translated from: Die griechische Tradition der aristotelischen Syllogistik in der Spätantike

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V. Conversion (*antistrophḗ*)

Before we move on to syllogistic, this chapter will discuss the late antiquity theory of conversion. This will serve to illustrate how the early Aristotelians handled a traditional subject systematically. In the *Prior Analytics*, conversion is not a self-contained subject but simply a device for making imperfect syllogisms perfect. As a result they are not treated with the degree of seriousness that is needed for the construction of a syllogistic. In the *Prior Analytics* there is not even a definition of conversion. But in post-aristotelian times conversion came to be thematised as a subject of research. We can see some of the results of this collected together in Boethius' Summaries, in particular in the *Introductio ad syllogismos categoricos*.

But in his commentary on the *Prior Analytics* Alexander treats conversion less systematically than Boethius does. After indicating that *antistrophḗ* has several meanings (*pleonakhȏs légetai*) he briefly explains different applications of this concept in the context of logical studies. [Alex. in an. pr. 29,7ff] Ammonius and Philoponus on the other hand discuss conversion thoroughly and very systematically. The presentation below is based on the systematic presentation of conversion by these two scholars. This preference implies—though of course there are reservations—that the systematic treatment of a single viewpoint generally gives best results.

The two commentators begin their discussion with an etymological clarification of *antistrophḗ*. They tell us that *antistrophḗ* is strictly *isotrophḗ*. [Only the adjective form *isóstrophos* is referenced, but apparently this word is extremely rare. It is used by Niomachus Gerasenus (2nd c. AD) in the sense of musical strings 'turned the same way' (*isóstrophoi khordaí*), cf. *Harmonicum Enchiridium* ch. 6 in *Musici Scriptores Graeci* ed. K. Jan, Leipzig 1895, p. 247.2.] The word *isostrophḗ* is not otherwised referenced; no doubt Ammonius constructed the word only for purposes of explanation. The point that they mean to make with this word concerns only the prefix *íso*. They believe that 'being-the-same' is the fundamental requirement of conversion. One can infer from this the claim that conversion is a kind of relation (*prós ti*). /80/ 'Being-the-same' can't be a property of a single object; a thing that is the same is the same as something else. So conversion is always a matter of two objects. If we recall what was said in the previous chapter, this claim should need no further explanation.

Ammonius and Philoponus also take the word *antistrophḗ* to have three different applications, according to the kinds of object that this relation applies to: conversion of terms, conversion of *protáseis* and conversion of syllogisms. [Ammon. in an. pr. 35,10. Philop. in an. pr. 40,10ff.] *antistrophḗ tôn hórōn* is what is referred to in modern relational logic as the 'converse of a relation'.

> [Philoponus in this passage gives as examples only symmetrical relations, such as friend-friend and enemy-enemy. This raises the question whether Philoponus takes *antistrophḗ tôn hórōn* or *antistrophḗ en toís hórois* to refer specifically to symmetrical relations. But since Philoponus in his commentary on the *Categories* has no particular difference of terminology for symmetric as opposed to converse relations, the answer to the question has to be No. In the present passage Philoponus seems to have no particular reason for his choice of examples. We should note, by the way, that in his commentary on the *Categories*, when he speaks of the converse relation to symmetrical relations, Philoponus makes no use of the terminology *antistrophḗ tôn hórōn* (in cat. 111).]

Aristotle mentions converses of relations in his *Categories*. [cat. 7, 6b28ff.] In fact he uses here the expression *antistréphein*, but he doesn't use the full expression *antistrophḗ tôn hórōn* for the converse of a relation. Alexander does use this expression as part of his terminology, but with a different meaning. According to him, we have *antistrophḗ tôn hórōn* when we swap the places of the terms in a sentence in such a way that the subject becomes predicate and the predicate becomes subject but the quality and quantity of the sentence remain the same. *antistrophḗ* in this sense corresponds to a specific usage of *antistrophḗ* by Ammonius and Philoponus—a usage which occurs already by the time of Alexander and Galen. [Galen, inst. log. VI.3. Alex. in top. 264,19. Ammon. in de int. 194,15. Philop. in an. pr. 42,20.] Now the terminology *antistrophḗ tôn hórōn*, as used in the school of Ammonius, is obviously an unfortunate choice of terminology, inasmuch as *hóros* is not used for the specific way it occur in the relations discussed in *Categories*, nor does it ever have the *haplê̄ phōnḗ* that Ammonius and Philoponus ascribe to it in *Categories*. Nevertheless it is easy to see how these commentators came to choose this inappropriate expression: /81/ they wanted to make their conception of the logical system apply also to the theory of *antistrophḗ*, and thus to bring the theory in the *Categories* into line with that in the *Prior Analytics*. At least Ammonius doesn't forget to remark that Aristotle himself didn't use *antistrophḗ tôn hórōn* in the sense he has presented. [Ammon. in an. pr. 35,13.] In spite of the attempt to incorporate *antistrophḗ tôn hórōn* into the system of logic in this way, it played no role at all in the formal logic of the time, in particular in the proof theory. This is unsurprising if one thinks about the state of development of relational logic as a formal system at that time.

