (40^b17-22)

> Ὅτι μὲν οὖν οἱ ἐν τούτοις τοῖς σχήμασι συλλογισμοὶ τελειοῦνταί τε διὰ τῶν ἐν τῶι πρώτωι σχήματι καθόλου συλλογισμῶν καὶ εἰς τούτους ἀνάγονται, δῆλον ἐκ τῶν εἰρημένων· ὅτι δ᾽ ἁπλῶς πᾶς συλλογισμὸς οὕτως ἕξει, νῦν ἔσται φανερόν, ὅταν δειχθῆι πᾶς γινόμενος διὰ τούτων τινὸς τῶν σχημάτων.

The referent of ‘what has been said’ is *APr* 1.7, mentioned in section 3, where Aristotle shows that each of the moods in the three figures is reducible to Barbara and Celarent. Aristotle argues for the conclusion that any broad syllogism—‘every syllogism without qualification’—is reducible to Barbara and Celarent in the rest of *APr* 1.23. Despite perhaps implying here that every syllogism proceeds through *one* of the moods, Aristotle’s argument rests on the claim that any broad syllogism can be represented as a

series of moods. He argues that this series is finite, since every regress of premisses from which to deduce a conclusion is finite, in *APo* 1.19-22.[24]

The claim that any broad syllogism can be represented as a series of moods resembles a contemporary completeness theorem. Contemporary logics typically employ two notions of consequence: a proof theoretic notion of derivability and a semantic notion of truth preservation in all models. The notions might be fruitfully thought of as extensions of the methods of demonstrating validity introduced in typical first–year logic courses: the step-wise use of intuitively valid derivation rules to transform the premises of an argument into its conclusion, and the use of truth tables to demonstrate that there are no interpretations of the nonlogical constants where the premises are all true and the conclusion false. The metalogical results of soundness and completeness ensure that the two notions are extensionally equivalent. If a conclusion S is derivable from a set of premises K, then soundness ensures that there are no models where all of K is true but S is false; if, on the other hand, there are no models where all of K is true but S is false, then completeness ensures that S is derivable from K. The completeness theorem thus shows that the derivation system does not undergenerate: there are no validities expressible in the object language which cannot be demonstrated to be valid by the derivation rules.

There are reasons to resist pressing the analogy too far. There are certainly disanalogies between mathematical logic and the syllogistic. As we noted in section 2, Aristotle lacks a sharp distinction between syntax and semantics.[25] But Aristotle's claim

[24] For further discussion, see Lear (1979) and Scanlan (1983).
[25] Lear (1980, 2) rightly notes that, if a proof theory is expressed in terms of uninterpreted schemata, there is a pressing need to justify the inference rules with a semantic theory: "it

resembles modern completeness theorems in this sense: he appears to hold that all the valid inferences which are expressible in an object language consisting of just categorical assertoric propositions, and meeting the constraints of a broad syllogism discussed in section 1, are derivable within the assertoric syllogistic. There are, however, difficulties in assessing this claim. Aristotle defends his thesis that all broad syllogisms proceed through a series of moods by appeal to two lemmas. First, Aristotle holds that

T8 It is necessary that every demonstration and every syllogism should prove either that something belongs or that it does not, and this either universally or in part. (*APr* 1.23, 40^{b}23-25)

Ἀνάγκη δὴ πᾶσαν ἀπόδειξεν καὶ πάντα συλλογισμὸν ἢ ὑπάρχον τι ἢ μὴ ὑπάρχον δεικνύναι, καὶ τοῦτο ἢ καθόλου ἢ κατὰ μέρος, ἔτι ἢ δεικτικῶς ἢ ἐξ ὑποθέσεως.

Aristotle does not say why he holds that every broad syllogism must conclude with a categorical proposition. But, as we have seen, he seems to hold that any genuine proposition is categorical.[26] So here is a first difficulty that faces us: it is difficult to assess Aristotle's claim that all broad syllogisms proceed through the moods without a detailed study of Aristotle's philosophy of language.

It is clear then that Aristotle's claim that all broad syllogisms can be represented as a finite series of moods is made under certain restrictions. As we have seen, the characterization in **T1** of a broad syllogism places certain constraints on moods: for

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has become too easy to assume that a syntactic inference must be justified by some form of semantical soundness proof. This is because logicians have tended to treat formal systems as uninterpreted, as a safeguard against theoretical assumptions remaining hidden in the underlying logic." But, as Lear goes on to observe, one might recognize the desideratum to justify the choice of valid inferences, even if these are not uninterpreted rules.

[26] If Aristotle holds that a conjunction or a conditional does not express a single proposition, he may hold that conjunction introduction and *modus ponens* are not broad syllogisms. For discussion of the hypothetical syllogism, see Lear (1980).

example, moods must be non-circular and multi-premised. However, as we have also seen, the moods are held to constraints apparently not placed on them by the characterization of a broad syllogism. For example, the expressive power of the object language is restricted: the conclusion of any mood must be a categorical proposition. And adjacent premises must share a term. Some have understandably held that Aristotle fails to defend this latter claim. Smith (1989: 140), for example, asserts that the requirement that adjacent premises have a common term is left unproven. Aristotle does however *purport* to defend the requirement. He writes:

T9 For a syllogism, without qualification, is from premises; a syllogism in relation to this term is from premises in relation to this term; and a syllogism of this term in relation to that is through premises of this term in relation to that. And it is impossible to take a premise in relation to B without either predicating or rejecting anything of it, or again to get a syllogism of A in relation to B without taking any common term, but <only> predicating or rejecting certain things separately of each of them. (*APr* 1.23, 41^{a}4-11)

ὁ μὲν γὰρ συλλογισμὸς ἁπλῶς ἐκ προτάσεών ἐστιν, ὁ δὲ πρὸς τόδε συλλογισμὸς ἐκ τῶν πρὸς τόδε προτάσεων, ὁ δὲ τοῦδε πρὸς τόδε διὰ τῶν τοῦδε πρὸς τόδε προτάσεων. ἀδύνατον δὲ πρὸς τὸ Β λαβεῖν πρότασιν μηδὲν μήτε κατηγοροῦντας αὐτοῦ μήτ᾽ ἀπαρνουμένους, ἢ πάλιν τοῦ Α πρὸς τὸ Β μηδὲν κοινὸν λαμβάνοντας ἀλλ᾽ ἑκατέρου ἴδια ἄττα κατηγοροῦντας ἢ ἀπαρνουμένους.

