

Analyses of Aristotle

Jaakko Hintikka

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Selected Papers

6

ANALYSES OF ARISTOTLE

JAAKKO HINTIKKA SELECTED PAPERS

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ANALYSES OF ARISTOTLE

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ORIGIN OF THE ESSAYS

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1. “On Aristotle’s notion of existence”, *The Review of Metaphysics* vol. 52 (June, 1999), pp. 779–805. Reprinted with permission.
2. “Semantical games, the alleged ambiguity of ‘is’ and Aristotelian categories”, *Synthese* vol. 54 (1983), pp. 443–468 (D. Reidel Publishing Co., Dordrecht).
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7. “Aristotelian induction”, *Revue Internationale de Philosophie* vol. 34 (1980), pp. 422–439. Reprinted with permission.
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13. “The fallacy of fallacies”, *Argumentation* vol. 1 (1987), pp. 211–238 (D. Reidel Publishing Co., Dordrecht).
14. “Socratic questioning, logic, and rhetoric”, *Revue Internationale de Philosophie* vol. 47, no. 184 (1993), pp. 5–30. Reprinted with permission.

INTRODUCTION

The purpose of the introduction to a book should be the same as that of the label on a medicine bottle. It should tell the reader how to use the text of the book. The present volume needs such instructions more than most books, including the earlier volumes of my selected papers. The main warning that the label on this product should proclaim is not to read the papers printed or reprinted here in the same way as fully polished contributions to scholarly journals on ancient philosophy. I have been, and I continue to be, fascinated by Aristotle's philosophical ideas. I have thought about them, and I have come up with a number of interpretations of them. The essays published or republished here are presentations of these interpretations. Alas, they are all sketches rather than fully argued and documented papers. The reason is obvious. My main lines of work in philosophy run elsewhere and have the first claim to my working time and energy. I fully admit this orientation of my philosophical interests does not excuse the sketchiness of my papers. Since I was aware of the situation for a long time, I hoped to rewrite some of the papers published here and replace some others by new ones in such a way that the interpretational argumentation and scholarly documentation would be on the same level as in specialized publications on ancient philosophy. Reluctantly, I have reached the conclusion that I will never have a chance of doing so. Hence my only chance of bringing my interpretational ideas to the attention of a wider philosophical audience is to reprint the original papers as they are, with an explanation of their status.

My main reason for doing so is a strong belief in the potential importance of the interpretations I outline in these papers. The first and foremost aspect of this importance is the giving of new general perspectives on Aristotle's philosophy. It might seem overoptimistic, not to say pretentious, to think that after more than two millennia there could be unused clues to Aristotle's thinking. The fact nevertheless is, I believe, that in some cases the progress of systematic conceptual analysis (and synthesis) puts what Aristotle is doing – or, rather, thinking – in a new light. Even the most central concept of all, ontology, the concept of being, bears witness to these opportunities. For a century and a half, the consensus of philosophers is that this concept is irreducibly ambiguous between being in the sense of identity, predication, existence and subsumption. This assumption may be called the Frege-Russell ambiguity thesis. But is the thesis true? Everybody admits that there are different uses of words for being, but the Frege-Russell thesis tries to explain

these differences by declaring a single verb to be ambiguous. This ambiguity thesis is even built into the standard logical notation. It is therefore little short of a shock to realize that nobody before the nineteenth century accepted the ambiguity thesis. Aristotle is a case in point, and this fact at once puts much of his thinking in a new light. Some of the consequences of this insight are explored in the essays below devoted to Aristotle's treatment of the notions of existence and of category. For instance, when it is realized that the notion of being can be handled without assuming the Frege-Russell ambiguity, as it is handled in ordinary language, Aristotle's theory of categories suddenly becomes eminently easy to understand. At the same time, Aristotle's treatment of existence in the context of a syllogistic science explains some of the most characteristic features of his doctrines about the structure of science and scientific explanation. For instance, the structure of an Aristotelian science becomes understandable in the light of these insights. This structure was first explored in the essay 'On the ingredients of an Aristotelian science'.

Another important distinction between different kinds of being, orthogonal to the distinction between different categories, is the distinction between potential being and actual being. The problem as to how this dimension of being is related to the rest of Aristotle's metaphysics is briefly discussed in the essay "The role of modality in Aristotle's metaphysics".

Again, Aristotle's logic is usually considered as a system on a par with our deductive systems. There is not necessarily anything wrong in doing so, but it does not help to understand how Aristotle came to develop his ideas about logic. An enhanced topical interest in question-answer dialogues and in their logic has led to the idea of considering the Socratic *elenchus*, his method of questioning, as Aristotle's starting-point in his work in logic. Plato had been so impressed by the Socratic method that he had systematized and institutionalized it into questioning games which served as the method of philosophical argumentation and philosophical training in his Academy. Aristotle was the first to develop a systematic theory of such dialectical games, as he himself confidently states at the end of *De Sophisticis Elenchis*. But it is important to realize that the new theory he had developed is not a logical theory of deductive reasoning in our sense, but a theory of the Socratic questioning games. But Aristotle did not stop here. He was as competitive as the next Greek. He wanted to know how to play these games so as to win in them. Now any trial lawyer can tell you what is crucial in successful cross-examination: predicting the interlocutor's answers. Now Aristotle realized that some answers can be predicted with complete certainty. They were the answers which in our terminology are logically implied by the interlocutor's earlier answers. Aristotle began to study and to systematize them and – presto! – deductive logic was born.

This idea and its consequences are studied in several of the essays, including the essay on the development of his methodology and the note on his early logic. It is a consequence of this insight that Aristotle's entire logic and methodology were thought of by him as being conducted within an interrogative framework. This puts into a new light also Aristotle's theory of fallacies, some

aspects of his rhetoric and the subsequent history of his methodological ideas. An explanation why Aristotle's logic turned out to be syllogistic is proposed in my joint paper with Ilpo Halonen entitled "Aristotelian explanations".

Yet another perspective is obtained by understanding Aristotle literally when he says that thinking of anything – say X – means realizing the form of X in one's soul. From this it follows that what necessarily accompanies X must also be present in one's mind. To put it bluntly, all logical consequences present themselves to one's mind necessarily, and all necessary connections between forms – all natural laws – can be discovered by means of thought-experiments. This line of thought is presented in the essay on Aristotle's theory of thinking. It follows that Aristotelian methodology did not consist in collecting evidence and then drawing inferences from it. Scientific method consisted for Aristotle in building the relevant forms in one's mind. It was concept formation, not unlike searching for a definition. This puts into a new light Aristotle's entire methodology, including his notion of induction, to which an early essay is devoted. It also provides a new perspective on Aristotle's views on both theoretical and practical syllogisms, and thereby on both Aristotle's syllogistic theory and on his strange views on the weakness of will. The parallelism between these two subjects is highlighted by the title of the paper on "Aristotle's incontinent logician".

Since part of the interest of a volume like the present one is that of a historical record, I have not revised them so as to bring them to a complete conformity with each other or to with my present views. Likewise, I have not tried to eliminate overlap between the different essays. This reappearance of the same themes in different essays is only partly explainable by the interrelatedness of Aristotle's different ideas with each other. For technical reasons, it has been impossible to make the modes of source references uniform from essay to essay. I realized the magnitude of this problem too late, and as a result I can only hope that it bothers my readers less than it bothers me.

In spite of these imperfections, I hope that these essays will inspire others to explore further the possibilities that they open of understanding better Aristotle's thought. I also have to hope that others will also marshal more evidence and perhaps even better evidence for the interpretations in the essays printed or reprinted in this volume.

My sincere gratitude is due to all the Socratic and non-Socratic interlocutors with whom I have discussed the themes of these essays over a period of forty-some years. I am afraid that I cannot even recall all of them nor therefore individuate my thanks. Perhaps thanking Russ Dancy will symbolize my thanking of all of these colleagues.

Likewise, I owe thanks to all of the secretaries and assistants who have on different occasions helped me with the essays printed or represented here. They are the ones who literally write one's papers, as we all know. Perhaps warm thanks to my present secretary, Lynne Sullivan, will serve as an expression of my appreciation of what they all have done.

Last but not least, I thank my longtime publisher and their editors and other staff not only for undertaking the publication of my selected papers but also for carrying the project to a conclusion.

Boston, October 2003
Jaakko Hintikka

CHAPTER 1
ON ARISTOTLE'S NOTION OF EXISTENCE

1. ARISTOTLE AS A DIALECTITIAN

Tom Nagel once wrote a paper on “What is it like to be a bat?” I am tempted to give this paper the somewhat less outlandish title “What would it be like to be Aristotle?” Notwithstanding the lip service some scholars have paid to the peculiarities of Aristotle’s ways of thinking as compared with ours, I have seldom felt that a commentator has managed to get inside Aristotle’s mind and made us grasp what made Aristotle tick – or, rather, think in the way he did. All too often Aristotle has been treated by twentieth century philosophers as if he were, to borrow an Oxonian phrase, just “a fellow of another college.” The reason for such an alienation is not a lack of any intuitive *Einfühlung* or intellectual sympathy in the eighteenth-century sense. It is not a Schelerian failure but a Collingwoodean one. It is typically a failure to grasp the problem context of Aristotle’s thought and to grasp his ultimate presuppositions. In my earlier work, I have sought to identify some of his presuppositions and problems. Only some of them are relevant here. One interesting background feature of Aristotle’s thinking about logic, reasoning and the scientific method is that he is considering such matters always in a dialectical context, in the sense of thinking of them on the model of question-answer dialogues not unlike the Socratic *elenchus*. That this was the model of Aristotle’s methodology in the *Topics* is of course fairly obvious. Yet what is not usually noted is that Aristotle is still in the two *Analytics* thinking of the scientific method as an interrogative process. What constitutes the bridge between the overtly dialectical framework of the *Topics* and the syllogistic framework of the two *Analytics* is the idea that logical inferences are those answers to questions that are (as we would explain the matter) logically implied by the respondent’s earlier answers.

One example should be enough to show this. Right in the middle of explaining the nature of logically necessary inferences Aristotle suddenly catches himself and warns that such inferences are not the only steps of interrogative inquiry.

Yet one might perhaps wonder what purpose there could be in asking [questions] about such items if it is not necessary for the conclusion to be the case – [apparently] you might as well ask an arbitrary question and then state the conclusion. Yet we should ask questions not on the grounds that the conclusion will be necessary because what makes the conclusion necessary was asked earlier (*dia ta erotemena*) but rather because it is necessary for the person who accepts the proposals [that is, who answers

the questions in the proposed way] to state the conclusion – and to state it truly if they hold truly.¹

I have modified Barnes' translation here in that I have taken the words διὰ τὰ ἠρωτημένα at 75a25–6 in their most straightforward sense as meaning “because of what was asked earlier,” that is, in effect, “because of the earlier answers.” As far as Aristotle's “proposals” are concerned, according to him in a propositional question a preferred answer is proposed to the responder; see for example, *Topics* I 4, especially 101b28–36.

Most recent translators and commentators have had no inkling of what is going on in this passage. Out of desperation, some even try to insert a completely unsupported restriction to merely dialectical reasoning. Yet as soon as we realize that Aristotle is treating the entire inquiry, including deductive steps, as an interrogative process, what he says becomes crystal clear. What he is doing is to think of necessary inferences, too, as question-answer steps in an inquiry. They are the ones where the answer is necessitated by earlier answers. After all the attention he had lavished on such necessitated answers (alias conclusions of syllogisms) in the *Prior Analytics* and in the beginning of *Posterior Analytics*, he realized that he had to remind his audience of the framework in which he was operating, that is, to remind them of the truism that in an interrogative inquiry we also need non-necessitated answers. In such steps, Aristotle might have said, the answer still is necessary *ad hominem*, albeit not *ad argumentum*. By contrast, the quoted passage thus shows vividly is that logical inferences were for Aristotle a subclass of answers to questions. The conclusion of a logical inference was still for him in the *Analytics* an answer to a question.

Another instance of the dialectical character of Aristotelian science is the fact there need not be any one stage of scientific inquiry at which all the first principles have been found so as to be ready to serve as premises of scientific syllogisms. The mistake of thinking that there must be such a stage according to Aristotle might be called the “Euclidean fallacy.” It has come about by projecting the Euclidean, not to say Hilbertian, idea of an axiomatic science back to Aristotle. Aristotle discusses the different first principles of a science on different occasions, notably in *Posterior Analytics* A 2 and 10, but nowhere does he say or imply that there is a stage in the development of a science when those principles are all known to the scientist in such a way that all the rest could be proved syllogistically from those premises, and those premises only. Of course, from the interrogative viewpoint there is little reason to expect that there should exist such a privileged stage. One of the results of the present paper will be evidence to show that Aristotle did not embrace the simple Euclidean model of a science.

Hence an important part of thinking like Aristotle is to think dialectically, that is to say, to think of scientific inquiry as a partly tacit questioning process. Now questions are requests of information, in other words, means of coming to know something new. Since scientific syllogisms are a part of this enterprise,

they have a tacit but important epistemic element. Aristotle's syllogistic cannot be expected to be a purely extensional logic. It would be surprising if it did not involve, however implicitly, ingredients that we would identify as belonging to epistemic logic. Thus the dialectical character of scientific inquiry according to Aristotle implies definite suggestions for the interpretation of his syllogistic logic.

2. ARISTOTLE'S UNITARIAN CONCEPT OF BEING

Another massive difference between Aristotle's conceptual presuppositions and ours is the absence of the Frege-Russell thesis about the ambiguity of verbs for being like the Greek *einai*. I have dealt with this matter before but it is important enough to be reiterated. Everybody and his sister will agree that verbs like *is* can be used in different ways. Sometimes they express identity, sometimes predication, existence, or subsumption. Yet the Frege-Russell ambiguity thesis goes way beyond merely pointing out this distinction between different uses of *ist* or "is" or *estin*. It attributes the distinction to an ambiguity of the single verb, and not for instance to differences between different context of use.

In a way, it is not surprising that Aristotle did not uphold this Frege-Russell ambiguity claim. For to the best of my knowledge no philosopher before the nineteenth century assumed the ambiguity thesis. What I have slowly come to realize is that Aristotle may have been the only early philosopher who consciously considered the ambiguity thesis even though he, too, rejected it.

If you want evidence for Aristotle's awareness of a possible distinction and for his rejection of it, it should suffice to quote *Metaphysics* Γ, 2.1003b22–30:

Now if *to be* and *to be one* are the same, that is, a single nature, in the sense that they accompany each other as principle and cause, not as being expressed by the same definition (although it makes no difference but rather helps our argument if we understand them in the same sense), since "one man" and "man" as well as "existent man" and "man" are the same thing, in that the reduplication in the statement "he is a man and an existent man" yields no fresh meaning (clearly one cannot distinguish the two either with respect to coming to be or to ceasing to be), and similarly for being one. ...²

I will try to examine in a separate paper Aristotle's reasons for rejecting the Frege-Russell thesis.

It is interesting to see that a part of Aristotle's assimilation of the different Fregean senses to each other is present as early as in *Sophistical Refutations* 6.169a 8–10:

For the same definition (*horos*) applies to "one single thing" and to "the thing" simply; the definition, for example, of "man" and "one single man" is the same, and so, too, with other instances.³

It is likewise interesting to see that the identification of “man” and “one man” which is in effect an identification of the predicative and the identificatory senses of being, is not here extended to being in the sense of existence. This extension seems to be a later development in Aristotle’s thought.

Further evidence of Aristotle’s rejection of the Frege-Russell thesis is easily forthcoming. This rejection means that he was operating with a unitarian concept of being. In the fullest sense, *einai* had to comprise all of the first three Frege-Russell senses of being, that is, predication, existence, and identity. This might seem to be paradoxical, for Aristotle like all sensible logicians must have realized that in some of its uses *einai* might be missing one or two of these components. Yet this would be a serious objection to my interpretation only if the different Frege-Russell senses were for Aristotle different meanings of *einai*. Then the absence of one of them would change the total meaning of this verb. Since the different Frege-Russell senses are for Aristotle only different components of a unitarian meaning one of them could be missing without affecting the basic meaning of the word. To make an instant comparison, the word “athletic” is likely to connote both strength and speed. Yet a weight lifter can be an athlete without being agile, and a sprinter can be fast without being strong. For the Aristotelian unitarian notion of being, it suffices that in principle there always could be the other component senses present, too. In the case of an occurrence of *einai* in Aristotle, the right question to ask is not which Frege-Russell sense he is using the word in, but rather which of the component meanings are present on that particular occasion. The possibility of there being several possible answers to the second question does not make Aristotle’s use of the word equivocal. In some case, a missing component force might be restored by means of collateral arguments. Indeed, it will be seen that in the atomic premises of an Aristotelian science the existential sense is initially absent but can be brought in via collateral arguments.

By calling Aristotle’s concept of being unitarian, I do not mean that he did not make distinctions between different uses and even different senses of being other than the Frege-Russell ones. The most prominent of them are the distinction between being in different categories as well as the contrast between potential being and actual being. It is important to realize, however, that these distinctions are not the same as the Frege-Russell distinction between the different meanings of verbs for being.

There may even be additional ingredients in the unitarian notion of being in Aristotle. For one way in which the epistemic ingredient that was surmised in sec. 1 above to be there in Aristotelian syllogisms can raise its head here is to lend the predicative component of Aristotelian *estin* the force of “is known to be.”

My claim is not belied, either, by the so-called Hermann’s rule.⁴ This rule, as you undoubtedly know, is supposed to distinguish the copulative (predicative) *estin* from its other Frege-Russell senses. More fully expressed, the distinction is supposed to be marked by the difference between the enclitic accent, as in ἐστὶ and the orthodone accent, as in ἔσται. Even though Hermann’s rule has

been thoroughly demolished by Charles Kahn, it still seems to enjoy currency among classicists. It may therefore be in order to point out that Aristotle's explicit refusal (in *Metaphysics* Γ, 2. 1003b22–30) to construe the distinction as one of meaning provides one more nail – admittedly of a non-philological kind – to the coffin of Gottfried Hermann's rule. Whatever it is that the distinction between the two kinds of accent does, it does not in Aristotle mark a difference between two meanings of *esti*, for there is no such difference. In fact, Herr Hermann was an early nineteenth-century German philologist who created his rule under the influence of (his interpretation of) Kant's distinction between existence and predication. We have much more solid reasons to reject Hermann's rule lock, stock and barrel than to use it to challenge my interpretation of Aristotle's concept of being.

Thus an important part of thinking like Aristotle is to think without relying on the Frege-Russell ambiguity thesis. This is no mean feat, for the ambiguity thesis is built right into the notation of our twentieth-century basic logic, including the received first-order logic. And the use of this logic is one of the mostly firmly entrenched habits of twentieth-century philosophers. When I first challenged the role of this logic as a codification of our actual *Sprachlogik* in the presence of a senior philosopher of language, his reaction was to look at me and to say: "Nothing is sacred in philosophy any longer." Hence one thing we have to do in studying Aristotle's concept of existence is not to foist our contemporary first-order logic on him.

3. THE INNER TENSIONS OF ARISTOTLE'S NOTION

Indirectly, this logic can nevertheless help us to understand Aristotle's problems with the concepts of being and existence. In the light of hindsight, many of those problems can in fact be traced to the tension between the different Frege-Russell components in Aristotle's unitarian notion of being. More explicitly speaking, an important rationale of the Frege-Russell distinction is that the different senses of being they distinguish exhibit different kinds of logical behavior. For instance, the identity sense is obviously transitive, but the predicative sense is not. In fact, this is the source of one of Aristotle's earliest puzzles about the concept of being.

For example, "If Coriscus is different from a man, he is different from himself for he is a man," or "If he is different from Socrates, and Socrates is a man. ..." ⁵

Aristotle's solution to such sophisms is not to separate the identity sense of *estin* from the predicative one but to separate the kind of predication that allows *estin* to be transitive from the kinds of predication that does not allow it. The former is in *Sophistical Refutations* identified with essential predication, the latter with accidental one, and sophisms of the kind just quoted are said

to be fallacies of accident. Indeed, Aristotle continues the quoted passage as follows:

... they say that it has been admitted that Coriscus is different from a man [that is, not a man], because it is an accident that the person from which he said that Coriscus is different is a man.⁶

Of course, Aristotle's point is not that the person different from Coriscus (for example, Socrates) is a man by accident, but rather that "not being Coriscus" is a predicate that does not entail "being a man."

Aristotle struggled with the transitivity problem later, for instance in *On Interpretation*. I will not try to discuss this delicate problem here beyond pointing out that what has been seen brings out an interesting connection between Aristotle's notion of essential predication and the identity sense of *einai*.

Likewise, anybody with a unitarian concept of being will face puzzles concerning the existential component of notion of being. These problems are thrown into a sharper focus by the fact that existence was not expressed by a separate verb but by the absolute construction with *einai*. At first sight, on the unitarian view any occurrence of *einai* might therefore be expected to carry an existential force. Yet that simply is not always the case. In *On Interpretation* 11.2 1a25–9 Aristotle notes that from

(1) Homer is a poet

we cannot infer

(2) Homer is (that is, exists).

Why not? According to Aristotle the reason is that in (1) Homer is said to be only incidentally – whatever that means.

There has been a considerable discussion among interpreters as to when an inference of the same form as from (1) to (2) is valid according to Aristotle, for instance, an inference from

(3) every B is A

to

(4) every B is (that is, exists).

Aristotle's words suggest that the validity depends on the predications (3) being an essential one. Yet when is it essential? What is his settled view? It seems that a satisfactory answer must depend on the context. Inferences like one from (3) to (4) are justified only after we have shown that A is what it means for B to be, that is, to exist. In virtue of the inextricability of the existential and predicative being from each other this amounts to the question as to what it means to be B, that is, what the essence of B is.

Still another difference between the different Fregean uses or senses of "is" is that the predicative "is" has a contrary, the identificatory one does not. This

distinction is seen for example, from *On Interpretation* 11.21a29–32, where Aristotle speaks of predications ($\chi\alpha\tau\eta\gamma\omicron\rho\acute{\iota}\sigma\iota\varsigma$) that do not have contraries and identifies them with $\chi\alpha\theta' \alpha\upsilon\tau\acute{o}$ predicates.

4. ARISTOTLE'S TREATMENT OF EXISTENCE

Now showing what the essences of different beings are is a matter of scientific syllogistic proofs. Hence we are led to ask: How did Aristotle treat existence in the context of a syllogistically structured science?

Aristotle's answer is given in *Posterior Analytics* 2.2. In 2.1 he has distinguished four types of questions that can be raised in science. The two questions concerning particular objects are "if it is" and "what it is." The former is a question of existence, the latter of definition (identity). The question is how these questions get answered in a syllogistic context. In 2.2 Aristotle tells us that all four types of questions concern the middle term, including questions of existence.

We seek, whenever we seek the fact or if it is *haplos*, whether there is or not a middle term for it.⁷

What this means for questions of fact is clear. In order to establish that

(5) every C is A

we have to find a middle B such that the following are true:

(6) every B is A

(7) every C is B.

Yet what could it mean to find a middle term that would prove existence (being *haplos*)? At first sight, knowing that Aristotle (like other competent speakers of the ancient Greek) expressed existence by means of the absolute construction with *estin*, it looks as if what is needed is B such that the following can be established:

(8) every B is (that is, exists)

(7) every C is B.

From these we might then be able to conclude

(9) every C is (that is, exists).

We might call inferences from (7)–(8) to (9) *existential syllogisms*. Basically, reliance on them is the view I want to attribute to Aristotle. However, in the form I have presented this view it is unacceptable. For one thing, there are no such existential syllogisms explicitly present anywhere in Aristotle. So how can this be what he means?

It can be, and I believe that it is, but in a somewhat oblique sense. A syllogism from (7) and (8) to (9) is not acceptable to Aristotle, not because it is not valid, but because it involves in a sense using existence as a predicate. As Aristotle himself puts the same problem in *Posterior Analytics* 2.7.92b12–15:

Next, we say that everything which a thing is must be proved through a demonstration, – except its *ousia*. But existence is not the *ousia* of any thing; for the things that existence do not constitute a kind [genus]. There will therefore be a demonstration that the item exists.⁸

Since existence thus is not a genus, it cannot operate as a syllogistic major term.

Yet even though purely existential syllogisms are impossible for Aristotle, existential syllogisms can in a sense be present in Aristotle as components of ordinary syllogisms with a major term restricted to some one category. This is the sense in which there will according to Aristotle be a demonstration (*apodeixis*) of existence. What I mean are syllogisms of the following form:

(10) every B is (an extant) A
 every C is B

 ergo: every C is (an extant) A.

It is in this sense that Aristotle can say that existence is proved by means of a middle term – not alone but as the existential component of an ordinary syllogism. In contrast to (10) the existential force does not carry upwards from the minor premise to the minor term. In other words, the following quasi-syllogism is not valid:

every B is A
 every C is (an extant) B

 ergo: every C is (an extant) A.

The tacit role of existential syllogisms in Aristotle has made his views more difficult to interpret than they should be. The precise import of Aristotle's treatment is highly relevant to the subsequent history of the different issues concerning existence. A number of them come up when it is asked: Is existence a predicate? As was seen, for Aristotle existence was not a predicate in the most literal sense, perhaps in the two most literal senses. First, existence could not operate as a syllogistic term, for “being is not genus.” As was pointed out, this is why purely existential syllogisms like (10) are not admitted by Aristotle. Second, existence was not expressed predicatively by Aristotle or by the other Greeks of his time, but by the absolute construction with *estin*.

Yet if so, if for Aristotle existence was not a predicate, what was the target of the subsequent critics of the view that existence is one? Could they possibly have been criticizing Aristotle? Yes, they could have, for the tradition of “existence as a predicate” is subtler than is usually realized. One way of seeing

this is to observe that Kant's famous criticism of existence as a predicate applies to views other than the ones Aristotle did not hold. What Kant argues is that the concept of hundred dollars – sorry, thalers – is not changed in the least if we add the notion of existence to it.

The small word 'is' adds no new predicate, but only serves to posit the predicate *in its relation* to the subject. ... The content of both must be one and the same; nothing can have been added to the concept, which expresses merely what is possible, by my thinking its object (through the expression 'it is') as given absolutely.⁹

What this means is that Kant is not only rejecting the view that existence can serve as an independent syllogistic term. (Kant's "absolute givenness" is clearly what is expressed by the absolute construction of verbs for being.) He was also denying that the idea of existence can be part of the force of a syllogistic term, in other words, that it adds something to concepts, presumably including the major terms of syllogisms, when conjoined with them. In other words, proper syllogisms cannot carry any existential force of the kind explained earlier. This Kantian thesis is a modern idea, closely related to the requirement that existence be expressed only by the existential quantifier. (The fact that in non-free logics individual constants carry an existential presupposition does not make an essential difference here.) This part of Kant's criticism does apply to Aristotle, for it was seen that syllogistic terms could carry an important existential force for him. To what extent Kant was aware of precisely what he was criticizing remains to be investigated. It can be seen however, that Kant's choice of words was not the aptest one in that something subtler was involved than a denial that "existence is a predicate" in the simplest possible sense of the expression.

5. WHENCE THE ASYMMETRY?

In spite of the simplicity of syllogisms like (10), they show us a remarkable thing. From the vantage point of our ordinary twentieth-century logic, syllogisms are at bottom symmetrical with respect to their major and minor premise. What happens is merely that a middle term is inserted between the major term and the middle term. Logically speaking, the two premises should have precisely the same form.

Yet one of the most conspicuous features of Aristotle's logic is that he treats major and minor premises differently. This is the case among other *loci* in his theory of science, which I will discuss in section 7 below. Moreover a similar asymmetry is rampant in Aristotle's modal logic. Yet what are the sources of this asymmetry? One place where it shows up is in epistemic logic.

What it amounts to there is an asymmetry between the potential major premise

$$(11) (\forall x)(B(x) \supset KA(x))$$

and the potential minor premise

$$(12) (\forall x)(C(x) \supset KB(x))$$

where “K” means “it is known that.” What I mean by asymmetry is the simple fact of logic that while the epistemic syllogism

$$(13) (\forall x)(B(x) \supset KA(x))$$

$$(\forall x)(C(x) \supset B(x))$$

$$(\forall x)(C(x) \supset KA(x))$$

is valid, the syllogism

$$(14) (\forall x)(B(x) \supset A(x))$$

$$(\forall x)(C(x) \supset KB(x))$$

$$(\forall x)(C(x) \supset KA(x))$$

is not. Thus according to epistemic logic knowledge (being known) trickles down in a chain of syllogisms from the major premise to the conclusion in each syllogism. This asymmetry matches the asymmetries of Aristotelian modal syllogisms. For according to him only the major premise needs to be necessary in a barbara-type syllogism in order for the conclusion to be necessary. It is also easy to understand why the knowledge operation should attach itself to the consequent of a premise like (11) according to Aristotle. Here it is instructive to think of (11) as an answer to the question “Are all the B’s known to be A’s?” We have to know what the B’s are in order to raise a well-defined question as to whether they are known to be A – or so Aristotle seems to have thought. Moreover from epistemic logic it is seen that this is enough to create the asymmetry in question. Yet why should this translate into a corresponding descent of the existential force? It is clear that for Aristotle we can have knowledge only of what exists. Hence (10) can be considered as a weaker version of (13) and (8) as a weaker sister of (11). And this is merely an instance of a more general way of thinking in Aristotle. Even though it is not easy to say precisely what Aristotle was thinking here, a connection in Aristotle between being known and existing is conspicuous enough. He insists repeatedly that only what exists can be known.¹⁰ Nor is this an idiosyncratic idea on Aristotle’s part. Early Greek thinkers, including Plato and Aristotle thought of knowledge as a *dynamis* which is successful when it “hits its object” or “realizes itself in its object.”¹¹ Here we are dealing with another Collingwoodean presupposition of Aristotle’s and Plato’s. For the purpose of reaching its object, this object of knowledge must exist. Conversely, if the object of my thought-act exists, then it is tempting to think that this thought-act has succeeded and therefore amounts to knowledge. This comes close to being literally true in the case of existential knowledge claims. If I claim that “A” exists, then if it does, I am right. Aristotle’s unitarian conception of being undoubtedly encouraged him

to extend this idea to claims of something's being as it is claimed to be in other Frege-Russell senses of being. Hence a transition from the validity of (13) to the validity of (10) would have seemed almost a matter of course for Aristotle. In this way, the role of syllogisms as means of knowledge acquisition and knowledge justification, the conjunction with his unitarian treatment of being, helps to understand Aristotle's trickle-down theory of existence.

6. EXPLANATIONS AND EXAMPLES

According to this theory of Aristotle's, in chains of scientific syllogisms existence is transferred from top down, from more general premises to less general ones. Thus in any one science, it suffices to assume existential force for the major term. As a part of the syllogism, this existential force is transferred to the minor term mediated by the middle term, as (10) shows.

This trickle-down property is the main peculiarity of Aristotle's treatment of existence which I will focus on in this paper. It requires a number of explanatory comments. First, the idea of existential force has to be understood correctly. In twentieth-century discussions, by existential presuppositions one typically means of assumptions of non-emptiness of different terms. What is meant here by existential presuppositions is the existential force of verbs for being. This is a much more sweeping requirement than the requirement of non-emptiness.

Similar things can arguably be said of necessary being in Aristotle – insofar as it can be distinguished from knowable being. Hence the appearance of the asymmetry in Aristotle's modal logic is only to be expected.

This is also one of the places where we need to appreciate the difference between Aristotle's ways of thinking and ours. Aristotle is not thinking model-theoretically of a fixed domain over which quantifiers range. He is thinking of the information conveyed by an actual utterance of a proposition. If we tried to force Aristotle's treatment into a some sort of model-theoretical frame, we might be tempted to think of a Meinongian universe of possible objects some of which are suddenly assumed ad hoc to be actual. Yet this idea does not by itself explain the crucial asymmetry which was discussed earlier. Nor is it easy to see what an alternative model theory would look like in realistic detail. In any case, such a model theory is not necessary for the purpose of understanding what Aristotle has in mind, anyway. What it shows that there is no simple way of expressing Aristotelian existential assumptions in a modern logical notation.

Aristotle's treatment of existence in a syllogistic context is connected with his habit of dealing with singular terms and general terms on a par. For instance, Aristotle is clearly thinking of the fallacious inference from (1) and (2) as being on a par with syllogistic inferences involving general terms. Hence, as attributing existence (being *haplos*) to an individual A means for Aristotle the presence of A in actuality, in the same way the proposition "every B is" means for Aristotle that all the (possible) members of the class of B's exist in full reality.