The last-named form of conversion, conversion of syllogisms, is what we have when two syllogisms are related to each other so that one syllogism contains as a premise the negation of the conclusion of the other syllogism, and as conclusion the negation of a premise of the other syllogism. Examples of this are *Barbara* (Aab, BaC ⇒ AaC) and *Baroco* (AaB, AoC ⇒ BoC). This conversion is treated systematically in the *Prior Analytics*.

[An. pr. B8–10. In this work we will use as names for the moods the codewords *Barbara*, *Celarent*, *Darii* etc. which were invented and introduced in the Middle Ages as a mnemonic device. But I differ in the way I symbolise the syllogisms from the usual traditional way in one respect: the letters a, e i, o, which represent the different ypes of categorical sentence, will here stand not for "all ... are —" or "no ... are —" etc., but for "— is true of all ..." or "— is true of no ..." etc. Thus for example *Barbara* will be symbolised in this work not as BaA, CaB ⇒ CaA, but as AaB, BaC ⇒ AaC. In this way the place of the predicate in the formulas for categorical sentences or sentence-forms comes before the place of the subject. G. Patzig has already indicated (a.a.O, p. 19) how this exchange of places allows us to reproduce in a reasonable way Aristotle's own formulation of categorical sentence-forms. Since it also allows us to reproduce in a reasonable way the formulations used by the commentators, I follow Patzig in this nonstandard usage.]

The explanation that Philoponus gives in I,2 of his commentary on the *Prior Analytics* for this conversion is quite remarkable. According to it, two syllogisms are converses of each other when a sentence taken as premise in one of the syllogisms is the conclusion of the other syllogism, and the conclusion of the former syllogism is one of the premises of the latter. [Philop. in an. pr. 40,15ff.] The condition on the quality of the sentences exchanged in this way goes missing. Generally one understands by conversion of syllogisms an operation that derives from one syllogism another syllogism that has the same validity. /82/ One can prove the legitimacy of this operation by considering the law of propositional logic $(p \wedge q \rightarrow r) \rightarrow (p \wedge \neg r \rightarrow \neg q)$. Thus if conversion of syllogisms is understood, as it was by the commentators, as a kind of relation, then correspondingly it will be understood as a logically explained relation between two valid syllogisms that are related in the same way as $p \wedge q \rightarrow r$ is related to $p \wedge \neg r \rightarrow \neg q$. But conversion of syllogisms, as Philoponus explains it in A2 of his Commentary, doesn't express any logical relationship, given that the propositional thesis $(p \wedge q \rightarrow r) \rightarrow (p \wedge r \rightarrow q)$ is not universally valid. Even more remarkable is the example that he gives for this in this passage: it consists of the following two complex syllogisms. “The soul moves by itself (*tò autokínēton*). Whatever moves by itself moves eternally (*tò aeikínēton*). Whatever moves eternally is immortal. So the soul is immortal.” The syllogism given as converse to this reads: “The soul is immortal. Whatever is immortal moves eternally. Whatever moves eternally moves by itself. So the soul moves by itself.” This is remarkable not only because of the quality of the exchanged sentences that occur in it. In the second syllogism Philoponus also takes, in place of the premise “Whatever moves by itself moves eternally”, the sentence with the order of the terms switched around: “Whatever moves eternally moves by itself”, without making any comment on this difference between the two syllogisms. The example doesn’t fit the explanation. One has to suspect that Philoponus has directed his explanation towards the particular features of the matter of the concrete example that he has chosen. The terms in his example all turn out to have the same extension, and this makes it seem that the two syllogisms which he gives have some regular logical relationship. But if the identity of the extensions is taken on board as a relevant factor for the logical enquiry, the sentences of the examples will need to be rewritten in a corresponding way, for example “Whatever moves by itself moves eternally” needs to be rewritten as “The things that move by themselves are identical with the things that move eternally’, and so on. That done, it can be added that Philoponus’ example and also his explanation have a logically demonstrable content which can be expressed as follows: In the example it is a question of the relation between the two inferences $A = B, B = C, C = D \Rightarrow A = D$ and $A = D, D = C, C = B \Rightarrow A = B$. This relationship is logically demonstrable in that the validity of the first inference means the same thing as the validity of the second and conversely. In his explanation it is a question of the relation between the inference rules $x = y, y = z \Rightarrow x = z$ and $x = y, x = z \Rightarrow y = z$, and this relation is logically demonstrable since the universal validity /83/ of the one inference rule implies that of the other.

