Some Sketchy Notes on the Reaper Argument[1]

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Abstract: The paper deals with the possible readings of The Reaper Argument premisses. Some conjectures related to the Stoics' alleged proof of the argument are discussed.

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Almost two decades ago, G. Seel proposed a very comprehensive interpretation of The Reaper Argument. The argument is rarely addressed in philosophical discussions and attempts at its interpretation remain unique. It is commented on in detail in Seel (1993) and, in a condensed and slightly corrected version, in Seel (2001).

The Reaper Argument (**RA**) usually appears in discussions of determinism and the truth of predictions about future contingencies, often accompanied by two other arguments – *The Lazy Argument* (**LA**) and *The Master Argument* (**MA**). The list of related arguments is sometimes longer. Some authors associate **RA** with the 'True to Necessity' or the 'True to Fate' arguments. Analyzing an argument which can obviously not be verified at all is an ungrateful task. Our approach to the argument or its reconstruction is far from novel. We only put forward some problems emerging from this argument and note some further questions left open in Seel's reconstruction.

It seems that, in its days, the argument had been occasionally enriched and reformulated by many scholars – the Megarians, the Stoics

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and probably the Peripatetics. Since not all phases of the development of the argument can be reconstructed, and a complete picture of its original form and genesis cannot be presented, there are few options available. *One* of the possible approaches to reconstruction is to present the argument in the manner of the Stoics and understand it as closely as possible to their own logical skills and tastes as we know them. *Another* approach is to follow the traces of its original form and enrich its reconstruction by at least some of the available parts of its possible history. On *the last* option, the genesis and intermediate transformations of the argument are ignored, and the argument is simply approached with the formal tools available today. Given the limited and poor sources available, the first two approaches are hardly viable. On the other hand, the third approach completely neglects the aim of the argument. However, this situation is comparable to that of other familiar arguments from the past. By a partial combination of the three approaches, we might at least arrive at *some* knowledge about the ancient ways of solving logical puzzles.

1 The argument

At first sight, the formulation of the argument seems unproblematic. There are three sources and they agree, in principle, with each other on the way of exposing it. One of them comes from Ammonius (*in Int.* 131,20-132,7), another one from Stephanus (*in Int.* 34,34-35,10), and the last one from an anonymous author (*in Int.* 54,8-55,5 *Tarán*).

As far as we know, Ammonius gives the best presentation of the argument:

> … 'if you will reap', it says, 'it is not the case that perhaps (*takha*) you will reap and perhaps you will not reap, but (*alla*) you will reap, whatever happens (*pantos*); and if you will not reap, in the same way it is not that perhaps you will reap and perhaps you will not reap, but, whatever happens, you will not reap. But in fact (*alla mén*), of necessity, either you will reap or you will not reap'. Therefore (*ara*), the 'perhaps' has been destroyed (*aneiretai*)…

In older sources, the argument is known only by its name. In an explicit form, its content appears in Aristotle's commentators for the first time. Let us briefly consider some of its characteristics. All of the sources seem to share a common kernel. They all appear in a wider context of discussions concerning themes from Aristotle's treatise *De interpretatione*. In contrast to **MA**, there is no passage in Aristotle either directly or apparently connected to this argument. The motivation for invoking the argument in all of the three cases is thus indirect in character. In Ammonius and Stephanus, the argument appears paired with other arguments sharing a common goal. The first in the pair (that is, our argument), is the 'more verbal' (Amm.: *logikôteros*; St.: *logikos*). The other one ('*the argument from divine foreknowledge*') is the 'more troublesome' (one "more related to the nature of things"; Amm.: *pragmateiôdesteros*; St.: *pragmatoeidês*). Both Ammonius and Stephanus follow the same line of reasoning in claiming that the *more verbal* argument 'proceeds as in the case of some activity (*energeia*) of ours'; the 'activity' being exemplified by reaping. Commentators and doxographers tell us that the argument was understood as a sophism. The ancient commentators took it that the argument is not sound. For Stephanus and Anonymous, the argument is superficial *(epipolaios)*. For Plutarch (*De fato*, 574E) and Diogenes (vii. 43-4), it is a sophism, as well.[2] For Ammonius and Stephanus, it is an *aporia* "for those who hear them" but, as Ammonius assertively adds, one that is "easy to replay". The three quotations generally agree as to the content of the argument. All of them use the same substantial terms, especially the key pair *takha/pantos*. The quoted premisses seem to originate in a common source (probably in the lost commentary by Porphyry). The three commentators present the argument as rivaling their own positions. Stephanus explicitly says that he "brings in [the argument] from the outside", noting that the main motive of the argument is "to destroy the contingent". Ammonius takes it as an attempt "to make all things necessary": the two major premisses contain claims concerning 'truths in advance', and the argument is explicitly deterministic, since it states that all future events are necessitated.

Whom can we attribute this argument 'from the outside'? Only the Anonymous commentator is explicit on this question: he sees the argument as stemming from the Stoics. Other known sources also associate it with this school but without mentioning the content of the argument. One could thus be led to accept **RA** as an argument of the Stoics. However, Anonymous could also be interpreted as saying that the argument

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2 On the Stoics' relation to *sophism* and *aporia*, *cf.* Atherton (1993), Seel (1993), or Marko (2011a; 2011b).

had been taken from another source, while the Stoics merely presented it as one of their *aporiai*. Seel (2001) follows this very line of reasoning.

2 Ancient traces of the argument

It is clear that the argument did not originate in the Stoic school. According to (D.L. vii. 25), Zeno bought it on the market from an unknown Dialectician, paying twice the price. This dramatic layer of the story about Zeno's fascination with the argument makes clear that from this point on, Zeno is in possession of a solution to the argument. *Not just one* solution, however. In his testimony, Diogenes does not refer to one argument – the 'Reaper' – but uses the plural, 'Reapers' (vii. 44). The founder of the Stoic school acquired seven 'Reapers' on the market and depending on how we interpret the testimony, this could either mean all the variants of **RA**, or seven arguments similar in kind, or seven different modes of this argument.

It is commonly held that the real development of Stoic logic started with the later heads of the school. However, Zeno's interest in sophisms is not merely a minor curiosity. Zeno based a number of his own arguments on the model of the fortuitously acquired commodity. At least one, cited in Plutarch, is preserved – it is formed in a manner similar to *a simple constructive dilemma* (*De Stoic. rep.* 1034E). Zeno was committed to finding the way out from captious puzzles, and even wrote a book on *analyzing and solving sophisms* (*lyseis*; D.L. vii. 4). His dialectical technique and skills were rated highly by the early Stoic students. However, for centuries since the time of the anecdote, the conflict between the two logical conceptions – those of the sellers and those of the buyers in the transaction – was presented as some kind of a conceptual conflict. But overall, the purchase of the argument seems to have been a good bargain for the further progress of logic.

The high price paid for the argument seems to have created a sense of attachment in the Stoic school. From that time on, the argument is presented as part of the Stoic philosophical folklore. It is difficult to ascertain whether the argument suffered from transformation or not – we know nothing about it. It is reasonable to suppose, though, that it was in some respect 'standardized' for educational purposes. Later popular comments like those in Lucian (Luc. *Vit. auct*., 22; *Symp.* i. 23.153; *Schol. in Luc. Vit auct*. 24*sq*.) leave an undoubted and common impression in that they classify it among the arguments of the Stoics (as opposed to the Megarians or the Dialecticians).