Furthermore, what has been found shows that in a sense existence was a predicate for Aristotle after all. Admittedly, it could not be predicated alone. Yet this is because it was too wide a predicate, so to speak, violating the division of beings into different categories, not because it is not a predicate of sorts. If Aristotle had not had his theory of categories, existence would have been a viable predicate for him. Indeed, existence in some one category should be a genuine predicate for Aristotle, even though he admittedly thought of the existence of each genus characteristic of some particular science as having been introduced by the definition of that genus.

These insights into Aristotle's treatment of existence help to understand several different aspects of his writings. To take an example almost at random, commentators have been puzzled by what Aristotle says in *Posterior Analytics* 2.1–2 about statements of existence (that is, being *haplos*). What he says is that such existential statements are also proved by means of a middle term. The puzzle is prompted by the fact that there are no examples of syllogisms proving existence in the Aristotelian *corpus* and even more by the fact that in the case of substances the question of existence does not seem to turn on the middle terms of the syllogisms. For a substance seems to exist in virtue of what it is itself, not because something else can be predicated of it. This quandary has been discussed among many others by Gómez-Lobo.¹² I will examine briefly his views as an illustration of the implications of what has been found here. Gómez-Lobo writes as follows:

David Ross confesses openly his perplexity; “But how can εἰ ἔστι or τί ἔστιν applied to *substance* be supposed to be concerned with a middle term? A substance does not inhere in anything; there are no two terms between which a middle term is to be found” (Ross 1965, p. 612). H. Tredennick puts forward similar views: “But when he [sc. Aristotle] goes on to say that in every case we are looking for a middle term doubts arise; because it is not obviously true that when we ask whether a substance exists or what it is, we are inquiring for its cause” (Tredennick 1960, p. 11).¹³

In brief, there seem to be only two ways out of this dilemma, either to deny that Aristotle is dealing with substances in *Posterior Analytics* 2.1–2 or to deny that he is dealing with existence there. Ross and Tredennick try to take the first way out, Gómez-Lobo the second.

Neither way is in fact correct, for we have here a neat case of *tertium datur*. Even in the case of substances, we have to prove their attributes syllogistically. Moreover as a component of those syllogisms, existential force trickles down from the generic premises through a series of syllogisms, mediated by their middle terms. There is no need of considering Aristotle's εἰ ἔστι statements in *Posterior Analytics* 2.1–2 or elsewhere as elliptical predications or otherwise different from purely existential ones.

Gómez-Lobo defends his interpretation by reference to *Posterior Analytics* A 1.71a24–7 where Aristotle writes of a triangle:

If you did not know whether there was such-and-such a thing *haplos*, how could you have known that it had two right angles *haplos*?¹⁴

He claims that the logical form of the inference Aristotle contemplates here is

$$(15) (\forall x)(Tx \supset Rx)$$

and the conclusion Ra . Then according to him “the missing particular premise is obviously Ta , ‘a is a triangle.’” Yet a comparison with passages like *Posterior Analytics* 2.7.92b4–11 tell very strongly against such a reading. Aristotle is in them unmistakably dealing with nonelliptical existence assumptions as a pre-requisite to genuine knowledge, and by the same token in the passage under scrutiny.

This is strikingly reflected by the fact that in free logic (which is what we must be dealing with here)

$$(16) (\forall x)(Tx \supset Rx)$$

and

$$(17) Ta$$

do not entail Ra except in conjunction with the further premise $(\exists x)(a=x)$ asserting the existence of a . One is thus tempted to turn the logical tables on Gómez-Lobo and to say that from the vantage point of the correct logic the missing premise “obviously” is “ a exists,” not Ta .

Furthermore, Aristotle’s example in *Posterior Analytics* 1.1.71a24–7 is merely an illustration of what he says earlier at 71a11–16 about two ways we can have knowledge:

Of some things we must already believe that they are, of others we must grasp what items spoken about are (and of some things both).¹⁵

This is in turn the distinction between the different basic assumptions of a science that Aristotle makes for example, in *Posterior Analytics* 1.10. There it is clear that what is missing when we do not know that such-and-such item is not *haplos*, is not a premise of what it is like but an existential assumption.

In this way we can also find an answer to the question posed above as to when an inference like

$$(18) X \text{ is } Y$$

ergo: X is, that is, exists

is valid for Aristotle. The answer is contextual. It depends whether we have reached a stage in our science at which the premise “ X is Y ” has been linked to the generic premises of that science by a sequence of syllogisms and hence been imbued with the existential force. If we have, Y is the closest thing we can say of X . In typical cases, Y then specifies the species of X . This shows

how natural the view is that has been put forward by some scholars that the inference (14) holds just when Y is a species-term, even when it is not the whole truth.

7. EXISTENCE AND GENERIC PREMISES

Perhaps the most important single feature of Aristotle's philosophy explained by means of my analysis of his treatment of existence concerns Aristotle's views of the structure of a science and the basic assumptions of a science. They are expounded most fully in *Posterior Analytics* A 10. To a considerable extent, these views are determined by the nature of the syllogistic logic which Aristotle was presupposing. In that logic, a logical inference (syllogism) proceeds by inserting a middle term between two extremes.¹⁶ From this it follows that the primary premises of a science are the ones mediating the shortest steps in a series of nested terms. I will call them atomic premises. They constitute one class of *arkhai* of a science. Another class is constituted by the general principles of reasoning needed in all sciences.

The *prima facie* puzzling thing is that Aristotle postulates a third class of primary assumptions of a science. I will call them generic premises. Furthermore, they differ in an interesting way from the atomic premises. They even seem to be the only substantive assumptions of a science.

For every demonstrative science has to do with three things: what it posits to be (these form the genus of which it considers the attributes [that belong to their subjects] in itself); and what are called the common axioms, the primitives from which it demonstrates; and thirdly the attributes, of which it assumes what each signifies.¹⁷

Here the common axioms are fairly obviously the general principles of all demonstrations, independent of the science in question, such as the principles of contradiction and excluded middle. For evidence, we can look at *Metaphysics* Γ, and compare what Aristotle says there with his distinction between different *archai* of a science in *Posterior Analytics* A 2 and 10. The "attributes" correspond to atomic premises. Elsewhere Aristotle asserts or implies that all atomic premises are definitions, with the middle term serving as the definiens.¹⁸ The second of these passages is especially interesting, in that Aristotle there adds "what is simple" (τα ἅπλοια) to the principles of everything. These "simples" are the generic premises, which are at the same time definitions of the generic terms and postulations of their existence. Indeed, if we realize this "exceedingly difficult" (Barnes) section (96b15ff) becomes much clearer. In sum, clearly Aristotle must have identified the atomic premises with the definitions of the different terms – "attributes" as he calls them – studied in any one science.

The one feature of Aristotle's trichotomy that does not follow from the nature of syllogistic logic as we understand it today is precisely Aristotle's view

that all the existential assumptions of a science are vested in the generic premises. Of the widest (generic) terms Aristotle says that scientists "assume these to be and to be *this*."¹⁹ In contradistinction to generic terms, Aristotle says of the attributes:

As to what are attributes of these in themselves, they assume what each signifies ... and they prove that they are through the common items and from what has been demonstrated.²⁰

This is what Aristotle means when he says that in a science we assume the meaning of the attributes.²¹ In what sense the other starting-points of a science can also be considered definitions will be indicated below.

Aristotle is obviously assuming that existential assumptions are handed down step by step in a series of nested syllogistic terms ("attributes") starting from the top. The basis of such an assumption, the only reasonable explanation for it, is that Aristotle is treating existence in the context of a syllogistic science in the way I have diagnosed. This treatment is in my view a vital clue to Aristotle's way of thinking about the logic of scientific inquiry.

For if Aristotle treated existence in syllogistic contexts in the way I have argued, then it follows that all the existential assumptions of a science are borne by the major terms of its most general premises.

It is now seen also that even the atomic premises are not merely nominal definitions in the twentieth-century sense, even though Aristotle says that they merely tell us what the terms (attributes) studied in some one science signify. In other words, these definitions are creative, facilitating new conclusions. Indeed, in one sense, they are the most common material premises of scientific syllogisms. They are in fact as numerous (by a factor of) as the conclusions of scientific inferences.²² In brief, definitions in the form of atomic premises represent for Aristotle a perfectly genuine kind of basic knowledge peculiar to each science. If such a conception of definition strikes a twentieth-century reader as strange, it might be instructive for him to recall that in Euclid, too, definitions play an essential role in some of his proofs.²³

8. EXISTENCE AND CAUSE

One of the most interesting consequences of Aristotle's way of treating existence concerns the notion of cause (*aitia*) or explanation (the "why"). In order to see what is involved, consider a minimal (atomic) syllogism of some science or other, say the following:

(19) every B is (an extant) A
 every C is B

 ergo: every C is (an extant) A.

What is going on in (19)? In it, the middle term B almost literally conveys

existence from A to C. Moreover, since (19) was assumed to be an atomic scientific syllogism, B is the last link in a chain of terms that mediate the descent of existential force from generic premises to the particular terms within the scope of the genus in question.

In view of such considerations, it was not only natural but almost inevitable for Aristotle to identify the middle term B as the proximate cause or explanation of C. It is what confers the gift of existence to C. Aristotle's identification of the middle term with the cause is thus little more than a corollary to his treatment of existence.

The peculiarities of Aristotle's views become clearer when we move to consider his notion of first cause. Clearly, as the proximate cause is given by the middle term of an atomic syllogism, so is the first or ultimate cause given by the term from which the existential assumptions trickle down to other terms. These are the most general terms of the different sciences. They are the existential and hence the causal and explanatory foundation of everything.

If this is evident, it is evident too that one cannot demonstrate the proper principles of anything; for those will be principles of everything, and understanding of them will be sovereign over everything. ... For you understand better if you know from the higher causes; for you know from what is prior when you know from uncaused causes.²⁴

Here the contrast with modern views is striking. For us, the first cause is a particular event, so to speak the big bang, the kick that started all the different causal chains rolling. Such an ultimate cause would be an event, or perhaps an initial state à la Laplace, but not a universal truth. (If you believe in the law of everything's return, alias the ergodicity of the universe, the initial state might not even play any explanatory role.) There is nothing here that would lend the most general laws a superior status. Hence the causal role Aristotle assigns to the most general truths and terms of any one science has to be explained. Moreover the obvious explanation is the status of such terms as the source of all existential force *apud* Aristotle. By connecting with each other the idea of universality and first cause, that is, of God, Aristotle's treatment of existence deeply influenced subsequent history of philosophy.

9. EXISTENCE AND SCIENTIFIC INQUIRY

Aristotle's theory of science with its threefold distinction between three kinds of principles can nevertheless be seen to lead him into a *prima facie* conflict with his conception of knowledge. For Aristotle the notion of knowledge is in a sense a goal-directed one. We know something only when our thinking hits its object. Accordingly, genuine knowledge must be knowledge of something existing, for it cannot reach or "hit" an object that does not exist.

Yet this seems to violate directly Aristotle's idea that the atomic premises of

a science do not carry an existential commitment. Such premises are mere definitions. They are supposed to tell us what the terms involved mean, in other words, what it is to be something. Yet they do not carry existential force. Hence we can scarcely be said to know "what it is," that is, to know those atomic premises in the full sense of the term if we do not even know that their terms exist. Hence in the actual process of scientific inquiry we cannot simply start from atomic premises. Those premises could support scientific conclusions when they are tied together in a linear sequence of syllogisms only if they had existential force.

This Aristotelian requirement may be considered a special case of his idea that in a full-fledged notion being there must be all the different Frege-Russell senses present, including the existential one.

Again, how will you prove what a thing is? For it is necessary for any one who knows what a man or anything else is to know too that it is (for of that which is not, no one knows what it is – [you may know] what a name signifies when I say goatstag, but it is impossible to know what a goatstag is).²⁵

Yet an atomic premise does not *per se* guarantee that its terms exist. Hence it cannot represent a full-fledged knowledge even of what its terms are. Yet how can it then serve as a primitive premise of any scientific syllogism? Obviously it cannot, and obviously therefore the actual procedure in science (even in its syllogistic part) is more complex than a mere piling up of minimal syllogisms.

The same problem can be formulated in terms of what is required of a definition or an account of what a thing is. Merely specifying what a term signifies is not enough. One has also to know that the definiendum exists. Or, rather, we are dealing with two different senses of definition. We might call them type one and type two definitions. The former are sometimes referred to as nominal definitions and the latter real definitions. What Aristotle means is nevertheless a far cry from what the terms "nominal definition" and "real definition" have meant in subsequent history of philosophy and logic. For, as we have seen, even type one definitions can act as syllogistic premises, thus be creative, and represent genuine knowledge about reality. What makes the real difference between a type one and a type two definition is that the latter, but not the former, guarantees the existence of the definiendum.

Of course there is a third type of definition ("type three definition"). This is because in the case of the widest (generic) term that serves to specify the field of a science type one and type two definitions coincide. Aristotle describes type three definitions by saying that

The definition of immediates is not undemonstrable positing of what they are.²⁶

Definitions of type three are obviously intended to be the generic premises of

the different sciences. The word “undemonstrable” might nevertheless seem very strange here. For all first principles of science are undemonstrable, including the generic premises. Likewise, the term “immediate” strikes a false note, for atomic premises (type one definitions) are also immediate, even in a more obvious sense.

Indeed, Aristotle cannot solve his problems merely by distinguishing the three types of definitions from each other. The main problem that remains is the following: If we are to use primary atomic premises in scientific syllogisms for the purpose of obtaining knowledge in the full sense of the word, these syllogisms must be able to establish existence and not only *Sosein*. For this purpose, atomic premises apparently must be type two definitions. Yet what is given to us as starting-points (*arkhai*) of atomic syllogisms in each science are merely type one definitions. Hence we must somehow bring the existential force down from the generic premises to bear on atomic premises before we can use them as premises of proper scientific syllogisms.

Aristotle’s self-confessed difficulty thus is precisely that atomic premises, even though they can serve as definitions (of type I) of what something is, cannot yield knowledge that what is defined exists.

So will the definer prove if not what a triangle is? Yet then he will know by definition what it is and yet not know if it exists; and this is impossible.²⁷

Aristotle’s discussion of this problem has prompted an extensive interpretational literature which will not be reviewed here.²⁸ The situation is fundamentally quite simple, once it is realized what his problem was.

Aristotle’s solution explained primarily in *Posterior Analytics* 2.8. It is an application of his treatment of the notion of existence as I have diagnosed it to a syllogistic context. This solution is in effect to point out that existence is carried down by any old chain of syllogisms, even before this chain has been analyzed into minimal (atomic) steps and therefore before we have reached an explanation (the why). This kind of knowledge of existence without knowing the why is what Aristotle illustrates by “incidentally knowing that a thing is” at 93a22 and 25. Thus we can come to know that something is both in the predicative and the existential sense without yet knowing the why it is. One need not know “what a thing is”, either, for knowing what it is goes together with the cause or explanation, that is, with the why provided by the middle term of a minimal syllogism.

Aristotle’s own explanation runs as follows:

When we discover it, we know at the same time the fact and the reason why – if we proceed through immediate premises. Otherwise we know the fact but not the reason.²⁹

Aristotle’s example is a lunar eclipse. The quoted passage continues by reference to it.

Moon, C, eclipse A, not being able to produce a shadow although nothing visible is between us and it B. If B ... holds of C, and A being eclipsed, holds of B, then it is plain *that* it is eclipsed but not yet *why*; and we know *that* there is an eclipse but we do not know what it is.³⁰

There is a scholarly problem here in that in the crucial sentence at 93a36 a number of texts read, not δι' ἀμέσον, but διὰ μέσον, giving it the sense of "if we proceed through middle terms." Indeed this is how Barnes³¹ translates the passage, appealing to "most MSS." This majority all belongs to the same tradition, however, and hence do not provide independent evidence for each other. In contrast there is a MS, namely, Waitz's n (Ambrosianus 490), which represents an independent tradition and which gives the reading adopted here.³² The question is in any case decided by the sense of Aristotle's words, which is incompatible with the Barnes translation.

We should not be puzzled by the fact that Aristotle seems to be contrasting with each other knowledge *that* and knowledge *why*, not knowledge of atomic premises and knowledge of the existence of their terms. Aristotle points out in so many words that knowledge of existence and knowledge of facts are analogous; they are both explained by means of a middle term.³³ This analogy is in turn rooted in Aristotle's treating the existential and predicative senses of *estin* on a par.

Thus there can be two kinds of syllogistic demonstrations going on in an Aristotelian science. On the one hand, there are demonstrations from type two definitions. They are the proper scientific syllogisms. They must proceed by the minimal (shortest) syllogistic steps. On the other hand, preliminary to such demonstrations there are syllogisms lending the existential force to atomic premises. These syllogisms need not be analyzed down to their shortest possible steps. Such syllogisms have as their conclusions potential atomic premises. They restore the existential force of those premises, but they do not demonstrate them as definitions, as answers to why-questions. For that purpose, a demonstration through minimal syllogistic steps is needed. For the "why" is given only by the middle terms of a chain of immediate syllogisms.

This explains also Aristotle's choice of words at *Posterior Analytics* 2.10.94a9–10 (cf. above). Those words assume a natural meaning if they can be taken to refer to the existential component of the premises of scientific syllogisms. For this component is undemonstrable only in the case of generic premises, whereas in all the other primary premises it is mediated by preliminary nonimmediate syllogisms.

Thus Aristotle's problem in *Posterior Analytics* B 8 is not just that one can be aware of a fact but not of its reason or that atomic syllogistic premises (type I definitions) can be true but not incapable of establishing existential conclusions. It is not that run-of-the-mill syllogisms cannot provide an explanation unless they are atomic. His problem can only be appreciated against his treatment of existence outlined in this paper. It is due to the fact that in this treatment atomic premises cannot serve as premises of fully scientific inferences

before they somehow receive the existential force that only the generic premises of a science automatically have.

Here my diagnosis of Aristotle's way of dealing with existence helps to solve another major problem of Aristotelian interpretation. At the same time, Aristotle's theory of definitions of different kinds is a vivid example of what was said earlier about the interrogative structure of Aristotelian epistemology and methodology. What has now been seen implies that there literally is no stage of our knowledge of a science (*apud* Aristotle) when we have reached all (and only) the first principles of a science so that all that is needed henceforth is merely to draw logical conclusions from them. For it was seen that before proper scientific conclusions can be drawn from atomic premises, they must receive an existential force by means of other syllogistic inferences from primary premises of a science. And Aristotle's account shows that the premises of such preliminary syllogisms typically are not atomic, that is, not among the first principles of a science.

This discrepancy between Aristotle and Euclid is seen to be an unavoidable consequence of Aristotle's characteristic assumptions in his logic of science. As a result of these assumptions, the structure of the actual dialectical unfolding of an Aristotelian science is more complicated than has usually been realized.

One such apparent complication is that Aristotle in *Posterior Analytics* 7–8 clearly envisages two different kinds of syllogistic inferences being carried out in a given science. There are on the one hand the syllogisms that prove existence.

There will therefore be a demonstration that the item exists. And this is what the sciences as a matter of fact do: a geometer assumes what triangle means and proves that triangles exist.³⁴

Now such demonstrations must establish existence, that is, be like (7)–(9). But they do not establish the why or what the item in question is. That can be established only by chains of atomic syllogisms.

We can now go back to another one of our earlier questions. One of them was: When does a proposition like

(20) every B is A

entail according to Aristotle

(21) every B is (that is, exists)?

The answer can now be seen to depend, not merely on the terms B and A, but on the stage of inquiry which we have reached. If (20) has been reached by a sequence of syllogisms from the generic premises of a science (not necessarily by a sequence of atomic or minimal inferences), we can conclude (21) without further ado, if not, we cannot. This can presumably be extended to all purported inferences from "B is A" to "B exists," such as from (1) to (2) or from (3) to (4) above.

Some general remarks may still be in order concerning the structure of an

Aristotelian science and its several ingredients. In Chapter 3 below it will be emphasized that according to Aristotle general relationships between forms – presumably represented by the terms of a scientific syllogism – can in principle be ascertained as it were by thought-experiments, that is, by realizing the relevant forms in our mind by thinking of it. This implies that the problem of finding the definitory characterizations that manifest themselves in the form of atomic premises is essentially one of concept formation, of forming the relevant forms from the materials provided in the last instance by sense-perception. Thus atomic premises are also obtained in a sense from experience, but only in a secondary sense, namely, in the sense that the terms (concepts) that they involve must in the last analysis be derivable from sense-experience.

In contrast, it is the task of ascertaining which forms are instantiated outside the mind that requires an extra empirical input – or else proof of assumptions that have an existential force.

These observations throw some more light on the different ingredients of an Aristotelian science. It shows why the existential component of scientific syllogisms had the significance it had for Aristotle. A much greater part of the empirical content of a scientific proposition (premise in a sequence of scientific syllogisms) resides in its existential force than it does for us post-Fregean philosophers. Among other things, this helps to understand the attention paid to the role of existential assumptions by Aristotle in *Posterior Analytics* 2.3–10.

NOTES

1. *Posterior Analytics* A 6, 75a22–7. In quoting *Posterior Analytics*, I have followed, with some changes, Jonathan Barnes' translation in *Aristotle's Posterior Analytics*, 2d ed. (Oxford: Clarendon Press, 1994). Otherwise I have followed mostly Loeb Library translations, such as Hugh Tredennick's translation and commentary in *Aristotle Posterior Analytics*, Loeb Classical Library (1960), with the exception of those instances in which I have tried to use the translations in the Clarendon Aristotle volumes (for example, *Aristotle's Prior and Posterior Analytics*, ed. W. D. Ross [Oxford: Clarendon Press 1965]).
2. *Metaphysics* Γ, 2.1003b22–30.
3. *Sophistical Refutations* 6, 169a 8–10.
4. See Charles H. Kahn, *The Verb 'be' in Ancient Greek*, vol. 6, *The Verb 'Be' and Its Synonyms* (Dordrecht: D. Reidel, 1973), Appendix A.
5. *Sophistical Refutations* 5, 166b32–4.
6. *Sophistical Refutations* 5, 166b34–6.
7. *Posterior Analytics* B 2, 89b36–7.
8. *Posterior Analytics* B 7, 92b12–15.
9. See Immanuel Kant, *Critique of Pure Reason*, trans. Norman Kemp Smith (London: Macmillan, 1956), A598–602.
10. See for example, *Posterior Analytics* A 1, 71a24–9; B 7, 92b4–8; cf. 8, 93a27–8.
11. Cf. Jaakko Hintikka, "Knowledge and Its Objects in Plato," in *Knowledge and the Known* (Dordrecht: D. Reidel, 1974), 1–30.
12. Gómez-Lobo, "The So-called Question of Existence in Aristotle *Posterior Analytics* 2.1–2," *The Review of Metaphysics* 34 (1980): 71–89.

13. Gómez-Lobo, "The So-called Question of Existence," 73.
14. *Posterior Analytics* A 1, 71a24–7.
15. *Posterior Analytics* A 1, 71a11–16.
16. Cf. *Posterior Analytics* A 22, 84a36–7.
17. *Posterior Analytics* A 10, 76b11–16.
18. See *Posterior Analytics* B 3, 90b24–5; 13, 96b22–3; 17, 99a20–24.
19. *Posterior Analytics* 76b5–6.
20. *Posterior Analytics* 76b6–10.
21. *Posterior Analytics* 76b6–10.
22. See *Prior Analytics* A 25.
23. See Ian Muller, *Philosophy of Mathematics and the Deductive Structure in Euclid's Elements* (Cambridge: MIT Press, 1981), 38.
24. *Posterior Analytics* A 9, 76a16–20.
25. *Posterior Analytics* B 7, 92b4–8.
26. *Posterior Analytics* B 10, 94a9–10.
27. *Posterior Analytics* B 7, 92b17–18.
28. See, for example, Owen Goldin, *Explaining an Eclipse* (Ann Arbor: University of Michigan Press), 1996.
29. *Posterior Analytics* B 8, 93a35–7.
30. *Posterior Analytics* B 8, 93a37–b3.
31. Barnes, *Aristotle's Posterior Analytics*, 57.
32. W. D. Ross, *Aristotle's Prior and Posterior Analytics*, 87–8.
33. See *Posterior Analytics* B 2, especially 90a6–14.
34. *Posterior Analytics* B 7, 92b14–16.

CHAPTER 2

SEMANTICAL GAMES, THE ALLEGED AMBIGUITY OF “IS”, AND ARISTOTELIAN CATEGORIES

1. GAME-THEORETICAL SEMANTICS FOR FORMAL LANGUAGES

In earlier papers, I have sketched an approach to logical and linguistic semantics which embodies some of the same ideas on which Wittgenstein's notion of language-game is based.¹ One of these ideas is that in order to appreciate the semantics of a word (or any other primitive expression of a language) we should study its function in the rule-governed human activities which serve to connect our language (or a fragment of a language) with the world. What Wittgenstein called *language-games* can typically be considered as such linking activities. In the languages (or parts of languages) I will study in this paper, certain activities of this kind are construed as games in the strict sense of the mathematical theory of games. They are called *semantical games*, and the semantics based on them is called *game-theoretical semantics*. Its basic ideas are explained most easily by reference to formal but interpreted first-order languages. Such a language, say L , can be assumed to have a finite number of primitive predicates which are interpreted on some given fixed domain D . Their being interpreted on D amounts to saying that any atomic sentence formed from one of the predicates of L plus the appropriate number of proper names of the elements of D (whether the names are in L or not) has a definite truth-value, true or false. One of the main tasks of any semantics for first-order formal languages is to extend this assignment of truth-values to the rest of the sentences of L .

This can be done by defining certain two-person games $G(S)$, one for each sentence S of L . The players are called Myself (or I) and Nature. The game $G(S)$ can be thought of as an attempt on the part of myself to verify S against the schemes of a recalcitrant Nature. This motivates the games rules, which may be formulated as follows:

- (G. \vee) In $G(A \vee B)$, the first move is made by myself, who chooses A or B . Accordingly, the rest of the game is $G(A)$ or $G(B)$.
- (G.&) In $G(A \& B)$, the first move is made by Nature, who chooses A or B . Accordingly, the rest of the game is $G(A)$ or $G(B)$.
- (G. \sim) $G(\sim A)$ is played in the same way as $G(A)$ but with the roles (as defined by these rules) of the two players exchanged.
- (G.E) In $G((\exists x)F(x))$, the first move is made by myself, who chooses an element of D . If it has a proper name in L , the players use this name. If not, the players give it a proper name, and go on to use

it. Let this name be (in either case) “ b .” Then the rest of the game is $G(F(b))$.

(G.U) Likewise for $G((x)F(x))$, except that Nature chooses b .

(G.A) If A is an atomic sentence, the game $G(A)$ is won by myself if A is true, by Nature if A is false.

We may think of these semantical games as zero-sum games: what is won by myself, Nature loses, and *vice versa*.

COMMENTS: (i) Since each move in a given game removes one occurrence of the logical symbols \sim , \vee , $\&$, $(\exists-)$, $(-)$ from the sentence considered, the game will come to an end in a finite number of steps in a situation in which (G.A) is applicable. Hence (G.A) suffices to define winning and losing for all games (so far considered).

(ii) Even when the game has reached a sentence A , the two players need not know D completely. In order to allow for the possibility of incomplete information, we must require that some moves are made on the basis of an incomplete knowledge (at the time) of the domain D .

(iii) The given initial sentence S can now be defined to be *true* if there exists a winning strategy for myself in $G(S)$. S is *false* if there is a winning strategy for Nature.

(iv) In the simplest first-order languages, this truth definition is equivalent with the usual Tarski-type definitions, as one can easily ascertain. Beyond these simple cases, there are nevertheless many possibilities of further applications of game-theoretical semantics which are not amenable to traditional treatments, or are not treated equally easily by old methods. Among such extensions of our simple games, one can mention the following:

(a) Game-theoretical truth definition can be used in games on urn models (see Rantala (1974), Hintikka (1974a)), and not only on classical (invariant) models.

(b) My game-theoretical approach can be extended by means of the idea of a subgame.² In this direction, game-theoretical semantics converges with the functional interpretations first proposed by Gödel (1959).

(c) Game-theoretical truth definitions can be used even in infinitely deep logics, i.e., in logical languages where atomic formulas cannot always be reached from a given sentence by a finite number of steps of analysis.³

(d) Informational independence of different quantifier moves (failure of perfect information) gives us an opportunity to develop a semantics for branching (more generally, partly ordered) quantifiers.⁴

2. GAME-THEORETICAL SEMANTICS FOR FRAGMENTS OF NATURAL LANGUAGES

Game-theoretical semantics is thus a powerful and flexible tool in the semantics of formal languages. This prompts the question as to whether it can be used in the study of natural languages as well.

It follows from what has been said that game-theoretical semantics will apply to natural languages at least in so far as they can be translated into, or paraphrased in, formal first-order languages. The number of eminent philosophers, logicians, and linguists who have in fact sought to use first-order logic as their main semantical framework shows that even this kind of indirect applicability to natural-language sentences (*viz.*, via their translations into the language of predicate logic) is not without interest. However, such an indirect application merely moves our difficulties into a new *locus* by turning them into translation problems. Hence it is of great interest to try to develop a game-theoretical semantics for natural languages directly, without taking the trouble of first trying to translate natural-language sentences into the canonical notation of formal quantification theory.

There may be reasons to think of the language to which the new game rules are applied as a regimented (“formalized”) variant of English. If so, this regimented discourse is quite different from any traditional logical formalism, and much closer to the surface forms of English than the usual canonical notations of logical symbolism.

Game-theoretical semantics can in fact be extended to natural languages like English fairly directly. Much of the extension is obvious. Perhaps the most important nontrivial change is that, in the game rules for natural-language quantifiers, it is whole quantifier phrases, not bound variables, for which proper names are now plugged in. This necessitates amplifications in the game rules which serve to take care of the quantifier phrase itself. For instance, a special case of a game rule (G. some) for the English quantifier word *some* will be as follows:

(G. some) (special case). If the game has reached a sentence of the form

(*) $X - \text{some } Y \text{ who } Z - W$,

an individual may be chosen by myself. If the proper name (preexisting or freshly dubbed) of this individual is “*b*,” the game is then continued with respect to

(**) $X - b - W$, b is a Y , and $b Z$.

It is assumed in this special case that Y , and Z , and $X - W$ are singular and that *who* occupies the subject position in the clause *who Z*. It is obvious in principle how these simplifying assumptions can be dispensed with.

Much more has to be said of the anaphoric relations that hold in (**), in relating to those holding in (*). An outline of a theory of anaphora in English

has been presented in Hintikka and Kulas (1985). It will not be relied on in this paper, however.

It is especially instructive to compare (G.E) and (G. some) with each other. Both involve a substitution of a proper name, but the *substituens* is different in the two cases: a formal variable in (G.E), but a complete quantifier phrase in (G. some). This throws some light on the differences in the ways the semantics of formal and natural languages work.

The corresponding special case of the game rule for *every* might be run as follows:

(G. every) (special case). If the game has reached the sentence

(*) $X - \text{every } Y \text{ who } Z - W$,

an individual is chosen by Nature. If the proper name (preexisting or freshly dubbed) of this individual is "*b*," the game is continued with respect to

(**) $X - b - W$, if *b* is a *Y* and *b* *Z*.

With this one change, the game-theoretical treatment of quantificational and truth-functional discourse can be extended from formal languages to natural ones.

One feature of the resulting theory is worth pointing out here. There is in game-theoretical semantics for a natural language typically one game rule for each semantically primitive word or phrase. (This is the case even more clearly in the game-theoretical treatment of formal languages.) An interesting exception is *is*. Insofar as a special provision has to be made for the purpose of treating *is*, it does not take the form of a game rule but rather a stipulation as to how the outcome of a play of one of our games is to be treated semantically. These outcome sentences may take several different forms, many of which involve *is*, e.g.,

b is A. (e.g., "Jack is blond.")

b is an X. (e.g., "Jack is a boy.")

b is. (e.g., "God is.")

S is a Y. (e.g., "Red is a color.")