[The proofs of the statements above can be sketched as follows. Both the validity of the inference $A = B, B = C, C = D \Rightarrow A = D$ and the validity of the inference $A = D, D = C, C = B \Rightarrow A = B$ relies on just one law of the theory of identity, namely to the law of transitivity of identity. So a person who accepts the universal validity of this law must already thereby at the same time accept the validity of the two inferences. In proving the logical relationship between the inference forms $x = y, y = z \Rightarrow x = z$ and $x = y, x = z \Rightarrow y = z$ one needs also the law of symmetry: this law says “If $x = y$ then $y = z$”. The first step of the proof is: from $x = y, y = z \Rightarrow x = z$, by substituting variables we get $y = x, x = z \Rightarrow y = z$ [y/x, x/y]. The second step is: from $y = x, x = z \Rightarrow y = z$ we get $x = y, x = z \Rightarrow y = z$ by replacing $y = x$ in the first inference rule by $x = y$ on the basis of the law of symmetry. The legitimacy of this replacement relies on the propositional logic thesis $[p \wedge q \rightarrow r] \wedge [p \leftrightarrow t] \rightarrow [t \wedge q \rightarrow r]$. Thus the logical relationship between the two inference rules $x = y, y = z \Rightarrow x = z$ and $x = y, x = z \Rightarrow y = z$ consists in the fact that one can be got from the other by applying logical laws and rules.]

But an inference that consists of identity statements is not a syllogism, and not everything that is valid in the theory of identity is valid in syllogistic. Maybe one should not go as far as saying that Philoponus' explanation of conversion of syllogisms is false. It can hardly be a matter of falsehood when the basic issue here is how to define a concept. At most we can say that Philoponus in this passage proposes an unusual definition of conversion of syllogisms, and that his conversion of syllogisms doesn't represent any logical relation between syllogisms. Indeed one can ask whether this unusual kind of conversion serves any useful purpose. But Philoponus himself never uses this conversion. In II,8–10, where he treats of conversion of syllogisms in the usual sense, he makes no mention of the conversion in I,2. It seems he has no recollection of what he wrote in I,2 about conversion of syllogisms. Perhaps when he wrote I,2 he didn't yet have any precise idea of what conversion of syllogisms is. Ammonius, in the passage where he speaks about the different kinds of conversion, includes conversion of syllogisms by name but gives no further explanation of them. Thus Philoponus must have reckoned that this explanatory passage was needed. The chief merit of his commentary is to give explanations. But in giving this explanation he must, as often, have had to rely on his inadequate knowledge. But he himself seems to have been sure he knew what he was doing, since he thought that he knew a suitable example. This is very likely the only possible explanation for the fact that Philoponus in I,2 explains conversion of syllogisms in this remarkable way. - The passage just mentioned in I,2 is one of numerous indications of a very suspicious feature of the quality of Philoponus' writing. A carelessness that one associates with ignorance /84/ stands alongside a detailed style of writing. One has to suspect that the second book of the *Prior Analytics*, which includes a treatment of the conversion of syllogisms, was in late antiquity, or at least in the time of Philoponus, not read with any enthusiasm. The conversion of syllogisms, like some other points of theory in the second book of the *Prior Analytics* that have an interest for formal logic, attracted rather little attention and played only a minor role in the logic of late antiquity.

Unlike the conversion of terms and the conversion of syllogisms, the conversion of the *prótasis* was of critical importance for ancient logic. Its importance lay in the fact that it made possible the completion of most syllogisms, and hence the systematisation of syllogistic.

Ammonius and Philoponus distinguished a further three different kinds of conversion, and defined them using the method of division as discussed in our previous chapter. But because this time the task is to give definitions of certain regularities, rather than to give a systematic overview of the whole content of categorical logic, the division is accordingly carried out in a different way.

