

A NON-EXTENSIONAL NOTION OF CONVERSION IN THE *ORGANON*

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THIS paper is about a special notion of conversion found in *Prior Analytics* 2. 22, 68^a16–21. I hope to show that the notion is worth studying for two reasons: firstly because it is interesting in itself, and secondly because it has implications for the semantics of a-propositions (that is, assertoric universal affirmative propositions).

Let us say that A is a-predicated of B if and only if the a-proposition ‘A belongs to all B’ is true. The notion of conversion in question is: A converts with B if and only if A is a-predicated of everything of which B is a-predicated *including* B itself, while B is a-predicated of everything of which A is a-predicated *except* of A itself. We may call this asymmetric conversion.

The point is that B is not a-predicated of A although it is a-predicated of everything else of which A is a-predicated (Section 1). Commentators have found this puzzling or incoherent. I shall argue that it is incoherent from the perspective of a certain extensional semantics of a-propositions (Sections 2 and 3). That semantics is based on what J. Barnes has called the orthodox interpretation of Aristotle’s *dictum de omni*: A is a-predicated of B if and only if every individual which falls under B falls under A.

On the other hand, the heterodox interpretation of the *dictum de omni* is: A is a-predicated of B if and only if A is a-predicated of everything of which B is a-predicated. I intend to defend and develop this interpretation. The result will be a non-extensional semantics of a-propositions in which a-predication is a primitive

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preorder relation. The semantics is non-extensional in the sense that B need not be a-predicated of A if both terms have the same extension (that is, the same set of individuals which fall under them). This leads to a coherent account of asymmetric conversion (Sections 4 and 5).

We shall then consider how the notion of asymmetric conversion is motivated. I shall argue that it is motivated by Aristotle's theory of predication in the *Topics* and *Posterior Analytics*. According to that theory, substance terms such as 'animal' cannot be predicated, in the proper sense, of non-substance terms such as 'having a soul'. On the other hand, 'having a soul' can be predicated of 'animal'. Thus, 'having a soul' may be predicated of everything of which 'animal' is predicated *including* 'animal' itself, while 'animal' is predicated of everything of which 'having a soul' is predicated *except* of 'having a soul' itself (Sections 6 and 7). Finally, I shall argue that this account of asymmetric conversion is supported by Aristotle's examples of a-predications in *Prior Analytics* 1. 1–22 (Section 8).

1. Asymmetric conversion

Chapter 2. 22 of the *Prior Analytics* contains several remarks on conversion (*ἀντιστρέφειν*). The one we are going to study is:

ὅταν δὲ τὸ A ὅλω τῷ B καὶ τῷ Γ ὑπάρχη καὶ μηδενὸς ἄλλου κατηγορήται, ὑπάρχη δὲ καὶ τὸ B παντὶ τῷ Γ, ἀνάγκη τὸ A καὶ B ἀντιστρέφειν· ἐπεὶ γὰρ κατὰ μόνων τῶν B Γ λέγεται τὸ A, κατηγορεῖται δὲ τὸ B καὶ αὐτὸ αὐτοῦ καὶ τοῦ Γ, φανερόν ὅτι καθ' ὧν τὸ A, καὶ τὸ B λεχθήσεται πάντων πλὴν αὐτοῦ τοῦ A. (*Pr. An.* 2. 22, 68^a16–21)

When A belongs to the whole of B and of C and is predicated of nothing else, and B belongs to all C, then it is necessary for A and B to convert. For since A is said only of B and C, and B is predicated both of itself and of C, it is evident that B will be said of everything of which A is said except of A itself.

The first sentence contains the phrases 'belongs to the whole of' and 'belongs to all'. Both of them express a-propositions, that is, the kind of categorical proposition which occurs in the syllogism Barbara. A-propositions are often represented by formulae such as 'AaB', with A being the predicate term and B the subject term.

The second sentence contains the phrase ‘A is said only of B and C’. This phrase does not contain a quantifying expression such as ‘the whole of’ or ‘all’. None the less, there is no reason to doubt that ‘A is said of B and C’ is intended to mean the same as ‘A belongs to the whole of B and of C’ in the first sentence. The same is true of all occurrences of ‘be said of’ and ‘be predicated of’ in our passage; all of them appear to indicate a-propositions as well as ‘belong to the whole of’ and ‘belong to all’. If so, then all these phrases state that an a-proposition is true in the context under consideration. Instead of saying that an a-proposition is true we shall often say that the predicate term is a-predicated of the subject term.

Aristotle starts by assuming that A is a-predicated of both B and C. He also assumes that there is nothing else of which A is a-predicated. The latter assumption needs to be qualified, though; for at the end of the passage Aristotle appears to imply that A is a-predicated of itself.¹ Thus, A is a-predicated of A, B, and C, and of nothing else. In addition, Aristotle assumes that B is a-predicated of B and of C.

It is worth noting that Aristotle acknowledges a-propositions of the form ‘BaB’. It is sometimes thought that such propositions are not admissible in Aristotle’s syllogistic since the predicate and the subject of categorical propositions must be two distinct terms.² However, there is hardly any evidence for this in the *Prior Analytics*.³ On the contrary, Aristotle accepts such propositions in our passage from 2. 22. One may even attribute to Aristotle the view that propositions of the form ‘BaB’ cannot be false.⁴ In any case, in

¹ ‘B will be said of everything of which A is said except of A itself.’ Cf. J. Barnes, *Truth, etc.: Six Lectures on Ancient Logic [Truth]* (Oxford, 2007), 494.

² J. Corcoran, ‘Completeness of an Ancient Logic’ [‘Completeness’], *Journal of Symbolic Logic*, 37 (1972), 696–702 at 696; R. Smith, ‘Completeness of an Ecthetic Syllogistic’ [‘Ecthetic Completeness’], *Notre Dame Journal of Formal Logic*, 24 (1983), 224–32 at 225; G. Boger, ‘Aristotle’s Underlying Logic’ [‘Underlying Logic’], in D. M. Gabbay and J. Woods (eds.), *Handbook of the History of Logic*, i. *Greek, Indian and Arabic Logic* (Amsterdam, 2004), 101–246 at 131 and 238.

³ Cf. Barnes, *Truth*, 387–8. Both Corcoran, ‘Completeness’, and Smith, ‘Ecthetic Completeness’, intend to prove that a certain deductive system for Aristotle’s syllogistic is complete with respect to (i.e. strong enough to prove everything valid in) a certain semantics. The proposition ‘BaB’ is valid in their semantics, but not provable in their deductive systems. So the proof of completeness fails when propositions such as ‘BaB’ are admitted.

⁴ Two passages are sometimes adduced for this. Firstly, *Pr. An.* 2. 15, 64^b7–13 (in conjunction with 64^a4–7, 23–30); cf. J. Łukasiewicz, *Aristotle’s Syllogistic from the Standpoint of Modern Formal Logic [Syllogistic]*, 2nd edn. (Oxford, 1957), 9;

our passage Aristotle assumes that the a-proposition ‘BaB’ is true, and he also appears to assume that ‘AaA’ is true.

At the end of the passage Aristotle denies that B is a-predicated of A (‘except of A itself’). So the notion of conversion under consideration involves an asymmetry inasmuch as A is a-predicated of B but B not of A. In order to distinguish this kind of conversion from other kinds of conversion in the *Organon*, let us call it asymmetric conversion. We may define it as follows: A is a-predicated of everything of which B is a-predicated *including* B itself, while B is a-predicated of everything of which A is a-predicated *except* of A itself.

This definition of asymmetric conversion does not specify the number of terms of which B is a-predicated. In our passage, B is a-predicated only of B and C, and of nothing else. However, this does not seem to be essential to the notion of asymmetric conversion in which Aristotle is interested; the notion should also be applicable if B is a-predicated of some more terms D, E, F, and so on. In fact, the letter ‘C’ in our passage may be thought of as a placeholder for a plurality of terms, or as standing for a kind of logical sum of such a plurality. At least the letter ‘C’ is used in this way later on, in *Prior Analytics* 2. 23.⁵

Explaining asymmetric conversion has proved challenging. Alexander reportedly regarded the critical phrase ‘except of A itself’ as a mistake; he argued that it would be correct to say ‘and also of A itself’.⁶ Pseudo-Philoponus found the notion of asymmetric conversion quite astounding (*θαυμάσιον πάνυ*, 470. 6 Wallies). Among recent commentators, Smith finds it puzzling and Barnes incoherent.⁷ Barnes does not explain why he finds it incoherent, but his view appears to depend on a certain assumption about the semantics of a-propositions, namely, on assuming an extensional semantics of a-propositions.

The purpose of the next section is to describe the most common version of such an extensional semantics. Section 3 will then ex-

P. Thom, *The Syllogism* [*Syllogism*] (Munich, 1981), 92. Secondly, our passage in *Pr. An.* 2. 22, 68^a19–20; cf. Łukasiewicz, *Syllogistic*, 149; J. van Rijen, *Aspects of Aristotle’s Logic of Modalities* (Dordrecht 1989), 209; Barnes, *Truth*, 494.

⁵ *Pr. An.* 2. 23, 68^b27–9; similarly *Pr. An.* 1. 28, 44^a11–17; *Post. An.* 1. 20, 82^a25.

⁶ According to an anonymous scholiast (194^a40–2 Brandis, see also 194^b1–2).

⁷ R. Smith, *Aristotle: Prior Analytics* [*Prior Analytics*] (Indianapolis, 1989), 218; Barnes, *Truth*, 494.

plain why asymmetric conversion seems to be incoherent from the perspective of that semantics.

2. The orthodox *dictum de omni*

In the first chapter of the *Prior Analytics* Aristotle explains the meaning of a-propositions. His explanation later came to be known as the *dictum de omni*:

λέγομεν δὲ τὸ κατὰ παντὸς κατηγορεῖσθαι ὅταν μηδὲν ἢ λαβεῖν (τῶν) τοῦ ὑποκειμένου καθ' οὗ θάτερον οὐ λεχθήσεται. (*Pr. An.* I. I, 24^b28–30)

We say 'predicated of all' when none (of those) of the subject can be taken of which the other will not be said.

There are some textual issues. The bracketed phrase 'of those' (τῶν) occurs in one of the major manuscripts, but not in other major manuscripts. Moreover, the phrase 'of the subject' (τοῦ ὑποκειμένου) is sometimes regarded as a non-Aristotelian gloss, although it occurs in all manuscripts.⁸

However, the general idea of the *dictum de omni* remains more or less unaffected by these textual issues. The phrase 'none . . . can be taken' can be taken to mean 'there is none . . .'.⁹ Thus, the *dictum de omni* states that AaB if and only if there is none (of those) of B of which A is not said. Now, the phrase 'none (of those) of B' is often taken to mean 'no individual which falls under B'. In this case, the *dictum de omni* states that AaB if and only if there is no individual which falls under B but not under A. This is what J. Barnes has called the orthodox interpretation of the *dictum de omni*.¹⁰

Aristotle also mentions a *dictum de nullo*, explaining the meaning of e-propositions. He does not spell it out, but merely says that it is similar to the *dictum de omni* (*Pr. An.* I. I, 24^b30). Presumably he had in mind that the *dictum de nullo* is obtained by omitting the negation 'not' (οὐ, 24^b30) in the *dictum de omni*.¹¹ If so, the orthodox

⁸ M. Wallies, 'Zur Textgeschichte der Ersten Analytik', *Rheinisches Museum*, 72 (1917–18), 626–32 at 626–7; D. W. Ross, *Aristotle's Prior and Posterior Analytics* [*Analytics*] (Oxford, 1949), 292; Barnes, *Truth*, 387 n. 34.