This feature of the behavior of *is* in game-theoretical semantics is likely to be connected with its status as an auxiliary in grammar. It is also interesting in that it shows that *is* belongs to that part of semantics which deals with what in the game-theoretical treatment are atomic sentences and their ingredients. We might call this subsystem of semantics the *referential* system as distinguished from the *structural* subsystem that deals with the semantics of nonatomic sentences. The former subsystem has not been dealt with in recent philosophical and logical discussions from a game-theoretical viewpoint. One by-product of the study of *is* in game-theoretical semantics might thus be to call attention to this neglect.

One way of systematically carrying out the extension of game-theoretical

semantics from formal to natural languages would be to cast game-theoretical semantics for natural languages in the form of a formal model of such languages, somewhat in analogy with Montague semantics. Even though I shall not try to carry out such a development here in any detail, the project of doing so offers us a useful vantage point from which to view the issues which will be taken up in the rest of this paper.

It is important to note that I am not proposing to translate natural languages into the canonical notation of received formal logic. Such translations may perhaps ensue from a game-theoretical treatment of natural languages, insofar as it is successful. However, these possible translations are at best by-products of the game-theoretical treatment, not a tool it can use. In other words, the formal model itself that I am envisaging is a direct model of a natural language. Its primitives, including quantifier words, are those of English, and its expressions have in principle the same surface forms as those of a class of English expressions. The game rules apply to these regimented English expressions, not to their possible translations into a logical notation, and so do the semantical notions that can be defined in terms of the semantical games sketched above.

In this paper, I shall for the most part restrict my explicit attention to the English counterparts to formal logicians' existential and universal quantifiers, and disregard all the so-called nonstandard quantifiers, such as "many," "few," "most," "several," "the," etc. I believe that essentially the same things can be said of all these quantifiers, but I will try to say them of the former only.

3. THE ALLEGED AMBIGUITY OF "IS" ACCORDING TO FREGE AND RUSSELL

One of the most important consequences of the basic ideas of game-theoretical semantics relates to the Frege–Russell claim that words like *is* are ambiguous. Frege and Russell claimed, in effect, that *is* and its cognates are ambiguous in several ways. They distinguished between the following different meanings, each with a different formalization in the usual formalization of first-order logic (lower predicate-calculus):

- (i) the *is* of identity, as in "Jack is John Jr." or $\text{Jack} = \text{John Jr.}$;
- (ii) the *is* of predication (the copula), as in "Jack is blond" or $\text{Blond}(\text{Jack})$;
- (iii) the *is* of existence, as in "God is" or $(\exists x)(\text{God} = x)$;
- (iv) the *is* of class inclusion (generic *is*), as in "Man is an animal" or $(\forall x)(\text{Man}(x) \supset \text{Animal}(x))$.

What is more, Frege and Russell built (as we can see from (i)–(iv)) this ambiguity into that marvelous creation of theirs, modern (elementary) logic, variously known as first-order logic, quantification theory, or lower predicate-calculus. Anyone who uses this logic as his or her framework of semantical representation is thus committed to the Frege–Russell ambiguity thesis.

In an earlier paper I have shown that this ambiguity claim is false if game-theoretical semantics is the right semantics of the relevant aspects of English.⁵

Of course there are different *uses* of *is*. This does not imply, however, that we are dealing with a real ambiguity. The different uses do not represent different *meanings* or *senses* of the verb in game-theoretical semantics. Not only is the Frege–Russell ambiguity dispensable in my semantics; it can be shown that there are cases in which the Frege–Russell distinction cannot be made in game-theoretical semantics. Indeed, these cases comprise most of the typical uses of *is*. In this sense, game-theoretical semantics offers a counterexample to the Frege–Russell ambiguity thesis. Even if we do not want to commit ourselves to saying that game-theoretical semantics is the last and final truth in the semantics of natural languages, it offers a possible and indeed eminently viable semantical framework alternative to the received ones, in which the auxiliary verb *to be* does not exhibit the Frege–Russell ambiguity.

This conclusion has both linguistic and philosophical implications. For instance, no major philosopher before Frege (or possibly before John Stuart Mill and De Morgan) seems to have maintained the Frege–Russell ambiguity claim. Conventional formal logic, which goes back to Frege and which is based on the Frege–Russell thesis, is thus an entirely unsuitable tool in discussing pre-Fregean philosophers' views on existence, predication, identity, and being.

Linguistic repercussions of the demise of the hegemony of the Frege–Russell thesis include a re-evaluation of our frameworks of semantic representation and a critical look at the notion of ambiguity itself. Furthermore, my revisionary result is not without relevance to the grammatical theory of auxiliaries, even though I am not in this paper dealing with it directly. For one thing, if the Frege–Russell thesis is correct and the auxiliary verb *is* is radically ambiguous, there is little hope of construing the linguistic category of auxiliaries as a universal of any sort or even as a uniform grammatical category, at least insofar as semantics is concerned. Those linguists who are maintaining that there is a well-defined grammatical category of auxiliaries in natural languages like English should therefore welcome heartily my refutation of Frege and Russell *qua* theorists of English auxiliaries.

4. GAME-THEORETICAL SEMANTICS AS A MANY-SORTED THEORY

But what can we say of the ambiguity or nonambiguity of *is*? I have so far only suggested that it does not exhibit the alleged Frege–Russell ambiguity. But maybe it is ambiguous in other ways. In order to discuss this subject, we have to go back to the basic ideas of game-theoretical semantics.

There are indeed further insights to be derived from a closer analysis of the special case of (G. some) formulated earlier. In it, the selection by myself of an individual *b* enabled the players to move from

(1) $X - \text{some } Y \text{ who } Z - W$

to

(2) $X - b - W$, b is a Y , and b Z .

In this case, the entity selected obviously has to be a human being. In the case of other *wh*-words, the choice is to be made from other classes of entities. For instance, if instead of (1), the players were facing

(3) $X - \text{some } Y \text{ where } Z - W,$

where the relative clause can be thought of as being formed from an expression of the form

$Z - \text{in } V,$

the choice d would have to be a spatial location, and the output sentence would be

(4) $X - d - W, d \text{ is a } Y, \text{ and } Z \text{ in } d.$

What can we say of this kind of move in general? How are the players supposed to know what class of entities to make the selection from? The first approximation toward an answer which I will suggest is that it is by and large shown by the *wh*-word (“who” in (1), “where” in (3), and analogously in other cases). This is obviously the natural first guess on any view. According to this view, each different *wh*-word (plus certain phrases containing such words, e.g., a preposition + a *wh*-word) comes, apart from a number of exceptions which have to be discussed separately, associated with a different range for the quantifier which that *wh*-word basically is. Among these different *wh*-words (and expressions with the same function) there are the following:

- (5) (i) who
 (ii) that, which
 (iii) when
 (iv) where
 (v) why
 (vi) how
 (vii) equal to which, greater (smaller) than which
 (viii) like which

Speaking of *wh*-words here requires an explanation. What is listed in (5) are, of course, different relative pronouns, words with a comparable function, and certain phrases which behave similarly. Most of them are identical in form with certain corresponding question words and phrases. The latter are what is properly referred to as “*wh*-words” and as “*wh*-phrases.” However, in some cases there are discrepancies. For instance, the question word corresponding to “that” (and “which” in some of its uses) is “what,” and the *wh*-phrase corresponding to “like which” is “like what.” In some cases, there is a question phrase to which no relative-pronoun-like expression naturally corresponds. A case in point seems to be “how much,” even though some of its uses resemble those of relative pronouns. (Witness, e.g., sentences like “Some reliable indication of how much money Poland owes to its neighbors is obtained from its balance of payments.”) These differences between relative pronouns (and their cousins) and *wh*-words will nevertheless be disregarded in this paper.

It requires a separate investigation to decide which phrases involving wh-words (e.g., preposition + a wh-word) require a separate domain of values to be chosen in our semantical games. Some such prepositional phrases require further qualifications in our formulation of rules like (G. some) in the first place. I shall not discuss them here, however.

Apart from such complications, we have found a rough one-to-one correlation between the different wh-words (plus a number of other phrases involving wh-words) and the widest ranges that quantifiers in English can have. (Smaller ranges can always be established by relativization.) To have a word for these maximal quantifier ranges, I shall take a hint from Plato and call them maximal genera. (Cf. Plato's *megista gene*.)

5. PREDICATIVE CORRELATES OF THE MAXIMAL GENERA

This correlation between the different maximal genera and the different wh-words and phrases is paralleled by a distinction between different substitution-instances of our Y (see (1) above). In order to see this, note what can happen to a quantifier phrase like

(6) some Y wh-x Z,

(where wh-x is a wh-word) when its several elements are allowed to disappear. Notice, first of all, that the relative clause wh-x Z may be absent. (Indeed, the rule (G. some) should be modified so as to allow for this case.) When this happens, the wh-word cannot any longer be used as a guide to the subdomain (maximal genus) from which the individual *b* is to be chosen. All we have then to indicate the range of choice is Y. Clearly, the meaning of Y will tell what this range is. As a mechanism to accomplish this, some system of semantical markers can be used. The details are not relevant here. As a special case, we obtain a classification of the *simple* substitution values of "Y," i.e., of the simplest things that can be said of an entity. This multiple classification will match (at least roughly) the list of different wh-words, for both serve to signal the same thing: the set from which the individual *b* in (G. some) is to be selected.

This observation is further confirmed by noting what happens when we try to remove Y, too, from the input sentence of rules like (G. some). (This case, too, must be included as a variant form in rules like (G. some).) According to the line of thought I have been following, in this case nothing would remain to indicate the subdomain of a player's choice. What actually happens in English is precisely what I have led you to expect. We can omit Y only if the quantifier word occurring in the rule is amplified so as to provide the missing information as to what the domain of a player's choice is. In other words, (6) ceases to be grammatical, but becomes grammatical when the quantifier word *some* is replaced by a longer variant. Corresponding to the different wh-words (5), these are in the case of *some*:

- (7) (i) someone, somebody
 (ii) something
 (iii) sometimes
 (iv) somewhere, someplace
 (v) somewhy, for some reason, because of something
 (vi) somehow, someway, somewise
 (vii) somewhat, some amount, some
 (viii) of some kind

Thus, it appears that in deciding what maximal genus the players' choices are made from, they do not rely only or principally on the *wh*-word which occurs in the quantifier phrase. They rely in the first place on the meaning of *Y*. When *Y* is not around, the information it normally codifies has to be supplied by the quantifier word itself, which therefore has to be amplified as indicated by (7).

For *every* the corresponding partial list is the following:

- (8) (i) everyone, everybody
 (ii) everything
 (iii) always, every when
 (iv) everywhere, every place
 (v) (?)
 (vi) every which way, every how
 (vii) (?)

Similar lists can be given for "any," "no," etc.

The interesting thing here is not the details of the lists (7) and (8). These lists are rather messy in their details. What is interesting is the parallelism between (5) and (7). Even though this analogy is somewhat rough and ready, it is interesting in that it shows that there is a concurrence between the information concerning the relevant maximal genus which is yielded by the *wh*-word and which can be gathered from *Y*.

The latter source of information is open to the players even when the *wh*-word in question is one which does not help to decide between the different maximal genera. This happens particularly with the words *which* and *that*, the latter of which is obviously a variant of *what*. Their peculiarities require, in fact, a separate investigation.

That has at least four different uses. They are shown more clearly by their interrogative cousin *what*. The interrogative *what* can have at least these four paraphrases:

- (i) What (which) *object*?
 (ii) What (which) *animal*? More generally, what (which) living organism?
 (iii) What *kind of* object (or organism or person)?
 (iv) What *material*?

These observations are interesting in view of comparisons with formal languages of logic. If the view I am currently considering is right, natural languages have only a many-sorted quantification. Moreover, this many-sortedness

appears irreducible. Unlike many formal languages, natural languages like English do not operate by pooling the different restricted ranges of sortal quantifiers together.

For some purposes, this many-sorted quantification in English can nevertheless be (more or less naturally) reduced to relativized quantification. For some of the widest ranges of quantifiers, there are nouns which delineate that range. The following is a list of such nouns paralleling our earlier lists:

- (9) (i) person
- (ii) (a) object
- (b) animal, organism
- (c) kind
- (d) material
- (iii) time (moment or interval of)
- (iv) place
- (v) cause, reason
- (vi) way
- (vii) amount
- (viii) kind, quality

In their interrogative use, many of the quantifier phrases (5) admit of a paraphrase in terms of the corresponding member of (9), e.g., *who* as *which person*, *where* as in (*at*) *what place*, etc. This does not vitiate the character of the quantifier ranges that go together with (5) as the widest ones in English semantics – at least in the semantics of the part of English to which we are here, in effect, restricting our attention.

6. TOWARDS A FORMAL MODEL OF THE CORRELATED DISTINCTIONS: ITS MOTIVATION

What kind of formal model of English semantics is suggested by these observations? I cannot give a full formulation here, but some indications may nevertheless be not only relevant but useful. The main point concerns the formation rules for quantifier phrases. The substitution-instances of Y fall into a number of classes. (These need not be exclusive.) Corresponding to these, we have classes of primitive terms, the different maximal genera listed in (9). The choice of the *wh*-word used in a quantifier phrase has to be made accordingly, as indicated by (5).

Even if this simplified formal model does not reproduce everything that can be done in natural language, it will turn out to have considerable interest in its own right as an object of study. For instance, the limits of its expressive powers would be very interesting to examine more closely.

The parallelism between (5) and (7) (or (8) or any one of the analogues) nevertheless needs further discussion. I have not yet fully answered the basic question: What is the players' situation in making a move like the one from

(1) to (2)? How do they know which maximal genus to choose *b* from? In principle, there are two plausible sources of this information in (1). They are *Y*, especially the predicates it contains, and the *wh*-word. We shall, for the time being, work on the assumption that each *Y* which is available to us in English (or rather, the part of English we are considering here), entails one of the superpredicates (9). This superpredicate determines what the range of choice is for the players in a given move. This is the simplified model of English we are considering here. The adequacy of this model is of course partly an empirical claim.

There are nevertheless several conceptual issues involved in judging our simplified model. For one thing, its viability depends on the conceptual question as to precisely how the limits of a language or language fragment under scrutiny – in the present case, of a part of English – are drawn. One of the crucial questions is whether there are in English – or, rather, in the part of English we are considering – predicates which are not restricted to one of the maximal genera marked by (9). Here the boundaries of our language fragment matter crucially. For instance, philosophers have words in their jargon which break the division between the widest ranges of English quantifiers as we have delineated them so far, in some case comprehending all of them. Words like *entity*, *being*, *individual*, *particular*, etc., are cases in point. To have a word for them, I will extend the old scholastic terminology and call them *transcategor-ematic* words.⁶ However, for the purposes of this essay there seem to be good reasons for us to limit ourselves to fragments of English which do not contain such transcategor-ematic expressions. First, these expressions seem to be rather foreign to spontaneous, ordinary discourse in the use they are cast into here. Whatever frightening uncertainties concerning some strange apparition's status are supposed to be conjured up by the title of the current horror movie, *The Entity*, I doubt that they are of the same transcategor-ematic kind as those associated with philosophers' use of the same word.

Second, set-theoretical and semantical paradoxes serve as a warning not to assume that a part of discourse remains consistent when it breaks the boundaries of the quantifier ranges which go together with different *wh*-words and phrases. For this reason, too, such words and expressions should be excluded, at least until further notice. Thus, the limitation of the different substitution-instances of *Y* in (1)–(2) to those which entail one of the expressions (9) can almost be reached by a stipulation.

This is closely connected with a third point. One function of the transcategor-ematic vocabulary in ordinary language is metalogical and metasemantical. (Notice, for instance, how tempting it is to use such transcategor-ematic terms as *entity* in explaining our game rules, as I did above.) Now it seems to me amply motivated to deal with the metalogical and metasemantical part of a natural language separately, even if we admit that it is a genuine part of that language. For otherwise we are not likely to obtain any coherent semantical theory. This is what the interesting paradoxes show us. Tarski already noted that no coherent truth-definition is possible for a natural language in its entirety; for the language

in which the definition is to be given is supposed to be the same one, and yet it must be stronger than the given (object) language. Instead of giving up the whole enterprise, as Tarski did, the more constructive response would have been to try to find a hierarchical structure in natural languages, for instance, to locate interesting parts of natural language for which an explicit semantical theory can be developed. It is my tentative suggestion that we can do so by excluding transcategorematic vocabulary in the first place from the fragment we are examining.

This suggestion appears especially natural if we think of our game-theoretical semantics in analogy with such formal models as Montague semantics. In such a perspective, the main novelty of my theory seems to be that it uses a many-sorted logic rather than the usual one-sorted quantification theory. This is an essential improvement, it seems to me, over an aspect of the basic Fregean model with which Montague and others are still in basic agreement. However, it remains to be seen whether it is a theory good enough to capture the actual subtlety of natural languages.

With these qualifications in mind, we thus stick, for the time being, to the analogy of (5), (7), and (9). Or, more accurately, we restrict ourselves to a part of English in which the parallelism holds.

7. DIFFERENT USES OF "IS"

But what does all this have to do with the different uses of *is*? An interesting double answer is implicit in what has been said. Since the widest ranges of English quantifiers – prominently including existential quantifiers – are the maximal genera that go together with the different *wh*-words, the distinction between the latter is also *ipso facto* a distinction between the different uses of existence and of the existential *is* in English. Since identity presumably makes sense only within one and the same class over which we can quantify, these classes will also go together with different uses of the *is* of identity in English. Moreover, it was suggested that in each case of predication in English – and hence in each case of predicative *is* – we are moving within one of the maximal genera marked by (9). The same classification is inevitably also a classification of different uses of predicative (copulative) *is*.

An even more striking partial answer is obtained by going back to (1)–(2) (or to any other parallel instance of (G. some)). In the second conjunct of the output sentence, we have an occurrence of *is* that has no precedent in the input sentence. It comes about as a result of the application of (G. some). In the Frege–Russell classification, it would have to be an *is* of predication, for the whole function in (G. some) of this *is* is to restrict the choice of *b* to individuals of a certain kind. We can classify such apparently predicative occurrences of *is* according to the *wh*-word occurring in the quantifier phrase to which (G. some) is applied. Thus, we obtain a rough one-to-one correlation between certain predicative uses of *is* and the different *wh*-words in English.

This parallelism which we have found between the different existential senses of *is* and certain of its predicative uses offers further evidence, albeit indirect, for my criticism of the distinction between those two senses of *is*.

Our findings concerning the multiple relations between different semantical phenomena may thus be summed up in the form of a list of correlated distinctions. They amount to differences among the following:

- (10) (i) Different wh-words (and phrases).
- (ii) Different widest classes of entities over which English quantifiers can range.
- (iii) Different uses of the existential *is* in English.
- (iv) Different uses of the *is* of identity in English.
- (v) Different uses of the predicative *is* in English.
- (vi) Different classes (mutually exclusive and collectively exhaustive) of simple predicates of English.

Moreover, each member of these multiple analogies goes together with a categorial word from our list (9).

It is to be pointed out that in addition to the uses of *is* within each maximal genus there are uses of *is* to relate members of different maximal genera to each other. The following are cases in point:

Jill is blond.

This statue is of bronze.

Stuart is in Oxford.

It is now ten o'clock in Hong Kong.

Do these coinciding distinctions mark different *senses* (*meanings*) of *is* or merely different *uses*? Is *is* ambiguous? Since I believe that ambiguity is relative to a semantical framework, I do not have to give an absolute answer to this question. The distinction is the important thing; how it is labelled is not very important. The operative question is, rather, whether we can develop a trans-categorial theory of *is* and its conceptual neighbors. The answer to this question is more likely to depend on our self-imposed restrictions on metalogical notions than on *is* itself.

8. ARISTOTELIAN CATEGORIES RECONSTRUCTED

At this point, a philosophical reader is likely to have a vivid *déjà vu* experience. For what seems to be emerging as a consequence of the basic assumptions of game-theoretical semantics is nothing but a modernized version of Aristotle's doctrine of categories, not in its details (after all, Aristotle was dealing with a different language), but in all of its leading theoretical ideas. Aristotelian scholars have found the combination of different ideas in Aristotle's distinction between different categories intensely puzzling. These different aspects of Aristotle's theory include the following:

- (11) (i) Different questions one can ask about a given entity, and hence different question words (and certain related phrases) in a language. (Cf. Ockham (Loux), pp. 8–9; Ackrill, p. 79; Gomperz, p. 39; Kahn, *passim*.) Several scholars have argued on this basis that Aristotle’s distinction is firmly based on the structure of Greek (Trendelenburg, Benveniste, Kahn).
- (ii) Different highest predicates under one or other of which everything that is has to fall (Bonitz et al.).
- (iii)–(v) Different senses of verbs for being in their different uses: (iii) existential, (iv) copulative (Apelt, etc.), (v) identifying.
- (vi) Different widest classes of primitive predicates in the language in question. Indeed, (vi) is closest to Aristotle’s explanation of the categories in his *Categoriae* (see 1b25–2a10).

Scholars have complained that Aristotle is “confusing” these different senses of “category” with each other. (See, e.g., Maier, Ross.) They have also quarrelled at length as to which of the distinctions (11)(i)–(vi) Aristotle “really” intended. What we have found shows that these problems are both spurious. Aristotle is not “confusing” the different distinctions, for they go naturally together. For the same reason, it makes little sense to ask which distinction he really had in mind. The real problem is to understand what Aristotle is doing in assimilating the different distinctions (11)(i)–(vi) to each other. This question we can now answer. These distinctions in fact go together for the very interesting systematic reasons which we have just uncovered. In fact, the distinctions (11)(i)–(vi) match very well the distinctions (10)(i)–(vi), which we were led to make and to assimilate to each other on the basis of our game-theoretical analysis. We have thus found a partial vindication of Aristotle’s theory and an explanation of what clearly are its most puzzling overall features. Aristotle is not confusing different distinctions with each other. He is in effect pointing out important interrelations which obtain – on the view we are considering – between the different distinctions (10)–(11).

Now we can see one reason why the formal model I sketched earlier is so interesting. It is interesting (among other reasons) because it embodies the traditional doctrine of the categories. The limitations of the model will therefore be limitations of the doctrine of categories.

Thus, we have reached another interesting – albeit somewhat tentative – consequence of the basic assumptions of game-theoretical semantics, applied in the natural way to the semantics of English. Earlier we saw that one of the metatheorems of game-theoretical semantics is the failure of the Frege–Russell distinction between several allegedly different meanings of *is*. Now we have just seen that game-theoretical semantics implies a version of Aristotle’s doctrine of categories, incorporating all of the most important – and most puzzling – general theoretical features of the latter.

These observations incidentally also vindicate some of my terminological stipulations. My choices of the old term “transcategorematic” for the use I am

making of it and of the locution “maximal genera” for the widest quantifier ranges turn out to be historically justified. It is not only Plato who speaks of *megista gene*. Aristotle likewise uses closely related locutions such as “indivisible concepts” (*ta amera*) and “(true) universals” (*ta katholou*) for his categories.⁷ (See *An. Post.* B 19, 100b1–2.)

The similarities between my theory and Aristotle’s doctrine of categories are not accidental, but can be pushed further. For instance, one corollary to what we found is that Aristotle’s category of relation is not the class of relations. It has to be a class of predicates (cf. (vi) above), and hence it is the widest class of *relational predicates*. A closer look at what Aristotle says readily confirms this prediction.

This fact is an instructive instance of a much more general feature which is characteristic of the Aristotelian doctrine of categories. It is *not* a distinction between entities of different *logical types*. (Cf. item (b) of the list given below.) This of course goes against what a modern philosopher who learned his or her logic on Bertrand Russell’s knee would think first. Nevertheless, it would be precisely the same mistake (same by analogy) as was committed by those philosophers who think of Aristotle’s category of relation as the supreme class of relations we may want to consider.

Furthermore, the problem (mentioned above) as to whether the parallel distinctions (9) represent different meanings or merely different uses of *is* has likewise a counterpart in Aristotle. One of the crucial questions he discusses in his metaphysics is whether the uses of *to einai* in different categories are merely “homonymous” (equivocal) or whether they have something in common. In order to defend the possibility of his “first philosophy” or “science of being *qua* being” (i.e., metaphysics), Aristotle must argue for the latter option, as he in fact does repeatedly (but not invariably), principally in *Metaphysics* Γ. Game-theoretical semantics thus offers a framework for discussing and evaluating this famous (or notorious) doctrine of Aristotle’s.

Likewise, the contrast in (9)(ii) between (a) and (b) on the one hand, and (c) on the other, can be put to use as a rational reconstruction of Aristotle’s distinction between primary and secondary substances. Furthermore, it may be that the logic of the difference between common nouns and adjectives for the former can be substitution-values of Y in such rules as (G. some) is related to the logic of Aristotle’s distinction between essential and accidental predication.

A terminological and conceptual side glance may be in order at this point. A sharp distinction ought to be made between different uses of the term *category* in recent literature. These different uses (or senses) include at least the following:

(a) *Aristotelian categories*. (My rational reconstruction of them enables us to see more clearly than before what they are all about.)

(b) Categories in the sense of *logical types* (as Russell called them). My reconstruction shows that these “categories” are conceptually different from (a), even though there are interrelations. Or perhaps I should rather speak here of problems concerning the precise relationship of (a) and (b).

Recently I have been suggesting that this notion of logical type is perhaps not quite as sacrosanct as it has been in the logical and philosophical discussion of the last hundred years. At the very least, the selection of types that can be expressed in one's formal languages ought to be enriched. This is also one of the changes Montague tried to bring about in his formal models for natural languages.

(c) Categories in the sense of *categorial grammars*. These sometimes come close to (b), although one cannot simply identify the two.

(d) Most definitely (a)–(b) have to be distinguished from the notion of a *grammatical* category, even though it may be thought of as one of the aims of linguistic theorizing to bring them all together.

9. THE FAILURE OF ARISTOTELIAN CATEGORIES

We have thus reached an interesting reconstruction of the Aristotelian doctrine of categories within game-theoretical semantics. The historical and systematic interest of this reconstruction is not spoiled by the fact that it will be found to be in the last analysis an inaccurate representation of the logic and semantics of natural languages, notwithstanding its initial plausibility. On the contrary, the possibility of critically evaluating Aristotle's doctrine is highly interesting in its own right. Moreover, such criticisms are the more convincing the better justice my reconstruction does to Aristotle's views.

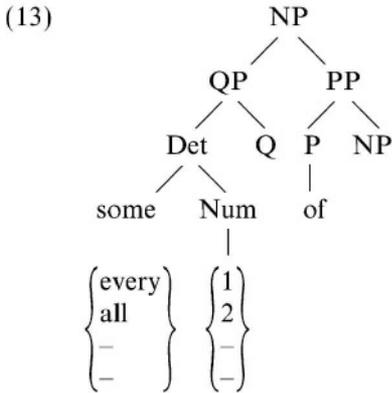
An opening for criticism is due to the fact that my reconstruction of Aristotle is based on simplifying assumptions which now have to be discussed in greater depth. Such a discussion must be based on an analysis of the structure of the quantifier phrases themselves to which our quantifier rules are to be applied. Unfortunately, the semantical and syntactical analysis of quantifiers has been one of the most notorious moot points in recent linguistics. I cannot develop a full-fledged theory of this subject in a single essay. A few words on the subject are nevertheless in order.

So far, we have considered only a relatively simple structure of English quantifier phrases, viz. the one illustrated by (1). For instance, a quantifier phrase might have the structure

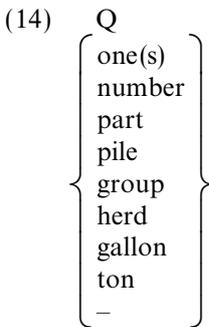
(12) some Y who Z.

A familiar case is one in which Y is a count noun. Such nouns presuppose a domain of individuals on which they are defined. As long as we confine our attention to such cases (and perhaps restrict our formal semantical models to them), some version of the Aristotelian doctrine of categories appears to be a virtually inevitable consequence. But is this familiar case really representative? As long as we are working along the same (or similar) lines as the best-known recent formal theories of semantics, such as Montague semantics, it is not unnatural to think that whatever goes into Y consists ultimately of predicates and functions, each defined within some given maximal genus. However, this

is not the best available analysis of English quantifier phrases, even when we leave the relative clause “who Z” (and its analogues) out of the picture. As far as the syntactical situation is concerned, I shall here rely on Joan Bresnan’s (unpublished) treatment. On her analysis, a quantifier phrase (in my sense but with the relative clause omitted) has a structure somewhat as follows:



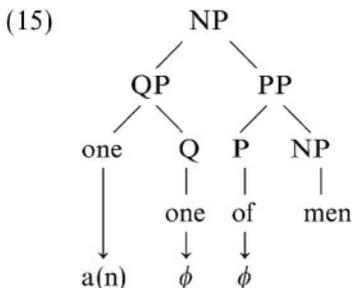
Here Q seems to mark quantity classifiers, e.g.,



An example of an unabbreviated NP of this form might be every three gallons of fine old wine.

every three gallons of fine old wine.

This analysis relies on Perlmutter’s hypothesis that *a(n)* is a proclitic variant of the numeral *one*. We have to derive, for instance, *a man* from (13) as follows:



Here, the first arrow is motivated by Perlmutter's hypothesis. Bresnan has shown how to motivate the two others as well.

One fact that is here interesting for our present semantical purposes is that the different parts of Joan Bresnan's analysis correspond (as Bresnan herself has pointed out) to the different roles of quantifier phrases in my semantical games, at least roughly. The determiner Det specifies which player or players make a move (and, if both players make a move at the same time, how their moves are related to each other). The quantity classifier Q serves to individuate the elements of the players' domain of search jointly with the PP.

This analysis of quantifier phrases does not by any means automatically invalidate our reconstructed version of Aristotelian category theory. However, it does open a door to a line of thought which leads us beyond Aristotle's categories and also in certain respects beyond the modern logic of quantification. What happens here is that the individuals over which our quantifiers range are no longer taken for granted in all uses of language but that our language can be used to specify how these instances are, as it were, built out of more primitive ingredients. The most common case is undoubtedly one in which the NP of the PP is a mass term and the Q of the QP (see (13)) is a unit of the mass in question. Then (13) shows how our individuals are, as it were, constructed out of the material specified by the mass term. This observation has in fact a moral for formal models of semantics. If such models are to accommodate mass terms with their characteristic uses, we cannot postulate just one fixed domain of individuals, but must allow for the introduction of new ranges for quantifiers as indicated.

This shows one way in which new ranges of quantifiers can be manufactured in ordinary discourse. However, it is really a special case from the vantage point of the general semantical situation. On the list Q, all the words exhibited are amount terms. Instead of them, we can nevertheless have words specifying what kind of object is formed from the material specified by the last NP of (13). Examples of this include the following:

- (16) some statue of black marble
 each cube of ice
 every third table of pale rosewood
 few bracelets of pure gold
 a sphere of bronze.

This observation is related closely with what Aristotle says. What he does, if only for the category of substance, is to think of our individuals as being combinations of matter and form. (See especially *Metaphysics Z.*) In the schema (13), it is the NP (of PP) that specifies the matter while the Q of the QP can specify a form (as in some of the examples (16)) and not just a quantity (as in (14)). Once again, Aristotelian ontology reproduces, if not etymology, then another aspect of ordinary-language semantics, viz. the semantical structure of quantifier phrases. Examples (16) can be thought of as illustrating the

Aristotelian ideas of form, matter and the way form and matter are combined in a substance.

Our line of thought can be pushed further, however. Instead of being a mass term, the NP of PP in (13) may indicate already formed discrete individuals, while the Q of QP specifies an entity of a higher logical type formed from these individuals. The following are examples of resulting quantifier phrases:

- (17) some number of people
 each discrete set of moments of time
 almost every partly ordered set of commodities
 an additive group of numbers
 a continuum of colors
 few sequences of notes
 every connected set of locations.

It is clear that the result of such constitution of higher-type entities out of individuals breaks the boundaries of simple-minded Aristotelian categories. As can be seen from (17), the same structural terms, playing the role of the Q of (13), apply in different categories. Yet the outcome entities (all groups, all partly ordered sets, all continua, etc.) can be quantified over. This shows that the Aristotelian scheme of a finite number of fixed co-ordinated categories is an oversimplified model of natural languages.

The new “categories” (ranges of quantifiers not included in any traditional categories) are much more like logical types than Aristotelian categories. In this direction, traditional (Aristotelian) categories therefore are beginning to change in the direction of categories in the modern sense of logical types.