In testimonies of various lists of Stoic puzzles, the argument is presented as one of the sophisms and *aporai*. The argument is not convincingly 'typical' of the Stoics, but the sources also list many other arguments now known as 'non-Stoic' as belonging to the Stoics. Still, we can at least assume that the argument can certainly play a role in the presentation of dialectical skills, the power of logical tools and techniques of argumentation. However, it remains exceptionally strange that any information about the content of this argument only emerges almost eight centuries after its first appearance.

It is difficult to infer any common generic features or some basis for systematization of arguments from these lists. Most of them have their roots in Eubulides and his followers. In any case, Lucian quotes **RA** side by side with the **MA** (*Vit. auct.*, 22) while Plutarch (*De fato* 574E) associates it with the **LA** (and yet another argument, concerning the Fate, which is otherwise unknown). All of the three arguments have many common features and, at the same time, differ from the other listed arguments.

3 Problems in the two leading premisses

As regards their components, the two opening premisses can be interpreted in several different ways. The most problematic terms are 'perhaps' (*takha*) and 'whatever happens' (*pantos*). Another problem is related to the question: how to interpret the connections between the sub-sentences ('*if*' and '*but*') in the two leading premisses?

3.1 'Perhaps'

According to Sedley's diagnosis (1977, 98), **RA** was a companion of **MA**, "aimed at proving that it is never logically correct to say 'perhaps'."[3] The assumption of this idea is that the word 'perhaps' directly introduces contingency. Therefore the term has to be avoided, because a predictive sentence about reaping is true in advance and by

3 These words are echoes of Zeller's reading of the argument (1880, 181-2, n.2): "the *therizon* was as follows: Either you will reap or you will not reap: it is therefore incorrect to say, *perhaps* you will reap."

no means related to a term such as ‘perhaps’. Why does Sedley not simply state that the argument is against contingency but insists on its prescriptive function regarding the usage of the term ‘perhaps’? One possible reason could be that the argument is not against contingency at all. For if it is, the sequent in the assumption – *i.e.* $\sim(\Diamond p \wedge \Diamond \sim p)$ – could be interpreted in the scope of the whole argument as a *petitio principii*, since the conclusion only claims what is already stated in premiss. This point echoes the reactions of Ammonius (*in De int.* 132, 2-3). Therefore, the argument could be about something else. From this perspective, Sedley’s observation may be justified, because the idea of the argument is not only in destroying contingency (if it is an obvious outcome of the actual truth of prediction), but in the prescription on the use of certain terms. Some Megarian sources related to the name of Diodorus confirm this solution, and it is very close to Diodorus’ own comments in the ‘anomalist vs. analogist’ debate on the origin of language, as well as to his interpretation of some linguistic expressions that are potential sources of confusion.[4]

However, even if the main intent of the argument is conventional prescription, there still remains the issue which lies in the background of the whole argument: if there are no contingencies, everything is either necessary or impossible. From this point on, the intent of the argument corresponds to the fatalistic attempt. Here we have to recall the fact that both Stoics and Megarians allowed for some kind of possibility. If the argument is indeed taken from one of their sources, then we are faced with another question: why would someone who accepts that some events are possible be against using the term ‘perhaps’ or against contingency at all?

We can only guess what was the position of Diodorus in this argument. The key for the answer could lie in the fact that there are some conceptual reasons not to identify ‘perhaps’ with ‘possibility’. Diodorus’ formulation of possibility is ‘what either is or will be’ (Alex. *in APr.* 183,34-184). If we say, in this manner, that the possibility of some particular future event is now, in effect, the ‘not yet actualized necessity’ of that event, then it is hard to identify this principle with the one that

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[4] One of his prescriptive examples is known from the argument usually interpreted as *the argument against motion*, that it is not correct to say ‘something is moving’ but ‘something has moved’; *cf.* S.E. *PH* ii, 242; especially, *M* x, 85*ff*.

claims that such event 'will *perhaps* be realized'. For Diodorus, there is no equality between:

α: "*it is not yet realized*"; and
β: "*perhaps it will be realized*".

The consequence of α is that the event in question would be realized because it *must be* realized once (*sooner* or *later*), while β expresses the possibility (however low) that an event in question *can be* realized, but *not necessarily* (since it can fail to occur).

This line of reasoning also has another branch. The Anonymous commentator emphasizes that with this argument, the Stoics wanted to show that there is no room for possibilities [*in. Int.* 54,8-9]. However, this claim disagrees with other sources about the Stoic conception of modalities, where an assertible (*axioma) is possible when it is both capable of being true* and is *not hindered by external things from being true* (D.L. vii. 75). The problem of an adequate interpretation of possibility[5] is the focus of Cicero's *De fato* in his exposure of the disagreement between Diodorus and Chrysippus. Unlike for Diodorus, for Chrysippus "even things which will not be are possible – for example, that this jewel be broken, even if *that will never be the case*" (*De fato* vii, 13). That is, not all dispositions of an entity will be actualized in reality, since they can be prevented by external causes. In Diodorus' formulation, it seems that all dispositions are real and will be realized (once, *sooner or later*) since there are no unrealizable possibilities.

We are now faced with several options. Either the Anonymous commentator's interpretation of the Stoic notion of possibility is wrong; or the argument (even if actually originated in the Stoics) is not complete or was not fully transferred; or some commonly known opinion is tacitly presupposed and for this reason viewed as superfluous to comment on (in these reflections on more important things in the discussion on Aristotle). In any case, in Anonymous' commentary, **RA** is associated with the Stoics, while in Cicero's *De fato*, in his exposition of **LA**, the Stoics are presented as strong opponents of the formulation of the argument found in Anonymous.

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[5] For the Stoics sources, *cf.* D.L. vii. 75; Boeth. *in Int.*[2] 234-5; 393; Plut. *De Stoic, rep.* 1055D-F; Cic. *De fato* 12-15; Epict. *Diss.* 2.19.1-5; Alex. *Fat.* 10; *Quaest.* 1.4.1; *in APr.* 177-8; Simp. *in Cat.* 195.

According to the sources, **RA** and **LA** present the familiar arguments even though we can only guess what this familiarity consist of. The Stoics criticized the connective in the pair of sub-sentences in **LA** in both of the leading premisses, insisting on interpreting the connection between the sub-sentences not as a *material*, but as a *relevant implication*. In the case of **RA**, this is not necessary, since the expressions in the consequents of the two leading premisses (as presented in commentators and contemporaneous students) seem to be conjunctions. Incidentally, this is precisely what the Stoics insist on in their critiques of **LA**: that these two have to be connected in some stronger sense than by material implication as supposed in Cicero (*De fato* xii, 28-9) and Origen (*Cels.* ii. 20).

For Sorabji (1998, 4-5; 2004, 118) the term 'perhaps' is ambiguous and does not introduce the future truth at all, since it is simply *a guarded statement* about the future. The idea had been suggested long ago by Toulmin (2003, 44-47). The guarded statement could be part of a twofold game. It is simply about actual possibilities. What contradicts it is not a future occurrence or non-occurrence of a predicted event, but any sentence that corresponds to this *guarded statement*. The point of the suggested game is this: when one says, "perhaps I will reap", its counterpoint is *not only* in "you didn't do what you had said (or promise, *etc*.)", but in something that *could* also correspond to the *guarded statement*, for example, "you will not". The phrase has nothing to do with future possibilities and contingencies. However, it is hard to represent the whole argument in connection with 'a guarded statement' except if the intent of the author is simply to provoke a captious game based on the ambiguity of 'perhaps'.