⁹ Barnes, *Truth*, 389.

¹⁰ Ibid. 406–9.

¹¹ Alex. Aphr. *In Pr. An.* 25. 17–19; 32. 20–1; 55. 5–7 Wallies; H. Maier, *Die Syllogistik des Aristoteles: Zweiter Teil* [*Syllogistik*] (2 vols.; Tübingen, 1900), ii. 150; T. Ebert, 'Was ist ein vollkommener Syllogismus des Aristoteles?', *Archiv für Geschichte der Philosophie*, 77 (1995), 221–47 at 231; Barnes, *Truth*, 390; T. Ebert

interpretation of the *dictum de nullo* is: AeB if and only if there is no individual which falls both under B and under A.

Aristotle does not mention a *dictum de aliquo* or *dictum de aliquo non* to explain the meaning of i- and o-propositions, respectively. However, given the traditional square of opposition, i-propositions are contradictory to e-propositions, and o- to a-propositions. As a result, the orthodox interpretation of the *dictum de aliquo* is: AiB if and only if there is an individual which falls both under B and under A. And similarly for the *dictum de aliquo non*.

The orthodox interpretation of the four *dicta* is often formulated in terms of classical first-order logic:

AaB	if and only if	$\forall x(Bx \supset Ax)$
AeB	if and only if	$\forall x(Bx \supset \neg Ax)$
AiB	if and only if	$\exists x(Bx \wedge Ax)$
AoB	if and only if	$\exists x(Bx \wedge \neg Ax)$

These four equivalences allow us to apply the standard model theory of classical first-order logic to categorical propositions: a categorical proposition is true in a first-order model if and only if the first-order formula assigned to it by the four equivalences is true in it. In these first-order formulae, x is a zero-order individual variable, and A and B are first-order predicates. In the standard first-order models, the semantic value of zero-order terms is an individual, and the semantic value of first-order predicates is a set of individuals.

Categorical propositions have a tripartite syntax, consisting of two argument terms and a copula. For example, the categorical proposition ‘AaB’ consists of the predicate term A , the subject term B , and the copula a . Models for the language of categorical propositions typically assign a semantic value to each of these three constituents. The first-order models determined by the orthodox interpretation of the four *dicta* are based on a primitive non-empty set of individuals. The domain of semantic values of argument terms of categorical propositions is the powerset (that is, the set of all subsets) of that set of individuals. The semantic value of each of the four copulae is a relation in this powerset. For example, the semantic value of the a -copula is the subset relation, and that of the e -copula the relation of disjointness. We may call

and U. Nortmann, *Aristoteles: Analytica Priora. Buch I [Analytica Priora]* (Berlin, 2007), 230.

the class of all such first-order models the set-theoretic semantics of categorical propositions.

In the set-theoretic semantics, the semantic value of argument terms of categorical propositions is a set of individuals—the set of individuals which fall under the term. Let us refer to this set as the extension of that term. The set-theoretic semantics is extensional in the sense that the truth of categorical propositions depends only on the extension of the two argument terms.

As is well known, there is a problem of existential import in the set-theoretic semantics. The problem is that Aristotle's conversion of a-propositions is not valid in it; for if the semantic value of the term B is the empty set, then 'AaB' is true and 'BiA' is false in any model of the set-theoretic semantics. The most common way to solve that problem is to assume that the empty set is not admitted as a semantic value of terms. Thus, the empty set is removed from the domain of semantic values of terms; all other sets of individuals, however, are usually admitted. As a result, the domain of semantic values of terms is the powerset of the primitive set of individuals minus the empty set.

Another way to solve the problem of existential import is to modify the truth-conditions of a-propositions in such a way that AaB if and only if the semantic value of the term B is (1) not the empty set and (2) a subset of the semantic value of the term A.¹² Thus, the empty set cannot serve as the semantic value of subject terms of true a-propositions. But it is not removed from the domain of semantic values of terms.

The purpose of the next section is to show that the set-theoretic semantics cannot give a satisfactory account of asymmetric conversion, regardless of which strategy to solve the problem of existential import is adopted.

3. Asymmetric conversion in the set-theoretic semantics

The definition of asymmetric conversion is: A is a-predicated of everything of which B is a-predicated *including* B itself, while B

¹² A. Prior, *Formal Logic*, 2nd edn. (Oxford, 1962), 169; M. V. Wedin, 'Negation and Quantification in Aristotle', *History and Philosophy of Logic*, 11 (1990), 131–50 at 135; A. T. Bäck, *Aristotle's Theory of Predication* (Leiden, 2000), 241–3; Ebert and Nortmann, *Analytica Priora*, 333.

is a-predicated of everything of which A is a-predicated *except* of A itself. According to the traditional interpretation of asymmetric conversion, the terms A and B have the same extension.¹³ In other words, the set of individuals which fall under A is identical with the set of individuals which fall under B. This view is incompatible with the orthodox interpretation of the *dictum de omni*. For if A and B have the same extension, the orthodox interpretation of the *dictum de omni* implies that B is a-predicated of A; but Aristotle denies that B is a-predicated of A. So if the traditional interpretation of asymmetric conversion is correct, which I think it is, then the orthodox interpretation of the *dictum de omni* is not correct.

In fact, it is difficult to make sense of asymmetric conversion on the orthodox interpretation of the *dictum de omni*. Asymmetric conversion implies that B is a-predicated of everything of which A is a-predicated except of A itself. Intuitively, this would seem to imply that every individual which falls under A falls under B. Thus the orthodox interpretation of the *dictum de omni* implies that B is a-predicated of A—which Aristotle denies. This kind of argument seems to have led to the traditional interpretation of asymmetric conversion. If the argument is correct, then asymmetric conversion is incompatible with the orthodox interpretation of the *dictum de omni*. However, the argument needs to be made more precise.

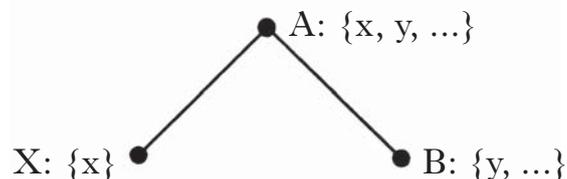
Consider the condition that B be a-predicated of everything of which A is a-predicated except of A itself. This may be expressed by the following two formulae: ‘not BaA’ and ‘for any X, if AaX and X is not identical with A, then BaX’. The latter formula needs at least two clarifications. Firstly, it involves the notion of identity, which is implicit in Aristotle’s phrase ‘except of A itself’. It is not necessary for us to determine exactly what notion of identity Aristotle had in mind. We shall only assume that in order for ‘X is identical with A’ to be true, the terms A and X must have the same extension (that is, the same set of individuals which fall under them). Thus, having the same extension is a necessary condition for identity, but need not be a sufficient condition.

Secondly, the formula contains the universal quantification ‘for

¹³ T. Waitz, *Aristotelis Organon Graece* [*Organon*] (2 vols.; Leipzig, 1844–6), i. 531; J. H. von Kirchmann, *Erläuterungen zu den ersten Analytiken des Aristoteles* (Leipzig, 1877), 245; Ross, *Analytics*, 480; G. Colli, *Aristotele: Organon* (Turin, 1955), 887; M. Mignucci, *Aristotele: gli Analitici Primi* (Naples, 1969), 698–9.

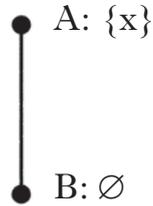
any X '. This may be interpreted in different ways. The most common is known as the objectual interpretation. According to it, the quantification 'for any X ' requires the formula to which it is applied to be true whatever semantic value is assigned to the variable X . In our case, this formula is 'if BaX and X is not identical with A , then BaX '. Now, X is a variable of the same type as the terms A and B ; it is an argument term of categorical propositions. Thus, the quantification ranges over the domain of semantic values of argument terms of categorical propositions. The orthodox interpretation of the *dictum de omni* does not, by itself, specify what that domain is. However, it determines a certain class of first-order models for categorical propositions, namely, the set-theoretic semantics. And in the set-theoretic semantics, that domain is the powerset of the primitive set of individuals, possibly minus the empty set.

Given objectual quantification, asymmetric conversion is almost inconsistent in the set-theoretic semantics. More precisely, it is consistent only if B is empty (that is, if the semantic value of the term B is the empty set). If B is not empty and ' AaB ' is true, the two formulae mentioned above are inconsistent. To see this, suppose that the first formula, 'not BaA ', is true. In this case, the set-theoretic semantics implies that there is an individual x which falls under A but not under B . Crucially, the singleton set $\{x\}$ is a member of the domain of semantic values of terms in the set-theoretic semantics. It follows that the second of the two formulae is false; for if the singleton set $\{x\}$ is taken as the semantic value of the term X , then the formula 'if AaX and X is not identical with A , then BaX ' is false:¹⁴



¹⁴ Firstly, ' AaX ' is true since x falls under A . Secondly, ' X is not identical with A ' is true for the following reason: since B is not empty, there is an individual y which falls under B ; since ' AaB ' is true, y falls under A ; y is not identical with x since y falls under B and x does not fall under B ; thus two distinct individuals x and y fall under A ; hence the semantic value of A is not the same as the singleton $\{x\}$, which is the semantic value of X ; so A and X do not have the same extension; as a result, ' X is not identical with A ' is true. Thirdly, ' BaX ' is false since x falls under X but not under B .

The assumption that B is not empty is needed to establish the truth of ‘X is not identical with A’.¹⁵ If B is empty, there are set-theoretic models for asymmetric conversion:



If B is empty, however, Aristotle’s conversion from ‘AaB’ to ‘BiA’ is invalid in the set-theoretic semantics. In any case, empty terms are not admitted in many versions of the set-theoretic semantics. In other versions, ‘AaB’ is false when B is empty. Thus, the set-theoretic semantics does not give a satisfactory account of asymmetric conversion under objectual quantification.

Instead of using objectual quantification, one might adopt what is known as substitutional quantification. This depends on what terms there are in the language under consideration. More specifically, the quantification ‘for any X’ refers to all terms of the same syntactic type as the variable X. It requires that each such term, when substituted for X in the formula to which the quantification is applied, have a true sentence as its result. Thus substitutional quantification disregards those members of the domain of semantic values which are not the semantic value of any term. So even if B is not empty, asymmetric conversion is consistent in the set-theoretic semantics. It can be satisfied when the language under consideration does not contain a term D such that the formula ‘if AaD and D is not identical with A, then BaD’ is false.

This is perhaps one of the best ways to make sense of asymmetric conversion within the set-theoretic semantics. Still, it has its drawbacks. Aristotle would be saying ‘A belongs to the whole of B and of C and is predicated of nothing else’ although his *dictum de omni* requires there to be an individual which falls under A but not under B or C. Asymmetric conversion would make sense only inasmuch as the language is not able to name certain items—items

¹⁵ Similarly, it can be shown that the two formulae under consideration are inconsistent in the set-theoretic semantics whenever at least two individuals fall under the term A. In this case, we need not assume that B is not empty and that ‘AaB’ is true. For the truth of ‘X is not identical with A’ follows from the fact that the semantic value of X, but not that of A, is a singleton set.

of which the orthodox interpretation of the *dictum de omni* tells us that they exist. While this is not impossible, it is not attractive as an interpretation of Aristotle.