Quantifier phrases like (17) are thus one of the many vehicles by means of which natural language transcends the limits of the fragments of natural languages in which the Aristotelian theory of categories – or some variant thereof – holds. If transcatagorematic words were a philosopher’s or a semanticist’s luxury, we could and should dispense with them in our theory of how honest-to-Austin ordinary language works semantically. But they are not used for those esoteric purposes only. As is suggested by examples like (17), our transcatagorematic vocabulary is used for perfectly substantive purposes. Hence, any realistic account of natural language must accommodate them and their use in quantifier phrases.

At the same time, we can see that Aristotle’s method of handling this situation, viz., his notion of form, does not do the whole job here. It sits most comfortably on the intermediate cases where the matter is completely unstructured, and the structure imposed on it (“the form”) is comparable to a fairly simple geometrical form, e.g., “a cube of ice.” The notion of form is much less happy in connection with complex relational structures, such as are exemplified by (17). In some ways, Aristotle’s notion of form was supposed to do the job our modern concept of relation (relational structure) is calculated to do – but could not quite manage it. Historically, it was primarily the logic of relations that led philosophers, logicians, and other thinkers out of the fly-bottle of

Aristotelian logic and Aristotelian categories. Now we can see that such a historical development is reflected in the synchronic facts of natural-language semantics.

However, the line of thought which I have sketched, and which is based on an analysis of quantifier phrases in English, is not the only direction in which some natural languages transcend the confines of Aristotelian categories. Another direction is that of *events*. This direction is messier philosophically than the one first considered. Indeed, it leads at once to the problem of whether events are (or can be) full-fledged basic particulars. There is more potential evidence than has been resorted to by philosophers, however, at least insofar as natural languages (and the ontologies they presuppose) are concerned. Sundry nominalization processes provide such evidence. We cannot examine them in this paper, however, except for suggesting a historical “application.” From this vantage point it is not accidental that Aristotle should have had considerable difficulties in accommodating change and motion in his conceptual framework and that the overthrow of his philosophy began in the area of the analysis of motion.

NOTES

1. See Hintikka (1982b) and the papers collected in Saarinen (1979). For a different kind of motivation for game-theoretical semantics, see Hintikka (1982a).
2. See Lauri Carlson and Jaakko Hintikka, ‘Conditionals, generic quantifiers, and other applications of subgames’ in Saarinen (1979).
3. See Hintikka and Rantala (1979).
4. See Hintikka (1974b); Barwise (1979).
5. See Hintikka (1979).
6. The term *syncategorematic* is sometimes used for this purpose. Both etymology and medieval usage make it more natural to speak instead of *transcategorematic* terms.
7. Aristotle sometimes uses the term *genus* in another, narrower, sense, as a mere correlate to *species*. In this sense, categories of course are not *genera*. However, this sense is not relevant to our present problems.

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CHAPTER 3

ARISTOTLE'S THEORY OF THINKING AND ITS CONSEQUENCES FOR HIS METHODOLOGY

PART I: ARISTOTLE ON THINKING

1. THINKING, KNOWING AND ALL THAT

In this paper I will try to deepen our understanding of Aristotle's epistemology and methodology by examining their relation to his ideas about thinking, logic and modality. It turns out that these relationships are extremely close and that they throw interesting light on Aristotle's theory and practice of scientific and philosophical argumentation.

But what did Aristotle think about thinking? As a preliminary step toward answering this question, it is useful to note that there was much less of a sharp distinction between the ancient Greek words for thinking, understanding and knowing than there is for us. Among these words I include *epistēmē*, *gnōmē*, *phronēsis*, and *noēsis* and of course the corresponding verbs. The semantical history of some of these words is studied in Bruno Snell's old (1924) but still useful monograph *Die Ausdrücke für den Begriff des Wissens in der vorplatonischen Philosophie*. One of the main upshots of Snell's careful analysis is precisely the close relation between different Greek words for knowledge and related ideas in early Greek philosophy. I have argued in an earlier paper (Hintikka 1980 (a)) that the received translations of *gignōsko* and *noeō* as knowing and thinking, respectively, should be reversed in a crucial passage in Parmenides, thus illustrating how blurred the semantical dividing line between the two is.

It is also easy to see the basis of this close relationship between thinking and knowing in the minds of Greek philosophers. Again, I have tried to call attention to this basis in my earlier work. (See Hintikka 1974, chapters 1–2.) What is going on is a tendency to think of knowledge as successful thinking, that is, thinking that hits its target. Thus, even though there is a distinction between the two, it lies largely in the presence or absence of a success condition, as modern semanticists would say. The psychological mechanism is the same, allowing the transfer of conclusions from Aristotle's conception of one kind of process to the other. Indeed, Aristotle uses the words *gignōskei* and *phronei* at *De An.* III, 4, 420a10–12 as referring to the functions of one and the same part of the soul. Elsewhere he throws in *epistēmē* for a good measure. Instead of *psuchē* he frequently speaks of *noūs*. Characteristically, in *An. Post.* B 19, 100b6 ff. Aristotle distinguishes different intellectual states from each other in terms of their always reaching truth or not always doing so, that is, in terms of their

success conditions. Without denying that there are distinctions between the meanings of the different words just discussed, it is eminently clear that the psychological mechanism is essentially the same in the case of all of them according to Aristotle.

Admittedly, different faculties like knowledge and true belief had to have different objects for Aristotle, as they had for Plato. However, from this does not follow that they could not both be characterized by the same relation to their objects, as long as those objects are different. And this is precisely the view we just found in Aristotle.

2. THINKING AS FORMAL IDENTITY WITH THE OBJECT

So what did Aristotle think about thinking? A key to his answer is found in *De Anima* III, 7, 431a1:

Actual knowledge (*epistēmē*) is identical with its objects.

Identical in what way? Aristotle answers: Identical in the sense of sharing the same form. He explains this point in 431b24 ff.:

In the soul that which can perceive and that which can know are potentially these things [i.e. the objects of perception or knowledge], the one the object of knowledge, the other the object of perception. These [things in the soul] must be either the things themselves or their forms; not the things themselves, for it is not the stone that is in the soul, but its form. Hence the soul is as the hand is; for a hand is a tool of tools and the intellect is a form of forms ...

Thus the relation of a thought (including knowledge and belief) to its object is an intimate one, viz. the relation of formal identity.

Needless to say, Aristotle's theory of thinking is thus seen to be quite striking. For him thinking is not representational. There is no "language of thought" for Aristotle. The forms in the soul do not *represent* the *pragmata* of the outside world. They *are* actual instantiations of the same forms. Aristotle does not have a picture theory of thinking; it is a zoo theory or modelling theory of thinking in that the *pragmata* are represented in the soul by actual instances of the same forms. Thinking of a complex subject is not to have its ingredients deputized in one's mind according to Aristotle, it meant to create as it were an actual scale model of the subject matter in one's mind.

It is not always noted that this is also what Aristotle says in his introductory remarks in *De Interpretatione* 7, 16a3 ff. Ackrill's translation reproduces Aristotle's ideas as follows:

Now spoken sounds are symbols of affections in the soul, and written marks symbols of spoken sound. And ... what these are in the first place signs of

– affections in the soul – are the same for all [men]; and what these affections are likeness of – are also the same.

The question I am raising here is what Aristotle means by saying that “affections in the soul” (Kant would have called them *Vorstellungen*) are *homōiomata* of *pragmata*. Ackrill’s translation of “likenesses” is not wrong, but it does not convey the full force of the word. For instance, Liddell and Scott report a use of the phrase *ex homoiōmatos* as meaning “in accordance with the practice in similar cases”. Obviously the different cases here are on a par, not meaning that one of them imitates others. Likewise, Aristotle himself writes in *Rhetoric* 1356a31 that rhetoric is a branch of dialectic and *homoioima* with it.” Here rhetoric is not merely a likeness of dialectic; it is another manifestation of the same principles.

Thus the intended force of Aristotle’s words in *De Int.*, 1 is the same as of his statements in *De Anima* (to which he refers himself at 16a8). An actual, albeit only formal, identity between thoughts and their objects is thus assumed in *De Interpretatione* and not only in *De Anima*.

In spite of Aristotle’s explicit statements, questions can be raised here concerning both terms of Aristotle’s relation of formal identity. On the one hand one can ask: Are the forms that are present in the soul forms of objects out there *simpliciter*, or are they somehow only forms of objects *qua* thinkable? Are they real objects or some sorts of intentional objects? Here it is instructive to see how Aristotle discusses the objects of senses earlier in *De Anima*. This discussion is helpful here because Aristotle’s conception of sense-perception is similar to his theory of thinking.

That which can perceive is ... potentially such as the object of perception already is actually. It is not like the object ... when it is being affected by it, but once it has been affected it becomes like it and such as it is. (*De Anima* II 5, 418a3–7.)

This is a strong assertion of the identity of the perceiving soul and the object of perception. I will return to the reality of forms in a thinking soul below in sec. 4.

On the other hand one can ask here: What is at the receiving end of this identity relation? In other words, the real question here concerns the status of the objects of perception and their forms. Are these forms maybe only forms of objects *qua* perceptible and thus relative to sense-perception and perhaps even relative to a particular sense-modality? Aristotle does say that objects of a specific sense are relative to one particular sense (418a24–26). A closer examination nevertheless shows that the object of each sense does not constitute a special class of entities, different from those that populate our familiar environment. They are ordinary entities, even though they are considered only in so far as they are accessible to one particular sense-modality. For instance, among the objects of sight there are colors (418a26–27). And for Aristotle,

color is not some sort of secondary quality. It is a constituent of reality. This is perhaps seen most directly from Aristotle's attribution of causal powers to *sensibilia*, as in 418a30–31:

Every color is capable of setting into motion that which is actually transparent, and this is its nature.

Thus it is clear that Aristotle is not postulating any special class of objects (or of forms of objects) when he speaks of object of perception, even when he makes those objects relative to one sense-modality.

The same holds also for the objects of thought. Indeed, it ought to have been clear from the second quote from Aristotle above that he is talking about the forms of actual objects and not about the forms of some second-class citizens of his ontology, some mythical *sensibilia* or *cogitabilia*. For he is there talking about the form of a stone, which presumably would qualify as an independent real object for Aristotle quite as much as it did for Dr. Johnson. Furthermore, Aristotle is there asserting the soul to be the form of *all* forms, not merely of forms of objects *qua* this or that. The same generality is implicit in the quote from *De Int.* 7.

Once this interpretational problem has been solved, further evidence for the formal identity of an object of thought and its representation in the soul is obtained from a similar identity in the more restricted realm of sense-perception. Indeed, Aristotle himself affirms the parity of thinking and perceiving in this respect in 417b16–18. It is Aristotle's explicit and repeatedly asserted view that in sense-perception, too, that which perceives literally becomes the same as the object of the relevant sense. Examples are found in *De Anima* II, 5, 418a3–5 and elsewhere.

The close similarity between thinking and perceiving in Aristotle has prompted an opposite objection to my interpretation of Aristotle's conception of thinking as a realization of forms in the soul. Are these forms perhaps restricted to sensible ones? In most of Aristotle's actual examples, he seems indeed to be dealing precisely with sensible forms. However, Aristotle's own statements of his doctrine do not have any qualifications whatsoever. What seems to have happened in such objections is an oversight. It is not realized that the formation of a form in the soul in thinking is not instantaneous, as in perception. The very process of concept (form) formation can be a complex one according to Aristotle. In sense-perception, the soul receives forms from the outsider. However, the soul is not restricted to such immediately given ones. It can take them apart, recombine them in different ways, integrate them with the forms received from other perceptions, and so on. Aristotle's own summary is presented in *An. Post.* B 19. What has misled my critics is the fact that the ingredients of the forms in the soul are initially given to us in sense-perception. From that fact it does not follow that the finished product of form-formation – in Aristotle's metaphor, the formation of soldiers after their flight has come to an end – is any longer a sensible form. (Cf. *An. Post.* B 19,

especially 100a 10-b4.) It is merely that its formation process started from sense-perception.

3. REFLEXIVE THINKING

An especially interesting testing ground for my interpretation is offered by the notions of reflexive thinking and reflexive knowing. What do I mean by saying that I know that I know? It is easy to list quite a few different things that such a locution can be used to mean. But Aristotle, like a modern epistemic logician, is not concerned with the ordinary language force of the locutions "knowing that one knows" or "thinking that one thinks". He is concerned with the implications of his own theory of thinking for reflexive thinking.

And these consequences, as acknowledged by Aristotle himself, agree with my interpretation, and help to confirm it. For what follows from Aristotle's theory, interpreted in my way, for the notion of thinking that one thinks? Thinking of X is realizing the form of X in one's soul. Hence to think that one thinks of X is to realize in one's soul the form of one's soul when one thinks of X. But the latter is simply the form of X. Hence, thinking that one thinks must on my interpretation of Aristotle be the same as thinking *simpliciter*.

The *prima facie* strangeness of such a view serves to confirm my interpretation, for this predicted view turns out to be Aristotle's. The equivalence of knowing and knowing that one knows is asserted or assumed by Aristotle on a number of occasions, including *Nicomachean Ethics* IX, 9, 1170a27 ff.; *Eudemian Ethics* VII, 12, 1245a6 ff.; *De Anima* III, 4, 429b6–430a9; *Metaphysics* XII, 7, 1072b20 ff. and 9, 1074b33 ff.

With a marvelous consistency, Aristotle goes on to apply his theory of thinking even to his deity. According to Aristotle, the human soul is "the form of forms". However, these forms are present in the human soul in most cases only potentially. In contrast, the unmoved mover is pure actuality. Hence all the forms are actualized in the soul of Aristotle's deity. But the only place where they are so realized is precisely in the soul of the unmoved mover. Hence the only thing his thoughts can be about are themselves: the unmoved mover is thinking about his own thinking.

This is of course precisely Aristotle's doctrine of his unmoved mover in *Met.* XII. What has been pointed out that shows that Aristotle's views are not daring theological speculation, but corollaries to his theory of thinking, combined with his ideas about potentiality and actuality.

When it comes to reflexive activity a comparison between thinking and perceiving in Aristotle is instructive. As was seen, Aristotle applies the same realization-of-a-form view to sense-perception as he uses in connection with thinking. In *De Anima* III, 2, 425b12–15 Aristotle raises in so many words the question as to how we perceive that we see and hear. His preliminary answer is that the sense of sight "is concerned with itself", i.e. we see that we see. Even though Aristotle notes the difficulties about this view, he ends by affirming

that “that which sees is in a way colored; for each sense-organ is receptive of the object of perception without its matter” (425b22–24). This remark is calculated by Aristotle to remove the sting from the objection that secondary seeing is not identical with primary one, because its primary object is color, and the soul as seeing something colored cannot itself be colored, can it now? Aristotle responds by pointing out that according to his theory the seeing soul is in a sense colored after all, viz. in that it shares the form of the color.

The difference between seeing and thinking is not that seeing does not imply seeing that one sees, but rather that thinking that one sees does not presuppose seeing. For “perceptions and imaginings remain in the sense-organs even when the objects of perception are gone” (425b24–26).

Incidentally, this quote helps to show in what sense the objects of perception – the objects whose form the soul shares – are for Aristotle not sense-data like perceived colors, but actual objects like stones and statues.

4. FORMS IN THE SOUL ARE ON A PAR WITH FORMS OUTSIDE THE SOUL

These observations naturally lead to my next main interpretational point. A modern reader of Aristotle is tempted not to take him quite literally when he speaks of the (formal) identity of a thought and its object. Recalling that there are objects and objects, a twentieth-century philosopher easily slips into thinking that the object Aristotle is thinking of is some sort of intentional object. As we might put it, in thinking the object of thought appears in the soul as an intentional object of the same sort as its target. Because of this temptation, it is important to be absolutely clear that for Aristotle the realizations of forms in the soul are in all respects as authentic instances of the forms in question as their realizations outside the soul. What this means is *inter alia* that forms as they are manifested in the soul have *ceteris paribus* all the same powers as they have in their manifestations outside the soul. This again is amply confirmed by what Aristotle says. Perhaps the most telling passage is *Met.* XII, 4, 1070b33–34:

For medical art is in a sense health, and the building art is the form of the house, and man begets man.

Further examples of the same identity are found *inter alia* in *Met.* IX, 9, 1051a30–31, *De Anima* III, 7, 431a3–4, etc.

One of the most striking uses Aristotle makes of the idea that a realization of a form in the mind has all the same powers as its other realizations occurs when Aristotle argues for his view that:

all things come-to-be ‘out of a homonym’ [i.e. out of an equally named thing], just as is the things [that come-to-be] by nature, or out of a part that is homonymous (*Met.* VII 9, 1034a22, Furth translation).

Aristotle applies this view to artifacts, continuing:

for instance, 'the house out of a house', *qua* by the agency of a mind; for the art is the form.

The cryptic last clause means that what gives a craftsman his ability to produce an artifact is the presence of the form of this artifact in his mind. And here crafts must be understood not only so as to include all arts but also what we would consider technologies.

So thus it follows that in a certain sense the health comes to be out of health and the house out of house: for the medical arts and the house-building arts are the form of the health and of the house ... (*Met.* VII 7, 1032b11 ff.)

Thus it is the form of a house in the mind of the builder that "begets" a house in perfectly as real a sense as man begets a man according to Aristotle.

This aspect of Aristotle's theory of thinking is closely related to the view which we find both in Plato and in Aristotle that it is the knowledge of the nature of X that gives one the power to being about X. I have examined this idea in an earlier paper.

In an entire different direction my thesis implies that for Aristotle geometrical forms (geometrical objects) are represented in the soul by the very same geometrical objects when one thinks of them. Not only does Aristotle countenance this corollary of the views I have ascribed to him. He feels called upon to reassure his audience that geometrical forms need not be realized in the soul in the same scale, only as proportional miniatures. Furthermore, Aristotle pushes his luck or at least his proportionality idea even further. Not only are geometrical objects (forms) represented in the mind by proportionally identical forms. The interrelations of such objects, for instance distances, are likewise represented by proportional relations. (Do we perhaps have a clue here to the prominence of the theory of proportions in Greek mathematics?)

... there are in the mind similar figures and movements. How, then, when the mind thinks of bigger things, will its thinking of them differ from its thinking of smaller things? For all internal things are smaller [than things outside] and proportional (*analogon*) to them. Now as we may assume within each person something proportional to the forms, so too, we may doubtless assume something else proportional to distances. (*De Mem.* 452a11 ff.)

Amusingly, several recent translators have not quite believed their eyes and added to the third quoted sentence an euphemistic "as if". There is no such caveat in the text, however, and I have just shown you why there cannot be any such qualification in Aristotle's mind, either.

The fact that we cannot always realize in external reality all the forms we

can think of is merely a corollary to the resistance of the matter (medium) in which the realization is supposed to take place.

5. ARISTOTLE AND PLOTINUS

Some additional interest is lent to Aristotle's theory of thinking by its similarities and dissimilarities with Plotinus' views on the same subject. (Concerning Plotinus, I am making use of the valuable studies by E. K. Emilsson and A. H. Armstrong.) Usually, Plotinus is considered in the context of Platonic and Neoplatonic ideas, but in the case of his ideas about thinking and its objects are in some respects so close to Aristotle that A. H. Armstrong has argued for an actual influence "mediated by Alexander Aphrodisias' account of the active intellect in his *De Anima* and *Mantissa*".

Here I am concerned with Plotinus in so far as his ideas are related to Aristotle and help us to understand Aristotle's thought.

It is in fact remarkable that Plotinus embraces essentially the same (or closely similar) idea of the identity of a thought with its object as Aristotle. He also applies the same view to his doctrine of the deity. One of the main differences between Plotinus and Aristotle is diagnosed by Emilsson. It lies in the fact that according to Aristotle a human being has in the last analysis obtained the ingredients of the form it has originally from sense-perception, whereas for Plotinus sense-perception can give us mere images or *eidia*, not the real things. And that "reality" of a thing seems to be identified by Plotinus with its quiddity. Hence for Plotinus the intellect can in the last analysis know only what it has always known.

One might be tempted to put this down as a facet of Plotinus' general distrust of senses and sense-perception. However, it is instructive to note that there is some pressure exercised on Aristotle, too, by his own conceptual assumptions to assume some version of the pre-existence of forms in the soul. For even in the case of a combined form, Aristotle must not only assume that it pre-exists in the soul potentially. It is only potentially that an Aristotelian soul can be the form of all forms. What is more, that potentiality must according to Aristotle's collateral assumptions be activated by an actually existing instance of the same form. But who or what is the thinker who is actively thinking of it? I will not try to untie the tangled web of the doctrine of active intelligence in Aristotle beyond pointing out that this doctrine is not dispensable frosting on his ontological cake but a serious problem forced upon Aristotle by his own conceptual assumptions, in this case, by his views of thinking, potentiality and actuality, problems which he probably never straightened out completely.

Plotinus cuts this Gordian knot by assuming (or maintaining on some other grounds) the pre-existence of the objects of thought in the soul. This makes a human soul *apud* Plotinus similar to the mind of Aristotle's deity, for whom objects of his thought are always immanent and actually present.

A comparison between Aristotle and Plotinus is made somewhat unsharp

by the fact that Plotinus did not have quite the same clear concepts of form and matter, potentiality and actuality, etc. as Aristotle did. In particular, Plotinus' notion of form seems to have been a mixture of Platonic, Aristotelian and Stoic ideas. Hence he did not have available to him an equally clear notion of formal identity between thoughts and objects of thought as Aristotle did.

6. SUCCESSFUL THINKING

A comparison between Plotinus and Aristotle can throw further light on the latter's views. Aristotle maintains that falsity and error enter into the epistemic process only when we start to combine and separate the forms, for "unification and separation are in judgment and not in things." But it is sense-perception that has originally given us these forms. Hence sense-perception itself cannot be mistaken. In it, we receive the form of something or else, period. Thus, in a sense, sense-perception has to be taken for granted. Aristotle is thus a realist in roughly the same stamp as Moore and the early Russell who insisted that in each experience, including perception, something is actually given to me. In Aristotle's case, this "something" was a certain form actually instantiated in the soul. Aristotle's notion of form thus serves him very well here, for it enables him to maintain a kind of identity of the perceiving soul with its objects.

Plotinus does not have an equally sharp notion of form at his disposal. Hence he cannot maintain the formal identity of the perceiving soul and the object of its thought. Hence for Plotinus sense-perception was merely representative and hence mistake-prone. In order to combat skepticism, Plotinus therefore had to consider sense-perception not only as not being infallible in the sense Aristotle did, but on the contrary an epistemologically risky business. Hence only his idea of the immanence of the objects of thought could guarantee the infallibility of thinking as distinguished from sense-perception, whereas for Aristotle it was the immanent activities of combining and separating performed by the soul on forms derived from sense-perception that first introduced the possibility of error.

It must be realized that the kind of infallibility that I have ascribed to sense-perception is in a sense a definitory matter. If the form which is present in the soul on the occasion in question were not the form of the allegedly perceived object, we would be dealing with something different from perception, maybe with imagination. This poses the interpretational problem as to how Aristotle could think of such infallibility-by-definition of sense-perception as a sufficient basis of all science. This problem will be taken up in sections 14 and 18 below.

7. THINKING USES PARTICULARS, BUT IS NOT ABOUT THEM

A puzzle is prompted here by the contrast between universals and particulars. In *De Anima* II, 5, 417b22–24 Aristotle writes:

... actual perception is of particulars, while knowledge is of universals; and these are somehow in the soul itself.

This is a very puzzling passage, even though the real problem seems to be Aristotle's rather than mine. How can a universal be "in the soul itself" in the way in which the object of perception is (formally) not? How can a "universal itself" be in the soul, when it is also instantiated elsewhere all over the place? It seems to me that the only way of making sense of Aristotle's statement is to take it to mean that knowledge is *about* forms, which are fully present there in the soul, while perception is *about* the particulars that prompted the sensation. It cannot mean that in thinking, too, the relevant forms are present in the soul in the form (no pun intended) of particular representatives. On the contrary, it is Aristotle's explicit view that such particulars are involved in all thinking. As Aristotle says in *An. Pr.* B 21, 67a27–28:

In virtue of the universal knowledge, then, we contemplate the particulars, but we do not know them in virtue of their peculiar knowledge.

8. THE PROBLEM OF LOGICAL AND MATHEMATICAL REASONING

What Aristotle's view implies is that the process of reasoning must not turn on the use of any particular representatives of general forms, other than the ones present in the soul already. This requirement has important consequences for Aristotle's logical theory. It also poses a striking problem for Aristotle in his efforts to apply his syllogistic theory of reasoning to the mathematical sciences. This problem offers instructive glimpses into Aristotle's theory of thinking in general. In thinking of a mathematical theorem, for instance the theorem that the three angles of a triangle add up to two right angles, we are according to Aristotle obviously considering the form of a triangle and putting an instance of a triangle before our mind's eye. But saying this does not solve Aristotle's problems. When we prove the theorem, we typically need more than the given figure which instantiates the form in question. We need the additional mathematical objects, the "auxiliary" constructions, introduced in what Euclid later called the *kataskeuē* part of a geometrical argument. We may even need several different exemplifications of one and the same geometrical form, for instance two circles or two squares. (In the geometrical argument Socrates prompts Meno's slaveboy to carry out, they end up considering five interrelated squares, each with its individual diagonal.) These instantiations must be considered as particulars, not merely as representatives of a form. The reason is the proof may turn on their being different from each other and even having different properties. For instance, one circle or square may have to be taken to be larger than another. Hence *kataskeuē* is not possible without assuming that geometrical reasoning employs particular representatives of geometrical forms.

Plato seems to have been aware of the problem. His response was to allow each of the mathematical to have several instantiations, unlike the forms. In contrast, for Aristotle mathematical forms are on a par with other forms. On a level of purely logical theory, he therefore could not cope with mathematical reasoning. In order to salvage mathematical argumentation, he had to develop an elaborate special theory of mathematical objects, which we find in *Metaphysics* XIII–XIV. Whether or not this theory does the job it was calculated by Aristotle to do cannot be discussed here.

In fact, Aristotle faced a more fundamental problem. We have seen that Aristotle admitted that all reasoning involves the use of particular images, but he demanded that these particulars be considered only *qua* representatives of certain forms, not *qua* particulars.

Geometers do not suppose falsehoods, as some people have asserted. They say that you should not use falsehoods but that geometers speak falsely when they say that a line which is not a foot long is a foot long or that a drawn line which is not straight is straight. But geometers do not conclude anything from the fact that the lines which they have themselves described are thus and so; rather, they rely on what these lines show. (*An. Post.* A 10, 76b40–77a3; Barnes' translation.)

Unfortunately, it is Aristotle who is supposing a falsehood here. Admittedly, a mathematician does not use in his reasoning the fact that a geometrical object which he has drawn has a certain length. But a mathematician may very well use the fact that the side of one square he has drawn is precisely twice as long as the side of another square likewise exhibited in a figure.

Thus Aristotle's problem can be illustrated by means of his own comparison between thinking in general and the use of figures in a geometrical proof. In the universal and necessary thinking that is involved in scientific knowledge, we must make do with merely putting an instance of the form or complex of different forms in front of our mind's eye. We must not amplify the given configuration by introducing new exemplifications of the same forms into the figure. As Euclid would have put it, we may use *ekthesis*, but the use of *kataskeuē* is incompatible with scientific thinking.

This poses a serious problem for Aristotle not only in his theory of the mathematical sciences. It also put an onus on him in developing his system of logical inferences. For the technique of *ekthesis*, that is, of introducing particular representatives of general concepts, was not only part and part of the procedures of mathematicians. It was also used in logical theory. Aristotle himself makes *prima facie* use of it in his systematization of his syllogistic theory. In the end, however, Aristotle must eliminate the use of *ekthesis* from his syllogistic theory if this theory is to satisfy his own criteria of a genuine science. In an earlier paper (Hintikka 1978), I have discussed Aristotle's efforts in this direction. The tentative judgment I reached there is that Aristotle's efforts did not amount to

a complete success. Hence Aristotle did not manage to bring his theory of logical thinking quite in line with his theory of thinking in general.

PART II: ARISTOTLE'S METHODOLOGY IN THE LIGHT OF HIS THEORY OF THINKING

9. THINKING AND NATURAL NECESSITY

For the next step we must have the courage of the insights we have reached. For Aristotle, we can say, natural laws are necessary connections between forms. The necessity in question is of course some kind of natural necessity. For instance, the essence (essential form) of an individual is what makes it the individual it is. The individual exists in so far as it has its definitory form. In this sense, to use an un-Aristotelian expression, forms are the enforcers of natural laws according to Aristotle.

But what follows from all this for the notion of natural law when it is combined with Aristotle's theory of thinking? Suppose there is a necessary connection between two forms, say A and B, such that the presence of the forms necessitates as a matter of natural necessity the presence of the latter. Then if I manage to think of A, I inevitably (that is to say, by the same natural necessity) must think of B, too. For the same necessary relations hold between the two forms when they are realized in the soul as hold between them elsewhere. Or perhaps a more natural example would be offered by the two premises of a valid syllogism. If they "formally" (in Aristotle's sense, not in the sense of formal logic) necessitate a conclusion, then the mind automatically clicks and the conclusion is instantaneously realized in the soul as soon as the premises are actually thought of.

What these observations imply is a conclusion so striking that most Aristotelian scholars apparently have failed to attribute it to their master. What has been seen implies that according to Aristotle *one can become aware of any necessary connection between forms* and therefore of any Aristotelian natural law *simply by realizing these forms in one's soul*. To exaggerate the points ever so slightly, all that is needed in science are thought-experiments, not actual external experiments.

Aristotle does not always formulate this principle quite explicitly. Its presence and its importance in Aristotle's thinking is nevertheless shown by its implications for the rest of his philosophy and especially for his philosophical methodology.

This spontaneous insight into interrelations of forms according to Aristotle explains in the first place why he thought that the first atomic premises of scientific syllogisms are self-evident. For those premises express the definitions

of the terms (forms) in question. Hence to realize them is (by definition, so to speak) to realize the relevant forms fully and actually in one's mind. For what could be a more full-fledged way of bringing a concept fully and actually into one's mind than to think of its definition? Here we can see one of the many reasons why the theory of definition is a crucial part of Aristotle's theory of science – and even of his theory of thinking. I will return to this connection later.

10. LOGICAL AND NATURAL MODALITIES COINCIDE

More generally speaking it is now seen that for Aristotle there cannot be any hard-and-fast distinction between logical (conceptual) necessity and natural (e.g. physical) necessity. Since necessity and possibility are interdefinable according to Aristotle (and according to our contemporary conceptions), the same identity can be expected to hold between logical and natural possibility according to Aristotle. Once again, a consequence of The Philosopher's views has been found so strange that philosophical readers have not dared to interpret him in the intended way. Indeed, a distinction between logical and natural necessity has often been attributed to Aristotle, even by scholars who are focussing on the very notion of necessity in Aristotle. For example, Aristotle would not have been Aristotle if he had not made distinctions between different kinds of possibility and necessity. In my 1976 monograph, I carried out a systematic examination of the different distinctions between different kinds of modality. They turned out to agree with each other – and with the prediction that can be based on Aristotle's theory of thinking. The main distinction turns out to be between possibilities that are actualized instantaneously as soon as they obtain *qua* possibilities, and those that are actualized through a process of change or *kinesis*. This distinction has nothing to do with the distinction between logical and natural modalities.

In fact, Aristotle himself uses an altogether different distinction in order to deal with the cases where the moderns feel called upon to evoke the difference between logical and physical modalities. It is the distinction between absolute and relative (conditional) possibility, and by the same token between absolute and relative necessity. The interesting point here is that relative necessity is not a conceptually different kind of modality as compared with the absolute one. It is merely absolute necessity relationized to certain conditions.

How far Aristotle presses his conceptual luck is seen from *De Caelo* where he compares with each other the impossibility of seeing a sound and the impossibility of seeing men on the moon.

For further details and for further discussion, the reader is referred to my 1977 monograph (with Remes and Knuuttila).