Jennings (1994, 293-295) also analyses the term 'perhaps' in the sense of possibility related to non-truth-functional disjunctive contexts. He claims that sometimes the explicit 'or' can stand for 'and'. Furthermore, he also adds that there are contexts where "*possibly* α sometimes just represents a formulaic *mooting* of α rather than an assertion that α is possible, and sometimes no more than a tentative non-rejection of α or a suspension of disbelief in α." Following some of Jennings' suggestions, the negation of the whole bracketed phrase will hence lead toward a claim contrary to the 'perhaps' of the usual truth-functional reading. In our case, this could mean the following: "not both: it is 'questionable' p and 'questionable' $\sim p$". Hence, according to the third Stoic *indemonstrable*, one in the pair is not 'questionable', but 'un-questionable' – which is just a step from 'necessary'.

Sorabji's idea is very close to the one induced by Sextus (*PH* i. 194-5). Sextus devotes a passage to terms such as those discussed here. For him, *perhaps*, *maybe* or *possible* are "indicative of non-assertion." Though the non-assertion phrase 'perhaps it is' states nothing definitive, *it stays in opposition* to what is thought to conflict with it – with 'perhaps it is not'. Sextus does not claim that these two are of the same value, but that they both have an indefinite value insofar as we make a definitive affirmation of one. For Sextus, to be used indefinitely means to be used "in loose sense, either for question or for 'I do not know which of these things I should assent to and which not assent to' (*PH* i. 191; *cf*. *PH* i. 213; *M* i. 315)." What does this mean? It is not quite clear what kind of conflict Sextus had in mind. If the status of two opposite statements is the same, is it possible to substitute 'perhaps it is' for 'perhaps it is not', or *vice-versa*? If so, then they cannot be in conflict, since they have the same value. An interpretation that could preserve some kind of the conflict mentioned above is that the phrase 'perhaps' nevertheless introduces or expresses a tendency in attitude or inclination to one of two conflicted sentences equipped with 'perhaps'. According to Sextus, "now, when we utter it [i.e. *non-assertion*], we feel in this way with regard to these matters under investigation" (*PH* i. 193). Hence, if one says, "Perhaps there will be rain", *one does not have in mind* "Perhaps there will be no rain". One is only showing a *tendency* toward an indicative opinion despite not currently being able to give a definite affirmation on this matter. Only in this case, we suppose, could the two sentences remain in conflict.

Plutarch deals with a set of these terms in the same manner. He is acquainted with **RA** (*De fato* 574E) and mentions it only by name, along with other arguments. He associates it with **LA** and some unknown argument called 'contrary to fate'. In a wider debate about the nature of fate and necessity, he notes (only a few lines before he mentions the argument) things covered by fate like "the *contingent* and the *possible*, *choice* and *what is in our power*, *chance* and the *spontaneous*", as well as others similar matters "designed by the words *perhaps* and *peradventure* …" (*De fato*, 572D-F). The words 'perhaps' and 'peradventure' have the capacity to cover many things like those mentioned in his list – among them, 'contingent' and 'possible'. If the whole expression in brackets ('perhaps' *p* and 'perhaps' non-*p*) means contingency, then, following Plutarch, we could interpret 'perhaps' using something else from his list. The most appropriate candidate that corresponds with 'pantos', seems to be the term 'possible'.

3.2 'Pantos'

In translating and in an adequate (i.e., one applicable to the inference structure of the argument) formal reading of the vague adverb 'pantos', there are several possibilities. None of the options could be unambiguously inferred from the context. One solution is to find a term that would be complementary to the previous term 'perhaps'. Another is to view it as providing additional confirmation of something that the previous sub-sentences already claim (or could claim). This confusion could also be interpreted as intentionally provoked by the author's plan to create a kind of captious puzzle with different and misleading possible solutions.

The semantics' range of the adverb 'pantos' in the argument covers a wider spectrum: a simple reinforcement of truth in advance given in antecedent and *restating it in other words* but without modalising it (in the sense of 'really' related to confirmation of the future fact of reaping); a force modalising the antecedent (by 'necessary'); a simple *de omni* predication (in the sense of 'without exception') with projection of the fixed future truth value to the unrestricted truth; an expression of *certainty* as an additional affirmation of the fixed truth value stated in the antecedent, according to the principle 'from truth to certainty' (known from Cicero's *De fato* x, 21; one that in Epicurus causes a fear of fatalistic outcomes, there presented in pair with another principle 'from certainty to necessity'). Each of the adverb readings will give result in different formal features of the whole sentence.

'Perhaps' and 'pantos' seem naturally introduced into the argument as simple *complements*, camouflaged and masked by intention of making the argument more puzzling. In this direction, the best candidate seems to be modal pair *possibility-necessity*.[6] The reason lies in the composition of the argument as well as in the mutual dependence of these expressions.

3.3 'Alla'

Another problem in the formulation of the argument is how to read the *connectives*. According to Dionysius Thrax (*Conj*. 216.16–218.19) and Apollonius (*Ars gr*. 89.1), the function of the adjunct 'but' (*alla*) used in the two leading conditional sentences closely corresponds to 'and' (*kai*).

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[6] Seel (2001, 22) chooses a pair 'undecided'/'decided'.

As a logical operator, it is a member of Dionysius' list of conjunctive connectives (*men, de, te*, *kai, alla, émen, éde, atar, autar, étoi*). As regards its function in introducing conjunction, it is mostly unproblematic. Following Dionysius' instructions, we could read this part of the complex sentence as using this term to link several sentences by a *conjunction* of sub-sentences. This is also Seel's solution. However, it is not always clear what the additional features of *alla* are. Usually *alla* introduces *the opposite sentence*, like above in Ammonius' 'not this, *but* that': "not ('perhaps' *p* and 'perhaps' non-*p*), *but* 'pantos' *p*." This sentence is not only a simple way of introducing another conjunct, but also to stress that the preceding sentence and one that follows are mutually excluding and form logical complements. The meaning of the connection 'this *and* that' differs from that of the connection '*not* this, *but* that'. The former does not emphasize additional features of connection, while the second connection states that two sentences are, in some sense, dependent. The last connection could also be interpreted through implication or even associated with some complex structure with an assuming (here probably tacitly presupposed and exclusive) disjunction. We do not know much about the Stoic use of substitution instances and their interpretation of substitution in modal contexts. However, the negated (modalized) contingent claim in the first part of the expression – '*perhaps p* and *perhaps* non-*p*' – seems to be in direct opposition to the claim in the second part – 'pantos *p*'. Therefore, '*perhaps p* and *perhaps* non-*p*' and 'pantos *p*' are in a kind of a conflict, and could be interpreted also as the phrase 'not this, *but* that', as sequential – for 'not: *perhaps p* and *perhaps* non-*p*' could be seen as implying the consequent 'pantos *p*' (or even is equivalent with 'pantos *p*'). For example, the sentence 'one person cannot be both in Athens and Megara' (with the tacit assumption of a corresponding 'natural' disjunction: 'either one is in Athens or in Megara' since 'both in Athens and Megara' in this case is not a 'perfect and complete' conflict),[7] results in a connection corresponding in form to the one above, *i.e.* '*not* in Athens, *but* in Megara' or even to the sequential '*if not* in Athens, *then* in Megara'. The argument does not give an explicit corresponding disjunction as an assumption, but in respect to the meaning of the related phrases 'perhaps' and 'pantos', we could imagine a relation between these two as forming the Stoic *sequence*, i.e.,

7 Galen, *Inst. log.* ch. iv. The example would be a *defective conflict* since it is possible for a person to be at neither of the two places at one moment.

conditional. Or, by analogy with **LA**, even something stronger, i.e. a strict or relevant relation between the two sub-sentences.