Thus the set-theoretic semantics does not give a satisfactory account of asymmetric conversion, neither under objectual nor under substitutional quantification. We may conclude that the orthodox interpretation of the four *dicta* also fails to give a satisfactory account; for given this orthodox interpretation, the set-theoretic semantics would seem to be the natural class of models for the language of categorical propositions.

The purpose of the next section is to suggest an alternative semantics of categorical propositions, based on a heterodox interpretation of the four *dicta*. Section 5 will then argue that this alternative semantics gives a satisfactory account of asymmetric conversion.

4. The heterodox *dictum de omni*

Aristotle's *dictum de omni* states that AaB if and only if there is none (of those) of B of which A is not said. The orthodox interpretation takes 'none (of those) of B ' to mean 'no individual which falls under B '. In this case, the quantification 'none' can be taken to apply to a zero-order individual variable, while A and B are first-order predicates. Thus the quantification is applied to a variable of a different syntactic type from A and B .

On the other hand, there is the view that the quantification should be applied to a variable of the same syntactic type as A and B .¹⁶ In this case, the quantification does not range over a domain of individuals, but over the domain of semantic values of argument terms of categorical propositions (whatever these values are).

What does the *dictum de omni* mean if the quantification is applied to a variable X of the same syntactic type as A and B ? According to an interpretation espoused by M. Frede,¹⁷ it means that AaB if and only if for any X , if BaX , then AaX . In other words, A is

¹⁶ Maier, *Syllogistik*, i. 13 n. 1, and ii. 150–1; P. Stekeler-Weithofer, *Grundprobleme der Logik* (Berlin, 1986), 76; M. Mignucci, 'Aristotle's Theory of Predication' ['Predication'], in I. Angelelli and M. Cerezo (eds.), *Studies in the History of Logic* (Berlin, 1996), 1–20 at 4–5; id., 'Parts, Quantification and Aristotelian Predication' ['Parts'], *Monist*, 83 (2000), 3–21 at 8–15.

¹⁷ As reported by B. Morison, 'Aristotle, etc.' ['Aristotle'], *Phronesis*, 53 (2008), 209–22 at 212–15. Morison, too, defends this interpretation.

a-predicated of B if and only if A is a-predicated of everything of which B is a-predicated. This is what J. Barnes has called the heterodox interpretation of the *dictum de omni*.¹⁸

Barnes argues that the heterodox interpretation should be rejected for two reasons.¹⁹ The first is that it is more natural to read the Greek of Aristotle's *dictum de omni* in the orthodox way than in the heterodox way. Now, the orthodox interpretation may seem more natural by virtue of having been the dominant interpretation for many centuries. But it is difficult to see clear evidence for it in the Greek.²⁰ Considering syllogisms with the minor premiss 'BaC', Aristotle takes this a-proposition to imply that C is one of the Bs (τὸ δὲ Γ τι τῶν Β ἐστί, *Pr. An.* 1. 9, 30^a22). In the same way, the phrase 'none (of those) of the subject' (μηδὲν (τῶν) τοῦ ὑποκειμένου) in Aristotle's *dictum de omni* may refer to items of which the subject is a-predicated. Furthermore, we have seen that the phrase 'be said of' is used to indicate a-predications in Aristotle's discussion of asymmetric conversion.²¹ In the same way, the phrase 'be said of' (λεχθήσεται) in Aristotle's *dictum de omni* may indicate an a-predication.

It is true that Aristotle's *dictum de omni* does not explicitly express the heterodox interpretation. In order to do so, Aristotle could have used a phrase such as 'what B is said of all of, A is said of all of it' (*Pr. An.* 1. 41, 49^b24–5). There may be a number of reasons why Aristotle did not do so. For instance, he may have wanted to distinguish between the language of categorical propositions on the one hand and the explanation of its semantics on the other. But even so, it would not be unreasonable to assume that Aristotle's *dictum de omni*—or an important aspect of it—is adequately captured by the heterodox interpretation.

Barnes's second objection is that the heterodox interpretation is of no use because it is circular: for a-predication is explained or defined in terms of a-predication. This objection assumes that the *dictum de omni* should provide an explanation or definition of a-predication in terms of another, more primitive notion. However, there is no evidence for that in the *Prior Analytics*. Rather, as pointed out by B. Morison, the *dictum de omni* may be viewed as

¹⁸ Barnes, *Truth*, 406–12.

¹⁹ *Ibid.* 412.

²⁰ Morison, 'Aristotle', 214.

²¹ *Pr. An.* 2. 22, 68^a19–21; cf. also the use of 'be predicated of' and 'be said of' in *Pr. An.* 1. 27, 43^a30–2, 41–2.

a characterization of a-predication, specifying some of its properties.²² As such, the heterodox interpretation of the *dictum de omni* is informative and useful. To see this, let us consider the heterodox interpretation of all four *dicta*:²³

AaB	if and only if	$\forall X(BaX \supset AaX)$
AeB	if and only if	$\forall X(BaX \supset \neg AaX)$
AiB	if and only if	$\exists X(BaX \wedge AaX)$
AoB	if and only if	$\exists X(BaX \wedge \neg AaX)$

The first equivalence is special in that the relation of a-predication occurs on both sides. Given classical propositional and quantifier logic, this equivalence is equivalent to the statement that the relation of a-predication is reflexive and transitive.²⁴ Relations which are reflexive and transitive are called preorders. The heterodox *dictum de omni* is just another way of stating that a-predication is a preorder. The relations of e-, i-, and o-predication are defined in terms of that preorder. Each of these definitions implies certain logical properties of the three relations: for instance, the heterodox *dictum de aliquo* implies that i-predication is symmetric. Thus, the heterodox interpretation of the four *dicta* is useful inasmuch as it specifies logical properties of the relations of a-, e-, i-, and o-predication.

These properties suffice to account for the validity of all inferences held to be valid by Aristotle in the assertoric syllogistic. We need to consider only four inferences: the syllogisms Barbara and Celarent, and the conversions of e- and a-propositions. Given the square of opposition, the validity of all other inferences held to be valid by Aristotle follows from the validity of those four.²⁵ Barbara is valid by virtue of the transitivity of a-predication, Ce-

²² Morison, 'Aristotle', 214.

²³ Barnes's heterodox *dictum de nullo* (*Truth*, 409) is: AeB if and only if $\forall X(BaX \supset AeX)$. However, this is not in accordance with the view that the *dictum de nullo* is obtained from the *dictum de omni* by omitting the negation *ov* in 24^b30 (see n. 11 above). According to this view, the heterodox *dictum de nullo* is: AeB if and only if $\forall X(BaX \supset \neg AaX)$. The *dicta* for the two particular propositions are obtained by means of the square of opposition.

²⁴ If a-predication is transitive, the implication from left to right in the heterodox *dictum de omni* is valid; if a-predication is reflexive, the converse is valid. On the other hand, the condition $\forall X(BaX \supset AaX)$, viewed as a binary relation between A and B, is reflexive and transitive. So the heterodox *dictum de omni* implies that a-predication is reflexive and transitive.

²⁵ T. J. Smiley, 'What is a Syllogism?', *Journal of Philosophical Logic*, 2 (1973), 136–54 at 141–2.

larent by virtue of the transitivity of a-predication and the definition of e-predication. The conversion of e-propositions is valid by virtue of the definition of e-predication. Finally, the conversion of a-propositions is valid by virtue of the reflexivity of a-predication and the definition of i-predication: assume that A is a-predicated of B. Owing to the reflexivity of a-predication, there is something, namely B, of which both A and B are a-predicated. Hence, according to the definition of i-predication, B is i-predicated of A.

The heterodox interpretation of the four *dicta* can be taken to determine a class of models for the language of categorical propositions. Specifically, it can be taken to determine a class of first-order models as well as the orthodox interpretation. In this case, argument terms of categorical propositions are viewed as zero-order individual terms of a first-order language. The copulae a, e, i, and o, on the other hand, are viewed as binary first-order predicates. Thus the heterodox interpretation of the four *dicta* determines a first-order semantics of categorical propositions in basically the same way as the orthodox one.

The first-order semantics determined by the orthodox interpretation is the set-theoretic semantics. In it, the semantic value of an argument term of categorical propositions is a set of individuals. In the first-order semantics determined by the heterodox interpretation, on the other hand, this value is—logically speaking—an individual. It is a single primitive item without a complex structure, or at least it is considered as such. As a result, the distinction between a term and its semantic value is not as important as it is in the set-theoretic semantics. Thus, following a suggestion by R. Smith, we may assume that the semantic value of any term A is the term A itself.²⁶ But we may also take that semantic value to be any other kind of item.

In the set-theoretic semantics, the semantic values of the four copulae are defined in terms of another relation, namely, the relation of an individual being the member of the extension of a term. In the semantics determined by the heterodox interpretation, on the other hand, only the semantic values of the e-, i-, and o-copula are defined in terms of another relation, namely, in terms of a-predication. The semantic value of the a-copula (that is, the relation of a-predication) is taken as an undefined preorder. So the semantics

²⁶ R. Smith, 'The Syllogism in *Posterior Analytics* I', *Archiv für Geschichte der Philosophie*, 64 (1982), 113–35 at 123–4.

is based on a primitive preorder, and may therefore be called the preorder semantics of categorical propositions.

The heterodox interpretation of the *dictum de omni* does not tell us what that preorder is, or when it obtains between two items. However, a possible example of such a preorder can be found in *Prior Analytics* 1. 27. There Aristotle gives a threefold classification of beings (43^a25–43). First, there are beings such as Callias which are not predicated of any other being, but of which other beings are predicated. Such beings may be called individuals. Second, there are highest beings of which no other being is predicated, but which are predicated of other beings. Finally, there are intermediate beings such as man of which other beings are predicated, and which are themselves predicated of other beings. For instance, man is predicated of Callias, and animal of man. Beings of the second and third group may be called universals. If the relation of predication used here is a preorder, it may serve as the primitive relation of the preorder semantics. If so, then a term may be taken to be a-predicated of another if and only if its semantic value is predicated, in the sense of *Prior Analytics* 1. 27, of the semantic value of the other. Let the semantic values of the terms ‘animal’, ‘man’, and ‘Callias’ be the beings animal, man, and Callias, respectively. Then ‘animal’ is a-predicated of ‘man’, and ‘man’ is a-predicated of ‘Callias’—at least if, as Aristotle appears to think,²⁷ terms such as ‘Callias’ can serve as argument terms of categorical propositions.

Let me mention another difference between the set-theoretic semantics and the preorder semantics. In the former, the conversion of a-propositions gives rise to the problem of existential import. In the latter, such a problem does not occur; for the validity of that conversion can be established by means of the reflexivity of a-predication. A-predication is reflexive in the set-theoretic semantics as well as in the preorder semantics. But this does not help to establish the validity in the set-theoretic semantics of the conversion of a-propositions. Accounting for the validity of that conversion may therefore be viewed as an advantage of the preorder semantics over the set-theoretic semantics.²⁸

As I shall argue in the next section, a further advantage is that the

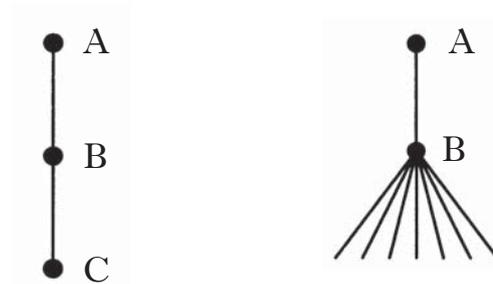
²⁷ *Pr. An.* 1. 33, 47^b22 and 30; 2. 27, 70^a16–18; see Mignucci, ‘Predication’, 10; id., ‘Parts’, 11; Barnes, *Truth*, 158–66.