They begin with four possible combinations of pairs of *protáseis*: 1) a pair of such *protáseis* which have the same terms, 2) a pair of such *protáseis* which differ in both their terms, 3) a pair of such *protáseis* which have the same subject but different predicates, 4) a pair of such *protáseis* which have different subjects but the same predicate. [Amm. in an. pr. 35,35ff; Philop. in an. pr. 40,27ff.] They establish that only the first combination is relevant for determining the conversion of the *protáseis*; according to them the other three combinations can be eliminated because they fail to contain the identity (*isótēs*) which is required to make it believable that *antistrophḗ* in its proper sense applies to them. Philoponus says that the last three combiniations are not constitutive (*asústatoi*) for conversion of *protáseis*. Thus at the first step the identity of terms is found to be a constitutive factor for conversion of *protáseis*. Ammonius' exposition breaks off at this point in the middle of a sentence, and for what follows we are reliant on Philoponus' account alone. At the second step Philoponus simultaneously applies two criteria for the division: the ordering of the terms and the quality of the *protáseis*. Thus we get again four different subclasses of pairs of *protáseis* that have the same terms: 1) /85/ the pair of such *protáseis* which are the same in both quality and order of terms, 2) the pair of such *protáseis* which differ in quality but are the same in order of terms, 3) the pair of such *protáseis* which differ both in quality and in order of terms, 4) the pair of such *protáseis* which are the same in quality but differ in order of terms. Setting aside the first pair, the remaining three pairs correspond to the three kinds of *antistrophḗ*. Thus at the second step it is established that difference in respect of quality or in respect of ordering of terms is a further constitutive factor for *antistrophḕ tôn protáseōn*.

Philoponus calls the second pair *endekhoménē antistrophḗ*. Normally one says that the sentences forming a pair of kind 2) are in a relation of opposition to each other, so that they are either contradictories or contraries or subcontraries. But Philoponus at this point says nothing about that. Nor does he consider all these relationships under another name. Rather he separates out just those sentences which are subcontraries, and he calls the relationship between these sentences *endekhoménē antistrophḗ*. As an example he takes two sentences: "Some people walk" and "Some people don't walk". He tacitly presupposes that in respect of truth-value the legitimacy of conversion in general rests on the sentences being true together (*sunalētheúein*). In effect he includes under sentence-pairs that satisfy the condition in 2) only those that satisfy the condition of being true together. Sentences that are contradictories can't in any way be true together; likewise sentences that are contraries. But for sentences that are subcontraries there is a different relationship between their truth-values, namely that they can never be false together, but it is not excluded that they are both in some specific case true together, as the example shows. Thus subcontrary sentence-pairs satisfy the condition of being true together, but so to say only halfway. This condition is according to Philoponus' tacit requirement a constitutive factor for conversion, and hence this pair can be recognised by Philoponus as a form of conversion - of course not in the full sense, but as a conversion that is possible only in certain cases. It is clear that the form of regularity in this conversion is one with little logical application. The term *endekhoménē antistrophḗ*, in the sense in which Philoponus uses it, makes no further appearances in the history of logic.

/86/ In this connection it is very interesting to see what Alexander takes an *endekhoménē antistrophḗ* to be. For Alexander it is a question of conversion between two modal sentences. He gives as an example, in the place where he speaks about various applications of *antistrophḗ*, the two following modal sentences: "It is possible that all humans walk" and "It is possible that no humans walk". [Alex. in an. pr. 29.20] When we have two such sentences, both containing the modality *endékhetai*, it is immediate that both sentences can be true together. If the first sentence is true then so is the second, and vice versa. It is possible that Philoponus' comments on the *endekhoménē antistrophḗ* result from a misunderstanding of what Alexander meant by *endekhoménē antistrophḗ*. When Alexander described the *endekhoménē antistrophḗ* as a kind of conversion, he was not applying the method of division. But Philoponus' attempt, using a division in which modality is not taken to be a criterion for subdividing, to explain systematically all kinds of conversion including the *endekhoménē antistrophḗ* of Alexander, could easily have the effect that the *endekhoménē antistrophḗ* of Alexander was taken by Philoponus to belong to assertoric logic and to correspond to *hupenantía*.