A quite different solution to reading the adjunct *alla* comes from Gaskin. He does not view '*alla pantôs thereis*' as a (conjunctive) part of the premiss. The adjunct is used in the function of "restating the conclusion of the argument in other words" (Gaskin 1995, 352). Probably the same reasoning is present in Seel when he seeks the "possibly oldest version of the argument" that would coincide with the original form of *aporia*. The reading he proposes in his conjecture (Seel 2001, 22) is such where '*pantos p*' also represents the potential conclusion of the premiss. According to this line of reasoning, '*alla pantôs thereis*' would be the natural outcome or conclusion of the preceding two sub-sentences, linked here with a conditional. In this sense, the meaning of *alla* only *imitates* a technical way of using connectives but has, in fact, an inferential function. Such interpretation naturally suggests that the argument is a *polysyllogism* consisting of at least two transient syllogisms formed by the two leading premisses.

If so, both of the leading premisses could be *monolémmata*, i.e. arguments with a single premiss. The evidence does not fully support this approach, since, according to Sextus, we know that the Stoics would not allow this (*AM* vii. 443), because an argument must have at least two premisses. However, there is an exception to Sextus' generalization, since, a few lines later, he informs us that Antipater, later the head of the Stoa, "asserted that arguments with a single premiss can be constructed" [*ibid.*] and that he was one "who does not rule out such arguments".[8] Besides some modern conjectures,[9] we know very little about the nature of this kind of arguments. According to these speculations, the model for interpreting, for example, the first premiss, would result in this form: *if p then* not: '*perhaps p* and *perhaps* non-*p*'; but (*therefore*), '*pantos p*'.

In his *Art of Grammar*, Dionysius also informs us about a special kind of syllogistic connectives (*ara, alla, allamén, toinun, toigartoi, toigaroun*) "which are well adapted to *conclusions* (*epiphorai*) and *co-assumptions*

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[8] S.E. *PH* ii. 167; *cf.* Varro, *Sat. Men*. fr. 291 (*Macropolis*), p. 50 *Astburg*; Alex. *in top*. 8.16-18; Apul. *in Int*. 184.20-3.

[9] Some polemical notes about this question can be found in Mueller (1989, 203-204), Mignucci (1993, 229) and Bozien (1996, 171-173, n. 83).

(*sullepseis*)."[10] *Epiphorai* are connectives which lead previous 'sayings' toward the conclusion which unifies more 'sayings' into one complex form. *Alla* and *allamén* are *sullepseis* here – the introductions of either a co-assumption or the next premiss. According to this interpretation, the sub-sentences of the two leading premisses – 'pantos *p*' in the first, and 'pantos ~*p*' in the second premiss – could also be separate premisses, and not merely co-assumptions conjunctively related to preceding expression.

What is the real function of the adjunct *alla*? Is it to emphasize a new premiss, to provide a complement statement in a conjunction, or to point out a conclusion? If the puzzle's author intent had been to cause a mess, this step was without a doubt successful.

The first part of the consequent is a sentence interpreted as a negated conjunction composed in the form of 'not both: … and …' (i.e. 'not both: *p and* ~*p*'). What kind of conjunction is $\Diamond p \wedge \Diamond \sim p$? According to the Stoic criteria, an alleged conjunction given in a modal form possesses *neither mutual sequence* nor *conflict* (which was, for Stoics, supposed to be present in the form 'not both: … and …'[11] – thus, here it is neither *akoluthia*, in a sense of relevant conditional, nor *mache*). Is it a conjunction at all? As Galen understood it, negated conjunction has to be reducible to a *third indemonstrable* ('it is not the case that both *p* and *q*; *p*; therefore not-*q*').[12] Is it possible to apply this rule to our example, developed from the model of *perfect conflict*, $p \wedge \sim p$ (where both connected members cannot fail to obtain at once), or to read it in a modal form as *defective conflict* (where both may fail to obtain)? Because both sub-sentences in our example "'perhaps' *p and* 'perhaps' non-*p*" are equipped with the diamond operator, these conjuncts do not form a mutual conflict suggested by the rule. To be true, a negated conjunctive pair must state a

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10 Dion. Thr., *Ars gr*. 95.2-96.2. Scholiast to Dionysius Thrax explains: "[Dionysius] calls *epiphora* the introduction of the next saying and *sullépsis* the sealing and concluding of the preceding saying" (441.8–10). Also, *cf.* Apoll. *Conj*. 250.12–20. On the *inferential* and the *co-assumptional* syllogistic connectives, *cf*. Barnes (2007, 250-259); on 'but' *cf. ibid.* (261-262).

11 *Cf.* Cic. *De fato* vii, 13 - ix, 17; Galen, *Inst. log*. iv; xiv.

12 Let us note two things. First, Galen is generally reserved toward the question whether negated conjunction is useful in a proof at all (*Inst. log*. xiv, 3). The second, let us here remind of Sextus words on dogmatists (the Stoics) that what follows from a conflict is *not only true* but also *necessary true* (S.E. *PH* ii, 186-7).

conflict between the conjoined elements. According to Galen, it seems that it could not even be a conjunction (neither *perfect*, nor *defective*), since the modal form of expression in neither of the senses results in a conflict.

In any case, what we learn from Galen, and what is more important to us, is that not only a particular connective renders some sentence aligned in a logical structure, but it is also determined by the nature of its objects (*pragmata*) or by the meanings of the included sentence. Furthermore, the connective itself (and its presence or absence, in some cases) plays a functional role in determining the meaning of a sentence. Apollonius confirms it by citation from Posidonius' *On connectives*: "[Posidonius] argues against those who affirm that connectors do not show anything but simply connect the phrase" (*Conj*. 214.4–6). In short, if we wish to interpret one sentence as conjunction, it is not enough to take over the connective directly. We have to respect the structure of the sentence as determined by the function of the connective, in relation to the nature of the objects that play a role in the composition of the sentence. This is also of interest in the formal translation of premisses of **RA**.

Here, the most probable option to read the first sentence in accordance with the '*not…, but…*' structure is: "If it is the case that *p*, then it does ***not imply*** '*perhaps p* and *perhaps* non-*p*', ***but*** (it implies) 'pantos' *p*." Here, 'but' is shorthand for 'but it implies'. The meaning of the sentence then corresponds to the theorem $[(A \to \sim B) \wedge (A \to C)] \leftrightarrow [A \to (\sim B \wedge C)]$.