²⁸ At the same time, it is also an advantage of the heterodox interpretation of the four *dicta* over the orthodox interpretation.

preorder semantics can give a satisfactory account of asymmetric conversion.

5. Asymmetric conversion in the preorder semantics

Any preorder can serve as the primitive relation of the preorder semantics, for instance:



Both these models satisfy asymmetric conversion: A is a-predicated of everything of which B is a-predicated *including* B itself, while B is a-predicated of everything of which A is a-predicated *except* of A itself. In the model on the left, the letter ‘C’ which occurs in Aristotle’s discussion of asymmetric conversion is taken to represent a single term like A and B. In the model on the right, it is treated as a placeholder for a number of terms of which B is a-predicated.

The model on the right can be constructed in such a way that every downward path of a-predications stops at an item which is not a-predicated of anything else. These items may be thought of as individuals such as Callias, as discussed in *Prior Analytics* 1. 27. If so, then A and B are a-predicated of exactly the same individuals, and may therefore be taken to have the same extension. This is in accordance with the traditional interpretation of asymmetric conversion, according to which B is not a-predicated of A although both terms have the same extension. Thus, we may say that the preorder semantics gives a satisfactory account of asymmetric conversion.

Given the traditional interpretation of asymmetric conversion, a-predication is non-extensional in the sense that it is not determined solely by the extension of the argument terms. For while both terms have the same extension, A is a-predicated of B, but B not of A. A-predication is non-extensional in this sense in the preorder semantics, but not in the set-theoretic semantics. Now,

the traditional interpretation takes the extension of a term to be the set of individuals which fall under it. But there are alternative notions of extension. For instance, the extension of a term might be taken to be the set of those items of which it is a-predicated. More precisely, the extension of a term A might be taken to be the set of those members of the domain of semantic values of terms such that 'AaX' is true when they are assigned as a semantic value to the variable X. In this case, a-predication would be extensional even in the preorder semantics. However, we shall use the term 'extension' in the traditional sense, referring to the set of individuals which fall under a term. In this sense, the set-theoretic semantics is extensional, and the preorder semantics non-extensional.

In the rest of this section, I want to discuss the preorder semantics from a mereological point of view. Alexander and Philoponus regard a-predication as a kind of part-whole relation.²⁹ Aristotle himself describes the relation between terms such as 'science' and 'medicine' as that of 'a whole to a part'.³⁰ In general, he tends to think of universals as wholes including as parts their species.³¹ Aristotle expresses a-propositions by the phrase 'being in a whole' (*ἐν ὅλῳ εἶναι*).³² Moreover, his terminology for universal and particular propositions is derived from part-whole terminology: *en merei* and *katholou*.

In modern formal mereology, there are two basic requirements imposed on the part-whole relation: that it be a preorder and that it be antisymmetric (that is, that any two items which are a part of each other be identical).³³ This basic system of mereology is often extended by additional principles. The additional principles usually assert the existence of certain items given the existence of other items. For instance, they assert the existence of complements, atoms, sums, or products. Another such principle is known as the mereological principle of (strong) supplementation: if A is not a part of B, then there is a part of A which is disjoint from B. In

²⁹ Alex. Aphr. *In Pr. An.* 25. 2-4 Wallies; Philop. *In Pr. An.* 47. 23-48. 2; 73. 22-3; 104. 11-16; 164. 4-7 Wallies.

³⁰ *Pr. An.* 2. 15, 64^a17 and ^b12-13, cf. 64^a4-7; see Smith, *Prior Analytics*, 203.

³¹ *Metaph.* Δ 25, 1023^b18-19, 24-5; Δ 26, 1023^b29-32; *Phys.* 1. 1, 184^a25-6.

³² *Pr. An.* 1. 1, 24^a13, ^b26-7; 1. 4, 25^b33; 1. 8, 30^a2-3; 2. 1, 53^a21-4; *Post. An.* 1. 15, 79^a37-^b20.

³³ See e.g. P. M. Simons, *Parts: A Study in Ontology* (Oxford, 1987), 25-41; A. C. Varzi, 'Parts, Wholes, and Part-Whole Relations: The Prospects of Mereotopology' ['Parts, Wholes'], *Data and Knowledge Engineering*, 20 (1996), 259-86 at 260-7.

other words, if A is not a part of B, then this must be substantiated by a supplement—a part of A which is disjoint from B. In terms of a-predication:

If not BaA , then there is an X such that

- (i) AaX , and
- (ii) for any Y, if XaY , then not BaY .

This principle is violated by asymmetric conversion; for asymmetric conversion implies that B is not a-predicated of A although B is not disjoint from anything of which A is a-predicated. Accordingly, that principle is not valid in the preorder semantics.

When the principle of supplementation is added to the basic system of mereology, the result is called extensional mereology.³⁴ It is so called because the addition of the principle implies that any two items which have the same non-empty set of proper parts are a part of each other.³⁵ Given antisymmetry, this means that any two such items are identical. A classical example of an extensional mereology is the powerset of any non-empty set with the empty set removed. This is the underlying structure of the set-theoretic semantics with the empty set removed from the domain of semantic values of terms.

The preorder semantics, on the other hand, may be viewed as a very weak non-extensional mereology. A-predication need not satisfy any of the additional principles which assert the existence of certain items such as supplements, complements, sums, products, and so on. It need not even satisfy antisymmetry. It is only required to be a preorder. Of course, models satisfying those additional principles are not excluded in the preorder semantics. In fact, any model of the set-theoretic semantics with the empty set removed can be viewed as a special instance of the preorder semantics.³⁶ Crucially, however, the preorder semantics is not restricted to such extensional models. It also includes non-extensional models. While these non-extensional models are not necessarily needed to

³⁴ Varzi, 'Parts, Wholes', 262.

³⁵ Simons, *Parts*, 28–9. Proper parts of A are those parts of A of which A is not a part.

³⁶ Consider a model M of the set-theoretic semantics in which the empty set has been removed from the domain of semantic values of terms. In M, there is an individual which is a member of two given sets if and only if there is a set which is included in both of them. Now, inclusion in M can be taken as the primitive relation of a-predication in the preorder semantics. The resulting model of the preorder semantics is equivalent to the model M.

account for the assertoric syllogistic developed in *Prior Analytics* 1. 4–7, they are needed to account for asymmetric conversion.

Given the heterodox interpretation of the four *dicta*, the mereological principle of supplementation is equivalent to:

If BoA, then there is an X such that (i) AaX and (ii) BeX.

It is often thought that Aristotle accepts this principle, and that his proofs by ecthesis are based on it.³⁷ Let us call it the strong principle of o-ecthesis. It is valid in the set-theoretic semantics (provided that the quantification ‘there is an X’ is objectual).³⁸ However, there is no evidence for it in the *Prior Analytics*. Among Aristotle’s proofs by ecthesis there is only one which involves assertoric o-propositions, namely, that of Bocardo in the third figure (P is the major term, S the middle term):

δείκνυται δὲ καὶ ἄνευ τῆς ἀπαγωγῆς, εἰὰν ληφθῆ τι τῶν Σ ᾧ τὸ Π μὴ ὑπάρχει.
(*Pr. An.* 1. 6, 28^b20–1)

This can also be proved without reductio, if one of the Ss is taken to which P does not belong.

The major premiss states that P is o-predicated of S. Aristotle sets out a term, call it N, which is one of the Ss and to which P does not belong. What does it mean that P does not belong to N? According to the strong principle of o-ecthesis, it should mean that P is e-predicated of N. According to the heterodox *dictum de aliquo non*, it should mean that P is o-predicated of N.

In *De interpretatione* 7, Aristotle discusses the meaning of negative sentences which lack a quantifying pronoun, such as ‘man is not white’. He points out that such sentences might seem to be equivalent to e-propositions, but that they are not.³⁹ So it is not

³⁷ Galen, *Inst. log.* 10. 8; Alex. Aphr. *In Pr. An.* 104. 3–7 Wallies; Łukasiewicz, *Syllogistic*, 65; G. Patzig, *Aristotle’s Theory of the Syllogism [Syllogism]* (Dordrecht, 1968), 161; N. Rescher, *Studies in Modality* (Oxford, 1974), 11; Smith, ‘Ecthetic Completeness’, 226–7; id., *Prior Analytics*, xxiii–xxiv; W. Detel, *Aristoteles: Analytica Posteriora [Analytica Posteriora]* (2 vols.; Berlin, 1993), i. 164; J. N. Martin, *Themes in Neoplatonic and Aristotelian Logic* (Aldershot, 2004), 19; the principle is also accepted by Barnes, *Truth*, 404–5.

³⁸ Patzig, *Syllogism*, 161; Smith, ‘Ecthetic Completeness’, 228. The mereological principle of supplementation, on the other hand, is valid in the set-theoretic semantics only if the empty set is removed from the domain of semantic values of terms; for otherwise the condition ‘for any Y, if XaY, then not BaY’ is always false since everything is a-predicated of the empty set.

³⁹ *Int.* 7, 17^b34–7; cf. C. W. A. Whitaker, *Aristotle’s De interpretatione: Contra-*

clear whether the phrase ‘to which P does not belong’ should be taken to refer to an e-predication.

In any case, as far as Aristotle’s ethetic proof is concerned, there is no need to specify the meaning of that phrase; for the relation between N and P does not play an important role in it. The proof can be based on any principle of o-ecthesis of the form: PoS if and only if there is an N such that N is one of the Ss and P does not belong to N. The only additional assumption we need is that the minor premiss ‘RaS’ and the fact that N is one of the Ss imply that N is one of the Rs. This suffices to give an ethetic proof of Bocardo.⁴⁰ So the proof does not require the strong principle of o-ecthesis. It can also be based on the weaker principle given by the heterodox *dictum de aliquo non*: PoS if and only if there is an N such that SaN and not PaN.

As far as I can see, the only commentator who gives textual evidence for the strong principle of o-ecthesis is G. Patzig, adducing the following passage:⁴¹

ἐὰν δὲ τι μὴ ὑπάρχειν, ᾧ μὲν δεῖ μὴ ὑπάρχειν, οἷς ἔπεται, ὃ δὲ μὴ ὑπάρχειν, ἃ μὴ δυνατόν αὐτῷ ὑπάρχειν· εἰ γάρ τι τούτων εἴη ταυτόν, ἀνάγκη τι μὴ ὑπάρχειν.
(*Pr. An.* I. 28, 44^a9–11)

If someone needs to establish that the predicate does not belong to some of the subject, he must look [βλεπτέον, 43^b40] to those which the term it must not belong to follows and those which are not capable of belonging to the term which must not belong to it. For if one of these should be the same, then the predicate proposed must not belong to some of the subject.

Patzig takes the phrase ‘he must look’ to indicate that the passage gives necessary conditions for the truth of o-propositions. However, the passage is part of a method, described in chapters I. 27–30, of finding suitable premisses to establish a certain conclusion. The phrase ‘he must look’ may well be taken to indicate how that method should be applied to o-propositions rather than necessary conditions for the truth of o-propositions. Moreover, Aristotle considers the set of terms ‘which are not capable of belonging to’ the predicate term (ἃ μὴ δυνατόν αὐτῷ ὑπάρχειν). It is not clear whether

diction and Dialectic (Oxford, 1996), 85; P. Crivelli, *Aristotle on Truth* (Cambridge, 2004), 244 n. 18.