A pair of such *protáseis*, which have the same terms but differ both in the order of the terms and in quality, correspond to *antistrophḕ sùn antithései*. An example of this is the pair of sentences "*ho ánthrōpos zô$_i$on*" and "*tò mḕ zô$_i$on oudè ánthrōpos*". It is worth noting that hypothetical logic also has certain inference forms that are likewise called *antistrophḕ sùn antithései*; inferences of the form "from $p \to q$ there follows $\neg q \to \neg p$" carry this name [e.g. Alex. in top. 192.11], but occasionally so do inferences of the form "from $p \to q$ and $\neg q$ there follows $\neg p$" [Ps-Ammon. in an. pr. 68.28, Galen inst. log. XIV, 17: *antistrophḕ metà antithéseōs*]. So we can see that the use of the term is quite loose. Both between the two hypothetical inference forms, and also between them and *antistrophḕ sùn antithései* in categorical logic, one can certainly see a kind of structural analogy which could justify the application of the same terminology in these cases. But it seems that nobody was interested in the question exactly what this analogy consists of. Truth to tell, the explanation that Philoponus aims to give specifically for *antistrophḕ sùn antithései* in categorical logic /87/ is anything but satisfactory. The definition of this *antistrophḗ* can't be given with the help of division, as he presents it in his Commentary. According to his explanation, for *antistrophḗ* to occur, in general the necessary condition is that both terms are common to both sentences of the pair. But this condition is not satisfied by *antistrophḕ sùn antithései*. As we can see from the pair of sentences given above as an example—this is a pair that Philoponus himself uses as an example—the two sentences have only one term in common, namely "*áanthrōpos*". The terms "*tò mḕ zō$_i$on*" are clearly not the same. We are faced with the fact that *antistrophḕ sùn antithései* can't be incorporated as it stands into the system of categorical logic, as the commentators claim. The desired incorporation can succeed only when so-called obversion and privative terms are taken into account in the process of division.

To the last pair of *protáseis* in Philoponus' classification there corresponds *haplê̄ antistrophḗ*. It appears that the definition which Philoponus gives for this *antistrophḗ* by division is basically sound. Nevertheless his definition in this case too is not altogether satisfactory. His definition states that *haplê̄ antistrophḗ* is what is common to a pair of sentences in respect of both terms, where the quality of the two sentences is the same but the ordering of the terms is reversed, and moreover the two sentences can be true together [Philop. in an. pr. 42, 17–19]. Philoponus explains this definition in detail. But before we examine his definition, we need to make a brief terminological remark. In traditional logic only E-conversion and I-conversion are referred to as simple conversion (translating *haplê̄ antistrophḗ*) or as pure conversion, while A-conversion is referred to as conversion per accidens, or as impure conversion. But Philoponus counts A-conversion as simple conversion too. As an example of simple conversion he gives the two sentences 'All people are animals' and 'Some animals are people'. According to his explanation this *antistrophḗ* counts as simple because in this *antistrophḗ* the ordering of the simplest parts of the *protáseis*, i.e. the *haplaī phōnaí*, is swapped around. If this is really a basis for applying the nam *haplȇ antistrophḗ*, then it does indeed follow that A-conversion can count as a form of *haplȇ antistrophḗ*, since in the case of A-conversion too the ordering of the simplest parts of the *protáseis* are swapped around. But on the other hand it is a fact /88/ that Philoponus' terminology is open to being misunderstood.

Having indicated the peculiarities of his terminology, we can now examine the definition. The first part of the definition, "the commonality in respect of both terms", is for Philoponus the genus of all forms of *antistrophḕ tōn protáseōn*. [Philop. in an. pr. 42,22. Cf. also Alex. in an. pr. 46,5–6. Ammon. in an. pr. 36,8. All of these use the same expression "*koinōnía*". In Boethius we find the direct translation of this word as "*convenientia*" (also *participatio*); De syllog. cat. 785C, 804C. Galen invents the word "*sunóroi*", inst. log. VI,3.] The other parts of the definition are explained as differentiae. The second part of the definiens, "with the same quality", serves as a distinguishing mark to separate *haplȇ antistrophḗ* from *antistrophḕ sùn antithései*. The third part, "with the ordering of the terms swapped around", serves as a distinguishing mark to separate *haplȇ antistrophḗ* from *endekhoménē antistrophḗ*. Finally one further differentia appears, which reads: "where both sentences are true together" (*metà toū sunalētheúein*). For Philoponus this differentia will separate *haplȇ antistrophḗ* from so-called *anastrophḗ*. He says that the *anastrophḗ* is in every respect like the *haplȇ antistrophḗ* except that the pair of sentences constructed by the *anastrophḗ* is false (*plȇn toȗ pseúdesthai*). As an example he gives two A-sentences: "All people are animals" and "All animals are people". [Philop. in an. pr. 42,21] It is noticeable that he says nothing explicitly about the division through which the last differentia was introduced, since in general he never fails to make some remark about division when he uses it, whether the remark is needed or not. On this occasion we feel the lack of any further remarks, since it is unclear exactly what he means by "true together". When one says of two sentences that they are true together, it would be easy to take this as meaning that the two sentences are equivalent. But if the differentia is understood in this sense, then Philoponus' definition can only apply to E- and I-conversion. In the case of A-conversion one can have a combination of different truth-values; for example the converse of the false A-sentence "All animals are people" is the true I-sentence "Some people are animals". What would be an appropriate way of expressing the relationship of the truth-values of these two sentences? Neither "*sunalētheúein*" nor "*pseúdesthai*" would seem to meet the case. Also to describe the relationship of the truth values of *anastrophḗ* as "*pseúdesthai*" is extremely unclear. What could it mean to say that a pair of sentences is false? Since *anastrophḗ* /89/ and *haplȇ antistrophḗ* form a dichotomous distinction, the truth-value relationship of *anastrophḗ* has to be the exact negation of "*sunalētheúein*". So one might hope to e able to illuminate the meaning of "*sunalētheúein*" by taking the negation of "*pseúdesthai*". But unfortunately it is impossible to make any resolution of the problem in this way, since the meaning of "*pseúdesthai*" is also unclear in the present context.