4 Dependencies among the sub-sentences

The first premiss says approximately this: If something is true (in advance) then its contingency is excluded and its necessity holds. If we look at the possible dependencies among sub-sentences in the leading premisses, we can, with no great effort, detect a number of relations of dependency among them. If we understand the sub-sentence at the beginning as expressing 'truth about the future,' we can easily see that this antecedent can be interrelated with the sentence in *the first part of consequent*. The sentence about the future at the beginning is in relation with the claim that not '*perhaps* be and *perhaps* not be'," which as a whole could play the role of the principle. Truth of *p* (T*p*) implies 'not both: *perhaps p* and *perhaps* non-*p*'. A version of this principle could claim that truth (about the future) forbids contingency, which partly corresponds to Ammonius' testimony about the conclusion of **RA**.

The antecedent of the first premiss could also be seen as related to the sub-sentence in *the second part of consequent*. We could interpret the relation as the principle 'from truth to necessity' mentioned by Cicero (*De fato* x, 21): if something is true in advance, then it is unavoidable and hence necessary. Then the term 'pantos' is used instead of necessity: if it is true that you will reap and that you cannot change it from a true to a false statement, therefore you will reap of necessity. The analogy is applicable to the second premiss on a similar basis.

In the source text, there are three types of connectives: 'if', 'but' (*ei*, *alla*) and 'but in fact', *alla mén* (which Ammonius puts before the third premiss). The order of the first two connectives can be composed in these ways: a) '*ei*… (…; *alla* …)' and b) '(*ei*…, …); *alla* …'. Both *ei* and *alla* are two-place connectives. We said that *alla* usually introduces either a next sub-sentence or a premiss. However, we saw that the function of *alla* is more complex than the one of the standard *kai*, and here it can play an inferential role. To sum up, the first premiss could be read (at least) in three ways (for a further option, for example, when between the first and the second sub-sentence is a conjunction, we would expect an explicit mention of *kai*):

a) {if you will reap → [(it is not the case that (perhaps (*takha*) you will reap and perhaps you will not reap)] ∧ (you will reap, whatever happens (*pantos*)) = $a \rightarrow (b \wedge c)$
b) {[if you will reap → it is not the case that (perhaps (*takha*) you will reap and perhaps you will not reap)] ∧ (you will reap, whatever happens (*pantos*)} = $(a \rightarrow b) \wedge c$

The first two ways are usual in Sextus' way of quoting the premisses. If we accept the connective *alla* as reinterpreted in a way suggested by Gaskin, there is yet another possibility:

b') {[if you will reap → it is not the case that (perhaps (*takha*) you will reap and perhaps you will not reap)] ⊢ (you will reap, whatever happens (*pantos*)} = $(a \rightarrow b) \vdash c$

At first glance, there seems to be nothing problematic about reading the original sentence in either of these ways. For example, the string a) $p \rightarrow (\sim(\Diamond p \wedge \Diamond\sim p) \wedge \Box p)$ resembles Seel's reading of the original text, while the string b') $p \rightarrow \sim(\Diamond p \wedge \Diamond\sim p) \vdash \Box p$ resembles his conjecture about the genuine historical form of the argument. In the sentence a) the antecedent implies non-contingency, along with additionally claiming the necessity of the antecedent. In b'), from the antecedent which implies non-contingency we have to be able to infer necessity. None of the two is a theorem or a valid inference. If we want to understand what is going on in these constructions, we have to point out the way they are composed. In addition, we have to understand the relation among the components of various potential candidates for **RA** premisses.

What can we detect from a closer look at the three sentences of the first leading premiss – p; $\sim(\Diamond p \wedge \Diamond\sim p)$; $\Box p$ – and their connectives? Let us look at each of these sentences separately. To obtain $\Box p$ from the first sub-sentence p, we must suppose an additional syllogistic step of 'the truth to necessity' principle as tacit – that Tp implies $\Box p$:

$$[(\mathrm{T}\alpha \rightarrow \Box\alpha) \wedge \mathrm{T}\alpha] \rightarrow \Box\alpha.$$

If we accept the principle 'truth to necessity' as an assumption in the argument, then an occurrence of non-contingency $\sim(\Diamond \mathrm{p} \wedge \Diamond\sim \mathrm{p})$ is superfluous in the argument, because we can directly obtain the intended conclusion by *a complex constructive dilemma* ('there is no place for contingency'):

$$[(p \rightarrow \Box p) \wedge (\sim p \rightarrow \Box\sim p) \wedge (p \vee \sim p)] \rightarrow (\Box p \vee \Box\sim p).$$

Obviously, the proof is also obtainable either without LEM or with necessity in front of a bracketed LEM: $\Box(p \vee \sim p)$.

Let us look at the relation of non-contingency and necessity, the second and the third sub-sentence. From non-contingency alone, $\sim(\Diamond \mathrm{p} \wedge \Diamond\sim \mathrm{p})$, we cannot infer necessity ($\Box p$) since negation of contingency implies (not sole $\Box p$, but) only non-contingency, $\Box p \vee \Box\sim p$ (or $\Box p \vee \sim\Diamond p$). Therefore, neither '$\sim(\Diamond p \wedge \Diamond\sim p) \rightarrow \Box p$' is itself a theorem nor '$(p \wedge \sim(\Diamond p \wedge \Diamond\sim p)) \rightarrow \Box p$' is some modal variant of the third indemonstrable, applicable in the reading of the first premiss.

However, we could also see the form of the leading premisses as including something like the *scope* of contingency. Although non-contingency is not equivalent with necessity, in our premiss it is claimed that the truth of the antecedent and the exclusion of contingency leads to necessity. This hints at some kind of a rule in the background of this transition: *if p is the case and it excludes the contingence, then necessity follows* ($\alpha \rightarrow \sim(\Diamond\alpha \wedge \Diamond\sim\alpha) \vdash \Box\alpha$) or, maybe, *if p is the case and the contingence is excluded, then necessity follows* ($\alpha, \sim(\Diamond\alpha \wedge \Diamond\sim\alpha) \vdash \Box\alpha$). None of these is valid rule due to the modal fallacy.

However, in *non-contingency normal modal logics* (traced by Routley, Montgomery and Cresswell), sharing the **T** schema $\Box\alpha \rightarrow \alpha$, interdefinability of our three expressions is acceptable: p; $\sim(\Diamond p \wedge \Diamond\sim p)$; $\Box p$.[13] Let us take the symbol ∇ as the primitive modal operator meaning 'it is contingent that' and Δ as defining *absoluteness* or *non-contingency* and meaning 'it is non-contingent (absolute) that'. Here truth does neither directly imply non-contingency, nor does it (without additional assumptions) imply necessity. The strategy is as follows. Aristotelian interdefinability of the two terms can be read as $\Delta =_{df} \sim\nabla$. The connection between contingency and modality is obtained once the following definitions are applied:

$$\Delta\alpha =_{df} \Box\alpha \vee \Box\sim\alpha$$
$$\Box\alpha =_{df} \alpha \wedge \Delta\alpha;$$

The last claim corresponds to $\Box\alpha \dashv\vdash \alpha \wedge \sim(\Diamond\alpha \wedge \Diamond\sim\alpha)$. And here we are: since $\Delta =_{df} \sim\nabla$, we could translate our expression $(\mathrm{p} \wedge \sim(\Diamond p \wedge \Diamond\sim p)) \rightarrow \Box \mathrm{p}$ into logic with non-contingency. It means that from p together with $\sim(\Diamond p \wedge \Diamond\sim p)$, since $(\alpha \wedge \sim\nabla\alpha) \leftrightarrow \Box\alpha$ is a theorem here, we can infer $\Box p$. From a case/truth and the negation of its contingency, we can infer its necessity. Let us remind that the situation is comparable to **LA** (and partly to **MA**), where *all three premisses of the LA argument are proposed to be in the form of theorem* as well.