⁴⁰ M. Malink, ‘ $T\Omega I$ vs $T\Omega N$ in *Prior Analytics* I. 1–22’, *Classical Quarterly*, NS 58 (2008), 519–36 at 528–30.

⁴¹ Patzig, *Syllogism*, 162.

the modally qualified phrase ‘which are not capable of belonging to’ refers exactly to all e-predications.⁴² Thus, the passage does not provide convincing evidence for the strong principle of o-ecthesis.

This concludes our discussion of logical models for asymmetric conversion. I have argued that the set-theoretic semantics does not provide satisfactory models for it. In particular, it does not provide models which are in accordance with the traditional interpretation of asymmetric conversion. The preorder semantics, on the other hand, can provide such models. However, this does not explain how the notion of asymmetric conversion is motivated. Why was Aristotle interested in it? What examples did he have in mind? Why is B not a-predicated of A although it is a-predicated of everything else of which A is a-predicated? Those are the questions that will be addressed in the remainder of the paper. I shall argue that asymmetric conversion and its non-extensional features can be motivated by Aristotle’s theory of predication in the *Topics* and *Posterior Analytics*.

The next section focuses on the *Topics*’ theory of predicables. It offers two interpretations of asymmetric conversion within that theory. On the first interpretation, A is a differentia whose only direct species is B: for instance, ‘footed’ as a differentia of ‘footed animal’. On the second interpretation, A is a proprium of B: for instance, ‘having a soul’ as a proprium of ‘animal’.

6. Asymmetric conversion and the predicables

According to the traditional interpretation of asymmetric conversion, B is not a-predicated of A although both terms have the same extension. Ross’s explanation of this is that ‘B is the only existing species of a genus A which is notionally wider than B’.⁴³ However, this appears to conflict with Aristotle’s view that ‘of every genus there are different species’ (*Top.* 4. 6, 127^a23–4).⁴⁴ Nevertheless, asymmetric conversion may be explained in terms of notions such as that of genus and species. More precisely, it may be explained by means of the *Topics*’ account of what later came to be called the predicables: genus, differentia, definition, proprium, and accident.

⁴² Patzig, *ibid.*, neglects the modal qualification, translating the phrase as ‘those to none of which the second [term] belongs’.

⁴³ Ross, *Analytics*, 480.

⁴⁴ See also *Top.* 4. 3, 123^a30–2; 1. 5, 102^a31–2; *Alex. Aphr. In Top.* 323. 22–8 Wallies.

Let us start with the relation between genera and the differentiae of their species, for instance, between ‘animal’ and ‘footed’. Aristotle asserts:⁴⁵

ἐπ’ ἔλαττον γὰρ καὶ ἡ διαφορὰ τοῦ γένους λέγεται. (*Top.* 4. 1, 121^b13–14)

The differentia is said of less than the genus.

τὸ γένος ἐπὶ πλεόν λέγεται τῆς διαφορᾶς. (*Top.* 4. 6, 128^a22–3)

The genus is said of more than the differentia.

ἐπιφέρει γὰρ ἐκάστη τῶν διαφορῶν τὸ οἰκείον γένος. (*Top.* 6. 6, 144^b16–17)

Each differentia imports its appropriate genus.

This appears to imply that the extension of the differentia is a subset of the extension of the genus. Thus, according to the orthodox interpretation of the *dictum de omni*, the genus is a-predicated of the differentia.

On the other hand, Aristotle denies that the differentia partakes (μετέχειν) of the genus.⁴⁶ The reason is that the only items which partake of a genus are its species and the individuals falling under it:

οὐ δοκεῖ δὲ μετέχειν ἡ διαφορὰ τοῦ γένους· πᾶν γὰρ τὸ μετέχον τοῦ γένους ἢ εἶδος ἢ ἄτομόν ἐστιν, ἡ δὲ διαφορὰ οὔτε εἶδος οὔτε ἄτομόν ἐστιν. δῆλον οὖν ὅτι οὐ μετέχει τοῦ γένους ἡ διαφορὰ. (*Top.* 4. 2, 122^b20–3)

Nor is the differentia generally thought to partake of the genus; for what partakes of the genus is always either a species or an individual, whereas the differentia is neither a species nor an individual. Clearly, therefore, the differentia does not partake of the genus.

This passage occurs shortly after Aristotle stated, in *Topics* 4. 1, that ‘the differentia is said of less than the genus’. Now, Aristotle also denies that the genus is predicated (κατηγορεῖσθαι) of the differentia. He does so in *Topics* 6. 6,⁴⁷ a few lines before stating that ‘each differentia imports its appropriate genus’. Again, the reason is that the genus is predicated only of its species and of individuals:

οὐ γὰρ κατὰ τῆς διαφορᾶς, ἀλλὰ καθ’ ὧν ἡ διαφορὰ, τὸ γένος δοκεῖ κατηγορεῖσθαι, οἷον τὸ ζῶον κατὰ τοῦ ἀνθρώπου καὶ τοῦ βοῦς καὶ τῶν ἄλλων πεζῶν ζώων, οὐ κατ’ αὐτῆς τῆς διαφορᾶς τῆς κατὰ τοῦ εἶδους λεγομένης. εἰ γὰρ καθ’ ἐκάστης τῶν διαφορῶν τὸ ζῶον κατηγορηθήσεται, . . . αἱ διαφοραὶ πᾶσαι ἢ εἶδη ἢ ἄτομα ἔσονται, εἴπερ ζῶα· ἕκαστον γὰρ τῶν ζώων ἢ εἶδος ἐστιν ἢ ἄτομον. (*Top.* 6. 6, 144^a32–^b3)

⁴⁵ See also *Top.* 4. 2, 123^a6–7; *Metaph.* Δ 3, 1014^b11–14.

⁴⁶ See also *Metaph.* K 1, 1059^b33.

⁴⁷ See also *Metaph.* B 3, 998^b23–7; *Post. An.* 2. 3, 90^b34–8.

The general view is that the genus is predicated, not of the differentia, but of that of which the differentia is predicated. For instance, animal is predicated of man and ox and other footed animals, not of the differentia itself which is said of the species. For if animal is to be predicated of each of its differentiae, then . . . the differentiae will be all either species or individuals, if they are animals; for each of the animals is either a species or an individual.

The phrase ‘not of the differentia itself’ (οὐ κατ’ αὐτῆς τῆς διαφορᾶς) is similar to the phrase ‘except of A itself’ (πλὴν αὐτοῦ τοῦ A) in the discussion of asymmetric conversion in *Prior Analytics* 2. 22.

Aristotle holds not only that the genus cannot be predicated of the differentia, but also that the species cannot be predicated of the differentia.⁴⁸ For instance, ‘man’ cannot be predicated of ‘two-footed’. Again, the reason appears to be that the species is predicated only of its subspecies and of the individuals falling under it (although individuals are not explicitly mentioned here):

ὁμοίως δὲ σκεπτέον καὶ εἰ τὸ εἶδος ἢ τῶν ὑποκάτω τι τοῦ εἴδους τῆς διαφορᾶς κατηγορεῖται· ἀδύνατον γάρ, . . . συμβήσεται τὴν διαφορὰν εἶδος εἶναι, εἴπερ κατηγορεῖται τι αὐτῆς τῶν εἰδῶν. (*Top.* 6. 6, 144^b4–8)

Likewise you must enquire also if the species or any of the items that come under it is predicated of the differentia; for this is impossible, . . . if any of the species be predicated of it, the result will be that the differentia is a species.

Now, consider a differentia which has only one immediate species, and therefore the same extension as that species. As Alexander points out, Aristotle appears to accept such differentiae in a passage mentioning differentiae which are ‘said of the same’ as the species:⁴⁹

ἀεὶ δ’ ἡ διαφορὰ ἐπ’ ἴσης ἢ ἐπὶ πλείον τοῦ εἴδους λέγεται. (*Top.* 4. 2, 122^b39–123^a1)

The differentia is always said of the same as or of more than the species.

Alexander’s example of a differentia said of the same as its species is ‘footed’ as a differentia of ‘footed animal’, with ‘footed animal’ being regarded as a species of ‘animal’.⁵⁰

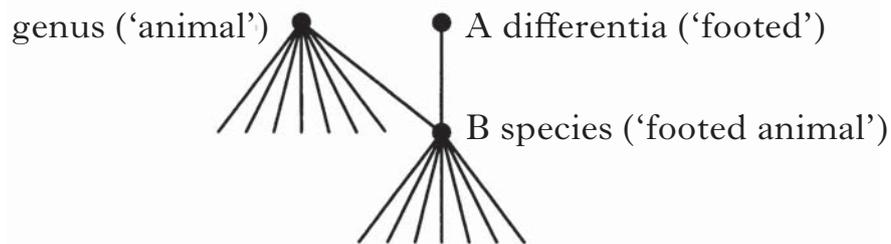
⁴⁸ Cf. also *Metaph.* B 3, 998^b24–5.

⁴⁹ Alex. Aphr. *In Top.* 317. 10–13 Wallies. On the other hand, in *Top.* 6. 6, 144^b5–6, Aristotle seems to hold that every differentia is said of more than the species.

⁵⁰ Aristotle regards ‘footed animal’ as a genus under ‘animal’ (*Top.* 6. 6, 144^b22–5). This suggests that ‘footed animal’ is a species of ‘animal’.

Being said of the same as the species, such a differentia seems to be predicated of everything of which the species is predicated, and of nothing else. If so, we may say that the differentia is predicated of everything of which the species is predicated *including* the species itself, while the species is predicated of everything of which the differentia is predicated *except* of the differentia itself.

However, this is not meant to imply that the species or the differentia is predicated of itself. The notion of predication used here by Aristotle may or may not be reflexive. If not, we may consider its reflexive closure, that is, the smallest reflexive relation which contains the original relation of predication. Furthermore, the notion of predication used by Aristotle may or may not be transitive. If not, we may consider its transitive closure. The resulting preorder can be used as the primitive relation of the preorder semantics. This leads to the following model for asymmetric conversion:



In this model, a-predication is identified with the reflexive and transitive closure of the notion of predication used in *Topics* 6. 6. The resulting relation of a-predication is non-extensional: although the species has the same extension as the differentia, the differentia is a-predicated of the species, but not vice versa. In addition, the genus is not a-predicated of the differentia although the extension of the differentia is included in that of the genus. Furthermore, the mereological principle of supplementation is not valid: the species and the genus are not a-predicated of the differentia although the differentia is not a-predicated of anything disjoint from the species or the genus. These non-extensional features of a-predication are motivated by the theory of predicables.

Let me give another example of asymmetric conversion within the theory of predicables: the relation between propria and their subjects. A proprium is a predicate which, unlike genera, differentiae, and definitions, is not predicated essentially of the sub-

ject, but ‘belongs to the subject alone and is counterpredicated [*ἀντικατηγορεῖται*] of it’ (*Top.* 1. 5, 102^a18–19). For instance, ‘capable of learning grammar’ is a proprium of ‘man’, and ‘having a soul’ is a proprium of ‘animal’.⁵¹ Aristotle’s explanation of counterpredication is: ‘if something be a man, then it is capable of learning grammar, and if something be capable of learning grammar, it is a man’.⁵² This suggests that propria have the same extension as their subjects.