11. ARISTOTLE AND THE IDEA OF LOGICAL NECESSITY

Another major consequence of Aristotle's psychological theory of thinking is that all necessary, i.e. logical, consequences of actual thought-of premises are

automatic, instantaneous, and unavoidable. This view of Aristotle's is undoubtedly the source of the idea of "logical necessity" in the history of philosophy and also the source of the unfortunate confusions that have surrounded this idea. There is indeed here a remarkable contrast between our contemporary idea of rules of logical inference and Aristotle's idea of logical inference and of the "laws of thought" that govern it. For a contemporary logician, a rule of inference is not a law of thought either in the sense of a natural (necessitating) law or in the sense of a norm for thinking. It is not an order, it is a permission. Rules of inference do not tell you what they must do, they tell you what you may do. They do not necessitate any particular conclusion. For one thing, in normal circumstances there are several different logical conclusions that you can draw from the set of premises that are available to you and that you are actually contemplating. The "rules of inference" do not tell which one of those different possible inferences to draw. In fact they do not even tell that you should draw any inference at all.

In contrast, for Aristotle a logical inference is an unavoidable one. It is not hard to see what the source of the confusion is. What the logical necessity of, say, a valid inference from F to G means is that you cannot realize a situation in which it is true that F without *ipso facto* realizing a situation in which it is true that G. But from this it does not follow that if you think that F you must therefore think that G. It does not follow, that is to say, if your idea of thinking is purely representational. But of course it was not that for Aristotle. For him, to think that F is to realize a state of affairs formally identical with the holding that F in your soul. And if the realization of G is an inevitable consequence of the realization of F, then Aristotle is right and you must inevitably think that G too as soon as you think that F. Thus the alleged psychological necessity of valid logical inferences is a straightforward consequence of Aristotle's theory of thinking.

That Aristotle in fact maintained the psychological necessity of logical inferences (which of course were all the strict inferences for him) is amply shown by his writings. Perhaps the best test case is a *prima facie* surprising corollary of his necessitarian view. If logical inferences are automatic and unavoidable, there is strictly speaking no possibility of making mistakes in logic, except through sheer inadvertance. In general, we obtain in this way an interesting perspective on Aristotle's logical theory.

The scope of the insights we have reached nevertheless extends way beyond Aristotle's logic. For one thing, Aristotle himself maintains a strict parallelism between theoretical and practical reasoning. In most respects, a practical syllogism is for him like a theoretical one. This leads Aristotle to attribute to practical reasoning some binding force as to theoretical reasoning. In other words, it leads Aristotle down the garden path of the Socratic paradox, according to which you cannot fail to draw the right conclusion in the form of the right act from practical premises. This corollary to Aristotle's modal concepts predictably plunges him into the notorious problem of *akrasia* or "weakness of the will" (sometimes also referred to as "incontinence"), more accurately the

problem of how one can act against one's own practical judgement. Aristotle's views commit him to a paradoxical denial of the possibility of *akrasia*, that is, the possibility of acting against what one actually knows to be good for you.

Aristotle's outright denial of *akrasia* in the strong sense is not any more perplexing than the initial *aporia* to which his discussion of *akrasia* was to provide a solution. The strangeness of Aristotle's last and considered views of *akrasia* is a measure of the depth of the conceptual assumptions on which his thought was based. And the most important assumptions relevant here are the ones examined earlier in this paper. Aristotle makes it clear in *Nic. Eth.* VII, 3, 1147a25–31 that the root of the problem of *akrasia* is the nature of practical syllogism, where actual belief in both premises necessitates the conclusion, which is an action.

12. CAN A LOGICIAN BE INCONTINENT?

This diagnosis of the aetiology of Aristotle's views of *akrasia* is confirmed by the fact that Aristotle holds closely similar views of the impossibility of incontinence in logic. In the same way as fully conscious moral mistakes are impossible according to him, in the same way a fully conscious mistake in logic is likewise an oxymoron. Indeed, in *An. Pr.* B 20–21 Aristotle examines mistakes in logic in a way that exhibits interesting similarities with his analysis of *akrasia*. It is of some interest that Aristotle feels called upon to discuss the very possibility of mistakes in logic in his theoretical treatise in logic, instead of relegating the elimination of logical mistakes to his discussion of fallacies in *De Sophisticis Elenchis*.

In *An. Pr.* B 20–21 Aristotle examines various kinds of mistakes in logic, and ultimately rests his case on the very same distinction between actual (active) and merely potential knowledge as was the kingpin of his discussion of *akrasia*.

... 'to know' can be used with three meanings: as knowing by means of universal knowledge; knowing by means of the peculiar knowledge of something; or as knowing by means of exercising knowledge; and consequently 'to be in error' also has the same number of meanings. (*An. Pr.* B 21, 67b2–6.)

In the case of apparent mistakes in logic, the person in error

... does not have knowledge in the sense of exercising it.

This is parallel with *Nic. Eth.* VII, 3, 1147a25–31, where Aristotle likewise distinguishes from each other universal knowledge, peculiar knowledge, and active knowledge.

If there is an apparent failure of complete parallelism here, it lies in the nature of Aristotle's different problems in the two cases. For in *Nic. Eth.*

Aristotle is not dealing merely with an agent who fails to draw a valid conclusion, but with one who draws a wrong one. To explain such an eventuality, Aristotle points out that an *akrates* actually has a second universal premise actually operative in his mind, and one whose main premise is actually thought of. It is this second universal premise that prompts an agent to commit *akrasia*. Hence, it is “in a way reason and belief that make him [an *akrates*] behave incontinently” (1147b1–2).

On a closer examination, it is seen that Aristotle discusses in fact parallel cases of theoretical mistakes in *An. Pr.* B 20, 66b18–34. He ends up with an apparently paradoxical statement that such cases are impossible (66b34), which of course only means that the beliefs in the premises cannot all be actual (actively exercised) knowledge, just as an *akrates* cannot actually (actively) know both of his practical premises.

In a number of passages, for instance in *An. Pr.* B 20, 67a6–21 and *An. Post.* Aristotle gives an interesting twist to the idea of a merely potential knowledge of the main premise in some cases, explaining it by saying that in some cases the agent did not know that the particular instance existed in the first place to which a universal major premise was to be applied. This interesting suggestion illustrates his logical acumen, but does not change the overall conceptual situation.

It is quite striking that in discussing mistakes in logic Aristotle deals mostly with inferences from premises that are partly false. In such cases, a full-fledged knowledge of all the premises is impossible, and hence they do not amount to genuine uses of “logical *akrasia*”. In other words, the mistake in question concerns the premises, not the inferential step. Interestingly, the only type of situation in Aristotle in which a person is not mistaken about the premises and yet fails to draw the conclusion is described by him as follows:

For example, if A belongs to everything to which B belongs and B to every C, then A will belong to every C. Therefore, if someone knows that A belongs to everything to which B belongs, then he also knows that it belongs to C. But nothing prevents him from being ignorant that C exists as, for example, if A is two right angles, B stands for triangle, and C stands for a perceptible triangle.

Clearly, such cases are not genuine instance of full-fledged logical *akrasia*. Thus the answer to the title question of this section is: no, for Aristotle there is no such thing as “logical incontinence”, that is to say, no such thing as a failure to draw the right logical conclusion from fully actual premises.

This conclusion is closely related to Aristotle’s decline of the presence of second-order automatic knowledge in the mind whenever the primary knowledge is present in the mind. (Cf. section 3 above.)

13. ARISTOTLE AND THE INTERROGATIVE APPROACH TO INQUIRY

Aristotle’s theory of thinking can be put to a different methodological perspective. This perspective is part and parcel of the interrogative approach to inquiry

which I have developed and explored in the course of the last several years. (For an interim report on this work, see Hintikka 1999.) One of the first and most important questions concerning any type of interrogative inquiry concerns the class of answers that are available to the inquirer. In virtually all contemporary discussions of epistemology and philosophy of science it is assumed, usually tacitly, that the only answers nature can give to a scientific inquirer's questions are particular propositions. Mother Nature, so this assumption goes, will not tell you what happens always and everywhere. She will only tell you what happens here and now, in a particular observation or experiment the inquirer must himself or herself make the transition from such particular data to a genuine generalization, for instance law or theory, hence facing the problem of induction.

I have dubbed the assumption that only particular (quantifier-free) propositions are available to an inquirer in empirical science the Atomistic Postulate. I have also argued that it is not a realistic assumption in the philosophy of science or in ordinary-life reasoning. Be that as it may, Aristotle's methodological theory involves a clear denial of the Atomistic Postulate, in that the insights that one can reach by realizing appropriate forms in one's mind are general truths, typically general implications.

This makes Aristotle's epistemology virtually incommensurable with epistemologies based on the Atomistic Postulate, which in practice means incommensurable with most of epistemological and methodological discussion after the seventeenth century. Among other things it means that there was no logical problem of induction for Aristotle. We have according to him direct access to general truths about the world. This is what I am conceptualizing as the assumption that an Aristotelian inquirer will receive general propositions as answers to his or her questions. And if so, no rules of inductive inference are needed to reach general truths.

Ordinary deduction can be expected to do the job, for among the premises that can be used in such deductions there already are general propositions. Hence there is no need for special inductive inferences for Aristotle.

As a consequence, when Aristotle speaks of induction or, rather, of *epagoge*, he cannot have in mind what we mean by the word "induction", but something else. What something else is will be discussed later in this paper.

The real logical and epistemological problem for Aristotle was not a transition from particular data to generalizations. His implicit difficulty was a different one. Aristotelian thought-experiments can only be expected to yield one kind of information, viz. information as to which form necessarily accompanies which one. This restriction is neatly reflected by the structure of Aristotle's syllogistic logic, where everything ultimately comes down to the transitivity of class-inclusion. What it means in effect is that the answers available to an Aristotelian inquirer are severely limited as far as their logical form is concerned. They are general implications and nothing more. They have only one layer of quantifiers, all of them universal. In logicians sometime terminology, they are A-propositions, in contrast to E-propositions whose quantifier prefix consists

of existential quantifiers only, from AE-propositions, whose prefix is of the form $(\forall x_1) (\forall x_2) \dots (\exists y_1) (\exists y_2) \dots$, and so on.

The main logico-epistemological problem confronting Aristotle was thus not Hume's problem, that is to say, the problem of somehow inferring A-propositions (and maybe other general propositions) from quantifier-free propositions. It was the problem of somehow inferring more complex propositions, such as AE-propositions, from A-propositions.

This problem is closely related to the problem of understanding mathematical reasoning, which typically traffics in propositions that are much more complex quantificationally, by means of syllogistic logic, which is (part of) the logic of A-propositions.

Thus we can see in what an important way Aristotle's theory of thinking as a realization of forms in the soul influences his epistemological and methodological views, including the main conceptual problems Aristotle had to face in his theory according to his own lights.

14. SCIENTIFIC INFERENCE AS A PROCESS OF CONCEPT FORMATION

The fact that logical inferences are automatic for Aristotle has also an important consequence concerning his conception of the overall structure of a science. It is often said that according to Aristotle a fully developed science consists of first premises and of syllogistic conclusions drawn from them. This is nevertheless a misunderstanding of what the syllogistic structure of a science means in practice for Aristotle. All the actual inferences from the first premises are automatic and instantaneous. Hence a science does not begin by putting forward its first syllogistic premises. It effectively ends with the discovery of its first principles. All the real work of a scientist consists in digging up those first premises. Inferences from them will take care of themselves.

This conclusion will be confirmed further by what will be found later in this paper.

Why, then, cannot we make a short shrift of all science according to Aristotle, simply by performing the different thought-experiments that are needed to uncover the different laws of nature? Why are we not scientifically omniscient? Before answering this question it may be instructive to note the sense in which we are indeed omniscient, albeit only collectively not individually. Not only does Aristotle maintain that "all knowledge comes from pre-existing knowledge" (Aristotle's "law of the constancy of knowledge", see *An. Post.* A 71a1–2). He has the temerity to apply this idea even to actual history. In *Met.* XII 8, 1074b7–14 he goes as far as to write:

But if one were to separate the first point from these additions and take it alone ... and reflect that, while in all likelihood (*katā tō eikōs*) each art and each science has often been developed as far as possible and has again perished, these opinions, while others, have been preserved with the present like the

relics of an ancient treasure. It is only in this way that we can explain the opinions of our ancestors and forerunners. [Emphasis added.]

Thus for Aristotle mankind would indeed be scientifically and technologically omniscient, relative to our inherent potentialities, were it not for the fallibility of our collective memory.

The real answer to my *aporia* is nevertheless a different one. In order to perform the relevant sort of thought-experiment I must have the requisite concepts (forms) actually present in a fully formed state in my soul. This is no mean requirement. Fulfilling it means to build up the concepts in question step by step in my mind till they are actually present there in a fully articulated form. Only then are Aristotelian thought-experiments possible. Of course in a sense they are not any longer necessary, for what for us is an inference will then take place automatically.

This leads me to a remarkable conclusion. *The scientific and philosophical enterprise is essentially a matter of concept formation* according to Aristotle. A scientist's business is not to collect and collate facts and draw inferences from them. Rather, his first and foremost business is to build up the concepts we need in science and philosophy. Once one has formed the right concepts, the first syllogistic premises of the science in question are obvious. Hence there is a kind of double automatism in an Aristotelian science. Not only are the syllogistic conclusions foregone in the sense of being necessary and instantaneous. The first premises of such scientific syllogisms are also seen to be true as soon as one has managed to form the right concepts (the right definitions) in one's mind.

This conceptual character of the scientific enterprise according to Aristotle is also what aligns his own methods of philosophical reasoning with what he maintains is the proper procedure of a scientist. At the same time, it explains why the actual vagaries of sense-perception which Aristotle brushes under the rug of definitional infallibility do not impair according to him the scientific process.

15. SCIENCE AS A SEARCH FOR DEFINITIONS

This is one of the main insights into Aristotle's methodology I am offering to you in this paper. It can be illustrated, confirmed and developed further by applying it to a number of more specific issues in Aristotle.

An alternative, and more perhaps authentically Aristotelian, way of saying that for him the most important business of science is concept formation, is to say that it is a search for definitions. For Aristotle, to grasp the form of X is to grasp the definition of X.

Accordingly, for Aristotle "the starting-points (*arkhai*) of [scientific] demonstrations are definitions" (*An. Post.* B 3, 90b24–25). In other words, in scientific syllogisms "the middle is the definition of the major term; this is the reason

why all sciences are based on definitions” (*An. Post.* B 17, 99a21–23). And the aim of the presyllogistic (and hence nonautomatic and nontrivial) part of the scientific enterprise *apud* Aristotle was seen to be in search of such just premises.

In fact, in *An. Post.* B 7 92a36–11 Aristotle implies that in induction the particular cases are “obvious” (*delon*). Hence the act of induction is presumably based on a judicious cutting of the cake of the whole generalization into suitable subcases.

Here a more general overview of Aristotle’s ideas may be in order. The unqualified statements by Aristotle to the effect that all first premises of scientific syllogisms are definitions occur mostly in *An. Post.* B. In apparent contrast, in *An. Post.* A, Aristotle seems to say that only some of the first principles of a science are definitions.

I call first principles (*arkhai*) in each genus those that cannot be proved. Thus the meaning of primary terms (*tā prōta*) and the attributes demonstrated from them must be assumed. But that they are, must be assumed of the first principles (*arkhai*), but proved of the attributes. (*An. Post.* A 10, 76a31–35.)

The *arkhai* here are, as I have shown, the terms of the widest “generic” premises of any one science, whereas “attributes” are terms occurring in narrower “atomic” first premises. The latter occur in premises which are called in so many words “definitions” by Aristotle in *An. Post.* A 2, 72a21–23. The assumptions in which the former occur appear to be the more important assumptions, but unfortunately for my thesis – so it seems – they are exempted from being merely explications of meaning.

16. THE ROLE OF EXISTENTIAL ASSUMPTIONS

This is nevertheless the kind of apparent exception that proves the rule in the literal rather than the mistaken vulgar sense. A full analysis of Aristotle’s thought on this matter would require a more detailed examination of the texts than I can undertake here. The main outlines are nevertheless simple enough to be sketched here.

According to our twentieth-century lights, lit by such luminaries as Frege and Russell, both the general and the atomic premises of a science must be nontrivial and carry an assertive force. Neither could be definitions, for definitions are for us mere stipulations and therefore empty of assertive content. The fact that Aristotle considers some syllogistic first premises mere definitions already shows that he is in a different ballpark. But why doesn’t he consider all of them definitions, as he himself later maintains in *An. Post.* B?

The reason lies in an extremely interesting and subtle feature of Aristotle’s logical thinking to which I have called attention elsewhere. It is that according to Aristotle existential assumptions filter downwards in a chain of scientific

syllogisms. In any one member of the chain, existence assumptions need to be made only for the major term. The syllogism itself serves to extend these existential assumptions to the minor term.

Even without any close exegesis, it is not hard to see that this what Aristotle is proposing in such passages as the following:

When we ask the question of fact or of being *haplōs* [meaning here existence], we are asking whether the term has a middle term or not. (*An. Post.* B 2, 89b36–37.)

Because Aristotle does not distinguish from each other the allegedly different Frege-Russell meanings of *estin*, he seems to be confusedly inferring in *An. Pr.* A from the absence of existential force in the atomic premises to the fact that these premises do not have any factual content. Actually, Aristotle's way of thinking is highly plausible. If atomic premises do not say that something *is* in the sense of existing, how can they say that something *is* in the sense of being so-and-so? Surely assertive force presupposes existential force, Aristotle may have averred, thereby parting company with twentieth-century logicians.

But perhaps there is no real confusion in Aristotle. Perhaps what we are dealing with here is an inevitable limit of Aristotle's idea that the first truths of a science are all conceptual truths. For the minimum additional assumption for a real science can very well be thought of as being the assumption that the relevant concepts exist in the sense of being exemplified in part of reality, in the genus, that the science in question is studying? The very enterprise of defining something might seem to depend on its existing in the first place. Indeed, Aristotle holds in so many words that

we can discover what a thing is only if we know that it is. (*An. Post.* B 8, 93a23–25.)

Be this as it may, Aristotle himself felt the need of clarifying the situation further in *An. Post.* B. Predictably, the starting-point of this fuller analysis is a distinction between being in the sense of existence (being *haplōs*), being in the sense of identity (the *what*), and being in the veridical sense (the *that*, as in *it is the case that*), with the question of the *why* thrown in. (See *An. Post.* B 1–2.)

And the outcome of Aristotle's second sailing on the unruly waters of primary truths is just what I said that would be. Even the generic premises turn out to be definitions of sorts. These premises are now identified as having immediate (better, unmediated, *amesa*) premises. According to Aristotle in *An. Post.* B 10, 94a9–10,

the definition of immediates consists in an indemonstrable assumption of what they are.

Even more generally speaking, it is a telling fact that Aristotle unmistakably

discusses in the crowning final *coda* of *Analytica Posteriora* (*vide* B 19) the discovery of the first truths of science as a process of concept formation, just as I have maintained that he in effect does all along.

17. ARISTOTLE'S CONCEPTION OF INDUCTION (*EPAGŌGĒ*)

In trying to interpret Aristotle's search of the first premises of science as a process of concept formation, another *experimentum crucis* is obviously his notion of induction. For us post-Humean philosophers induction is an inference from known particular cases to a general truth (or else to an unknown particular case). But what is induction, or rather *epagōgē*, for Aristotle? Through a lucky coincidence of scholarly autobiography, I do not have to examine this question in full detail here. As it happens, I developed a full-fledged interpretation of Aristotle's notion of *epagōgē* before I began to examine his general methodology (Hintikka 1980(b)). The upshot of my earlier paper is precisely what we have here been led to expect. Induction is the same as, or at least proceeds in tandem with, the search for definitions.

Indeed, I argued that the most instructive instance of fullest and inductive reasoning in Aristotle is his example calculated to illustrate the search for definitions. This example is the search for the definition of *megalopsuchia* in *An. Post.* B 13. The search proceeds by considering in turn all the different varieties of *megalopsuchia*. For each of the different kinds, we first find out what it is that makes us call its members *megalopsuchoi*. There are as it were partial definitions of *megalopsuchia*. The true definition is found by seeing what is common to all those partial definitions for "every definition is always universal".

This process exhibits an obvious analogy with Aristotle's official discussion of induction in *An. Pr.* B. How precisely that analogy goes was discussed in my earlier paper. Even if that paper needs a re-examination, this is not the place to launch one, especially as I am convinced that the main ideas of the earlier paper are safe and sound.

Instead, I will emphasize a few points not made in that earlier paper. Simo Knuutila (1993) has meanwhile examined Aristotle's actual use of the notion of induction in his own argumentation. The upshot is clear. Induction means for Aristotle *practicus* an argument which establishes a generalization for a class by establishing it for each of a finite number of its special cases. Now such arguments are trivial if thought of as deductive inferences and useless if they are thought of as basic forms of inductive arguments. For before such a step of overarching generalization you must have established a partial generalization for each of the subspecies or other subcases, presumably by some means other than induction.

In order to make sense of Aristotle's procedure we must obviously ascribe to it as elements of conceptual analysis of the kind which is present in the *megalopsuchia* example. Indeed, there are two different kinds of conceptual

analysis present here. First, the partial definitions which form the stepping stones to the full definition are clearly not obtained by ordinary observation. Rather, we have to ask what it is that we have in mind when we call the members of one of these subclasses *megalopsuchia*. Second, the search of the common element in the partial definition is clearly not a mechanical procedure, but of the nature of conceptual analysis.

The crucial insight in dealing with Aristotle's notion of *epagōgē* requires a change of perspective. Aristotle's various statements about induction are bound to be intensely puzzling as long as we view him as dealing with inferences from particulars to general laws. When we shift our viewpoints and look upon what he is doing as a search of the definition of a general term through an examination of its meanings when applied to a number of subfields, in other words, view induction as a process of reconciling a number of partial definitions, Aristotle's procedure loses its strangeness.

All this illustrates what I meant by saying that for Aristotle the search of the first syllogistic premises of a science is essentially a process of concept formation. It also shows how thoroughly mistaken it is to assimilate Aristotelian *epagōgē* to the modern idea of an inference from particular (individual) cases to a generalization. Aristotle admittedly says things that are often translated by saying that according to him induction proceeds from particulars to the general. For instance, in *An. Post.* B 7 92a36 ff. he seems to refer to induction as "an enumeration of manifest particular instances". But, if Aristotle is half-way consistent, "particular instances" (*hekasta*) are meant to be subcases, not particular instances. And if so, then the phrase "particular instances" is simply a misleading translation. (The ordinary meaning of the term is already closer to "subcases" than to "particular instances".) What Aristotle means is the *epagōgē* proceeds from limited generalizations to a full generalization.

Here a longer historical perspective turns out to be highly illuminating. It can be shown, even in the absence of a full study, that in much of its early semantical history the notion of induction did not mean an inference or any other kind of passage from particular to general laws. (See here Hintikka 1999, chapter 8.) Rather, it meant a step from a limited generalization to a broader one or – as in Aristotle – a process of reconciling several partial generalizations with each other so as to bring them under the same general law. For instance, this is how Newton uses the term "induction". The main essential differences between him and Aristotle are, first, the quantitative nature of Newton's partial generalizations in contrast to Aristotle's qualitative ones and, second, Newton's greater wariness concerning the epistemological prospects of induction which he declares to be only "the best method of reasoning that the nature of things allows us". But even with these qualifications, the closeness of Newtonian induction to Aristotelian *epagōgē* is striking, not to say surprising.

It is also striking that the process of reconciling partial generalizations with each other in modern science is not merely or even in the first place a merely empirical (observational or experimental) procedure. It involves typically a manipulation of the mathematical formulas expressing the partial generalizations in question, trying to interpret them mathematically as special cases of

one single overarching mathematical law. A comparison with this procedure and the nature of Aristotelian induction as conceptual analysis (conceptual reconciliation of different partial generalizations) is highly suggestive.

18. ARISTOTLE'S EMPIRICISM IN A NEW LIGHT

But if all natural laws are at bottom conceptual, what becomes of Aristotle's vaunted empiricism? I seem to contradict the most basic facts about the historical Aristotle by turning him into a rationalist. Where did he need experience in the first place? The answer is that Aristotle did indeed need experience and that he therefore was a genuine empiricist. But his empiricism was of a kind we twentieth-century philosophers are not used to dealing with, was a kind of conceptual empiricism. Aristotle needed experience, not so much to give him the facts from which he can infer scientific laws but to give him the concepts out of which he can build (or refine) the notions involved in natural laws.

In the *megalopsuchia* example we can see vividly how immediate perception or perhaps simple reflection on our concepts can furnish the ingredients out of which a complex concept, complete with its definition, can be built.

Since experience was calculated to provide the right conceptual or "formal" ingredients out of which the basic scientific concepts could be built, rather than indubitable basic facts, Aristotle did not have to worry about the fallibility of experience in the same way as a modern philosopher like Descartes.

19. SURVEY OF ARISTOTLE'S THEORY

These observations show the affects of Aristotle's theory of thinking on his epistemological and metaphysical ideas. Some of them are connected with the corollary that says that connections between forms and the nature of forms can be grasped simply by realizing these forms in one's soul. But where does this idea come to play in Aristotle's methodological discussions? As far as logical inferences are concerned, it is not difficult to defend the interpretation that they are automatically drawn once the premises are actually present in the soul according to Aristotle. But where does the presence of form in the soul make itself known in the process of reaching the premises? Aristotle's primary answer to the question as to how to search for first premises is: dialectically. And for Aristotle dialectics means – or at least includes – the process of examining, probing and reorganizing forms so as to reach the right definitions and whatever else may be needed as first premises of a science. Induction is for Aristotle a part of such a process. In fact, most of the methodological discussion in *An. Post.* is devoted to this process of step by step formulating of the concepts that are needed in a science. Even though Aristotle does not put much emphasis on the term dialectic in *An. Post.*, the word is in

a sufficiently wide sense eminently applicable to what is described in much of *An. Post.*

But where does the direct insight into the forms in one's mind come in? A look at Aristotle's discussion quickly shows that this does not happen in the search of atomic premises. They are typically obtained by induction or by some other technique. In contrast, no dialectic can get us to the highest premises of a science. They have to be assumed. And when this climb higher and higher is continued, we ultimately hit the widest genera. Their definitions are needed as the most general syllogistic premises, and such premises cannot any longer be reached dialectically.

It is here in my view that the need of as it were reflexive insight into the forms in one's mind enters into the picture. Such insight provides the most general concepts we need and ipso facto the most general premises we need. As is well known, Aristotle has a term for such a direct insight into the most general concepts. The term he uses is the famous *noūs*. Now we can recognize its function in Aristotle's conceptual scheme. It is the door through which direct insights into forms in one's mind enters into Aristotle's system.

From this vantage point, we can understand what Aristotle is up to in his summary of the scientific process in *An. Post.* B 19.

The most important point that has to be understood in order to appreciate what Aristotle is doing in *An. Post.* B 19 is the division of labor between *epagōgē* and *noūs*. In 100a15-b5 Aristotle writes (in Barnes' translation):

What we have just said but not said clearly, let us say again: when one of the undifferentiated things makes a stand, there is a primitive universal in the mind (for though one perceives the particular, perception is of the universal – e.g. of man but not of Callias the man); again a stand is made in these, until what has no parts and is universal stands – e.g. *such and such* an animal <stands>, until animal does, and in this <a stand is made> in the same way. Thus it is clear that it is necessary for us to become familiar with the primitives by induction; for perception too instills the universal in this way.

Aristotle's term for Barnes' "primitives" is *ta prōta*.

This passage shows clearly that the role of *epagoge* is to effect the concept formation that leads from perceptions to the definitions that figure as premises of atomic syllogisms.

20. THE ROLE OF *NOŪS*

But where does the direct non-dialectical insight into the interrelations of forms come in? The continuation of the passage just cited is so familiar that it is scarcely necessary to quote it. Yet its interpretation is far from obvious.

Since of the intellectual states by which we grasp truth some are always true

and some admit falsehood (e.g. opinion and reasoning – whereas understanding and comprehension are always true), and no kind other than comprehension is more certain than understanding, and the principles of demonstrations are more familiar, and all understanding involves an account – there will not be understanding of the principles; and since it is not possible for anything to be truer than understanding, except comprehension, there will be comprehension of the principles – both if we inquire from these facts and because demonstration is not a principle of demonstration so that understanding is not <a principle> of understanding either – so if we have no other true kind apart from understanding, comprehension will be the principle of understanding. And the principle will be of the principle, and <understanding> as a whole will be similarly related to the whole object.

What Barnes translates as “understanding” is of course *epistēmē* while “comprehension” is *noūs*. It is *noūs* that is said to give us the *arkhai* of science. Even though in *An. Post. A 2*, 72a6–17 Aristotle says that he is identifying *ta prōta* and *arkhai*, here in *B 19* he is using these terms differently. What has happened between *An. Post. A 2*, and *An. Post. B 19* is that Aristotle has clarified the role of existential assumptions in scientific syllogisms. In *A 2*, premises without existential force were not hypotheses, i.e. did not have assertoric force. By the beginning of *An. Post. B*, Aristotle has reached a point where he recognizes syllogisms without existential force as *bona fide* inferences, that is, inferences establishing that there exists a middle term, even though they do not establish existence unless the major premise can be assumed to carry existential force. This creates a need of terminological distinction between two kinds of first premises, viz. on the one hand the widest premises, which are the only ones that initially have existential content and hence the only true *arkhai*, and on the other hand the intermediate atomic premises. The latter are in a sense primary, *ta prōta*, but not in the same sense as the most general ones. They are primary merely in the sense that no further term can be inserted between their two terms. Such atomic premises can be reached by induction, but the most general ones only by *noūs*. Why not in other ways? Because the existential force flows from the top down while induction works its way from partial generalizations to wider ones in other words, upwards toward more general premises.

Noūs can according to Aristotle pertain only to the most general premises. This can be seen as follows: According to Aristotle, *noūs* is always active hence it can only provide actual (active) knowledge. But knowledge which does not carry with it the existence of its object is merely potential. Hence *noūs* must provide the first premises which carry existential force. According to Aristotle, those are the widest (generic) premises of each science, ultimately the most general premises possible.

The direct access to forms which is guaranteed by Aristotle’s theory of thinking thus comes into play in two ways in Aristotelian epistemology:

(1) First, as providing for automatic logical (syllogistic) inferences; (2) Second, as providing the most general scientific premises in the form of *noūs*.

21. THE NATURE OF NOŪS

The results reached here throw light on the nature of *noūs* in Aristotle. The following observations can be made here:

- (1) *Noūs* is not a mysterious faculty of the mind. It is simply a matter of the soul's having access to the forms which are present in it.
- (2) What is special about the realization of forms through *noūs* is that they have to be present in the soul actually, not merely potentially. Since they are the most primary assumptions, there cannot be anything prior to them to activate them. In this sense, the forms have to be there in the soul permanently. It is in this sense that Aristotle can say that "mind does not think intermittently" (*De. An.* III, 5, 430a22–23). This doctrine of the active *noūs* is a consequence of Aristotle's modal theory, which requires any instance of a form to be activated by an actual earlier exemplification of the same form. (Cf. section 14 of this paper.)
- (3) The communality of the active *noūs* also becomes understandable. What it means is that the same forms are actively present in the "active *noūs*" part of each soul. It does not presuppose the postulation of any world soul over and above the souls in the usual sense.

22. DOES ARISTOTLE PRACTICE WHAT HE PREACHES?

My results have another important application. They enable us to reconcile two things that often are thought to exhibit a surprising and disconcerting, to wit, Aristotle's theory of science and his own scientific practice. These alleged discrepancies between these two are multiple. They concern both the structure of a science and the nature of the reasoning that is involved in scientific thinking.

The discrepancies between what Aristotle preaches and what he practices methodologically are supposed to include the following:

- (1) In *An. Post.* a science is apparently said to consist of syllogistic deductions from first premises. Yet in Aristotle's own scientific work, syllogistic deductions are few and far apart, and most of the discussion is devoted to a search for the first principles.
- (2) In *An. Pr.* I, 30, 46a17–22, Aristotle says that

It falls to experience to provide the first principles of any subject.

Yet Aristotle virtually always begins his own discussion of any scientific problem, not from what experience tells us about it, but from what his predecessors

had said about it and what other reliable common opinions (*endoxa*) there are about it.

Aristotle routinely lumps both kinds of starting-points under the heading of *phainomena*. Not surprisingly, translators have had a hard time trying to come up with a single plausible translation. Many scholars, including such movers and shakers as G. E. L. Owen (1986 cf. also Nussbaum 1982), have considered the very term *phainomena* ambiguous. This is supposed to induce a similar ambiguity in such closely related terms as *epagōgē*.