5 The third premiss: disjunction and its modal forms

The function of the third premise of **RA** (quite like in **LA**) is to regulate the two leading premisses towards conclusion. The premiss is given in this way: $\Box(p \vee \sim p)$ (in **LA** it is given without necessity in front of the bracket). Aristotle and the Peripatetics agree that this premiss could be applied to future contingencies. What they do not accept is the distribution of necessity over conflict variables inside brackets, i.e., that one of the disjuncts is necessary in advance. From Cicero we know that for the Stoics, *certainty*, *truth*, *necessity* and *fate* are dependent notions. Chrysippus wishes to convince us that "every proposition (*axioma*) is either true or false" and that "all things come about through fate and through eternal causes of the things that are going to be" (*De fato* x, 21). Fate and eternal causes are powers which provide and secure future

[13] For a genesis and general summary of the problem, cf. Humberstone (1995, 215-217) and Zolin (1999).

truth. We can thus imagine that Chrysippus would allow the distribution of the box in front of the brackets over the disjuncts inside of them. The result of this distribution would be the following: to obtain the conclusion of the argument, only the third premiss would be sufficient. According to Cicero (if he is telling us the whole truth), the Stoics would agree with the biconditional statement $\Box(p \vee {\sim}p) \leftrightarrow (\Box p \vee \Box{\sim}p)$ and with its validity not just for the past, but without any time limitation and hence for the future as well. From the point of view of contemporary modal logic, this biconditional statement (and the equivalence of the two expressions) is not correct and presents a modal fallacy. This is perhaps the point that irritates commentators of Aristotle's *De interpretatione*. If one accepts non-contingency in the form of $\Box p \vee \Box{\sim}p$, we will expect that one is also constrained to accept its equivalency ${\sim}(\Diamond p \wedge \Diamond{\sim}p)$. It seems that the Stoics are not perfect candidates for this equivalency. Although the topic is much wider, let us say that they have sympathy for the third premiss of Diodorus' **MA**, that "there is something possible which neither is nor will be true"(*cf.* Epict. *Disc.* ii. 19.1-5), and they illustrate it with an example like the one about the broken jewel, cited in Cicero. The most probable candidate who would accept this equivalency comes from Megara. Besides, one has to add that in the background of both forms of the non-contingency expressions lies *the principle of plenitude*, which is valid in *deterministic frames* where possible worlds are reduced to the actual. The last point is the closest to the position of Diodorus. He is partly able to escape the danger of collapsing modalities in a substitution instance of the above equality (for example $\Diamond p \rightarrow \Box p$),[14] by accepting some wider scope for occurrence of necessity and understanding it as something like "what either is or ('*sooner or later*') will be." This leads to the 'stretching time' fatalism (one form of the 'event fatalism'; cf. Marko 2011b, 464-465) where a future event is inevitable although it is not fixed to a particular moment in the future, but to several potential moments. This is different from the strict logical determinism or Taylor's fatalism (1962), because it leaves at least some narrow space for free will and does not have completely fixed future marks.[15]

[14] Blackburn (2000, 93) used to call the expression "an orthodox modal determinacy axiom" that "defines determinism".

[15] For some early ideas concerning formal aspects of the system *cf.* von Wright (1974, *ch.* iii.8).

Let us briefly add that in modern terms, the third premiss $\Box(p \vee {\sim}p)$ is not problematic. It is obtainable by the application of the rule of necessitation to the theorem $p \vee {\sim}p$. However, the form $\Box(p \vee {\sim}p) \rightarrow (\Box p \vee \Box{\sim}p)$ could be defined only by assuming a class of *deterministic frames* that are *not valid in all frames*. By analogy, the distribution of the future (tense logic) prefix F over disjunction (as the tense logic counterpart of forward looking possibility) is not restricted (*i.e.* $F(p \vee {\sim}p) \rightarrow (Fp \vee F{\sim}p)$, *resp.* $\Diamond(p \vee {\sim}p) \rightarrow (\Diamond p \vee \Diamond{\sim}p)$ are valid), but it seems that this does not correspond to our aims, since it has features related to possibility.[16]

6 Modal syllogism

One of the principal problems with the interpretation of **RA** lies in the fact that the decision in favor of some proof procedure is directly dependent on what we recognize as the dominant intention in a source. If we interpret the argument as one belonging to the Stoics, then we have to turn to their tools and their standard procedures. If the argument is not of the Stoics, what are the options? The argument is dominantly equipped with modal terms. The Stoics were not sympathetic to this way of forming an argument. We do not know with certainty whether this argument belongs to Stoics, nor do we know the exact formal procedure for an analysis of the preserved form. We have no reliable evidence concerning the Stoic use of syllogisms with modal notions, in terms of their logical techniques as they are known to us. Neither Apuleus nor Galen leave space for this subject in their treatises based on Stoic logic. We know, however, that Cleanthes and Chrysippus shared a wide interest in the problems of modalities and that **MA** was part of this serious concern. Both **LA** and **RA** are modally equipped arguments and, according to the sources, we know they used to deal with it. However, there are no traces of their solutions in any comprehensive and useful form. On the one hand, we could conclude that they have not developed the logical tools necessary for solving this type of arguments comparable to those given in the form of *lemas*. Barnes repeats Boethius' opinion that, for the Stoics, the modal syllogism is in some sense pointless.[17] If the Stoics did not indeed have

16 *Cf.* some ideas of Surowik (2003) and his deterministic interpretation of $Fp \vee F{\sim}p$ in $K_t \cup \{G\alpha \rightarrow F\alpha\}$ which escapes the problem of the last moment in K_t.

17 Boet. *hyp. syll.* i, ix 3. *Cf.* Barnes' comment on the Stoics' relation to the modal syllogism (2007, 434 *ff*).

modal syllogism then at this point the chances for a proof seem to be limited. On the other hand, there are evident indications in the sources that the Stoics are not indifferent to the problems of modality and that they must have been involved in this kind of arguments. Either way, we know that the Stoics are able to face **RA** by using their logical tools and skills even without fully focusing on the modal elements of the argument. They rather read it as a logical form reducible to *themmata* and *indemonstrable*, in a sense more related to a propositional form.