A proprium is a predicate which is predicated of something, namely, of its subject (*περί τινος κατηγορούμενον*, *Top.* 1. 8, 103^b7–8). For instance, ‘having a soul’ is predicated of ‘animal’. On the other hand, we know from *Topics* 6. 6 that genera and species are predicated only of their subspecies and of the individuals falling under them (and possibly of themselves). However, the proprium ‘having a soul’ is not a subspecies of the genus ‘animal’ or an individual falling under it (nor should it be identical with the genus ‘animal’). The same is true of the proprium ‘capable of learning grammar’ in relation to the species ‘man’. This suggests that the genus ‘animal’ and the species ‘man’ are not predicated of their propria. If this is correct, then we may say that the proprium is predicated of everything of which the subject is predicated *including* the subject itself, while the subject is predicated of everything of which the proprium is predicated *except* of the proprium itself. (Again, this is not meant to imply that the proprium or the subject is predicated of itself.)

The next section discusses two passages from *Posterior Analytics* 1. 19 and 1. 22 which support this account of the relation between propria and their subjects.

7. Asymmetric conversion in the *Posterior Analytics*

In *Posterior Analytics* 1. 19–23, Aristotle presents an argument to the effect that there are no infinite chains of predications and therefore also no infinite chains of demonstrations. The argument is based on certain assumptions about the notion of predication used in 1. 19–23. Aristotle distinguishes between what later came to be called natural and unnatural predications.⁵³ Examples of unnatural

⁵¹ *Top.* 1. 5, 102^a19–20; 5. 4, 132^b16–18.

⁵² *Top.* 1. 5, 102^a20–2; cf. also 5. 4, 132^b16–18.

⁵³ *Post. An.* 1. 19, 81^b25–9; 1. 22, 83^a1–18; cf. also *Pr. An.* 1. 27, 43^a33–6.

predications are: ‘the white is a man’, ‘that large is a log’, ‘the white is walking’; examples of natural predications are: ‘the man is white’, ‘the man is walking’, ‘the log is large’. Aristotle emphasizes that only natural predication is predication in the proper sense; unnatural predication is

ἤτοι μηδαμῶς κατηγορεῖν, ἢ κατηγορεῖν μὲν μὴ ἀπλῶς, κατὰ συμβεβηκὸς δὲ κατηγορεῖν. (*Post. An.* 1. 22, 83^a15–17)

either not predicating at all or else predicating not *simpliciter* but predicating accidentally.

Aristotle denies that unnatural predications can occur in demonstrations (1. 22, 83^a18–21). Accordingly, the claim that there are no infinite chains of predications is stated and proved only for natural predications. Unnatural predications are disregarded.

Giving a general account of unnatural predication is not straightforward. But it may be helpful to have a look at Philoponus’ account of it (*In Post. An.* 235. 10–236. 22 Wallies). Philoponus starts by assuming two mutually exclusive and jointly exhaustive classes of beings, namely, substances and accidents (235. 13–15). So the accidents are exactly the non-substances. When a substance is said of a substance, this is, according to Philoponus, a natural predication: for instance, ‘man is animal’. When a non-substance is said of a substance, this is also a natural predication: for instance, ‘man is white’. On the other hand, when a substance is said of a non-substance, this is an unnatural predication: for instance, ‘the white is a log’. The fourth case, when a non-substance is said of a non-substance, is more complicated. According to Philoponus, some such predications are unnatural while others are natural: for instance, ‘that baldheaded is white’ is an unnatural predication while ‘white is a colour’ is a natural predication (235. 21–236. 8). It is not my intention here to enter into a discussion of the fourth case. For our purposes, the third case is more important: when the predicate is a substance and the subject a non-substance, this is an unnatural predication, and hence no proper predication at all.

This can help to explain why, according to *Topics* 6. 6, substantial genera such as ‘animal’ are not predicated of the differentiae of their species. Consider the substantial species ‘man’ and its differentia ‘footed’. Although the differentia is part of the essence of the substantial species, the *Topics* takes it to belong to the category

of quality, not to the category of substance.⁵⁴ Thus, the substantial genus ‘animal’ cannot be predicated, in the proper sense, of the non-substantial differentia ‘footed’. It may be predicated of everything else of which the differentia is predicated, but not of the differentia itself. In the same way, we can explain why the substantial species ‘man’ is not predicated of its proprium ‘capable of learning grammar’; for propria such as ‘capable of learning grammar’ are presumably non-substance terms as well as differentiae.

Let us now turn to the two passages I want to discuss in this section. Both of them involve the notion of counterpredication (or equivalently, conversion).⁵⁵ In the first passage, Aristotle says that in a certain respect, every member of a set of mutually counterpredicated terms is related to every other in the same way (I. 19, 82^a15–19). Then he adds a qualification:

πλὴν εἰ μὴ ὁμοίως ἐνδέχεται ἀντιστρέφειν, ἀλλὰ τὸ μὲν ὡς συμβεβηκός, τὸ δ’ ὡς κατηγορίαν. (*Post. An.* I. 19, 82^a19–20)

unless they cannot convert in the same way, but one holds as an accident and the other as a predication.

There are different ways of construing and translating the Greek.⁵⁶ Nevertheless, the general idea of the sentence seems sufficiently clear. According to the traditional interpretation, espoused by Philoponus and others, ὡς συμβεβηκός refers to an unnatural predication, and ὡς κατηγορίαν to a natural predication.⁵⁷ Thus Philoponus (*In Post. An.* 224. 8–9 Wallies) holds that the sentence is about a pair of counterpredicated terms one of which is a substance term

⁵⁴ *Top.* 4. 2, 122^b16–17; 4. 6, 128^a26–9; 6. 6, 144^a18–19; cf. M. Malink, ‘Categories in *Topics* I. 9’, *Rhizai*, 4 (2007), 271–94 at 284–7.

⁵⁵ ‘Be counterpredicated’ (ἀντικατηγορεῖσθαι) and ‘convert’ (ἀντιστρέφειν) are used synonymously in the *Posterior Analytics*; cf. I. 13, 78^a27–8; I. 19, 82^a15–16.

⁵⁶ I take the phrase πλὴν εἰ μὴ ὁμοίως ἐνδέχεται ἀντιστρέφειν to mean ‘unless it is not possible that the terms convert [*or*: are converted] in the same way’: J. H. von Kirchmann, *Aristoteles’ Zweite Analytiken* (Leipzig, 1877), 39; E. Rolfes, *Aristoteles: Lehre vom Beweis. Zweite Analytik*, 2nd edn. (Hamburg, 1948), 41. A similar translation would be: ‘unless they are not convertible in the same way’: H. Tredennick, *Aristotle: Posterior Analytics* [*Posterior Analytics*] (Cambridge, Mass., 1960), 113; H. Seidl, *Aristoteles: Zweite Analytiken* [*Zweite Analytiken*] (Amsterdam, 1984), 101. However, some authors take the phrase to mean ‘unless it is possible that the terms convert not in the same way’: J. Barnes (ed.), *The Complete Works of Aristotle: The Revised Oxford Translation* [*Complete Works*] (2 vols.; Princeton, 1984), i. 134; id., *Aristotle’s Posterior Analytics*, 2nd edn. [*Posterior Analytics 2nd edn.*] (Oxford, 1994), 28; Detel, *Analytica Posteriora*, i. 42.

⁵⁷ Philop. *In Post. An.* 224. 5–18 Wallies; Waitz, *Organon*, ii. 350; Ross, *Analytics*, 569; Barnes, *Posterior Analytics 2nd edn.*, 171.

and the other of which is a non-substance term. His example is ‘man’ and ‘capable of laughing’ (γελαστικόν). When the latter term is said of the former, this is a natural predication; when the former is said of the latter, this is an unnatural predication (224. 9–14).

The terms ‘man’ and ‘capable of laughing’ are one of the ancient commentator’s standard examples for propria (ἴδια). The latter is the proprium, the former its subject. According to Philoponus (*In Post. An.* 246. 24–8 Wallies), when a proprium is said of its subject, this is a natural predication, and when the subject is said of the proprium, this is an unnatural predication. Given that unnatural predications are not predications in the proper sense at all, the subject cannot be predicated of the proprium. This supports the above account of the relation between propria and their subjects: the proprium is predicated of everything of which the subject is predicated *including* the subject itself, while the subject is predicated of everything of which the proprium is predicated *except* of the proprium itself.

The second passage I wish to discuss is complicated. It can be divided into three parts, the third one being the most important for us:

- (1) ἔτι εἰ μὴ ἔστι τόδε τοῦδε ποιότης κάκεινο τούτου, μηδὲ ποιότητος ποιότης, ἀδύνατον ἀντικατηγορεῖσθαι ἀλλήλων οὕτως, ἀλλ’ ἀληθὲς μὲν ἐνδέχεται εἰπεῖν, ἀντικατηγορήσαι δ’ ἀληθῶς οὐκ ἐνδέχεται.

Again, if it cannot be that this is a quality of that and that of this—a quality of a quality—then it is impossible for one thing to be counterpredicated of another in this way: it is possible to make a true statement, but it is not possible to counterpredicate truly.

- (2) ἢ γὰρ τοι ὡς οὐσία κατηγορηθήσεται, οἷον ἢ γένος ὃν ἢ διαφορὰ τοῦ κατηγορουμένου. . . . ὡς μὲν δὴ γένη ἀλλήλων οὐκ ἀντικατηγορηθήσεται· ἔσται γὰρ αὐτὸ ὅπερ αὐτό τι.

For either it will be predicated as a substance, i.e. being either the genus or the differentia of what is predicated. . . . Hence they will not be counterpredicated of one another as genera; for then something would itself be just what is some of itself.

- (3) οὐδὲ μὴν τοῦ ποιού ἢ τῶν ἄλλων οὐδέν, ἂν μὴ κατὰ συμβεβηκὸς κατηγορηθῇ· πάντα γὰρ ταῦτα συμβέβηκε καὶ κατὰ τῶν οὐσιῶν κατηγορεῖται. (*Post. An.* I. 22, 83^a36–^b12)

Nor will anything be counterpredicated⁵⁸ of a quality, or of any of the

⁵⁸ It is natural to understand ἀντικατηγορηθήσεται, which occurs in 83^b9, as the

other types of item—unless it is predicated accidentally; for all these items are accidents, and they are predicated of substances.

There are numerous problems concerning the details of this passage. What is more, the general purpose and structure of the passage are not clear. The traditional view (which is rejected by some commentators, though)⁵⁹ is that it presents a more or less continuous argument about counterpredication.⁶⁰

If this is correct, the purpose of the passage seems to be to reject certain kinds of counterpredications as inadmissible. In part (1) Aristotle denies that two terms can be counterpredicated in such a way that one is a quality of the other and vice versa. This probably applies not only to the category of quality, but also to the other non-substance categories of quantity, location, time, and so on.⁶¹ Thus, Aristotle may be taken to rule out certain kinds of counterpredications in which both terms are non-substance terms.