(3) Furthermore, and more generally, even if we acknowledge that much of Aristotle's actual work in such scientific treatises as the *Physics* consists in a search for the first principles of that science, Aristotle's entire procedure is dialectical rather than scientific. In dealing with any one problem, he typically begins with writing a number of views that his predecessors have held about that subject matter or views that otherwise recommend themselves to us. Then he points out that these views do not agree with each other. Often, he rehearses the arguments for both sides of the issue. Aristotle's own solution, which leads him to his own view, is not reached by adducing new facts or by drawing new inferences from the known facts. Typically, it consists in a conceptual analysis of the crucial concepts and theses involved in the relevant *aporia*, often culminating in a conceptual distinction between different senses of a word or an expression. For instance, in dealing with the problem of further contingents, the *denouement* is a distinction between the meanings of "what is, necessarily is when it is" and "what is, necessarily is *haplōs*", that is to say, is said to be without any further (temporal) qualification. Likewise, Aristotle's discussion of infinity turns on a distinction between two senses in which the infinite – or for that matter anything else – is said to be.

After having introduced the operative distinction or other solution (not to say dissolution), Aristotle goes on to show how that solution does justice to the different and apparently conflicting *endoxa* and to the arguments based on them.

In interpreting Aristotle, one of the most important questions concerns the way Aristotle follows this procedure in his more extensive investigations, such as the study of being *qua* being in the *Metaphysics*.

Aristotle's procedure in highlighting the most general premises makes little sense if he were merely looking for the factual premises of a science. For one thing, from the syllogistic structure of an Aristotelian science it follows that the primary syllogistic premises mostly are not the most general premises. The most primary syllogistic premises deal with the relationship of terms maximally close to each other extensionally and Aristotle thinks, maximally close to each other also by way of meaning.

Such primary premises do not form a short list like the basic assumptions of a modern scientific theory, such as Hilbert's geometry or Maxwell's theory of electromagnetism. In fact, Aristotle notes himself that in a science the first premises are as numerous as the conclusions.

Admittedly, the most general (generic) premises of any one science occupy a

special position for Aristotle. But this is merely due to Aristotle's treatment of existential assumptions in a science. As was pointed out, the generic premises are in the last analysis the sole repository of the existential assumptions of a science according to Aristotle. This, and no other factor, is what lends them their unique position in Aristotle's theory.

All the different aspects of Aristotle's typical methodological procedure become understandable when we look at it in the light of his theory of thinking and in the light of what that theory was seen to imply. For one thing, we must realize that he is taking the laws that hold in a science virtually for granted. Those are the laws whose validity we can realize by forming the right concepts in our minds. Aristotle thought of them as being initially given to us by experience or by the teachings of our predecessors. The problem is to find their roots in the interrelations of forms. And to do so is not to find any new facts, but to clarify the concepts (forms) involved in our mind so as to come to realize the validity of the laws in question. Owen and Nussbaum are right; there is no "Baconian picture" in Aristotle. But this is merely due to the fact that there is no Baconian agenda in Aristotle.

This entire procedure is obviously predicated on our being ultimately able to recognize the validity of valid scientific laws as soon as we see them clearly. And this assumption is supplied to Aristotle by his theory of thinking as a genuine realization of forms in one's soul.

At first sight, Aristotle's paradigm of scientific inquiry might thus seem so far removed from the procedures of modern science as to be incommensurable with it. By and large, it is true, an authentic understanding of the nature of the scientific enterprise according to Aristotle depends on a realization of the differences between his conceptions and those of modern scientists. However, those overall differences do not preclude the existence of smaller-scale similarities. For one thing, Aristotle's motion of induction (*epagōgē*) as a process of reconciling with each other a number of subordinate generalizations (partial definitions) has an interesting counterpart, in modern scientists procedure in reconciling partial generalizations with each other and in extending them beyond their original scope. Interestingly, this turns out on a closer historical examination to be precisely what the term "induction" was used to refer to by such modern scientists as Newton, as was noted above. It is of considerable interest and relevance to note that such an "inductive" reconciliation of partial generalizations is a largely conceptual problem. For instance, it may take the form of trying to reconcile two partial mathematical laws by interpreting them as extreme cases of one and the same unifying law. Such a reconciliation involves a heavy dose of analyzing the laws in question in mathematical terms, that is, conceptually rather than experimentally.

In the light of these insights, the alleged discrepancies between Aristotle's theory and practice of science can be seen to be but optical illusions. For one thing, if the actual holding of scientific laws is easy to ascertain once we have formed the right concepts, the main task of a scientist is to form those concepts.

In fact, Aristotle apparently thinks that the holding of the relevant laws has

been established before the proper business of a science begins. Since Aristotle does not distinguish sharply the existential *estin* from its factive use, the impact of such passages as was quoted above from *An. Post.* B 8, 93a23–25 comes close to asserting that we must first know that scientific laws in fact hold before we can look for the definitory formulas for its terms which can serve as the first premises of a syllogistic science. In fact, one of the “things” actually mentioned by Aristotle as needing a definition even after its existence has been ascertained is eclipse.

And for the purpose of explaining already established laws in terms of the concepts (forms) they involve, it does not matter whether the ingredients of those concepts come to us directly from our own experience or from the views of well-informed fellow thinkers – or fellow humans in general. In scientific inference, there may be a premium for direct experience, but in concept formation there need to be any such thing. Hence, *endoxa* are perfectly acceptable grist to Aristotle’s methodological mill. Indeed, the more fully our predecessors have managed to articulate the mangled and messy forms that raw experience gives us, the better starting-points they can be for Aristotle’s dialectical search for first premises.

Even if we do not go as far as to maintain that the relevant laws were according to Aristotle known to a scientist before he begins his proper task, the vagaries of *endoxa* pose no problems to him – according to his own lights. For one thing, the obvious factual unreliability of *endoxa* does not present any difficulty for Aristotle. For one thing, they are not premises from which any inferences are drawn, except tentatively, in the same probing manner as inferences are drawn by Socrates from his interlocutor’s admissions. The *endoxa* are starting-points of a dialectical process that can be a self-corrective one, even leading sometimes to the rejection of one of its own starting-points.

But even so Aristotle’s trust in *endoxa* might seem to be lackadaisical, were it not for his deep conviction that once we have merely clarified our own concepts the truth of the premises of a science can be ascertained by the simple expedient of realizing the requisite concept in one’s mind.

Hence Aristotle’s main concern in his dialectical search for the first premises of a science is not even the weeding-out of factual errors in the *endoxa*. It is the elimination of conceptual flaws, mistakes and inadequacies of *endoxa*. And it is the elimination of such conceptual imperfections that constitutes Aristotle’s agenda in his own scientific inquiries.

A fortiori, *endoxa* can be as good (and perhaps even better) input for Aristotelian science as direct observations and if that input is collectively labelled *phainomena*, there is no need to postulate different senses of the term in Aristotle, since both kinds of *phainomena* serve as starting-points of the same process. Owen notwithstanding, there is a uniform function for *phainomena* and for *epagōgē* in Aristotle.

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CHAPTER 4
ON THE ROLE OF MODALITY IN ARISTOTLE'S METAPHYSICS¹

1. SUBSTANCE AS A UNION OF MATTER AND FORM

One of the most crucial and at the same time most puzzling questions concerning the central books Z- θ of Aristotle's *Metaphysics* concerns the structure of his overall argument. What are his problems, and how does he propose to approach them? For instance, what is the relation of Aristotle's discussion of modality in *Met. θ* to his discussion of substance in *Met. Z-H*? Aristotle's writings are in general characterized by a remarkable tenacity in pursuing his main line of thought, obscure though his detailed remarks often be. If so, how is he led by his argument concerning the nature of substance in *Met. Z-H* to his analysis of potentiality in *Met. θ* ? My aim in this paper is to suggest an answer to these questions.

In so doing, we obviously have to start from Aristotle's main business, which is his concern with the notion of substance. Now one of the most crucial problems concerning substance which Aristotle discusses in *Metaphysics Z-H* is the unity of substance.

The substratum is substance, and this is in one sense matter ... and in another sense the formula or shape (that of which being a 'this' can be separately formulated), and thirdly the complex of these two, which alone is generated and destroyed, and is, without qualification, capable of separate being. (*Met. H* 1, 1042a25–32.)

Aristotle apparently assimilates matter and potentiality to each other, and likewise form and actuality:

by matter I mean that which, not being a 'this' actually, is potentially a 'this.' (*Ibid.* a27–28.)

But how do the two components, matter and form, manage to be combined into *one* entity, substance in the third (and most proper) sense? What constitutes the *unity* of a substance? Aristotle discusses this question at length in *Met. H*. His answer is stated at the end of that book:

But, as has been said, the proximate matter and the form are the same, the one potentially, and the other actually. Therefore to ask the cause of their unity is like asking the cause of unity in general, for each thing is a unity,

and the potential and the actual are in a way one. Thus there is no cause other than whatever initiates the change from potentiality to actuality. (*Met.* H 6, 1045b17–22.)

The kind of potency which characterizes matter is clearly the kind of potentiality that is sometimes known as the passive potency. It is distinguished from active potencies by Aristotle. Aristotle explains the distinction in *Met.* Δ 12:

‘Potency’ then means the source, in general, of change or movement in another thing or in the same thing *qua* other, but also the source of a thing being moved by another thing or by itself *qua* other. (1019a18–21.)

These two kinds of potencies, which we may call the active and the passive potency, are reciprocal. The one is the active source of the same change or movement which the other one is the passive capacity of undergoing. Clearly it is this correlative connection that Aristotle is appealing to at the end of *Met.* H to explain the unity of matter and form in a substance. The two kinds of partial potencies are but two sides of the same coin or, more literally, of the same total potentialities. The one can only be defined by reference to the other. Hence no further explanation is needed to account for their unity – or so Aristotle’s idea goes.

Admittedly, the unity of passive potency and the correlated active potency is not the same as the contrast between a passive potency and the correlated actuality. However, for Aristotle’s purposes the two contrasts can be treated as equivalent in that for him actuality and an active potentiality are closely related. Hence we can say that the unity of substance is according to Aristotle based on a correlation of active and passive potentialities which makes them pairwise one in the sense which Aristotle needs. Matter *is* the passive potentiality needed for the being of substance, and the form constitutes the actuality which serves as the active potency. Their correlative identity is supposed to explain the unity of substance.

2. ARISTOTLE EXPLAINS TOO MUCH

Why isn’t this all that Aristotle had to say? Why couldn’t he rest on his ontological laurels and stop the metaphysical inquiry which he had conducted in *Met.* Z-H right there? An answer to this question touches the heart of the role of modal notions like potentiality in Aristotle’s metaphysics. It shows what the hidden problems are which beset Aristotle’s metaphysics of modality and which forced him to continue the inquiry he had conducted in *Met.* Z-H and carry it to the treacherous territory of modality in *Met.* θ. It shows in brief, the *raison d’être* of *Met.* θ.

If what has been said so far were the whole story, Aristotle would indeed be in trouble. Why? The gist of his reconciliation of matter and form into one

happy unity in *Met. H* is the idea that the *unity* of a substance is *completely* explained by these two factors. Unfortunately for Aristotle, this explains too much. It will also explain the automatic *being* (existence) of a substance as soon as the two factors (active and passive potency) are present. For Aristotle consistently emphasizes that unity (being one) and simple being (being as existence) go together. For instance, in *Met. Γ 2* we read:

... being and unity are the same and are one thing in the sense that they are implied in one another as principle and cause are ... 'one man' and 'man' are the same thing, and so are 'existent man' and 'man.' (1003b23–27.)

Hence Aristotle's explanation of the unity of substance works only if the presence of the correlated active and passive potencies explains completely the being of a substance. The substance must come to be as soon as these two potencies are present together.

That this was Aristotle's general idea is seen from what he says in *Met. H* – the idea, that is to say, that the simultaneous presence of correlated active and passive potencies, rightly understood, must lead to actualization.

An active and a passive potentiality are *partial* potentialities. Aristotle presupposes in *Met. H*, first, that these two together constitute a *total* potentiality which does not need further components to be a potentiality in the fullest possible sense. Second, he is assuming that such a total potentiality is immediately and automatically realized as soon as all its components are present. For otherwise some further explanatory factor would be needed to account for the realization, and Aristotle's explanation of the unity of substances' would not be viable. In *Met. θ 5*, 1048a1–15 Aristotle accordingly first explains that in the case of what he calls rational potencies a desire or will is needed for their realization, for they have two different alternative outcomes:

Since that which is potential is potentially something at some time and in some way (and with all the other qualifications which must be present in the definition), and since some things can produce change according to a rational formula and their potencies involve such a formula, ... as regards [such potencies], when the agent and the patient meet in the way appropriate to the potency in question, the one *must* [emphasis added] act and the other be acted on. ... Therefore every thing which has a rational potency, when it desires that for which it has a potency and in the circumstances in which it has the potency, *must* do this [emphasis added].

Aristotle's further explanations show nicely the co-operation of active and passive partial potentialities in a complete potentiality, which he has just asserted to be realized as soon as it is present:

And it has the potency in question when the passive object is present and is in a certain state. ... To add the qualification 'if nothing external prevents

it' is no longer necessary; for it has the potency on the terms on which this is a potency of acting, and it is this not in all circumstances but on certain conditions, among which will be the exclusion of external hindrances; for these are barred by some of the positive qualifications. (1048a15–22; cf. also *Met. θ* 7, 1049a5–7.)

But this seems to lead to a paradoxical and untenable result. For the purpose of explaining the unity of substance, Aristotle had to assume that once the correlated active and passive potencies are present in the case of a substance, they must be realized; the substance must actually be there. Otherwise further ingredients will be needed to bring about a substance, and Aristotle's neat explanation of the unity of substance as a combination of two correlated factors will be insufficient. In the quoted passage, Aristotle seems to generalize this to all potencies. Indeed, it is hard to see how he could justify his treatment of the unity of substances unless he could treat it as a special case of his general theory of potentiality. But the general principle Aristotle seems to be appealing has the catastrophic consequence of driving him to a Megarian position. Every pair of full-fledged active and passive potentialities *must* be automatically realized. There is no room for unrealized potentialities, unless there are merely partial potentialities, for instance, passive potentialities without their active complement, or *vice versa*, or otherwise lower-grade potentialities. I have argued in the monograph referred to in note 1 that there were strong forces in Aristotle's thinking that pushed him toward this untenable position. We have now found an additional temptation for Aristotle to adopt the Megarian view, and say that only what is actual is, in the most full-fledged sense of the word, really potential.

3. ARISTOTLE'S WAY OUT

Of course, Aristotle does not want to accept the Megarian conclusion. In *Aristotle on Modality and Determinism* we explored several of his attempted way out, such as his famous discussion of future contingents in *De Int.* 9.² Here it suffices to concentrate on his definitive solution of this self-inflicted problem.

Where could Aristotle find a satisfactory solution? First, how could Aristotle disentangle himself from the Megarian implications of his own position? What this question means in most general terms is: Where could Aristotle find full-fledged potentialities that are unmistakably present but have not yet been realized?³

An answer is suggested by the idea of *dynamis* as a power or tendency. How can such a power be manifested? A *dynamis* must be a potentiality of something in the sense of having this something as its characteristic end or outcome. Now it lies close at hand to say that a *dynamis* can be 'seen' in two different ways: either from the fact that its end (i.e., what it is a potentiality of) in fact comes about or else from the fact that a change or movement toward that end is

taking place. In the first case, potentiality has already been realized, and no wedge has been driven between possibility and actuality (and necessity). However the second case is what Aristotle can use. Indeed, it is his only opening here. In such a case, a *dynamis*, that is, a power or potentiality, is unmistakably present, for how else could there be a change in the right direction? Nevertheless in such a case the potentiality has not yet been realized, for the outcome has not come about. In such cases, and in such cases only, can Aristotle find room for unactualized possibilities and hence escape the menace of determinism. The Megarian arguments, or at least some of them, can be accommodated in this account by saying that in the second type of case a change or movement is necessarily initiated as soon as the potentiality is present. From this it does not follow, however, that the potentiality itself is instantaneously actualized in the sense that the outcome is immediately realized. This, then, is the way – the only way – in which a genuine potentiality can exist unfulfilled according to Aristotle.

From this vantage point, several pieces of our puzzle at once fall into their places. If the only way in which potentiality can exist unfulfilled is in the form of a change towards its fulfillment, such a change or *kinesis* is the only form of actual existence which a potentiality can enjoy is so far as it is only a potentiality (i.e., in so far as it is still unfulfilled). But to say this is to assent *verbatim* to Aristotle's famous definition of *kinesis*:

The actuality (*entelecheia*) of what exists potentially, in so far as it exists potentially, is *kinesis*. (*Phys.* III 1, 201a10–11; the same formula is given at 201a27–29 and at 201b4–5).⁴

Now we can see what is meant by 'the actuality of what is potential' by Aristotle. Surprisingly or not, it means precisely what it says. The only way in which a potentiality can exist (be actual) as *potentiality*, that is without already having given rise to whatever it is a potentiality of, according to Aristotle is a change (movement) toward that which is potentiality of.

4. KINESEIS VS. ENERGEIAI

More generally, we can see how Aristotle's distinction between *kinesis* and *energeia* not only forms a natural complement to his theory of modality but also serves as a missing link which serves to free him from the clutches of determinism. What gives the distinction a special flavor is that *kineseis* and *energeiai* are considered by Aristotle in more than one capacity.

- (i) In a sense, they are for him different kinds of *goals* or *ends* of potentialities, namely, in the sense that one kind of potentiality is (completely) realized when it has given rise, not just to an ongoing *kinesis*, but to a *completed kinesis*, another kind when it has given rise to an *energeia* – which cannot help being complete.

- (ii) In another sense, *kinesis* and *energeiai* are different ways in which a potentiality can manifest itself, either incompletely (as an incomplete *kinesis*) or completely (as an *energeia*). Moreover, in a sense a *kinesis* is never the outcome or end of a potentiality (i.e., is never what the potentiality is a potentiality of), for when a potentiality is manifested as a *kinesis* we have a (potential) product or end separate from the activity in the form of which a potentiality is manifested.

This explains – among other things – the apparent inconsistency Aristotle exhibits in using the notion of *energeia* in *Met. θ* 6. This makes no sense unless the *dynamis-energeia* contrast has a dual role in Aristotle. It must mark, not just the potentiality-actuality polarity, but also a distinction between two different kinds of potentiality as well.

The important thing to realize is thus the dual role of the *kinesis-energeia* contrast as being at one and the same time a distinction between two kinds of potentiality *and* a distinction between potentiality and actuality.

5. THE UNITY OF SUBSTANCES

What we have found also shows what the intended link is between the concept of substance and the distinction between the two kinds of potentiality. It is that the kind of potentiality we are dealing with in the case of substances is the *energeia* type. Indeed in *Met. θ* 8, 1050b2–3 Aristotle says in so many words that ‘evidently, therefore, substance or form is *energeia*’. The force of Aristotle’s words is missed far too easily. We tend to take Aristotle as saying that a substance is an actual entity in contradistinction of merely potential ones. But, even though this is true, it misses Aristotle’s precise point, which is captured better by saying that Aristotle is telling us *what kind of potentiality* it is that a substance can possess and that leads to the existence of a substance. He is saying that it is of an *energeia* type potentiality (and hence a potentiality that cannot be disentangled from the corresponding actuality). For this reason, it is inevitably realized as soon as it exists as a full-fledged (first-order) potentiality. It is for this reason, and in this sense, that a substance is an actuality for Aristotle. Otherwise, he would face the awkward question: why cannot a substance, too, exist merely potentially? Surely the potential-actual distinction must be capable of applying also to substance! How can Aristotle deny the possibility of a substance’s existing possibly but not yet actually? The answer is that a substance can exist potentially, but since this existence, it was found above, is of the *energeia* type, it guarantees for Aristotle automatic being of the substance in question and by the same token guarantees for Aristotle an equally automatic unity.

Thus Aristotle’s ultimate solution for the problem of the unity of substances is to be sought in *Met. θ*, as is indeed seen from what he says there:

Clearly, then, in one sense the potentiality for acting and being acted on is

the same ..., and in another sense it is not; for it is partly in the patient (for it because it contains a certain principle, and because even matter is a kind of principle, that the patient is acted upon), and partly in the agent. (*Met. θ* 1, 1046a19–27.)

It is the distinction and clarification of these two senses that Aristotle is undertaking in *Met. θ*.

The answer to the problem of the two kinds of potentiality that emerges from *Met. θ* is the one briefly outlined above. Since a substance is an *energeia*, it is automatically realized as soon as the two component potentialities are present. Because of their mutually complementary character, a substance is also automatically and intrinsically one. The reason why this does not lead to a Megarian position is that *energeia*-type potentialities are not only the ones. There are also those potentialities which manifest themselves as *kinesis* and whose mode of existence is as a *kinesis*.

Thus Aristotle avoids the threat of being pushed into a Megarian position, for he can now happily acknowledge all sorts of unrealized potentialities of the other, *kinesis*, type. However, the line of thought which threatened to push him towards a Megarian position still applies to substance and indeed leads Aristotle to a number of interesting conclusions. Among them there is, as was noted, the thesis that substance is (is *only*) an actuality.

6. THE PRIMACY OF ACTUALITY – THE PRIMACY OF SUBSTANCE

Now we can also see a further purpose which is served by Aristotle's discussion of the priority of *energeia* in *Met. θ* 8–9. Because such potentiality-cum-actuality is exhibited only by substances, Aristotle's argument in effect is an attempted proof of the primacy of substances. As such, it may be thought of as fulfilling the promise Aristotle in effect made in *Met. Γ*, viz, to try to show that substance is primary with respect to the other categories.

Indeed, Aristotle's purpose of showing the primacy of substances in *Met. θ* 8–9 is shown by his own words.

Earlier, I ventured to identify the active element in potentiality with the form. What evidence is there for any such identification? The answer is that what Aristotle does in *Met. Z* 7–8 can be viewed as an argument for this very conclusion. In *Met. Z* 7, 1032b11–15 Aristotle concludes that things artificially generated always come from another instance of the same form, which is the *arkhe* of its coming-to-be.

Therefore it follows in a sense that health comes from health and house from a house; that which has matter from that which has not (for the art of medicine or of building is the form of health or the house).

Hence it is the form which is, in terms of Aristotle's own formulation in *Met.*

Δ 12, 1019a15–16, the *arkhe* of motion or change which is in something other than the thing changed’.

Moreover, the same is true of things naturally generated, according to Aristotle:

... by which they are generated is their formal nature, which has the same form as the thing generated (although it is in something else); for man begets man.

Hence the tentative identification I relied on can be justified. Moreover, as a by-product of this justification we can now see the place of *Met. Z 7–8* in Aristotle’s overall line of thought.

7. POTENCY VS. PASSIVE POTENCY

An interesting correction to popular ways of reading Aristotle is beginning to emerge here. We can now see that Aristotle was not formulating his last and final view when he identified the form-matter contrast with the actuality-potentiality contrast. Since a substance is an *energeia*, matter cannot be a potential substance, for such a potentiality must at once be realized. Rather, Aristotle’s point is that form and matter together constitute an *energeia*-type potentiality which is interchangeable with the corresponding actuality in the sense that it is *ipso facto* realized. In fact Aristotle needs, as was noted in the beginning of this paper, this automatic realization of a potential substance in order to explain the unity of form and matter in a substance. This unity is not one of potentiality and actuality, but of passive and active potentiality.

Another way of putting the same – or closely related – point is to say that what happens in *Met. θ* is that the matter-form contrast is transformed from a contrast between potentiality and actuality into a contrast between two kinds of potentiality, the *dynamis* type of potentiality and the *energeia* type potentiality. The former is the passive potentiality, the latter is the active one. The latter is always actual in some matter or other, but its realization in some specific medium may be as it were slowed down by the nature of the corresponding passive potentiality which turns the realization into a process of *kinesis*.

It follows from this that Aristotle’s argument in *Met. θ* for the priority of the actuality is in effect an argument for the priority of form in the characterization of substances. There is thus a great deal to be said for those interpreters who argue that Aristotle really identified a substance and its form.

In an earlier work, I have shown that throughout his works Aristotle consistently made the same distinction between two different types of potentiality of possibility.⁵ This is the same distinction as the *kinesis-energeia* contrast, when it is taken to pertain to kinds of potentiality. One corollary to this result is that Aristotle had nothing remotely like the concept of purely logical possibility. For clearly neither an *energeia* type potentiality nor a *kinesis* type potentiality is a pure logical possibility.

NOTES

1. This article overlaps with the monograph, Jaakko Hintikka et al., *Aristotle on Modality and Determinism* (*Acta Philosophica Fennica*, 29:1, Helsinki, 1977) and is calculated to bring the central results of that monograph to bear on Aristotle's treatment of the unity of substance.
2. See Jaakko Hintikka, *Time and Necessity* (Oxford: Clarendon Press, 1973), chapter 8; and *Aristotle on Modality and Determinism* (note 1 above), chapter 3, sec. 17, which I am following here.
3. I am following here *Aristotle on Modality and Determinism* (note 1 above), chapter 4, sections 21–26.
4. See W. D. Ross, *Aristotle's Physics. A Revised Text With Introduction and Commentary* (Oxford: Clarendon Press, 1936). Ross's mistaken reading of *entelecheia* as 'actualization' rather than 'actuality' is all the stranger as he is fully aware that this word in Aristotle normally means 'actuality' or 'complete reality' in a rather strong sense (cf. e.g., *Met. θ*, 4, 1047 b 1–2). See W. D. Ross, *Aristotle's Metaphysics. A Revised Text with Introduction and Commentary I–II* (Oxford: Clarendon Press, 1924).
5. See *Aristotle on Modality and Determinism* (note 1 above).

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CHAPTER 5
ON THE INGREDIENTS OF AN ARISTOTELIAN SCIENCE

1. THE PROGRAM

This paper is a part of a larger attempt to show that Aristotle held a consistent, fairly elaborate view as to what the different kinds of assumptions are that are needed in a science, how they are related to each other and to the idea of definition, and how they are obtained. I want to argue that Aristotle's different pronouncements on these subjects in the two *Analytics* hang together quite well, apart from some fluctuation of emphasis and of terminology.

The main lines of my argument for this thesis are four. First, I want to point out that Aristotle's syllogistic theory, together with his belief that syllogisms are the universal tool of any systematic science, naturally led him to a specific view of the ingredients of a science. One is almost tempted to say that Aristotle's views on the first principles of a science are predictable on the basis of his syllogistic theory, including his ideas about the role of existential presuppositions in syllogistic premisses.

Secondly, it seems to me that the same result is reached by taking Aristotle up on his statement that "all sciences are based upon definitions" (*An. Post.* B 17, 99a22–23). (In quoting Aristotle, I shall normally use Loeb Library translations. However, the Oxford translation is also occasionally used without explicit mention.) If so, the different starting-points of a science are as many kinds of definitions. Hence Aristotle's extensive discussion of the different types of definitions in *An. Post.* B 6–10, will amount to an exposition of his doctrine of the different starting-points (ingredients) of a science. A comparison between Aristotle's remarks on definitions and his theory of the axiomatic basis of a science will (hopefully) throw some light on each other.

Thirdly, the outcome of the first two kinds of considerations agrees with the explanations Aristotle himself gives of the several sorts of starting-points of a science. I want to show how precisely these explanations are to be understood. Fourthly, there is also an agreement between what these three lines of argument bring out and what Aristotle says of how the starting-points of a science are obtained. His different remarks on induction (*epagoge*) are especially relevant here.

In the present paper, I shall mainly restrict my attention to the first and to the third of these lines of thought.

2. DEIXIS VS. APODEIXIS

In trying to understand what Aristotle actually says in *Posterior Analytics* it is useful to note a few terminological idiosyncracies of Aristotle's. Perhaps the most important one for our present purposes is the following: Although Aristotle's usage vacillates, he often restricts *apodeixis* (*ἀπόδειξις*) to syllogistic proofs from scientifically acceptable premises, whereas *deixis* (*δείξις*) is used in a more general sense to cover the "showing" of the truth of all and sundry propositions, including the first premises of scientific syllogisms, which of course cannot themselves be proved syllogistically.

Detailed evidence for this point will be presented elsewhere. Some evidence for it is found (among other things) in the several places in which Aristotle contrasts *apodeixis* and induction (*epagoge*). Cases in point include *An. Post.* A 18, 81a40–61 and B 5, 91b14–15, 34–35. (There is no question that *epagoge* was for Aristotle a kind of *deixis*, too). In *An. Post.* B 8, 92b37–38, *apodeixis* and *deixis* are contrasted to each other in so many words.

A similar observation is made (with emphasis on the vagaries of Aristotelian usage) by Günther Patzig, *Aristotle's Theory of the Syllogism* (D. Reidel, Dordrecht 1968), p. 185, note 12. As Patzig shows, one cannot even exclude the possibility that Aristotle sometimes uses *apodeixis* in a wider sense more appropriate of *deixis*. This possibility is a rather distant one for our purposes, and has been badly exaggerated by Jonathan Barnes in his paper, "Aristotle's Theory of Demonstration", *Phronesis* vol. 14 (1969), pp. 123–152. Whatever the use of the term *apodeixis* may be on the different occasions in Aristotle, it *always* seems to have in his logical works a rather close connection with explicit demonstration.

After this preparatory remark, we can tackle the problem of the different ingredients of an Aristotelian science.

3. THE STRUCTURE OF ARISTOTELIAN SYLLOGISMS

Aristotelian explanations are supposed to take place by means of syllogisms. Now what is the structure of Aristotle's syllogistic theory? He reduces all syllogisms to those of the first figure. Other figures are "supplemented and augmented until immediate (*amesa*) premisses are obtained" (*An. Post.* A 14, 79a29–31). And while it is not entirely clear how Aristotle thinks that the superiority of the first figure is manifested, it is sufficiently obvious that this superiority is somehow due to the fact that syllogisms in the first figure turn directly on the transitivity of class-inclusion. (This is, for instance, the upshot of Patzig's patient examination of Aristotle's notion of perfect syllogism.) Aristotle says himself without qualifications that "the premises from which a conclusion follows are always related as whole and part" (*An. Post.* B 6, 92a12–13).

Accordingly, Aristotelian explanation will operate by making class-inclusions clear through transitivity of this relation, that is, by inserting intermediate

terms between the ones whose connection is to be explained. "It is by adding a term internally, and not externally, that a proposition is demonstrated", Aristotle says (*An. Post.* A 22, 84a36–37). It follows immediately that longer chains of scientific inferences (syllogisms from premises acceptable in a science) take the form of a nested sequence of terms. Each of them applies to its immediate predecessor so as to form a syllogistic premise.

From this fact, several features of Aristotle's theory of science follow as consequences. For one thing, we can see at once why for Aristotle "it is not possible to prove a fact by passing from one genus to another" (*An. Post.* A 7, 75a38). For all the other terms in a chain of syllogisms of the kind described must be narrower in scope than the predicate term of the last syllogistic premise – which is the term characteristic of the "genus" with which all the syllogisms of a given science are concerned.

4. ATOMIC CONNECTIONS

For the purposes at hand, it is even more important to observe that from the same syllogistic model a definite conclusion ensues concerning the first (primary) premises of scientific syllogisms. The first irreducible premises, or perhaps rather one class of primary premises, of an Aristotelian science are clearly the premises asserting *immediate* connections between terms, that is, connections between terms so close to each other that no further term can be inserted between them. In *An. Post.* A 20–22, Aristotle argues at length to show that there must be such immediate premises, i.e., that a sequence of terms interpolated between two given terms cannot proceed *ad infinitum*.

Although this is not the place to examine Aristotle's argument – or, rather, the several parallel arguments that he gives – in detail, a couple of aspects of them are relevant to our present interests. An ascending sequence of assertions in which a definite predicate is attributed to a definite subject cannot be infinite according to Aristotle, "for the subjects of which the attributes are stated are no more than those which are implied in the essence of the individual" – i.e., apparently, of the lowest subject term of the sequence – "and these cannot be infinite in number" (*An. Post.* A 22, 83b26–27). (The finitude of the elements in question is according to Aristotle a consequence of the knowability of essences.) If so, a sequence of minimal (immediate) premises will give us, when their subject terms are combined, the essence of the lowest subject, i.e., give its *definition*. Since each of the subject terms in the ascending sequence applies to its predecessors, the lowest atomic premises will furthermore give us the distinguishing characteristic of its subject, and in a sense therefore give us the definition of the subject term. Small wonder, therefore, that according to Aristotle "the basic premises of demonstrations are definitions" (*An. Post.* B 3, 90b24). We can see here how this view is strongly encouraged by Aristotle's theory of syllogisms as the universal vehicle of scientific demonstration. This effect of Aristotle's syllogistic theory on his views of the structure of a science has not always been fully appreciated, it seems to me.