7 Three Conjectures about the Stoics' solution

Three different approaches will be presented here. As the first, we have Seel's (1993; later partially refined in 2001) two-step reconstruction of **RA** (supposedly inspired by Ammonius' comment and his phrase "if you said" combined with the Diodorean truth criteria with *truth related to the time of utterance*). The first step is a proof from *truth about future* to *non-undecidedness*, while the second is the proof from *non-undecidedness* to *non-contingency*. The idea of the proof(s) is that *undecidedness* and *contingency* are different but related notions, since, according to Ammonius' remark, 'perhaps' introduces contingency (*In int.* 131, 31). P(IVc) in the second step assumes that "the future event is contingent *only if* its realization is not yet decided".
The *first* step in a proof:[18]

1. P (Ia) $C_{tn}C_{tf}p \rightarrow [\sim(U_{tn}C_{tf}p \wedge U_{tn}C_{tf}\sim p) \wedge D_{tn}C_{tf}p]$
   P (IIa) $C_{tn}C_{tf} \rightarrow [\sim(U_{tn}C_{tf} \wedge U_{tn}C_{tf}\sim p) \wedge D_{tn}C_{tf}\sim pt]$
   P (IIIa) $\Box(C_{tn}C_{tf}p \vee C_{tn}C_{tf}\sim p)$
   ____
   C (I) $\Box(U_{tn}C_{tf}p \wedge U_{tn}C_{tf}\sim p)$

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18 Here, *tn* indicates the present moment; *tf* indicates a certain instant in the future. The symbol *p* represents the state of affairs 'you are reaping'. Consequently, the expressions '$C_{tn}C_{tf}p$', '$U_{tn}C_{tf}p$', etc. do not represent propositions in the modern sense, but rather statements, which in their logical properties resemble the *axioma* of the Stoics. $K_{tn}C_{tf}p$: it is now *possible but not necessary* (contingent) that you will be reaping at the future moment *tf*. $D_{tn}C_{tf}p$ and $U_{tn}C_{tf}p$: it is now *decided*, respectively *undecided*, that you will be reaping at the future moment *tf*.

The *second* step in a proof, *from non-undecidedness to contingency*:

P (IVc) $(U_{tn}C_{tf}p \wedge U_{tn}C_{tf}{\sim}p) \leftarrow (K_{tn}C_{tf}p \wedge K_{tn}C_{tf}{\sim}p)$
C (I) ${\sim}(U_{tn}C_{tf}p \wedge U_{tn}C_{tf}{\sim}p)$

C (II) ${\sim}(K_{tn}C_{tf}p \wedge K_{tn}C_{tf}{\sim}p)$

The next type of reconstruction follows – logically valid one-step literal translation of **RA**:

2. $p \rightarrow ({\sim}(\Diamond p \wedge \Diamond{\sim}p) \wedge \Box p); {\sim}p \rightarrow ({\sim}(\Diamond p \wedge \Diamond{\sim}p) \wedge \Box{\sim}p); \Box(p \vee {\sim}p) \vdash {\sim}(\Diamond p \wedge \Diamond{\sim}p)$.

It corresponds with the structure suggested by Seel, but the second step of his approach (*from non-undecidedness to contingency*) is here omitted as redundant, because we take the reading of the sub-sentence ${\sim}(\Diamond p \wedge \Diamond{\sim}p)$ as 'negation of contingency' which appears in the conclusion, too.

According to the possible reading of the two leading premises, the closest logical form which corresponds to **RA** seems to be *a simple constructive dilemma* (**SCD**). However, there is a problem here. If we wish to analyze the argument as one of this form, some rearrangement and adjusting to this form is necessary. This is simply the price to be paid for this option. Moreover, by intervening on primary features, we could weaken the connection with its intended mission. On the other hand, if we wish to interpret it by neglecting the reasons of its potential advocates, then we could lose its original traces, along with at least the small chances we have of understanding its purpose. The former approach gives us better chances to take into account the historical circumstances of the argument, and it could at least show us some problems related to the skills of the age.

Let us start with the assumption that the argument is one of the Stoics' and that the closest form of it is really **SCD**. This approach is suggested in Seel's reconstruction (1993, 312; 2001, 157). Stoics are well acquainted with this form as well as with its inference procedure. One can find it in their sources in different variants – with one, two and three terms in the proof. With respect to the number of terms included in the argument, a constructive dilemma has several forms. Only some of these are of interest to us:

A)		**B)**		**C)**	
	$p \to p$		$p \to q$		$p \to r$
	$\sim p \to p$		$\sim p \to q$		$\sim p \to s$
	$p \vee \sim p$		$p \vee \sim p$		$p \vee \sim p$
	p		q		$r \vee s$

An argument which at the first sight could be compared with **RA** is a constructive dilemma *with one term* (including its negation) since one term appears throughout the whole argument. This corresponds to the form of **A** or **SCD**. However, if we take $\sim(\Diamond p \wedge \Diamond\sim p)$ as a unique consequent then our candidate is the second form **B**, since we need to differentiate the inverted antecedents from the consequent. The form suggests different terms in antecedents, while in both of the leading premisses, the consequents are the same. To see the argument in this form, we have to decompose it and/or reduce some of the elements of the two leading premisses. In this case, we will be pressed to construct its wider surroundings, including some additional assumptions that have to support this solution.

Let us assume that the two leading premisses form a unique kernel, one in accordance with the conclusion. The third premiss is a statement which only mediates or regulates the connection between the leading premisses and the conclusion.

We have two options for a reduced reading of the argument which correspond to the logical form of the dilemma. We could develop a reduced form of both leading premisses from the theorem (responding to an acceptable form of reading connective *alla* above):

$$\mathrm{A} \to (\mathrm{B} \wedge \mathrm{C}) \leftrightarrow (\mathrm{A} \to \mathrm{B}) \wedge (\mathrm{A} \to \mathrm{C}).$$

We can choose one of the conditional conjuncts – (A → B) and (A → C) – and then take the one that remains either as a tacitly held assumption or as one that is superfluous, not necessary for obtaining the intended conclusion. If we choose *the first conditional conjunct* (*i.e.* A → B), according to **SCD** we have the option **B**:

3. $p \to \sim(\Diamond p \wedge \Diamond\sim p);\ \sim p \to \sim(\Diamond p \wedge \Diamond\sim p);\ \Box(p \vee \sim p) \vdash \sim(\Diamond p \wedge \Diamond\sim p)$

The expression is valid. The question of disjunction with or without a square in front of the brackets remains open to interpretation. The leading premisses express the standpoint obtained in the conclusion according to which: what is true (or what is the case) implies non-contingency.

If we choose *the second option* (*i.e.* $A \rightarrow C$), it leads to **CCD** with the corresponding form **C**. Now, we obtain the form of disjunctive conclusion which does not fully correspond to the form of the original:

4. $p \rightarrow \Box p; \sim p \rightarrow \Box \sim p; \Box(p \vee \sim p) \vdash \Box p \vee \Box \sim p$

The expression is valid.[19] It led some authors to conclude that Chrysippus accepts (unreservedly, i.e. without time restrictions) the following claim: $\Box(p \vee \sim p) \rightarrow \Box p \vee \Box \sim p$.[20] This belief rests on the following views of Chrysippus: *a)* there are no exceptions to *The Principle of Bivalence* (every proposition is either true or false)[21] and *b) The Principle of Bivalence* coincides with *The Principle of Excluded Middle*, even for future contingents. Besides, now the principle 'from truth to necessity' is explicitly present in the two leading premisses: *what is true* (in the past, present or future) *is necessary true*. The last principle is an extended or 'unrestricted' form of *the principle of conservation of necessity* (accepted as unproblematic by the Peripatetics when applied to past cases). The principle can be understood as the outcome of another Stoic principle that "all things happen through antecedent causes"(Cic. *De fato*, x, 20 *sq*.). While 3 has the form of **SCD**, 4 is **CCD**. The conclusion in 4 corresponds with a non-contingency conclusion in 3 by a substitution of $\Box p \vee \Box \sim p$ for $\sim(\Diamond p \wedge \Diamond \sim p)$.