Part (2) deals with essential predications. Aristotle focuses on essential predications in which the predicate is a genus of the subject. He concludes that no two terms can be counterpredicated in such a way that one is the genus of the other and vice versa.⁶²

verb of this sentence: Waitz, *Organon*, ii. 357; Tredennick, *Posterior Analytics*, 123; J. Barnes, *Aristotle's Posterior Analytics*, 1st edn. [*Posterior Analytics 1st edn.*] (Oxford, 1975), 35; id., *Complete Works*, i. 136; Seidl, *Zweite Analytiken*, 107. However, some authors understand *κατηγορηθήσεται* as the verb of the sentence: M. Mignucci, *L'argomentazione dimostrativa in Aristotele* [*L'argomentazione dimostrativa*] (Padua, 1975), 468–9; Barnes, *Posterior Analytics 2nd edn.*, 32. Furthermore, I take *τοῦ ποιοῦ ἢ τῶν ἄλλων* to be the genitive object of the verb of the sentence: Tredennick, *Posterior Analytics*, 123; Seidl, *Zweite Analytiken*, 107; Barnes, *Posterior Analytics 2nd edn.*, 32. On the other hand, Barnes (*Posterior Analytics 1st edn.*, 35; *Complete Works*, i. 136) takes it to be a genitive attribute of *οὐδέν* ('no case of quality or the other kinds of predication').

⁵⁹ Mignucci, *L'argomentazione dimostrativa*, 460–9; Barnes, *Posterior Analytics 2nd edn.*, 177–8. One of the problems for them is to explain why counterpredication is mentioned in the passage, especially in 83^b9–10 (cf. Barnes, *Posterior Analytics 2nd edn.*, 177–8).

⁶⁰ Waitz, *Organon*, ii. 356–7; Ross, *Analytiks*, 578–9; D. W. Hamlyn, 'Aristotle on Predication' ['Predication'], *Phronesis*, 6 (1961), 110–26 at 119–20; Barnes, *Posterior Analytics 1st edn.*, 170; J. Lear, 'Aristotle's Compactness Proof' ['Compactness'], *Journal of Philosophy*, 76 (1979), 198–215 at 214.

⁶¹ Barnes, *Posterior Analytics 1st edn.*, 170.

⁶² Part (2) contains a passage (83^b1–8), not quoted above, which does not primarily deal with counterpredication. The passage reiterates a result stated at the beginning of chapter 1. 22 (82^b37–83^a1), namely, that there are no infinite chains of essential predications. This is one of the problems for the traditional view that 83^a36–^b12 is a unit dealing with counterpredication.

Finally, part (3), as I have translated it, denies that anything can be counterpredicated of a quality or of another accident. According to Philoponus, any being is either an accident or a substance. Thus, part (3) may be taken to deny that anything can be counterpredicated of a non-substance term—unless it is predicated unnaturally of it. Consequently, no two terms at least one of which is a non-substance term can be counterpredicated of each other, unless we accept unnatural predication.

It is not immediately clear whether parts (1)–(3) are intended to rule out the possibility of any counterpredication.⁶³ But it is often thought that they are.⁶⁴ If so, the aim of chapter 1. 22 may be to exclude not only chains of predications which are infinite in the sense that they consist of infinitely many terms, but also chains which are infinite in the sense that they constitute a circle of the form: A is predicated of B, B of C, ..., and N of A.⁶⁵ Given that predication is transitive, any two terms in such a circle are predicated of each other. In this sense, any two terms in the circle are counterpredicated of each other. So circles of predication can be ruled out by ruling out counterpredication.⁶⁶

Aristotle may also have had another reason to rule out all, or at least many, counterpredications. The reason has to do with his rejection of two views about demonstration in *Posterior Analytics* 1. 3. In order to reject the first view, Aristotle claims that there are no infinite chains of demonstrations (1. 3, 72^b22). He does not justify this claim in 1. 3, but only in 1. 19–23.⁶⁷ The second view rejected in 1. 3 implies that there are circular demonstrations. One of Aristotle's arguments against circular demonstration is based on

⁶³ For instance, do they rule out all counterpredications in which both terms are substance terms? Given that the definition of a substance term is a substance term (for instance, 'two-footed footed animal' as a definition of 'man'), is it counterpredicated of it? Or, is 'cloak' counterpredicated of 'coat' (cf. Philop. *In Post. An.* 246. 14–24 Wallies)?

⁶⁴ Waitz, *Organon*, ii. 356; Ross, *Analytics*, 578–9; Hamlyn, 'Predication', 119–20; Lear, 'Compactness', 214.

⁶⁵ This view is held by the authors mentioned in the previous note, except Lear, 'Compactness', 214. Lear thinks that Aristotle is not trying to reject some deviant type of infinitary chain, but 'simply trying to show that predication in fact forms a chain'.

⁶⁶ Furthermore, any pair of counterpredicated terms may be taken to constitute a circle of predication, and thus an infinite chain of predication (Waitz, *Organon*, ii. 356).

⁶⁷ 1. 19, 82^a6–8, refers back to the issue of infinite chains of demonstrations raised in 1. 3; cf. Waitz, *Organon*, ii. 349; Barnes, *Posterior Analytics 2nd edn.*, 169–70.

the thesis that circular deduction, and hence also circular demonstration,

οὐδὲ τοῦτο δυνατόν, πλὴν ἐπὶ τούτων ὅσα ἀλλήλοις ἔπεται, ὥσπερ τὰ ἴδια. (*Post. An.* 1. 3, 73^a6–7)

is not possible except in the case of items which follow one another, as propria do.⁶⁸

So circular demonstration is possible only for sets of terms which are mutually counterpredicated in the way propria are counterpredicated of their subjects,

τὰ δὲ μὴ ἀντικατηγορούμενα οὐδαμῶς ἔστι δεῖξαι κύκλω, ὥστ' ἐπειδὴ ὀλίγα τοιαῦτα ἐν ταῖς ἀποδείξεσι, φανερόν ὅτι κενόν τε καὶ ἀδύνατον τὸ λέγειν ἐξ ἀλλήλων εἶναι τὴν ἀπόδειξιν. (*Post. An.* 1. 3, 73^a16–19)

but items which are not counterpredicated cannot ever be proved in a circle. Hence, since there are few counterpredicated items in demonstrations, it is clear that it is both empty and impossible to say that demonstration may be reciprocal [that is, circular].

This argument against circular demonstration is based on the claim that there are few counterpredicated terms in demonstrations. Aristotle does not justify the claim in 1. 3, but he may be taken to justify it in our passage from 1. 22.

Whether or not this passage is intended to rule out all counterpredications, it certainly rules out some of them. In particular, Aristotle rules out—in part (3), as translated above—counterpredications in which one term is a substance term and the other a non-substance term. In doing so, he appears to understand counterpredication as mutual predication: A is predicated of B and B is predicated of A. Substance terms cannot be predicated, in the proper sense, of non-substance terms. As a result, counterpredications in which one term is a substance term and the other a non-substance term are ruled out.⁶⁹

On the other hand, counterpredication is one of the basic notions of the theory of predicables in the *Topics*: both definitions and propria are counterpredicated of their subjects. Aristotle appears

⁶⁸ Aristotle (*Post. An.* 1. 3, 73^a14–16) takes himself to have proved this thesis in *Pr. An.* 2. 5–7.

⁶⁹ This interpretation is supported by the fact that in part (1) of the passage the phrase ἀληθὲς μὲν ἐνδέχεται εἰπεῖν (83^a38) recalls the discussion of unnatural predication at the beginning of chapter 1. 22: ἔστι γὰρ εἰπεῖν ἀληθῶς τὸ λευκὸν βαδίζειν (83^a1–2).

to accept this also in the *Posterior Analytics*.⁷⁰ If so, then he accepts that non-substance terms are counterpredicated of substance terms; for instance, the proprium ‘having a soul’ is counterpredicated of the genus ‘animal’. Such counterpredications cannot be analysed as mutual predications in the *Posterior Analytics*’ sense of proper (that is, natural) predication. None the less, it would seem useful to have an account of such counterpredications in terms of proper predication. The notion of asymmetric conversion in *Prior Analytics* 2. 22 may be viewed as such an account. To this end, the relation of a-predication in terms of which asymmetric conversion is formulated may be identified with the reflexive and transitive closure of the *Posterior Analytics*’ notion of proper predication. Thus asymmetric conversion does not imply that ‘animal’ is a-predicated or predicated, in the proper sense, of ‘having a soul’. Rather, ‘having a soul’ is a-predicated of everything of which ‘animal’ is a-predicated *including* ‘animal’ itself, while ‘animal’ is a-predicated of everything of which ‘having a soul’ is a-predicated *except* of ‘having a soul’ itself.

8. A-predication in *Prior Analytics* 1. 1–22

Asymmetric conversion, I have argued, is motivated by a notion of predication according to which substance terms cannot be predicated of non-substance terms. We have considered models for asymmetric conversion in which a-predication is identified with the reflexive and transitive closure of that notion. Given that substance terms cannot be predicated of non-substance terms, the same is true of the reflexive and transitive closure of that notion of predication. Thus, substance terms cannot be *a-predicated* of non-substance terms in those models for asymmetric conversion.⁷¹ The purpose of the present section is to show that this is in accordance with Aristotle’s examples of a-predications in *Prior Analytics* 1. 1–22.

In order to prove that a given syllogistic mood is invalid, Aristotle uses counterexamples consisting of concrete terms. Among the terms used in the syllogistic in *Prior Analytics* 1. 1–22, I take exactly the following to be substance terms: ‘animal’, ‘man’, ‘horse’,

⁷⁰ See *Post. An.* 2. 4, 91^a15–18; also 1. 3, 73^a6–7 and 16–17.

⁷¹ However, there are a-predications in which both terms are non-substance terms; for any term is a-predicated of itself, even if it is a non-substance term.

‘raven’, ‘swan’, ‘cloak’, ‘snow’, ‘pitch’, ‘stone’, ‘line’, ‘unit’, ‘substance’, ‘number’. I take all other terms to be non-substance terms: for instance, ‘moving’, ‘health’, ‘awake’, ‘white’, and so on. Aristotle often assumes that non-substance terms are a-predicated of substance terms: for instance, he assumes that ‘animate’ is a-predicated of ‘animal’, ‘white’ of ‘man’, ‘moving’ of ‘animal’, and so on.⁷²

On the other hand, he virtually never assumes that substance terms are a-predicated of non-substance terms. There is only a single passage in *Prior Analytics* 1. 1–22 where Aristotle seems to assume such an a-predication: ‘all the awake (is) animal’ ($\pi\acute{\alpha}\nu \tau\acute{o} \acute{\epsilon}\gamma\rho\eta\gamma\omicron\rho\acute{o}\varsigma \zeta\acute{\omega}\omicron\nu$, *Pr. An.* 1. 19, 38^b1–2).⁷³ However, this example is part of a complex passage which constitutes one of the major difficulties of the modal syllogistic.⁷⁴

I cannot discuss that passage here. None the less, apart from a single passage (which is difficult in any case) Aristotle never assumes that a substance term is a-predicated of a non-substance term in 1. 1–22. This fact seems to me significant. It cannot be explained by the set-theoretic semantics. For from the perspective of this semantics there would seem to be no relevant difference between ‘moving belongs to all animal’ on the one hand and ‘animal belongs to all moving’ on the other. Rather, it can be explained by assuming that Aristotle’s notion of a-predication is based on the *Posterior Analytics*’ notion of natural predication. For according to this latter notion, substance terms cannot be predicated of non-substance terms.

On the other hand, Aristotle frequently assumes that substance

⁷² 1. 4, 26^b13–14; 1. 5, 27^b23–7, 32–4; 1. 6, 28^b22–4; 1. 9, 30^a29–30, 5–6; 1. 11, 31^b28–31, 32^a5; 1. 18, 37^b37–8; etc.