Here, then, we have one class of basic assumptions of a science *apud* Aristotle. I shall call them *premises about atomic connections*.

5. ATOMIC CONNECTIONS AS TURNING ON DEFINITIONS

By way of instant popularization, we may perhaps see now how a sequence of finer and finer syllogisms was according to Aristotle supposed to lead to a “discussion-stopper”. We may ask: “Why is every C an A ?” An Aristotelian answer is of the type: “Because every C is a B_1 , and every B_1 is an A .” Of course we can continue and to ask: “But why is every C a B_1 ?” By inserting more and more B_1, B_2, \dots (in a descending order) between A and C we finally come, if Aristotle is right, to a point at which the appropriate answer to the question, “But why is every C a B_k ?” is: “Because B_k is what a C is, that’s why.” One could equally well say: “Because that’s how a C ought to be *defined*.” One can perhaps see here the great temptation of this idea. No wonder that there always was a strong conceptual element to Aristotelian science. It is important to observe, however, in order to avoid misunderstanding, that the last answer cannot usually be for Aristotle: “Because B_k is what *we mean* by a C .” Those Aristotelian definitions which are obtained from an ascending sequence of immediate scientific syllogisms are not explications of how an expression is in fact used, but rather accounts of how a term should be defined in view of an exhaustive knowledge of the relevant facts.

6. COMMON AXIOMS

Moreover, his syllogistic theory suggested to Aristotle another class of basic assumptions of any particular science. These assumptions come into play through the very principles of syllogistic proof (*apodeixis*) with which every science operates according to Aristotle. What they are is partly shown by Aristotle’s syllogistic theory, including the machinery needed to reduce imperfect syllogisms to perfect ones. (For this machinery, see Patzig’s monograph.) In the last analysis, of course, this class of assumptions includes those and only those assumptions on which the whole structure of Aristotelian syllogisms is based. They are discussed by Aristotle in *Met.* IV, 3 (in addition to a number of other passages). They include both logical principles such as the laws of contradiction and excluded middle (Aristotle refers them as “the principles of syllogism”) and also such general mathematical principles as “take equals from equals and equals remain” (*An. Post.* A 10, 76a41). The study of all these principles is said – at least in *Met.* IV, 3 – to belong to “First Philosophy”.

Here we have another class of basic assumptions of a science. I shall call them *common axioms*.

7. *ATOMOS* VS. *AMESOS*

At this point we can undertake a terminological excursion which throws some light on Aristotle's intentions. We have seen that one class of primary assumptions of an Aristotelian science are the immediate syllogistic premises, i.e., premises between the terms of which no further terms can be interpolated. Now it may be the case – and it has to some extent already turned out to be the case – that of the other kinds of basic assumptions needed in a science some are immediate and some others non-immediate in the sense that the latter are established by means of further arguments while the former are not. What nevertheless makes both of them basic for the science (deductive system) in question is that the further arguments in question are not syllogistic. The same contrast of course applies also to syllogistic premises.

Thus we have two different kinds of immediacy and non-immediacy in Aristotle: (i) syllogistic premises are immediate if they do not allow for interpolation; (ii) they as well as other basic assumptions are immediate if they are not obtained by further arguments. This general sense is aptly characterized by Aristotle as follows: “An immediate (*amesos*) proposition is one which has no other proposition prior to it” (*An. Post.* A 2, 72a8).

Does Aristotle mark the distinction (i)–(ii) terminologically? As usual, he does not use a hard-and-fast terminology. However, his usage sometimes offers indications of the difference between (i)–(ii). The term *amesos* (*ἄμεσος*) is used by him as a general term covering occasionally both (i) and (ii). In its narrowed use, it emphasizes (ii) in contrast to (i). Because of the latter usage, it is misleading of Bonitz (*Index* p. 38A) to say that *τὰ ἄμεσα* are synonymous with *ἀναπόδεικτα* and opposed to *ἀποδεικτά*. This in fact characterizes better (i) than (ii), while *amesos* can be seen to apply more typically to (ii) than to (i), although it admittedly is frequently used by Aristotle in cases of (i), too. As a narrowed term covering (i) only, Aristotle occasionally uses *atomos* (*ἄτομος*). An instructive case in point is found in *An. Post.* A 14–15, 79a30 ff. There Aristotle refers to syllogisms of the first figure as *ἄμεσα*. Of course, this cannot mean that they lack a middle term. Nor is the contrast here between what is proved syllogistically and what is not, for the moods in the other figures are not reduced to those in the first figure syllogistically. Rather, the point is simply that unlike the other syllogisms they are not established by reducing them to perfect syllogisms. Hence the sense presupposed is (ii). Then Aristotle goes on to discuss immediate syllogistic premises and says that in them one term applies to another *ἀτόμως*. Here the sense involved is clearly (i).

Another interesting usage occurs in *An. Post.* A 22, 84a35. There an immediate syllogistic premiss is said to be not only *ameson*, but also *indivisible* (*ἀδιαίρετον*). The context shows that the latter term is what refers to the absence of intermediate terms. According to this typical (but not uniform) Aristotelian usage *atomon* equals *ameson* plus *adiaireton*. At *An. Post.* B 5, 91b32 *atomos* clearly refers to indivisible syllogistic steps (i).

In his commentary on *Aristotle's Prior and Posterior Analytics* (Clarendon

Press, Oxford, 1949), p. 678, Sir David Ross claims that in *Met.* 994b21 “τὰ ἄτομα is used of the highest universals”. This would constitute an exception to my suggestion that *atomos* is used by Aristotle to refer immediate (syllogistically unproved) minimal syllogistic premises. However, a comparison of *Met.* II, 2, 994b21 with such passages as *An. Post.* A 22, 83b32–84a6 convincingly shows that at 994b21 immediate syllogistic premises, and not other types of unproved assumptions (such as are involved in the introduction of the highest universals, cf. below), are what is at stake. This squares with my assertion that the term *ta atoma* is typically used by Aristotle to refer to the contrast (i) rather than (ii).

It is worth noting that the contrast between (i) and (ii) to some extent parallels my earlier contrast between the use of the terms *apodeixis* and *deixis* in Aristotle.

8. GENERIC PREMISES

After this excursion, we return to our survey of the different kinds of basic assumptions of an Aristotelian science. The contrast between general axioms and premises about atomic connections is a commonplace in the literature. There is a third class of basic assumptions, however, which is less conspicuous but perhaps even more important than these two. In order to find it, we may return to the connection between atomic premises and definitions which was registered earlier. Combining the subject terms of an ascending sequence of immediate syllogistic premises, yields a *full* list of the elements of the lowest subject term only on a further assumption. This is that the ascending sequence is continued as far as it can go. (According to Aristotle, it cannot be continued *ad infinitum*.) If it is not continued as far as it can be continued, we obtain lists of elements which stop at the widest term in the given sequence of premises, and hence are in a sense relative to it. Then the definitions we obtain from the sequence of scientific syllogisms for their respective subject terms yield the fuller analyses of what their essence is the further down these terms are from the widest one. As a limiting case, no definition is obtained for the widest term in question which would explicate its essence at all.

This, of course, is precisely the situation in any particular science according to Aristotle. Such a science is characterized by its subject matter, that is, by the genus of objects it is about. As Aristotle writes in *An. Post.* A 28, 87a38: “A single science is one whose domain is a single genus.” This genus plays precisely the role of the widest term in the remarks just made.

Thus the topmost premise in any maximally fine sequence of scientific syllogisms within one and the same science has according to Aristotle always the peculiarity that it does not contribute to the analysis of the narrower terms it contains. Nevertheless it is, like any other immediate premise, a kind of definition of its subject term. Since this term is the widest one in a given science, it is the term that specifies the genus this science is about. The topmost premises in the kind of sequence we are considering are therefore definitions of the

genus. Yet they have the peculiarity that they do not contribute very much to specifying all the different elements that would go into the full definition (essence) of the genus.

Here, I suggest, we have a third class of basic assumptions of a science according to Aristotle. I shall call them *the most general premises of a particular science* or in short *generic premises*. Aristotle himself characterizes these assumptions as assumptions concerning “the subjects which it [sc. the science in question] posits (that is, the genus whose essential attributes it studies) ...” (*An. Post.* A 10, 76b11–13). He distinguished them from assumptions concerning the attributes that can be used within the genus in question. If I am right, such a most general premise of a particular science is what Aristotle describes (in *An. Post.* B 19, 94a9–10) as a “definition of immediate (*amesa*) terms” which “consists in an indemonstrable assumption of what they are”.

9. GENERIC PREMISES CARRY THE EXISTENTIAL IMPORT OF AN ARISTOTELIAN SCIENCE

The status of these assumptions as a special class has often been hidden by certain features of the situation which for us moderns may appear somewhat surprising and even paradoxical.

First, it easily appears to us that the premises in question are not substantial assumptions at all, but rather mere definitory reformulations of tautologies of the form

(1) every G is a G ,

(where G is the genus in question), hence perhaps something like

(2) every G is a G'

where G' serves to define G . Thus Aristotle's statement that these amount to a positing of the genus G may easily appear gratuitous.

A conclusive answer to this putative objection is obtained from Aristotle's theory of the existential force of the premises of a scientific syllogism. This is especially clearly in evidence in *An. Post.* B 2. There it is said that the question of existence or “simply being” (Aristotle's phrase is $\tau\omicron\ \epsilon\acute{\iota}\ \acute{\epsilon}\sigma\tau\iota\nu\ \acute{\alpha}\pi\lambda\omicron\upsilon\varsigma$) is equivalent to the question whether there exists a “middle term”. By this, Aristotle means a suitable intermediate term between the given term and a higher one. Conversely, if there is such a middle term, that is, if we have a premise of the form

(3) every A is a B

which is appropriate to a scientific syllogism, it follows that the A 's exist. In other words, (3) implies according to Aristotle

(4) every A is (that is, is *haplos*, i.e., exists).

Hence in any appropriate syllogistic premise (3) there is according to Aristotle a hidden existential assumption, to the effect that all the *A*'s exist.

A modern modal logician of suitable persuasion – or a Leibniz, for that matter – might envisage the quantification in a premise like (3) as being basically over certain “possible individuals”. It is only in virtue of a special existential presupposition that the *A*'s and *B*'s have the additional predicate of existence. This treatment may seem a rather far cry from Aristotle's way of thinking, but in any case it shows the consistency of the latter. In some tense-logical version, it might even come fairly close to Aristotle's ideas.

Of course, within a given science we do not have to make this existential assumption separately for each immediate premise (3). The existential force is carried downwards from wider terms to narrower ones in a sequence of scientific syllogisms. Hence the only ultimate existential assumption needed in a science concerns the existence of the members of the genus which is its subject matter. The *existence* of all the other terms with which it deals can be proved, although their *definitions* – that is, the immediate or “atomic” premises which were seen to constitute a kind of definition of their subject terms – must be assumed. This, I take, is what Aristotle means by his enigmatic words in *An. Post.* A 10, 76a32 ff. where he writes: “Thus the meaning both of the primary truths ($\tau\acute{\alpha}$ $\pi\rho\omega\tau\alpha$) and of the attributes demonstrated of them ($\tau\acute{\alpha}$ $\acute{\epsilon}\kappa$ $\tau\omicron\upsilon\tau\omicron\upsilon\nu$) is assumed; as for their existence ($\theta\tilde{\nu}\tau\iota$ δ' $\acute{\epsilon}\sigma\tau\iota$), that of the principles ($\acute{\alpha}\rho\chi\acute{\alpha}\iota$) must be assumed, but that of the attributes must be proved. ... Also special to each science are those subjects whose existence it assumes and whose essential attributes it studies. ... Of these subjects both the existence ($\tau\acute{\alpha}$ $\acute{\epsilon}\tilde{\nu}\nu\alpha\iota$) and the meaning ($\tau\omicron\delta\tilde{\iota}$ $\acute{\epsilon}\tilde{\nu}\nu\alpha\iota$) are assumed; but of their essential attributes, only the meaning is assumed.” If I am right, $\tau\acute{\alpha}$ $\acute{\epsilon}\tilde{\nu}\nu\alpha\iota$ here means existence pure and simple, not being this or that. This is in fact strongly suggested by Aristotle's subsequent brief discussion (76b16–22) of why some of the different types of assumptions may appear to be absent from this or that particular science. It is hard to interpret, e.g., the words $\theta\tilde{\nu}\tau\iota$ $\acute{\epsilon}\sigma\tau\iota\nu$ otherwise than as speaking of existence.

Aristotle's terminology also shows that according to him the existential import is in fact carried downwards from the generic premises by means of strict syllogistic demonstrations. In *An. Post.* B 7, 92b12–15 Aristotle says that “we hold that it is by demonstration (*apodeixis*) that everything must be proved to exist, except essence. ... So there will be a demonstration (*apodeixis*) that a thing is ($\theta\tilde{\nu}\tau\iota$ $\acute{\epsilon}\sigma\tau\iota\nu$). This is how the sciences actually proceed.” The use of the “syllogistic” term *apodeixis* here is very suggestive (cf. section II above). Although Aristotle employs the neutral *deixis*-terminology most of the time in *An. Post.* A 10, there is one place even there where he speaks of *apodeixis*. It occurs at 76b10–11, that is, precisely where he is discussing how the existence of the “essential attributes” assumed in a science are established.

The role of the most general premises in an Aristotelian science must be recognized in order to be able to appreciate Aristotle's frequent comments on the importance of the most universal assumptions of a science. If premises about atomic connections were the only primary premises of a science, the

basic assumptions of a science were not the most universal ones but in a sense the most special ones – viz. in the very sense of being concerned with minimal steps from one term to another.

The importance of the existential force of syllogistic premises is not an accidental peculiarity of Aristotle's. I do not think that it is sufficiently explained by any peculiarity of his conception of syllogism nor even by his assumption that on the appropriate reading (quantification over all individuals, past, present, or future) a syllogistic premise has an empty antecedent only if this antecedent term is impossible. Aristotle's reasons are probably due to the deeply ingrained idea that no science worthy of the name can lack an object. Elsewhere I have studied the background and the role of this idea in Plato. (See "Knowledge and its Objects in Plato", *Ajatus* vol. 33 (1971).) In Aristotle, the same idea is perhaps seen in operation most clearly in the passages where he argues that there cannot be any *episteme* of what is destructible, for the "destruction of the knowable carries knowledge to destruction. ... For if there is not a knowable, there is not knowledge – there will no longer be anything for knowledge to be of" (*Categoriae* 7, 7b27 ff.).

It may also be observed that the existential presuppositions which we have come upon are much more sweeping than those often present in traditional syllogisms. Here it is not only the case that (3) implies

(5) Some *A* is a *B*

but also implies the (in some respects) stronger claim (4) – provided of course that premise (3) is of the kind that can occur in a chain of "scientific" syllogisms. This kind of conclusion would even be implied by premises of the form (1) or (2). They, too, imply

(6) every *G* exists.

The fact that this follows from the definition (2) shows why Aristotle can write of his most general premises as follows: "Thus it is clear that of essences too some are immediate (*amesa*, not *atoma!*), that is, they are first principles (*arkhai*), and both their existence and their definition (*τί ἐστί*) have to be assumed or made clear in some way" (*An. Post.* B 9, 93b21–24). The parallelism between this passage and *An. Post.* A 10, 76a32–36 is further enhanced by the identity of Aristotle's examples on the two occasions. It is instructive to see that in the former passage the entities in question are contrasted to "things which have a middle term, i.e., something distinct from themselves which is a cause of their being". These are clearly those subjects of atomic syllogisms which are narrower than the genus in question. Their existence is not assumed, but demonstrated through a syllogism by means of a middle term. For of course (3)–(4) imply "every *B* is (exists)". However, even in the case of these latter assumptions (assumptions III) "we do not actually demonstrate", Aristotle says, what their subject terms are (*τί ἐστί*), although we can exhibit it by means of a syllogistic proof (*apodeixis*).

10. "NOMINAL" DEFINITIONS. SUMMARY

A fourth class of assumptions which play a certain role in an Aristotelian science are what I shall call *nominal definitions*. What their status is in Aristotle will be discussed later.

Thus we have found the following four kinds of unproven assumptions of a given particular science in Aristotle's sense:

- I Common axioms
- II Generic premises
- III Premises about atomic connections
- IV "Nominal" definitions.

11. DEFINITIONS IN *AN. POST.* A 10 AND A 2

The nature of the fourth class of assumptions – if they may be so called – and their relation to others calls for a few additional explanations. In general, Aristotle's comments on what he calls definitions (*horoi*, *horismoi*) may at first appear puzzling and even confused, and may seem to suggest doubts concerning what I have said.

Most of the apparent difficulties are nevertheless due to Aristotle's fluctuating terminology. Among other fluctuations, entirely different things are on different occasions called by him definitions.

It is instructive to consider from this point of view what Aristotle says in his extended discussion of the different starting-points of a science in *An. Post.* A 10. There he says of assumptions of kind III – as we have seen – that they merely spell out the meaning of the attributes which are studied within the genus which is the subject-matter of the science in question. If so, it might perhaps be expected that they would be labelled definitions. Aristotle does not here do so, however. Significantly, premises of kind III are not called definitions in *An. Post.* A 10, although they are elsewhere so classified. Hence what are called here definitions (*horoi*) are clearly my "nominal" definitions IV. They make their appearance only at the end of *An. Post.* A 10. They are contrasted to *hypotheses* which are characterized by saying that they are "assumptions from which the conclusion follows in virtue of their being what they are" (76b38–39). In other words, they are assumptions that can function as premises of a scientific syllogism. They exclude, on one hand, the purely nominal definitions IV which "only need to be understood", Aristotle says, and on the other hand the general principles of proof I which Aristotle says are "in itself necessarily true and must be thought to be so" (76b23–24). Since assumptions III do function as premises of scientific syllogisms, they clearly are not definitions according to Aristotle's usage in *An. Post.* A 10.

A small puzzle is here posed by Aristotle's characterization at 76b35 of his *horoi* as not speaking of being or not being (*οὐδὲν γὰρ εἶναι ἢ μὴ εἶναι λέγεται*). Many translators render this by speaking of "existence or non-existence". If

this were correct, it would suggest that Aristotle's *horoi* in *An. Post.* A 10 are after all what I have called assumptions III, for they were seen to be distinguished from assumptions II by the absence of any existential force. However, there is no reason to take the phrase $\epsilon\acute{\iota}\nu\alpha\iota \eta\ \mu\eta\ \epsilon\acute{\iota}\nu\alpha\iota$ here as meaning specifically existence. The same locution and similar locutions are used elsewhere by Aristotle so as to include also being thus or not being thus, i.e., so as to cover the copulative uses of "is" and not only the existential one. (See, e.g., *De Int.* 13, 23a19–20, *An. Post.* A 2, 72a20–21.) Hence Aristotle's statement is just another way of saying that purely nominal definitions IV have no assertive force, i.e., that they do not assert any proposition any more than its contradictory.

What Aristotle says in *An. Post.* A 10 is thus seen to square very well with my distinction between the different basic assumptions I–IV of a science according to Aristotle.

It is a little harder to see what Aristotle is up to in the other main passage of *An. Post.* A in which the different basic assumptions of a science are discussed, viz. in *An. Post.* A 2, 72a5–24. (Part of this difficulty is perhaps due to its being only a tentative statement of Aristotle's views.) Most of what is said here is in full agreement with what we have found elsewhere, it is true. Again, definitions (*horismoi*) are (at 72a20–23) said not to make any assertions of being or not being ($\tau\acute{o}\ \epsilon\acute{\iota}\nu\alpha\iota\ \tau\iota\ \eta\ \mu\eta\ \epsilon\acute{\iota}\nu\alpha\iota\ \tau\iota$). Speaking of being *something* ($\tau\iota$) makes it especially clear that Aristotle is not here referring, the majority of translators notwithstanding, only to existence and non-existence. (This was in fact already pointed out by Richard Robinson in *Plato's Earlier Dialectic*, Clarendon Press, Oxford 1953, p. 101.) This conclusion is reinforced by the observation that Aristotle's remark is just a reformulation of the immediately preceding point that, in contrast to a definition, a thesis assumes one or the part of a proposition, that is, one of the two members of a pair of contradictories.

However, Aristotle's concluding statement seems to be out of step with the rest: "A definition is a thesis (literally: laying down) because the arithmetician lays it down that to be a unit is to be quantitatively indivisible. But it is not a hypothesis, because it is not the same to say what a unit is and that it is" (72a21–24). The contrast is apparently between what a unit is and its *existence*, for $\tau\acute{o}\ \epsilon\acute{\iota}\nu\alpha\iota\ \mu\omicron\nu\acute{\alpha}\delta\alpha$ might *prima facie* seem to mean nothing but the existence of the unit. Hence the difference between hypotheses and definitions now seems to be that the former have existential content whereas the latter do not. This would certainly be at variance with what Aristotle says elsewhere.

However, the crucial phrase $\tau\acute{o}\ \epsilon\acute{\iota}\nu\alpha\iota\ \mu\omicron\nu\acute{\alpha}\delta\alpha$ need not have any existential force here. Although it may not represent an especially happy choice of words on Aristotle's part, it can still mean simply "the unit's being", not "the existence of the unit". That it in fact does so is suggested (among other things) by the neat parallel the quoted passage has in *An. Post.* B 92b10–11: $\tau\acute{o}\ \delta\epsilon\ \tau\acute{\iota}\ \epsilon\acute{\iota}\sigma\tau\iota\nu\ \acute{\alpha}\nu\theta\rho\omega\pi\omicron\varsigma\ \kappa\alpha\iota\ \tau\acute{o}\ \epsilon\acute{\iota}\nu\alpha\iota\ \acute{\alpha}\nu\theta\rho\omega\pi\omicron\nu\ \acute{\alpha}\lambda\lambda\omicron$. The context of this parallel passage (see especially the immediately preceding sentence) shows that the contrast Aristotle is drawing there between "what a man is" and "man's being" is equivalent with

the contrast between questions of “what” ($\tau\acute{\iota}$ ἔσται) and questions of “whether” ($\delta\theta\tau\acute{\iota}$ ἔσται). The latter, which is analogous to “the unit’s being”, is distinguished by Aristotle firmly from questions of existence ($\epsilon\acute{\iota}$ ἔσται) in *An. Post.* B 1, 89b24–25.

Hence there is nothing incompatible with my interpretation here. Definitions are still being characterized by Aristotle as lacking assertive force, not as lacking existential import, as first seemed.

It must be admitted, however, that in other respects Aristotle may still be using the term “definition” in a wider sense here than elsewhere in *An. Post.* A. This is shown by the fact that the assumption which Aristotle labels a definition at 72a21–24 (assuming what a unit is) reappears in *An. Post.* A 10, 76a34–36 as a part of an assumption of kind II (assuming the meaning of a generic term), and hence as an assumption contrasted to definitions, as we found above.

12. ARISTOTLE’S FORMULATIONS

By way of conclusion, it may be interesting to see how the different assumptions I have distinguished from each other can be located in the two main passages in *An. Post.* A where Aristotle discusses the starting-points of a science.

Analytica Posteriora A 2, 72a5–24

I apply the term *thesis* to an immediate indemonstrable first principle of syllogism the grasp of which is not necessary for the acquisition of certain kinds of knowledge. Principles II–IV

But that which must be grasped if any knowledge is to be acquired, I call an *axiom*. Principles I

A thesis which assumes one or the other part of proposition, i.e., that something is or is not, is a *hypothesis*. Principles II–III

A thesis which does not do this is a *definition*. Principles IV

Analytica Posteriora A 10, 76a31–77a4

I call “first principles” in each genus those facts which cannot be shown. Thus the meaning both of the primary terms ($\tau\acute{\alpha}$ πρῶτα) and of the attributes shown of them must be assumed, but as for their being, that of the primary terms must be assumed but that of the attributes must be shown. Assumptions concerning the primary terms = assumptions II; the meaning of attributes = assumptions III

<p>Every demonstrative science is concerned with three things: the subjects which it posits (the genus whose essential attributes it studies), the so-called common axioms upon which the demonstration is ultimately based, and thirdly the attributes (<i>τὰ πάθη</i>) whose several meanings it assumes.</p>	<p>Positing the subjects = an assumption of kind II Common axioms = I Attributes assumed = III</p>
<p>Definitions are not hypotheses, because they say nothing of being or not being.</p>	<p>Assumptions IV</p>

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CHAPTER 6

ARISTOTELIAN AXIOMATICS AND GEOMETRICAL AXIOMATICS

Professor Szabó deserves credit for calling our attention to the interplay of philosophical and mathematical influences in the development of Greek axiomatics. It is this interplay that lends a special flavor to much of the early as well as some of the later history of the axiomatic method. I believe, however, that in the last analysis the total picture of the early development of axiomatics will turn out to be quite different from the one Szabó paints. My reasons for this belief are nevertheless subtler than one might first expect. Professor Szabó finds the true ancestors of the central mathematical methodology of the Greeks, including the axiomatic method, in the Eleatic dialectic. In so doing, Szabó *prima facie* misses a large part of the interdisciplinary interplay with which he is dealing. Most other historians of the axiomatic method would give the pride of place on the philosophical side of the fence to Aristotle, who is sometimes called the first great theoretician of the axiomatic method and whose ideal of a science was by any account explicitly and self-consciously axiomatic. Szabó admittedly discusses Aristotle, but gives the Stagirite short shrift, dismissing him as having played no real part in the development of the axiomatic methods actually used in mathematics.

Even if one believes that Aristotle's actual influence on mathematics was negligible, his views seem to merit close attention by all historians of the axiomatic method. The importance of these views lies of course in the fact that Aristotelian axiomatics is by far the most fully developed object of comparison on the philosophical side with the uses of axiomatic method in Greek mathematics. Szabó's procedure in downgrading Aristotle's role might thus seem unfortunate. Isn't he throwing by the board one of the most important sources of the very development he is dealing with?

It appears that some of Szabó's arguments for assigning Aristotle to the historical limbo he occupies in Szabó's story are in fact mistaken. Other pieces of evidence he presents are ambivalent, but not nearly as strong grounds for indicting Aristotle as Szabó seems to think. Without trying to present an alternative total picture of the development of the axiomatic method, I will begin by presenting a number of corrections to Professor Szabó's account, mostly to what he says about Aristotle.

All page references not otherwise specified will be to Arpad Szabó, *The Beginnings of Greek Mathematics*, D. Reidel, Dordrecht, 1978 (translation of *Anfänge der griechischen Mathematik*, R. Oldenbourg Verlag, München and Wien, 1969), or to Jaakko Hintikka, "On the ingredients of an Aristotelian science," *Nous* 6 (1972), 55–69 (Chapter 5 of the present volume).

(i) Szabó claims (p. 188) that the nontechnical meaning of *deiknymi* as “sichtbarmachen” is relevant to mathematical and philosophical usage. This claim is made dubious by the fact that Aristotle’s use of *deixis*, *deiknymi*, and related terms is already quite sophisticated. As usual, Aristotle is not consistent, and does not use strict technical terms. However, there is unmistakable contrast in Aristotle between *deixis* and *apodeixis*. (See Hintikka, sec. 2) Typically, the former could be used by Aristotle of all and sundry persuasive “showings,” while the latter was used of logical (syllogistic) inferences from appropriate premises. If further evidence is needed, one of the clearest examples of the Aristotelian distinction is found in *An. Post.* B 7, 92a34–b4, where *deixis* is the more general notion which comprises as special cases at least *apodeixis*, *epagoge*, and *aisthesis*. What some of the requirements of *apodeixis* are according to Aristotle is seen from *An. Post.* A 2, 71b20–25. There is a strong, albeit tacit, assumption in the latter passage that a syllogistic proof is a necessary condition of an argument’s being an *apodeixis*, even though Aristotle denies it is a *sufficient* condition. It is eminently clear that a syllogistic proof cannot be a necessary condition for *deixis* for Aristotle. (It is interesting to see that the demonstrative part of a Euclidean proposition was typically called in the late ancient mathematical and philosophical usage *apodeixis*, not *deixis*.) The Aristotelian evidence thus strongly suggests that the two terms *deixis* and *apodeixis* were fairly clearly separated from each other at an early stage of the development of axiomatics, and the presystematic connotations of *deiknymi* are therefore scarcely valid evidence concerning mathematical and philosophical ideas of demonstration at the time of Aristotle, let alone Euclid.

Even though the precise meanings of *deixis* and *apodeixis* are not among the reasons why Szabó downgrades Aristotle, my observation shows that there is more in Aristotle than first meets Szabó’s eye. In general, Szabó pays little attention to the interesting evidence for connections between Aristotle’s terminology and Greek mathematics marshalled in B. Einarson, “On certain mathematical terms in Aristotle’s logic,” *American Journal of Philology* 57 (1936), 33–54 and 151–172.

(ii) An important point is missed by Professor Szabó when he dismisses a suggested comparison between Euclid’s postulates and Aristotle’s hypotheses by saying (p. 230, cf. p. 307 of the German ed.) that Euclid’s postulates are not existential propositions, as Aristotle’s hypotheses are supposed to be. This is doubly misleading. For one thing, it was claimed already in antiquity that the so-called postulates were indeed existential assumptions. (For evidence and discussion, see E. Niebel, *Über die Bedeutung der geometrischen Konstruktion in der Antike (Kantstudien, Ergänzungshefte, vol. 76)*, Kölner Universitäts-Verlag, Cologne, 1959.) What is even more important is the striking fact that hypotheses were *not* claimed by Aristotle to be existential statements. When Aristotle speaks (in the passage referred to by Szabó and elsewhere) of “being or not-being” in characterizing hypotheses, he does not mean “existing or not existing.” His phrase comprises equally *both* “existing or not existing” and “being or not being thus.” (For evidence, see Hintikka, sec. 11; Richard

Robinson, *Plato's Earlier Dialectic*, p. 101; and Charles Kahn, *The Verb "Be" in Ancient Greek*, D. Reidel, Dordrecht, 1973.) In general there is no trace in Aristotle of any real distinction between the "is" of predication and the "is" of existence. Both ideas are included in the Aristotelian *estin*.

That *einai* did not have an exclusively predicative sense in Aristotle is perhaps seen easiest from *An. Post.* B 2–3. The same chapters show that Aristotle did not distinguish between the existential and predicative meanings of *einai* from each other at all. (For a general perspective on this issue, cf. also my paper '“Is”, semantical games, and semantical relativity,' *Journal of Philosophical Logic*, 8 (1979), 433–468.)

(iii) One of the focal points of Szabó's book is his claim that the method of indirect proof (*reductio ad absurdum*) originated from the Eleatic dialectic and that it played an important role in the development of axiomatics. These are interesting claims which deserve a longer treatment than I can devote to them here. In this paper, I merely want to call attention to the fact that there is a lot of material in Aristotle that is relevant to Szabó's claims one way or other. In some ways, this Aristotelian material is likely to strengthen Szabó's hand in that it shows some connecting links between the Eleatic dialecticians and the later mathematical and philosophical ideas. At the same time, the Aristotelian evidence strikingly belies Szabó's cavalier dismissal of the Stagirite.

The evidence is not unambiguous, either. If we take Szabó's first claim first, it is relevant to note that the connection between reductive proofs and the dialectical method is very unclear in Aristotle. In any case, we (including Szabó) should not underestimate the tremendous importance of procedures that must be classified as dialectical or direct descendants of dialectical procedures in Aristotle. By these I mean of course the procedures Aristotle envisages for establishing the first premises of any one axiomatically built science. Are these dialectical methods connected by Aristotle with the idea of indirect proof? Aristotle several times connects the idea of a reductive proof with his definition of possibility. (See *An. Pr.* A 13, 32a18 ff.) According to the definition, what is possible must be capable of being assumed without any absurdities resulting therefrom. Hence, if the diagonal of a square is not necessarily incommensurable with the side, we must be able to assume that it has been measured commensurately with the side. But this quickly leads to a contradiction. (Cf. *Met.* IX, 4.) Hence the diagonal of a square is necessarily incommensurate with the side.