The writing here is crabbed. But charitably, we might take the move to be an appeal to a theorem in the theory of relations. Broad syllogisms must conclude in a categorical proposition, and such a conclusion expresses a relation between the terms. From **T9**, Aristotle seems to hold that either a relation is primitive and indemonstrable or else obtains in virtue of each relatum being related to a shared third relatum. If this is correct, then Aristotle is relying on substantive and, by our lights, questionable claims about relations. Here then is a second difficulty that faces us: Aristotle's argument appears to rely on idiosyncratic views about relations. And so it is difficult to assess Aristotle's

claim that all broad syllogisms proceed through the moods without a detailed study of both his semantics and his theory of relations. However, it is the apparent *intention*, to provide an account of syllogisity, and not the *success* of this project, which has been my primary concern to this point in the paper.

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I will begin to bring the paper to a conclusion. Aristotle appeals to semantic principles such as the transitivity of a-predication or mereological principles such as the transitivity of mereological containment, when validating the moods. This gives us *prima facie* evidence of a philosophical interest in providing an account of syllogisity, the modal conception of logical consequence introduced in **T1**, in terms of a topic-neutral conception of validity. Such an account relies on substantive and extralogical theses in semantics, the theory of relations and perhaps mereology. For these reasons, the account is not an analysis. And the relevant conception of topic-neutrality is General, and not Formal.

The points of similarity with the model theoretic definition of logical consequence, as truth preservation in all models, are striking. Etchemendy (1990 and 2008) argues that the model theoretic account of logical consequence is also wrongly characterized as an analysis, but rather relies on substantive claims in metaphysics and semantics. Let me briefly discuss Etchemendy's argument; the discussion will bring out not only the similarities, but also the dissimilarities, with the Aristotelian picture; however, those disinterested in contemporary philosophy of logic could skip the next two

paragraphs. Etchemendy notes that the model theoretic definition is extensionally adequate only because of the strength of the underlying set theory and the weakness of the object language. One such assumption of the former kind is that the universe is infinitely large, an assumption built into the definition by the set theoretic axiom of infinity. Consider a sentence which is true in every finite model but false in some infinite model. For example, consider the sentence asserting that a transitive, irreflexive relation has a minimal element:

(1) $[\forall x \forall y \forall z(Rxy \& Ryz \supset Rxz) \& \sim \forall x Rxx] \supset \exists x \forall y \sim Ryx$.

Etchemendy (1990: 111-22) notes that a finitist can consistently assert both

(2) There are only finitely many objects, and

(3) Sentence (1) is not a logical truth.

(2) and (3) are consistent but, conjoined with the model theoretic definition of logical truth, yield a contradiction. Etchemendy occasionally gives the impression that the worry is that the alleged analysans depends on a contingency—namely, the size of the universe. However, the issue is not that a purported analysis of logical consequence relies on a *contingent* fact. As McGee (1992) notes, we may include sets into our ontology, to ensure the infinitude of the universe. Indeed, although we may disagree about whether our ontology ought to include sets, surely it is not a contingent matter: if there are sets, there are necessarily sets. The issue that Etchemendy identifies with the model theoretic definition is rather that an alleged analysis of logical consequence relies on an *extralogical* fact. Just as the model theoretic account of logical consequence depends on extralogical assumptions in set theory, so too the Aristotelian account of syllogisity

depends on extralogical assumptions in semantics, the theory of relations and perhaps mereology.

Etchemendy also notes that the model theoretic definitions avoid overgeneration of logical truths in part by the choice of logical constants. The object language of propositional logic takes as its sole logical constants the classical truth functional connectives. This is an expressively weak language. If we expand the expressive power of the object language, we can express sequences that are truth preserving in all models but which are not logically valid. To take an example from Etchemendy (2008: 272), if we add the standard quantifiers and identity, we can express the extra-logical fact that there are more than three billion objects; any argument with this conclusion is truth preserving but intuitively is not logically valid. So too the success of Aristotle's account of logical consequence depends in part on the severe limitations in expressive power of the object language of the syllogistic. Indeed, the plausibility of appealing to such theorems as the transitivity of mereological containment (or a-predication) depends in part on the restriction to categorical propositions and on the semantic profiles Aristotle assigns them.

There are also notable differences between Aristotle's project and the model theoretic project. As we have seen, Aristotle's modal conception of logical consequence is not our notion of validity. His conception of topic-neutrality does not employ notions of formality or independence from worldly features but rather relies on highly general features of the world. And finally, Aristotle's account of logical consequence is plausible only in the presence of semantic views – such as the view, discussed in Section 3, that the truth conditions for categorical propositions are given in mereological terms – as well as

metaphysical views in the theory of relations – such as the view, discussed in Section 4, that nonprimitive relations obtain in virtue of each relatum being related to a shared third relatum – which might well strike us as foreign.

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