To capture the logical character of sentence conversion exactly in words, it is helpful to disregard the fact that it can be thought of as a relation between two sentences, and move to thinking of it as in the first instance an operation. The conception of *antistrophḗ* as a relation rests grammatically on the use of the verb *antistréphein* as an intransitive verb; this verb with a simple dative or with *prós* can be trnslated as "to be converse to something". But the word is often used by the commentators as a transitive verb. [For example Alex. in an. pr. 78,14, Philop. in an. pr. 48,26. Also the expression "*tȇn antistrophȇn poieȋn*" is used for sentence conversion as an operation.] When the verb is being used as transitive, the nominalisation "*antistrophḗ*" can be read as a nomen actionis, signifying the corresponding operation. Then this operation can be defined as follows: to change a sentence by transposing its terms, and where appropriate by altering its quantity, into another sentence in such a way that the sentence formed in this way is always true when the original sentence is true. [In fact the authors of the Port-Royal Logic, among others, define sentence conversion in this way (p. 170). In traditional logic, as far as I know, conversion is never understood as being a relation.] As a result one can easily see that the logical character of the operation defined in this way is the basis for the logical character of the inference. The essential condition for the inference to be valid is similarly that the conclusion is always true when the premises are true. If sentence conversion is understood in this way as a kind of inference, the condition that we have just sketched, in terms of the relationship between the truth value of the sentence to which the operation is applied, and that of the sentence given by the operation, can no doubt be formulated in terms of "*sunalētheúein*". But it would take more than this to justify using this word in the realm of relations, applying it to a pair of contrasted sentences. If we want to maintain the qualification "*sunalētheúein*" we need at least to make a distinction between the sentences which stand in the relation of *antistrophḗ*, corresponding to the distinction between premise and conclusion, or antecedent and consequent. It could be that the questionable qualification "*sunalētheúein*" in Philoponus' definition /90/ properly belongs to those logicians who understand sentence conversion as an operation on a sentence that is true (or taken to be true) and seek to define it as such. If so then Philoponus must have taken over the notion carelessly; without making any effort to distinguish the subcases so that *sunalētheúein* also applies exactly to a pair consisting of two parallel sentences (granting that the use of division makes this quite complicated), he must have mindlessly copied into his definition the formulation handed down to him. But it could also been the case, and this is more likely, that his predecessors who sought to define conversion of sentences simply understood *sunalētheúein* as meaning equivalence. The fact that this description here doesn't apply to A-conversion was not perceived as disturbing, because they didn't regard A-conversion as conversion in the full sense. Alexander, who also uses the description "*sunalētheúein*" in his explanation of the concept of sentence conversion, but gives no adequate explanation of it, says explicitly in one passage that only E- and I-conversion are conversion in the strict sense. [Alex. in an. pr. 392,23.] This view of the inadequacy of A-conversion as sentence conversion was surely the origin of the traditional name "impure conversion" or "conversio per accidens". For those people who regarded the lawlikeness of sentence conversion as being as clear as that of inference or implication, and accepted it only on that basis, there was of course no reason to treat A-conversion any differently from the other conversions. But in antiquity sentence conversion was not explicitly taken to be a form of inference or implication, as it was in later times.