⁷³ Boger, ‘Underlying Logic’, 200, takes Aristotle to assume that ‘animal’ is a-predicated of ‘science’ in *Pr. An.* 1. 6, 28^b38–29^a2. In fact, however, Aristotle assumes that ‘animal’ is e-predicated of ‘science’, not a-predicated (*Alex. Aphr. In Pr. An.* 107. 4–8 Wallies; Thom, *Syllogism*, 62).

⁷⁴ The purpose of the passage is to prove that the modal premiss pair ea–2–QN is inconcludent. To this end, Aristotle assumes the truth of ‘motion (two-sided) possibly belongs to no animal’ and ‘motion belongs necessarily to all awake’ (38^a38–^b3). If ‘animal’ is a-predicated of ‘awake’, the perfect syllogism Celarent QXQ implies the truth of ‘motion (two-sided) possibly belongs to no awake’. So this latter proposition is compatible with ‘motion belongs necessarily to all awake’. For these and similar reasons, Aristotle’s claim of the inconcludence of ea–2–QN is often considered to be incorrect: e.g. S. McCall, *Aristotle’s Modal Syllogisms* (Amsterdam, 1963), 93; R. Patterson, *Aristotle’s Modal Logic: Essence and Entailment in the Organon* (Cambridge, 1995), 194–8; P. Thom, *The Logic of Essentialism: An Interpretation of Aristotle’s Modal Syllogistic* (Dordrecht, 1996), 111 and 128–9; U. Nortmann, *Modale Syllogismen, mögliche Welten, Essentialismus: Eine Analyse der aristotelischen Modallogik* (Berlin, 1996), 279.

terms are i-, e-, or o-predicated of non-substance terms. This is in accordance with the preorder semantics; for e-, i-, and o-predication are defined in terms of a-predication in such a way that substance terms can be i-, e-, and o-predicated of non-substance terms even if they cannot be a-predicated of non-substance terms.

In the second book of the *Prior Analytics*, Aristotle assumes that genera can be a-predicated of the differentiae of their species; for instance, he assumes that ‘animal’ is a-predicated of ‘footed’ (*Pr. An.* 2. 2, 54^b4–7; 2. 3, 56^a26–9). In this context, a-predication cannot be identified with the reflexive and transitive closure of the notion of predication used in *Topics* 6. 6. Nor can it be identified with the reflexive and transitive closure of the *Posterior Analytics*’ notion of natural predication (given that ‘animal’ is a substance term and ‘footed’ a non-substance term). However, the preorder semantics is not committed to identifying a-predication with the reflexive and transitive closure of these notions of predication. As mentioned earlier, any model of the set-theoretic semantics with the empty set removed can be viewed as a special instance of the preorder semantics. Such extensional models of the preorder semantics can be used to account for Aristotle’s statements in *Prior Analytics* 2. 2 and 2. 3. In such models, ‘animal’ can be a-predicated of ‘footed’ and of ‘having a soul’.

There are other models of the preorder semantics in which ‘animal’ is not a-predicated of ‘having a soul’. An example is models in which these two terms satisfy the condition of asymmetric conversion as discussed above. In such models, even the non-substance term ‘having a soul’ cannot be a-predicated of non-substance terms like ‘capable of learning grammar’ or ‘having a nutritive soul’.⁷⁵ Otherwise asymmetric conversion would imply that the substance term ‘animal’ is a-predicated of these non-substance terms, given the truth of ‘having a nutritive soul is not identical with having a soul’, etc. Similarly, ‘footed’ cannot be a-predicated of ‘two-footed’ in models in which ‘footed’ and ‘footed animal’ constitute an example of asymmetric conversion. One may assume that such models do not contain terms such as ‘two-footed’, ‘having a nutritive soul’, and so on (or any items which would serve as semantic values of such terms). Alternatively, one may assume that ‘footed’ is not predicated, in the proper sense, of ‘two-footed’, but only unnaturally.⁷⁶

⁷⁵ I am grateful to Jacob Rosen for drawing my attention to this point.

⁷⁶ According to Philoponus, there are both natural and unnatural predications in

Thus, ‘footed’ would not be a-predicated of ‘two-footed’ in models in which a-predication is taken to be the reflexive and transitive closure of natural predication. There are other models of the preorder semantics in which ‘footed’ is a-predicated of ‘two-footed’—but not in models in which ‘footed’ and ‘footed animal’ constitute an example of asymmetric conversion.

To sum up, the preorder semantics includes both extensional and non-extensional models. Asymmetric conversion requires non-extensional models. In particular, we have considered non-extensional models in which substance terms such as ‘animal’ cannot be a-predicated of non-substance terms such as ‘having a soul’. I have argued that these models can be explained by passages from the *Topics* and *Posterior Analytics*. If this is correct, then Aristotle’s treatment of a-predication in the *Prior Analytics* is influenced, at least in part, by the *Topics*’ and *Posterior Analytics*’ theory of predication.

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BIBLIOGRAPHY

- Bäck, A. T., *Aristotle’s Theory of Predication* (Leiden, 2000).
 Barnes, J., *Aristotle’s Posterior Analytics*, 1st edn. [*Posterior Analytics 1st edn.*] (Oxford, 1975).
 ——— *Aristotle’s Posterior Analytics*, 2nd edn. [*Posterior Analytics 2nd edn.*] (Oxford, 1994).
 ——— (ed.), *The Complete Works of Aristotle: The Revised Oxford Translation* [*Complete Works*] (2 vols.; Princeton, 1984).
 ——— *Truth, etc.: Six Lectures on Ancient Logic* [*Truth*] (Oxford, 2007).
 Boger, G., ‘Aristotle’s Underlying Logic’ [‘Underlying Logic’], in D. M. Gabbay and J. Woods (eds.), *Handbook of the History of Logic*, i. *Greek, Indian and Arabic Logic* (Amsterdam, 2004), 101–246.
 Colli, G., *Aristotele: Organon* (Turin, 1955).
 Corcoran, J., ‘Completeness of an Ancient Logic’ [‘Completeness’], *Journal of Symbolic Logic*, 37 (1972), 696–702.
 Crivelli, P., *Aristotle on Truth* (Cambridge, 2004).

which both terms are non-substance terms (*In Post. An.* 235. 21–236. 8 Wallies). If ‘footed’ is predicated unnaturally of ‘two-footed’, there might still be another two terms ‘footedness’ and ‘two-footedness’ such that the first is predicated naturally of the second.

- Detel, W., *Aristoteles: Analytica Posteriora* [*Analytica Posteriora*] (2 vols.; Berlin, 1993).
- Ebert, T., 'Was ist ein vollkommener Syllogismus des Aristoteles?', *Archiv für Geschichte der Philosophie*, 77 (1995), 221–47.
- and Nortmann, U., *Aristoteles: Analytica Priora. Buch I* [*Analytica Priora*] (Berlin, 2007).
- Hamlyn, D. W., 'Aristotle on Predication' ['Predication'], *Phronesis*, 6 (1961), 110–26.
- Lear, J., 'Aristotle's Compactness Proof' ['Compactness'], *Journal of Philosophy*, 76 (1979), 198–215.
- Łukasiewicz, J., *Aristotle's Syllogistic from the Standpoint of Modern Formal Logic*, 2nd edn. [*Syllogistic*] (Oxford, 1957).
- Maier, H., *Die Syllogistik des Aristoteles: Zweiter Teil* [*Syllogistik*] (2 vols.; Tübingen, 1900).
- Malink, M., 'Categories in *Topics* I. 9', *Rhizai*, 4 (2007), 271–94.
- 'TΩI vs TΩN in *Prior Analytics* I. 1–22', *Classical Quarterly*, NS 58 (2008), 519–36.
- McCall, S., *Aristotle's Modal Syllogisms* (Amsterdam, 1963).
- Martin, J. N., *Themes in Neoplatonic and Aristotelian Logic* (Aldershot, 2004).
- Mignucci, M., *L'argomentazione dimostrativa in Aristotele* [*L'argomentazione dimostrativa*] (Padua, 1975).
- *Aristotele: gli Analitici Primi* (Naples, 1969).
- 'Aristotle's Theory of Predication' ['Predication'], in I. Angelelli and M. Cerezo (eds.), *Studies in the History of Logic* (Berlin, 1996), 1–20.
- 'Parts, Quantification and Aristotelian Predication' ['Parts'], *Monist*, 83 (2000), 3–21.
- Morison, B., 'Aristotle, etc.' ['Aristotle'], *Phronesis*, 53 (2008), 209–22.
- Nortmann, U., *Modale Syllogismen, mögliche Welten, Essentialismus: Eine Analyse der aristotelischen Modallogik* (Berlin, 1996).
- Patterson, R., *Aristotle's Modal Logic: Essence and Entailment in the Organon* (Cambridge, 1995).
- Patzig, G., *Aristotle's Theory of the Syllogism* [*Syllogism*] (Dordrecht, 1968).
- Prior, A., *Formal Logic*, 2nd edn. (Oxford, 1962).
- Rescher, N., *Studies in Modality* (Oxford, 1974).
- Rolfes, E., *Aristoteles: Lehre vom Beweis. Zweite Analytik*, 2nd edn. (Hamburg, 1948).
- Ross, D. W., *Aristotle's Prior and Posterior Analytics* [*Analytics*] (Oxford, 1949).
- Seidl, H., *Aristoteles: Zweite Analytiken* [*Zweite Analytiken*] (Amsterdam, 1984).
- Simons, P. M., *Parts: A Study in Ontology* (Oxford, 1987).

- Smiley, T. J., 'What is a Syllogism?', *Journal of Philosophical Logic*, 2 (1973), 136–54.
- Smith, R., *Aristotle: Prior Analytics* [*Prior Analytics*] (Indianapolis, 1989).
- 'Completeness of an Ecthetic Syllogistic' ['Ecthetic Completeness'], *Notre Dame Journal of Formal Logic*, 24 (1983), 224–32.
- 'The Syllogism in *Posterior Analytics* I', *Archiv für Geschichte der Philosophie*, 64 (1982), 113–35.
- Stekeler-Weithofer, P., *Grundprobleme der Logik* (Berlin, 1986).
- Thom, P., *The Logic of Essentialism: An Interpretation of Aristotle's Modal Syllogistic* (Dordrecht, 1996).
- *The Syllogism* [*Syllogism*] (Munich, 1981).
- Tredennick, H., *Aristotle: Posterior Analytics* [*Posterior Analytics*] (Cambridge, Mass., 1960).
- van Rijen, J., *Aspects of Aristotle's Logic of Modalities* (Dordrecht, 1989).
- Varzi, A. C., 'Parts, Wholes, and Part–Whole Relations: The Prospects of Mereotopology' ['Parts, Wholes'], *Data and Knowledge Engineering*, 20 (1996), 259–86.
- von Kirchmann, J. H., *Aristoteles' Zweite Analytiken* (Leipzig, 1877).
- *Erläuterungen zu den ersten Analytiken des Aristoteles* (Leipzig, 1877).
- Waitz, T., *Aristotelis Organon Graece* [*Organon*] (2 vols.; Leipzig, 1844–6).
- Wallies, M., 'Zur Textgeschichte der Ersten Analytik', *Rheinisches Museum*, 72 (1917–18), 626–32.
- Wedin, M. V., 'Negation and Quantification in Aristotle', *History and Philosophy of Logic*, 11 (1990), 131–50.
- Whitaker, C. W. A., *Aristotle's De interpretatione: Contradiction and Dialectic* (Oxford, 1996).