Another solution (a less successful attempt regarding the conclusion in testimonies) is to take the expressions in the consequents of the leading premisses as a whole and to read them as separate terms of the consequents in the hypothetical premisses of the dilemma: $A \rightarrow (B \wedge C)$; $\sim A \rightarrow (B \wedge \sim C)$. Like in 4, the conclusion will be far from the one indicated in the sources. The conclusion of the dilemma formed in such

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19 *Cf.* Gahér's conjecture of the Stoics' **CCD** solution in Gahér (2006, 197).

20 This claim could (perhaps not quite fairly) sometimes be found under the title *The Chrysippus paradox* (Abelson 1963, 95; Cahn 1964, 302; Cahn 1967, 100).

21 Cic. *De fato* 21; 38; *Luc*. 95; *Tusc*. 1. 14; Plut. *Comm. not*. 1066 E, *De fato* 574 F; Aul. Gell. 16. 8. 8; Simpl. *In cat*. 406.34-407.5; *cf*. D.L. vii. 65-6; S.E. *M*. viii. 73-4; Stob. *Ecl*. i. 621.12-13 *Hense*; Suda i. 255 *Adler*.

a way would be (B ∧ C) ∨ (B ∧ ~C) and it corresponds with the form **C**, that is, **CCD**:

5. $p \to (\sim(\Diamond p \land \Diamond{\sim}p) \land \Box p); {\sim}p \to (\sim(\Diamond p \land \Diamond{\sim}p) \land \Box{\sim}p); \Box(p \lor {\sim}p) \vdash (\sim(\Diamond p \land \Diamond{\sim}p) \land \Box p) \lor (\sim(\Diamond p \land \Diamond{\sim}p) \land \Box{\sim}p)$

The expression is valid. We provide a connection between the two premisses and the conclusion. However, in the conclusion, the necessity prefixed to the antecedents of the two premisses is not separated, nor is separated the refutation of contingency. This does not mean that the author of the puzzle would not accept this formulation; it simply does not correspond with the intended conclusion given in Ammonius' text. In that sense, Seel's assumption of **SCD** being an adequate solution to **RA** is not acceptable without some additional reduction in the premisses.

The Stoics' solution of this *non-simple syllogism* is the last. Their proof procedure is strictly deductive and each step has to be either reduced to an *indemonstrable* or has to be derived from an indemonstrable by applying one of the appropriate rules like the *themata* (D.L. vii. 78). A proof corresponding to 3, with two hypothetical premisses and a disjunction (*dia triôn tropikôn*), could be obtained by a branching type of *reduction to indemonstrables* and writing q instead of $\sim(\Diamond p \land \Diamond{\sim}p)$:[22]

6. *a)*		$p \to q, {\sim}p \to q, p \lor {\sim}p \vdash q$	
b)		${\sim}p \to q, p \lor {\sim}p, {\sim}q \vdash \sim(p \to q)$	1. *thema*
c)	[2. *ind.*] ${\sim}p \to q, {\sim}q \vdash {\sim\sim}p$;	${\sim\sim}p, {\sim}q, p \lor {\sim}p \vdash \sim(p \to q)$	4. *thema*
d)		[5. *ind.*] $p \lor {\sim}p, {\sim\sim}p \vdash p; p, {\sim}q \vdash \sim(p \to q)$	3. *thema*
e)		[1. *ind.*] $p \to q, p \vdash q$	1. *thema*

For the Stoics a proof by reduction to indemonstrables could also be obtained *without* the third disjunctive assumption. They could ob-

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[22] The proof is obtained by the following rules (*indemonstrables* and *themata*): 1. *indemonstrable*: $p, p \to q \vdash q$; 2. *indemonstrable*: ${\sim}q, p \to q \vdash {\sim}p$; 5. *indemonstrable*: $p \veebar q, {\sim}q \vdash p$; and

1. *thema* $\dfrac{\alpha_1, \ldots, \alpha_n, \beta \vdash \gamma}{\alpha_1, \ldots \alpha_n, {\sim}\gamma \vdash {\sim}\beta}$; 3. *thema* $\dfrac{\alpha_1, \alpha_2 \vdash \alpha_3 ; \alpha_3, E \vdash C}{\alpha_3, \alpha_i , E \vdash C}$ 4. *thema* $\dfrac{\alpha_1, \alpha_2 \vdash \alpha_3; \alpha_1, \alpha_2 , E \vdash C;}{\alpha_1, \alpha_2, E \vdash C.}$

Cf. also Kneale's solution in (1986, 172). For further discussion, see Frede (1974), Ierodiakonou (1990; 1993; 2002), Bobzien (1996), Mignucci (1993) and Gahér (2006). Following Frede (1974, 187) Seel suggests 1., 2. and 4. *thema* as adequate.

tain the intended conclusion from the leading premisses with only two hypothetical premisses (*dia dio tropikôn*) and writing q instead of $\sim(\Diamond p \wedge \Diamond\sim p)$:[23]

7. *a)* $p \rightarrow q, \sim p \rightarrow q \vdash q$
   b) $p \rightarrow q, \sim q \vdash \sim(\sim p \rightarrow q)$ — *by 1. th., from a*
   c) [2. *ind.*] $\sim q, p \rightarrow q \vdash \sim p$; $\sim q, \sim p \vdash \sim(\sim p \rightarrow q)$ — *by 2. th., from b*
   d) [*1. ind.*] $\sim p, \sim p \rightarrow q \vdash q$ — *by 1. th., from c*

Finally, we can point out some concluding observations. The modern interpretation in 2, analogical to that of Seel (in 1), results in a logically valid conclusion. Contrary to Seel's estimation, the reconstructions according to **SCD** are not possible without additional tuning or a reduction of the premisses. Constructed in such a way, the inference procedure bypasses the rules of some alleged modal syllogistic system. The form of the first premise could be "*p* does ***not imply*** '*perhaps p* and *perhaps* non-*p*' ***but implies*** 'pantos' *p*." The conclusion is obtainable either only from the third premise or from (a reduction of) the two leading premises (even without assuming the third premiss). Steps from $\Box(p \vee \sim p)$ to $(\Box p \vee \Box\sim p)$ and its substitution instances ($\Diamond p \rightarrow \Box p$; $\sim(\Diamond p \wedge \Diamond\sim p)$, *etc*., that are characteristic of *deterministic frames*) are rather Megarian than Stoic, with respect to their understanding of what is possible. Due to the analogy with **MA** and **LA**, the argument seems to be a genuine Megarian pattern transferred by Zeno to the Stoics and revised in later times (probably by Antipater). It seems that the Dialectician's merchant sold the argument to Zeno with an incomplete interpretative manual and kept some of the keys to it to himself.

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23 The proof is obtained by the following rules (*indemonstrables* and *themata*): 1. *indemonstrable*: $p, p \rightarrow q \vdash q$; 2. *indemonstrable*: $\sim q, p \rightarrow q \vdash \sim p$; and

1. *thema* $\dfrac{\alpha_1, \ldots, \alpha_n, \beta \vdash \gamma}{\alpha_1, \ldots \alpha_n, \sim\gamma \vdash \sim\beta}$ 2. *thema* $\dfrac{\alpha_1, \alpha_2 \vdash \alpha_3;\ \alpha_1, \alpha_3 \vdash C}{\alpha_1, \alpha_2 \vdash C.}$

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