[In some textbooks of traditional logic, sentence convesion is characterised as a direct inference, in contrast to indirect inference, i.e. syllogism. See W. S. Jevons, *Elementary Lessons in Logic*, London 1870, p. 81; J. N. Keynes, *Formal Logic*, 4th ed., London 1906, p. 126. An example of taking sentence conversion explicitly as an implication is the celebrated "*Logica Hamburgensis*", which first appeared in 1632. J. Jungius, the author of this book, used the expression 'conversiva consequentia' (*Logica Hamburgensis*, ed. R. W. Meyer, Hamburg 1957, p. 119.) For him, consequentia meant just implication. There is no doubt that Jungius in using this terminology is attaching himself to the medieval tradition. The medieval scholastics were probably the first logicians who characterised the logical character of sentence conversion as a consequentia, where one should note that consequentia can mean either inference or implication. The difference between the two was not always sharp. See W. and M. Kneale, *Development* p. 279.]

In the thinking of the ancient logicians the relationship between the sentences of which *antistréphein* is asserted as a two-place predicate (transitive or intransitive) was probably something stronger than the relationship between premise /91/ and conclusion of an inference.

[Cf. the conjecture of K. Ebbinghaus: Ein formales Modell der Syllogistik des Aristoteles, Göttingen 1963, p. 30, and also the essay of M. Frede: Stoic vs. Aristotelian Syllogistic, in *Arch. f. Gesch. d. Phil.* vol. 56.1974, p. 20. By the way, one place in which Alexander uses *antistrophḗ* in a purely non-technical sense can indicate well what a narrow connection of sentences can be expressed by *antistréphein*. "*ei tò* Γ *en holō*$_i$ *tō*$_i$ *B, tò B katà pantòs toû* Γ *antistréphei gàr taûta allḗlois*" (in an. pr. 54,13–14). The relationship that this quotation expresses between two proposition is manifestly in its logical character not the relationship between premise and conclusion, nor that between antecedent and consequent; rather the two propositions mean the same thing, so they are related in such a way that in an argument one can simply use one of them in place of the other. In brief, *antistréphein* in this case expresses the relationship 'substitutable for'. We can't exclude the possibility that also when they used *antistrophḗ* in a technical sense, the ancient logicians took its logical character to be closer to simple substitution than to inferability.]

In fact, in the cases of E- and I-conversion the sentences that are converse to each other are related in such a way that either sentence is true under the same circumstances as the other. Although this relationship has no decisive significance for setting up a consequence relation, the ancient logicians supposed that it could legitimately be taken as essential for a pair of sentences to be converses of each other. This makes it understandable that from the outset they don't attempt to reach a definition which applies also to A-conversion, and that leaving A-conversion on one side they give a meaning to "*sunalētheúein*" that applies only to E- and I-conversion [*sunalētheúein* not in the sense of so-called material equivalence, but in the sense of identity of truth conditions). But admittedly one can't say with certainty that what we have just said can clarify the background to Philoponus' definition of *sunalētheúein*. When Philoponus tries to make the meaning of *sunalētheúein* clear by examples (as usual), he chooses only sentences which belong to A-conversion. The two sentences which he gives as an example are indeed true together: "Every person is an animal" and "Some animal is a person". But this example, taken at random, is of course not enough to convince us that "*sunalētheúein*" applies to A-conversion without more ado. We know that it is precisely in the case of A-conversion, as we have shown above, that other examples can be given which count against "*sunalētheúein*". But it is possible that Philoponus creates a conviction that his definition applies to A-conversion too, without concerning himself with this choice of examples. In any case his definition remains a general definition that ought to apply also to A-conversion, in view of /92/ the "*sunalētheúein*", and in spite of his efforts at having a systematic procedure and his control of examples, both of which have to be described as inadequate.

So far we have been considering how Philoponus tries to give a systematic presentation of the teaching material in question: he collects together everything that Aristotle says about *antistrophḗ*, and tries to put this collected material into a context that appears to make sense of it. The result is an overall picture that seems quite orderly. But in a discipline like logic, one expects that a highly systematic treatment will contribute, to an almost decisive degree, to clarifying the logical character of each of the objects being treated. In the case of Philoponus this expectation remains unfulfilled, in spite of his use of a rather pedantically systematic treatment. The reason is that his interest in the systematisation is not always accompanied by an interest in the things to be systematised, i.e. in logic. We even get an impression that he is primarily interested in cataloguing those objects of enquiry that have already been discovered; he constructs, on a not very fundamental pattern, just a catalogue that is quite systematic but not altogether built on principles that arise from the material itself.

For modern scholars the question how the validity of conversion as a logical regularity can be demonstrated is altogether more significant than the question how to place them within a systematic whole and thereby find textbook definitions for them. In antiquity too there was a fair amount of discussion of the proof of conversion. It seems that the proof of E-conversion in particular was the central theme of these discussions - with good reason: in Aristotle's teaching on conversion, E-conversion is fundamental since the validity of E-conversion is presupposed by the proofs of the remaining conversion rules. But the places where the proof of E-conversion is given lie just in the least comprehensible parts of the *Prior Analytics*; Aristotle uses there the method called ecthesis, which is in any case a difficult procedure, and he gives only a sketchy account of it. One can see why it was felt quite early on that another proof method needed to be found, that would work alongside Aristotle's method. The commentators report that Theophrastus and Eudemus discovered an easily understood and more enlightening proof method than Aristotle's. This method fell into place over time, while Aristotle's method gradually came to be disregarded as a result. It seems that by the time of Alexander the method of Theophrastus /93/ was clearly the preferred one. On the other hand Alexander set out to clarify the proof by ecthesis, and as a result made remarkable contributions that included some promising ways of thinking,

> [There has been much recent discussion of the proof by ecthesis. The central question in this discussion is: What should we understand by 'the term set out' in this proof? Alexander already answered this question in a way that is correct in principle. He seems to have understood ecthesis as a procedure for giving an arbitrary example; the basic idea of the procedure is that a person who is establishing some general claim about a class of individuals is allowed to do that as long as he can justify making this claim for the arbitrary individual chosen as an example. So the term that is set out is for him an individual (*tò átomon*). The ecthesis procedure as Alexander understood it should be compared with the procedure that K. Ebbinghaus indicates in his book on Aristotelian syllogistic, in a place where, inspired by P. Lorenzen, he talks about the dialogue basis of Aristotelian syllogistic. He points out there the possibility that the 'term set out' means 'a certain proposed instance' (*Ein formales Modell* p. 57 Remark 1). The basic idea supporting the legitimacy of the proof procedure, understood in this way, is close to that underlying one of the derivation rules used by Quine, namely universal generalisation (*Methods of Logic*, New York 1959, p. 159ff). Lukasiewicz and Patzig think that Alexander's understanding is incorrect; they propose a different way in which one might understand the procedure, whereby the term set out can be read as a concept variable bound by an existential quantifier. The fact that Alexander's intention can so easily be reduced to this interpretation is to a certain extent Alexander's own fault. He was not yet in a position to represent ecthesis as a robust proof procedure. In particular the fact that he presents ecthesis as a procedure to be completed by perception seems to have been what launched these two interpretations. Of course perception itself has no force in a logical proof. In the normal way of things an individual can be the object of a perception. But the actual setting out of a certain term for an individual can't be completed by a perception.]

though he too regarded Theophrastus' method as the better one. Philoponus followed him; in fact he seems to be in no better position than Alexander to explain proof by ecthesis as a procedure that is only approximately correct. One should note that in the compendia that have come down to us from late antiquity, no use is made of proof by ecthesis. The replacement of Aristotle's proof method by that of Theophrastus is an important event in the history of logic. In view of its historical significance it seems appropriate to say something here about Theophrastus' proof, although the proof itself doesn't date from the commentators. The commentators played the role of transmitters and mediators of this proof, in a way that was decisive for the logic of later times. Theophrastus' proof, as Alexander reports it - and Alexander's report is our earliest source for it - can be expressed as follows: "If A is denied of some B, then A is separated from B. Now a thing from which another thing is separated is itself separated from the thing separated from it. So B is separated from all of A. That being so, B is denied of all A." [Alex. in an. pr. 31,6ff. Philoponus in an. pr. 48,11-18 is almost identical with this passage.] /94/ The proof clearly rests on the thought that "A is said of no B" means the same as "A is separated from all B", and this thought presupposes in turn that terms for which A and B stand must properly be taken as concepts understood extensionally, that is as extensions of concepts, and "*katēgoreîsthai*" means not predication in the strong sense, but rather it denotes a determinate relationship between the extensions of the concepts.

The idea of establishing logic on an extensional basis is certainly compatible with the logic of the *Prior Analytics*, though this idea is not made explicit in the *Prior Analytics*. The first step towards an extensional logic was taken with the proof of Theophrastus set out above. It is not possible to say with certainty how far this idea progressed in late antiquity. We can infer that the meanings of A-sentences were sometimes read by the commentators in an extensional way from their frequent use of the word "*periékhein*", though it seems that they made less use of the extensional interpretation of these sentences in the theory of conversion - let alone in syllogistic - than they did with E-sentences. As for the rather difficult cases of I- and O-sentences, we don't find in the commentators any clear indication of the general role that these sentences played in the views of the commentators. It is certainly the case that their thinking was not always tied to a specific model that we might compare with Euler diagrams. All in all it seems that the extensional logic of late antiquity, up to the time of Philoponus, never came to fruition.