Can we find in these Aristotelian ideas traces of dialectic, Eleatic or otherwise? I cannot answer the question here to my own satisfaction. What I consider clear is that a connection cannot easily be excluded. For instance, indirect proofs are discussed by Aristotle in *Met.* θ in connection with Megarian views of determinism and denial of change. This already is something of a link between Eleatic dialectic and Aristotle, even though Aristotle clearly thinks of himself as opposing the Megarians. Elsewhere, I have shown that in spite of his avowed opposition, Aristotle came very close to sharing some of the key assumptions of the Megarians; see *Aristotle on Modality and Determinism* (Acta Philosophica Fennica, vol. 29, no. 1), North-Holland, Amsterdam, 1977. It is

clearly here that the best evidence can undoubtedly be found for a continuous development from Eleatic dialectic to a full-fledged method of indirect proof.

(iv) Likewise it is not easy to see if there is any evidence to connect Aristotle's ideas of indirect proof with his axiomatic method. On most occasions, there does not seem to be any connection. However, *Phys.* III, 8, 200a14–29 suggests that Aristotle was aware of the connection between indirect proofs and geometrical axiomatics. Further inquiry is needed to see whether we can gather here any hard evidence for Szabó.

(v) In general, Szabó postulates far too readily influences by one thinker on another. Frequently similarities which apparently indicate influences are in reality symptoms of shared presuppositions. For instance, the Platonic assumptions concerning knowledge, ignorance, and opinion which Szabó mentions on p. 309 and following (pp. 422 ff. of the German ed.) can be viewed as consequences of a shared model of knowledge as a goal-directed process rather than on any influence in the usual sense of the word. (See on this shared model Hintikka, "Knowledge and its objects in Plato," in J.M.E. Moravcsik (ed.), *Patterns in Plato's Thought*, or in Hintikka, *Knowledge and the Known*, D. Reidel, Dordrecht, 1974.)

In the same way, several of the observations Szabó adduces as showing Eleatic influence on the development of mathematical argumentation or as showing Aristotle's isolation from this alleged mainstream development allow for different explanations. Indeed, Szabó is in many respects neglecting Aristotle quite unjustifiably. There is nevertheless one respect in which Szabó is in my judgement arguably right in his treatment of Aristotle. Aristotle is a good witness to the developments we are here interested in, and he had an interesting and in many ways sophisticated conception of the axiomatic method. Moreover, his ideas were undoubtedly influenced by mathematical paradigms. However, there is a very real sense in which Aristotle's conception of an axiomatically built science is foreign to real mathematical methods of argumentation. Aristotle believed that the tool by means of which all the deductions needed in an axiomatic science are effected (as we would say in our twentieth-century terminology, by means of which theorems are derived from axioms) is his syllogistic logic. This assumption colors Aristotle's whole philosophical theory of the structure of an axiomatically constructed theory (a science), as it is presented in the *Analytica Posteriora*. It alienated him from mathematical practice, however, and led him to ideas quite foreign to what we are likely to find in mathematical axiomatics. Not only is it the case that syllogistic logic is insufficient to capture typically mathematical inferences. Since Aristotle's whole set of ideas concerning an axiomatically organized science is based on the syllogistic model, this model affects his theory of the structure of a science and not only his views of the individual deductive steps. In particular, Aristotle's syllogistic paradigm prejudices strongly his doctrine as to what the different starting-points (axioms and other primitive assumptions) of a science are. In my paper, "On the ingredients of an Aristotelian science," I have shown what the theory is to which Aristotle was led by his syllogistic paradigm. I argued in that paper

that there are four kinds of primitive assumptions in any one axiomatically built science *apud* Aristotle:

- (1) “Axioms” (in Aristotle’s narrow sense) common to all sciences.
- (2) Atomic premises connecting two adjacent terms figuring in a minimal syllogistic premise.
- (3) The widest premise of the science in question.
- (4) Nominal definitions.

The need of postulating (2) follows from the fact that the most primitive premises of syllogistic inferences are the ones which postulate connections between terms closest to each other. The special status of (3) is due to the fact that only the existence of the widest term figuring in a science has to be postulated. The existence of everything else in the field of that science can be proved syllogistically. This widest term thus serves to define the field of the science in question. For details and for evidence, I must refer the reader to my *Noûs* Paper (Chapter 5 of this volume).

The syllogistically rather than mathematically motivated character of an axiomatic theory according to Aristotle probably explains Szabó’s low opinion of Aristotle’s significance. He does not seem to be aware of the letter of Aristotle’s theory, as I argued earlier in this paper, but he may have caught some of its spirit. At least he is in this particular respect more perceptive than the scholars who have tried to understand the details of Aristotle’s theory of science by starting from its alleged mathematical models. Even though Aristotle obviously also tried to push the mathematical sciences to the Procrustean or perhaps rather syllogistic bed of his theory of science (for instance, a generous portion of his examples are borrowed from mathematical sciences), in most cases they measure up very badly to his exacting model. Perhaps the most striking example is the important fact that in mathematics a surprising number of different conclusions can be proved from a small number of assumptions. Yet Aristotle acknowledges in so many words that in scientific syllogisms “the starting points (*arkhai*) are not much fewer in number than the conclusions” (*An. Post.* A 32, 88b4–5.)

There are nevertheless some features of Aristotle’s theory of axiomatic science that seem to be better explainable by reference to mathematical practice than to the syllogistic model. Such features can also be used to throw light on the development of mathematical methods and modes of theorizing. Later, I shall give a couple of examples of such features.

Above, I said that the syllogistic character of Aristotle’s ideal of an axiomatic theory probably explains Szabó’s dismissal of Aristotle. This does not yet prejudice the question whether the character of Aristotle’s theory justifies Szabó. It seems to me that we can in fact use Aristotelian evidence somewhat more extensively than Szabó does for charting and evaluating the history of Greek mathematical methodology. But in order to do so, we have to understand Aristotle better than has been accomplished so far in the literature. We have to understand Aristotle so well as to know which aspects of his doctrines are

due to the syllogistic model and which ones are based on mathematical models. We must be able as it were to subtract the former from the totality of Aristotelian views in order to be able to reach the latter.

I believe that this can be done. In this paper, I can only outline a way of doing so, but I cannot trace all the consequences of the ideas I am about to outline. The fourfold distinction between different *arkhai* mentioned above and defended in my *Noûs* paper is a necessary first step. It must nevertheless be supplemented by insights I did not yet have when I wrote the earlier paper. There are in fact two important further features of Aristotle's theory which were not dealt with in my earlier paper and which seem to me to carry essentially further the line of interpretation begun in my 1972 paper.

(a) Aristotle has two senses of definition (*horismos*), the narrower and the wider one. The former restricts definitions to the "nominal" definitions (4) in the list (1)–(4) above. In the latter sense, not only (4) but also (2)–(3) are called by him definitions. Aristotle relies on the narrower sense in most of *An. Post. A* but on the wider one in most of *An. Post. B*. Hence Aristotle's discussion of the different kinds of definitions (and of the way these different kinds of definitions are reached) in *An. Post. B* 4–10 is in effect a discussion of the different ingredients (2)–(4) of axiomatic theories. The following comparison illustrates this parallelism.

An. Post. B 7–10

... in some cases what a thing is is immediate (*amesa*) and a principle (*arkhai*); and here one must suppose, or make otherwise apparent, both that they are and what they are (which is what the arithmetician does, for he supposes both what the unit is and that it is) ...

but in those cases which have a middle term ... one can ... make them clear through a demonstration (*apodeixis*), but not by demonstrating (*apodeiknymi*) what they are (93b21–28).

The definition of immediate (*ameson*) terms is an indemonstrable (*anapodeiktos*) assumption of what they are (94a9–10).

One definition therefore is indemonstrable account of what a thing is; one deduction of what it is, differing in aspect from demonstration (94a10–13).

This is what sciences actually do for the geometrician assumes what "triangle" signifies (*semainei*) but proves that a triangle is (92b15–16).

An. Post A 10

Proper [to each science] too are the things which are assumed to be, about which the science considers what belongs to them in themselves, as e.g. arithmetic is about units and geometry about points and lines. For they assume these to be and to be *this*.

As to what are attributes of these in themselves, they assume what each signifies – e.g., arithmetic assumes what odd or even signifies, and geometry what irrational or inflection or verging signifies – and they show that they are (*hoti d'esti deiknyousi*) through the common items (*ta koina*) and from what has been demonstrated (76b3–11).

I call principles in each genus what cannot be proved (*me endekhetai deixai*) to be. Now what both primitives (*to prota*) and the things dependent on them signify (*semainei*) is assumed; but that they are must be assumed for the principles (*arkhai*), and proved (*deiknymi*) for the rest. For instance, we must assume what unit or straight, and triangle signify, but that the unit and geometrical magnitude are; but we must show (*deiknymi*) that the others are (76a31–36).

In both columns Aristotle is clearly discussing the same thing, viz. the distinction between (2) and (3). (The translations are adapted from Jonathan Barnes' translation in the Clarendon Aristotle Series.)

If further evidence of the wide sense of *horismos* in *An. Post.* B is required, we can note that in *An. Post.* B 3, 90b24–28 Aristotle twice asserts that the starting-points (*arkhai, ta prota*) of a demonstration (*apodeixis*) are definitions (*horismoi*). This makes sense only if Aristotle is here considering (2)–(3) and not only (4) as definitions.¹

(b) The other main additional insight needed here is connected with our earlier observation in (ii) to the effect that Aristotle never really distinguished the existential and the predicative force of “is”. Hence the status of (3) as the only unprovable existential assumption of a scientific theory *ipso facto* meant that they were also in some sense the only unprovable predicative assumptions of a science. However, this unprovability cannot any longer mean unprovability in the sense that refers to *apodeixis* (cf. (i) above). It will have to mean impossibility to show the truth of (3) in the sense of some other variety of *deixis* than *apodeixis*.

Hence the question arises: Is there in Aristotle some nonsyllogistic sense of proving or “showing” in which the widest (and possibly also the narrowest) premise of each science, and only they, cannot be proved by the normal means that science operates with? Now there is indeed in Aristotle a variant of non-syllogistic showing that fills the bill neatly. That is the procedure he calls *epagoge* in *An. Pr.* B 23. Since it involves inverting one of the two premises of a syllogism, it involves terms that are *prima facie* wider or narrower than the extremes of the three syllogistic terms in question. Accordingly, it cannot be used to justify the widest premises (3) of an axiomatic science.² They are therefore unprovable in a double sense for Aristotle. They are the only premises of an axiomatic science that carry irreducible existential assumptions, and they must (possibly together with the narrowest premises) be justified by direct intuition (*noûs*) rather than by the systematic procedure of *epagoge* or “induction” through which atomic premises (2) are established.

Moreover, the inversion of a syllogistic premise which is involved in *epagoge* according to Aristotle seems to be just what is involved in reaching definitory atomic premises according to Aristotle's account in *An. Post.* B 8–10. The two can be shown to be structurally similar processes.

Thus we can summarize the ways in which the different kinds of basic ingredients of an Aristotelian science come to play:

- (1) Common assumptions (axioms) have to be known before any knowledge can be acquired.
- (2) Atomic premises are known through the particular kind of *deixis* which Aristotle sometimes calls *epagoge*. The same procedure is described in *An. Post.* B 4–10.
- (3) The generic premise: A generic premise is the widest premise of a science. It is known through *noûs*. The process of coming to know it is described by Aristotle in *An. Post.* B 19.

(4) Nominal definitions are arrived at by stipulation.

What does all this entail for the early history of the axiomatic method in general and for Professor Szabó's views in particular? It is tempting to try to draw a parallel between Aristotle and Euclid as follows:

<i>Euclid</i>	<i>Aristotle</i>
(1) <i>koinai ennoiai</i> (common notions)	general axioms
(2) definitions	atomic premises
(3) postulates	generic premises

The main difference between this way of comparing Aristotle and Euclid to each other and most earlier comparisons is the Aristotelian analogue I am assigning to Euclid's definitions. Usually they are compared with what Aristotle calls definitions in *An. Post.* A (especially A 10). It seems to me much more illuminating to try to assimilate them to what I have called atomic premises. If I am right, atomic premises are in fact called by Aristotle definitions, viz. in *An. Post.* B. Hence the sample evidence I gave earlier for Aristotle's dual usage in speaking of definitions also serves as indirect evidence for my Aristotle–Euclid comparison. Further evidence is likewise forthcoming; see for instance the passage quoted above from *An. Post.* A 10, 76a31–36; *An. Post.* B 3, 90b24–25; *Eth. Nic.* VI, 8, 1142a26 ff.

It also appears that the role of definitions was also on the mathematical side more important in antiquity than it is in modern mathematics. Some evidence concerning the way ancient mathematicians looked upon their own basic assumptions and upon the role of the definitions of the basic mathematical concepts is obtained from the criticisms levelled at Euclid's fifth postulate in antiquity. The gist of many of these criticisms is that Euclid's postulate does not give the essence of the straight line – or of any other geometrical concept, for that matter. (For instance, otherwise the objection that the converse of the fifth postulate is provable would not make much sense.) In slightly different words, the complaint was that the fifth postulate could not be conceived of as a definition.

My analogy between Aristotle and Euclid is inevitably only an approximate one, for reasons explained earlier. Even though I cannot examine the putative analogy as carefully as it deserves, the following failures can be registered here:

(i) Definitions do not typically operate as premises from which conclusions are drawn in Euclid, as definitions in the sense of class (2) have to do in Aristotle. Instead, the *apodeixis* part of a Euclidean proposition utilizes typically the common notions.

(ii) Euclidean definitions are not numerous enough to serve as syllogistic premises according to the Aristotelian scheme. (Cf. *An. Post.* A 88b4–5.)

(iii) Euclidean postulates are not wider in scope than the definitions, unlike Aristotelian generic premises.

(iv) There does not seem to be any reasonable sense in which Euclidean

definitions were thought of as being provable. They were not provable even in the loose sense of a *deixis* by *epagoge*.

It is not an accident, it seems to me, that most of these discrepancies turn on the Aristotelian idea that all primary premises of an axiomatic science can be thought of as definitions. As I tried to suggest in my *Noûs* paper, it was precisely the syllogistic model of scientific demonstration that encouraged Aristotle to assign such a sweeping role to definitions in an axiomatically constructed science. This illustrates vividly what I said earlier about the significance of the syllogistic model in alienating Aristotle's theory of the axiomatic method from the mathematical practice.

The basic reason for all these failures is Aristotle's syllogistic paradigm for his logic of science. When the effects of this particular paradigm are eliminated, however, several interesting comparisons are still possible between Aristotle and Euclid. Here I can only give selected examples, which exemplify the general points made above concerning the relation of Aristotle to the mathematical tradition.

(i) Aristotle's "common axioms" seem to be essentially tantamount to Euclid's "common notions". For instance, Aristotle's example in *An. Post.* A 10, 76a40 is identical with Euclid's third "common notion".

(ii) Szabó is on the right track in emphasizing (e.g., pp. 302, 232–233; pp. 413, 310–311 of the German) the role of definitions as basic assumptions in Greek mathematical theories. He could have found much more evidence for this view in Aristotle. The general historical significance of these comparisons cannot be discussed here.

NOTES

1. This is all the more striking because in some of the quotes given earlier Aristotle is apparently restricting the term *arkhai* to (3) rather than both (2) and (3).
2. I shall here overlook the interesting question as to what Aristotle is prepared to say of the narrowest syllogistic premises. Passages like *Eth. Nic.* VI, 8, 1142a26 ff. are relevant to this question.

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CHAPTER 7
ARISTOTELIAN INDUCTION

1. DIFFERENT TYPES OF PRIMITIVE ASSUMPTIONS IN ARISTOTLE

In an earlier paper, “On the Ingredients of an Aristotelian Science”, I have distinguished from each other the different types of primitive assumptions that go into a given science according to Aristotle.¹ The following kinds of assumptions were found:

- I Common axioms (e.g., principles of logic).
- II Generic premises (assumptions postulating the genus studies by the science in question).
- III Premises about atomic connections (unanalysable syllogistic premises).
- IV Nominal definitions.

It is to be noted that Aristotle also frequently calls II–III definitions, especially in *An. Post. B*.

The results of the earlier examination of the nature of I–IV will be presupposed here. They can be applied so as to throw some light on the following question: How, according to Aristotle, do we come to know the first principles of a science? We have found that there are several essentially different kinds of “first principles”, i.e., ultimate assumptions, in an Aristotelian science. Accordingly, there presumably will have to be several different ways of coming to know them, that is, different kinds of induction, for it is precisely induction that according to Aristotle “deals with the first and immediate (*amesos*) premise” (*An. Pr. B* 23, 68b30–31).

Admittedly, of the different kinds of assumptions, I–IV, the extreme ones do not perhaps offer separate problems. Of the common axioms (I) Aristotle says that “they must be grasped before any knowledge is to be acquired”. Hence a process of coming to know them might be thought to precede all scientific activity.

The situation is not as simple as this, however. On the one hand, according to Aristotle a scientist uses these common axioms (I) only insofar as they apply within his particular genus, and does not have to master them in their full generality. On the other hand, insofar as the common axioms (I), too, fall within the scope of some one science (presumably “science of being *qua* being” or metaphysics), they will be known in the same way as the primitive assumptions of any other science, the only difference being their greater generality. Hence, the common axioms (I) do not present special problems, and we are in effect led back to consider assumptions of the kinds II and III – and to recall

the famous problems concerning the possibility of metaphysics according to Aristotle.

Of the nominal definitions (IV), Aristotle says that they only have to be understood. There is accordingly no problem as to how we come to know them, for there is nothing to be known in them.

However, the distinction between II–III implies important differences between the ways in which we come to know the different primary assumptions of a science according to Aristotle. These differences have not always been appreciated by commentators. One reason for this is again Aristotle’s terminology. One of the general terms he uses for coming to know such premises as II–III is *epagoge* (ἐπαγωγή). It is usually translated “induction”, and although this translation is highly misleading if used without explanations, I shall use it here for simplicity. Now *epagoge* is used by Aristotle in two different ways, I shall argue. (Actually, quite a few different uses of the word can be discerned in Aristotle. Here we are solely interested in those occurrences of the word in which it refers to a way of coming to know primary premises of a science.) Sometimes *epagoge* is restricted to the process of coming to know assumptions of type III (atomic premises). On other occasions, Aristotle applied it also to the way of coming to know the generic premises II. Hence, we have to take a close look at Aristotle’s explanations to be able to distinguish the two processes from each other.

2. ARISTOTLE’S DIFFERENT ACCOUNTS OF INDUCTION

One aspect of the problem is to see how the different things Aristotle says of induction can be reconciled with each other – insofar as they can be reconciled without assuming that Aristotle is on different occasions speaking of different subjects.

The main discussions of induction in Aristotle are the following:

(i) In *Analytica Priora* B 23, Aristotle describes induction and relates it to certain kinds of syllogisms. To have a name for this chapter, I propose to call it (without thereby prejudicing the subsequent discussion) Aristotle’s “official account” of induction. According to this account, in induction we somehow convert a syllogistic premise so as to obtain the premises needed for another syllogism.

(ii) In *Analytica Posteriora* B 19, a semi-psychological account is given of the way in which the immediate premises of scientific syllogisms are obtained. This is said to happen by means of induction (100b3). No reference to a conversion of syllogistic premises is made. Induction seems to consist of the formulation of the appropriate concepts by comparing, shifting, and systematizing impressions one receives from sense-perception and retains in memory

(iii) In the *Topics* I, 12, induction occurs as one of the types of dialectical arguments, that is, one of the types of arguments which can be used independently of subject-matter and which normally start from generally accepted opinions. Aristotle says that “induction is ... more easily grasped by sense-perception and is shared by the majority of people, but syllogism is more cogent and more efficacious against argumentative opponents”.

A little earlier (*Top.* I, 2, 101a25 ff.), Aristotle mentions that dialectical arguments are useful in connection with the first principles (*ta prota*) of each particular science, “for it is impossible to discuss them at all on the basis of the principles (*arkhai*) peculiar to the science in question, since the principles are primary in relation to everything else, and it is necessary to deal with them through the generally accepted opinions on each point. This process belongs peculiarly, and most appropriately, to dialectic”. Here the principles, or primary premises, of a science are not reached by starting from sense-perceptions but from generally accepted opinions, *endoxa*.

(iv) It can be shown that the definitions which Aristotle discusses in *An. Post.* B 3–10, especially 8–10, include the first premises of each science. Hence his remarks in these chapters on the way such definitions are reached are also relevant to his theory of induction, for it is induction that is supposed to yield the first premises.

I shall argue that these accounts can be reconciled. The main discrepancies can be explained as follows:

(1) The “official account” (i) is restricted to those inductions which yield premises III while the account (ii) covers also, and perhaps principally, premises of the kind II. This explains part of the difference.

(2) Aristotle consistently thought that both observational and conceptual considerations can be involved in induction. This helps to explain the contrast between (ii) and (iii) as being largely an apparent one only.

In arguing for those points, we can use Aristotle’s remarks (iv) on the way definitions are reached in *An. Post.* B 3–10, as useful “missing links” between the apparently discrepant accounts.

3. ARISTOTLE’S “OFFICIAL ACCOUNT” OF INDUCTION

The longest passage in the Aristotelian Corpus dealing *explicitly* with induction is *An. Pr.* B 23. It has greatly puzzled commentators who have usually failed to connect it in an interesting manner with what Aristotle says elsewhere of induction. For instance, Sir David Ross thinks that it covers only the so-called complete induction in which a generalization is established (say) for a species by showing that it holds for each of its subspecies, which are finite in number.² Because complete induction is a relatively uninteresting special case. Ross therefore takes the discussion in *An. Pr.* B 23, to represent an isolated doctrine of Aristotle’s. This is not the right interpretation, however, as we shall see. On

the contrary, the “inductive syllogisms” discussed in *An. Pr.* B 23, are closely related to the syllogisms which are said to be correlated with premises of type III in *An. Post.* B. Let us first look at the former, however.

In *An. Pr.* B 23, 68b15, it is said that “induction, or rather the syllogism which springs out of induction, consists in establishing syllogistically a relation between one extreme and the middle by means of the other extreme”. Aristotle illustrates this by an example, letting “A stand for long-lived, B for bileless, and C for the particular long-lived animals, such as man and horse and mule”. Commentators have been puzzled here by the last part of Aristotle’s explanation of this example, viz. the explanation of C. It turns out later in Aristotle’s discussion that what Aristotle says here is not quite what he means. It is also important for Aristotle that C’s are bileless animals. Why should Aristotle call them instances of longevity rather than of bilelessness? We can see what Aristotle is doing, however. He does not really mean either. The term C is not supposed to be explained either by means of the notion of longevity or by means of the notion of bilelessness. It has to be taken *de re*, as it were. It represents simply a class of animals which *in fact* are long-lived and bileless. This is the class of animals for which we are looking for an explanation of their longevity, whose presence is thus taken for granted.

What is to be established inductively is that every bileless animal is long-lived, i.e., that

$$(1) (\forall x)(Bx \supset Ax)$$

What we have available for the purpose, according to Aristotle’s explanation, is first of all that

$$(2) (\forall x)(Cx \supset Ax)$$

Aristotle motivates this by saying that “whatever is bileless is long-lived”, which seems to be just what was to be proved, and hence to beg the question.

An explanation for the choice of words is easily forthcoming, however. Indeed, it is implicit in what was just said of the *de re* character of the term C. What Aristotle is thinking of is that, of each of those animals that in fact are bileless, we can find out that it also is long-lived. He is not assuming that we establish at this stage a generalization connecting the terms “long-lived” and “bileless”. He is merely thinking of what we can say of the problem cases which we are considering. Hence, (2) simply means that A is true of the problem cases of which C consists.

Once again we can thus see that Aristotle is not thinking of C as being characterized as the class of long-lived animals or of bileless animals but rather as a certain class of animals for which we are looking for an explanation of their longevity.

We also have “B applies to all C”, i.e.,

$$(3) (\forall x)(Cx \supset Bx).$$

This obviously represents the, as it were, purely empirical observation that bilelessness is present in all the problem cases. It leaves open the question whether bilelessness is the explanation of longevity for the C's. To be able to give such an explanation (Aristotle thinks), we must have available to us the major premise (1).

From (2)–(3) we of course cannot infer (1). We can do so, however, if (3) is convertible, so that we can move from (3) to

$$(4) (\forall x)(Bx \supset Cx),$$

i.e., to the claim that C applies to all B. Then (1) is entailed by (2) and (4). In fact, (2), (4), and (1) can be joined together so as to form a *barbara* syllogism.

This is now the crucial question Where does (4) come from? What entitles us to move from (3) to (4)? The only explanation Aristotle proffers is the following:

“But we must apprehend C as made up of all the particulars. For induction proceeds through an enumeration of all the cases”.

It is this passage that has encouraged the idea of “complete induction”, in other words, the idea that Aristotle is thinking of C as made up of a finite number of subclasses which together exhaust the range of B. This is not very likely, however. For one thing, elsewhere (*On the Parts of Animals* 670a20, 677a15–b11), Aristotle lists other bileless animals in addition to the ones mentioned here as constituting C, which therefore could scarcely have comprised “all the particulars” falling under B. Rather, Aristotle's statement should be seen in the light of his characterization of induction in *An. Post.* B 7, 92a37–38 as “showing by enumeration of manifest particular instances that every case is like this, because none is otherwise”.

Aristotle's point can be appreciated better by recalling the fact (to which we have already appealed repeatedly), that scientific syllogisms are supposed to answer “why”-questions. In the present case, what the desired end product is is clearly an explanatory syllogism of the form:

$$(5) ((\forall x)(Bx \supset Ax) \& (x)(Cx \supset Bx)) \supset (\forall x)(Cx \supset Ax).$$

What this explains (*apud* Aristotle) is why the animals comprising C are long-lived (i.e., are A's). They are long-lived because they are bileless (B). Now how can we come to see this through induction? Aristotle's answer is this: we need essentially the major premise (1). As Aristotle shows, it can be established by converting (3) into (4), that is, by making sure that the instances of C exhaust the instances of B, i.e., that bilelessness is present only in the particular animals we are considering. These are (of course) all the long-lived animals if we want to establish a universal explanation of their longevity, as Aristotle seems to have in mind. They constitute some smaller class if we are dealing with the explanations of longevity in certain particular cases. The crucial point is that C must exhaust B, for otherwise bilelessness (B) would not always give rise to the phenomenon we are interested in (C), and hence could not be an

explanation of the latter. The way to ascertain this is to understand C as made up of *all* the particular cases we want to consider.

Aristotle's point is thus fairly clear. At the same time, we can see how natural it was for him to think of C as being specified without reference to either longevity or bilelessness. It is simply the class of cases for which we are looking for an explanation of their longevity.

In *An. Pr.* B 23, Aristotle indicates that, in addition to inductions which serve to establish the major premise of an irreducible explanatory syllogism, there are similar inductions establishing the minor premise. If (5) is the explanatory syllogism, we show that (3) holds by first ascertaining that (1) and

$$(6) (\forall x)(Cx \supset Ax)$$

hold. Then (1) is somehow converted inductively so that we can infer (3) from (6) and from the result of the conversion, i.e., from

$$(7) (\forall x)(Ax \supset Bx).$$

4. THE BACKGROUND OF THE "OFFICIAL ACCOUNT"

But saying all this will probably still leave the reader puzzled as to how Aristotle can think that he can safely take the crucial step from (3) to (4). The following may help to serve as a brief guide for the perplexed here.

What Aristotle starts from is not an explicitly formulated term, but a bunch of particular cases. What he wants to arrive at is not primarily an insight that (4) holds (or that (3) can be turned around so as to become (4)), but a fuller understanding of the very terms A and B. Their meanings are in fact intertwined. As we can see from such passages as *An. Post.* B 8, 93a29–b14, the explanatory middle term B is the definition of A, or a part of the definition of A.

Once the soul has fully captured the appropriate terms, i.e., has captured the right form, the relation between B and A expressed by (1) can (according to Aristotle's own assumptions) be seen at once. For if (1) is true, it is necessarily true (because it possesses unrestricted generality, including generality with respect to time). That means that the forms B and A have a certain necessary relation to each other. But, for Aristotle, to think of x is to have the form of x in one's mind. Hence necessary relations between forms can be discovered in thought, because their necessary interrelations must be present also when they are exemplified in the soul.

Hence Aristotle's real problem is quite different from that of modern inductivists. Latter-day philosophers of science have, almost to a man, worried whether induction can give us certainty. This certainty is taken for granted by Aristotle. It is not his concern at all. What he is dealing with is how to get hold of the concepts, the "forms", which will give us a foothold for the operative inductive steps. They look like reversals of certain syllogistic premises, but in reality they

are of the nature of concept formation or conceptual insights. For Aristotle, induction in the technical sense thus means induction in the etymological sense, that is, a process of inducing in ourselves the right concepts.

In *An. Pr.* B 23, Aristotle does not analyze how that process actually proceeds, which has misled nearly all commentators. From other sources we can find more information concerning that step. In the example he uses, we can perhaps nevertheless see what he might have had in mind. What is needed is that we realize what it is about the particular cases in question that we are really interested in, i.e., what is common to all of C. Once we get hold of that, i.e., get hold of the term B, which helps to define A, the rest is easy (Aristotle thinks). The real reason why we have to consider the different instances C of longevity-cum-bilelessness is that it is by considering them that we can come to form the concept B. Since B is to be a partial definition of A and since C is in effect a list of the different cases of A, it has to be chosen in such a way that its presence implies C. In practice, choosing B in this way may consist in looking at different cases of C and seeing what they have in common, so that the explanation we want works not only in some cases of C, but eventually in all of them. This explains what Aristotle means by saying that induction proceeds by taking into account all cases. Furthermore, we can now see that it is essential for Aristotle's theory that the class of C's be not initially captured by any ready-made term. For the gist of Aristotelian induction lies precisely in the discovery that a suitable term does capture the right class.

This class can be thought of as the class of all the different cases of longevity, as Aristotle indeed indicates. It is for them that we are looking for an explanation of their longevity. As was already indicated, an explanation must, for Aristotle, be based on the definition of the major term involved. The establishment of the implication $(\forall x)(Bx \supset Ax)$ means, in effect, discovering (a part of) the definition of A.

5. SEARCH OF DEFINITIONS AS INDUCTION

If this is what is going on in Aristotle's official account of induction, it is to be expected that the search of primitive terms of a science should be identical in Aristotle with induction. Now such a search for such a term must obviously be the same as a search for its definition. This will in fact be found to be the case in Aristotle.

In order to see it we can return to the question as to what entitles us (*apud* Aristotle) to convert (3) into (4). Is sudden insight what is required here? It may *sometimes* be that all we need is sense-perception. Thus Aristotle writes in *An. Post.* B 2, 90a26 ff., in a surprisingly modern fashion: "If we were on the moon we should not be inquiring either as to the fact or as to the reason, but both fact and reason would be obvious simultaneously. For the act of perception would have enabled us to know the universal too; since, the present fact of eclipse being evident, perception would then at the same time give us the

present fact of the earth's obstructing the sun's light, and from this would arise the universal". In brief, if we were on the moon, we could see that the earth's obstructing the light is the cause of the eclipse.

It is important to realize, however, how very atypical such an instantaneous induction is for Aristotle, albeit sense-perception is perhaps ultimately needed to activate an induction in all cases.³

An even more representative – and illuminating – example is found in *An. Post.* B 13. Ostensibly, it deals with a search for a definition, not with induction. We have seen, however, that there are reasons to expect Aristotelian searches for definitions to be closely related to induction in his sense. Hence, Aristotle's example is highly relevant here.

The notion to be defined is *megalopsychia*, a puzzling notion indeed for any Greek moralist to analyze. (Aristotle's own substantial characterization of *megalopsychia* is given in *Nic. Eth.* 1123a34–1125a35 and is fascinating in its own right). To see the analogy with the examples already discussed, let *megalopsychia* be A, the different instances of *megalopsychia* from which an induction has to start C, and the defining characteristic to be found B. Aristotle writes as follows: "If we are inquiring what the essential nature of *megalopsychia* is, we should examine instances of man with *megalopsychia* we know of to see what, as such, they have in common. For instance, if Alcibiades was *megalopsychos*, or Achilles and Ajax were *megalopsychoi*, we should find, on inquiring what they all had in common, that it was intolerance to insult; it was this that drove Alcibiades to war, Achilles to wrath, and Ajax to suicide. We should next examine other cases. Lysander, for example, or Socrates, and then if these have in common indifference alike to good and ill fortune, I take these two results and inquire what common element there is in equanimity amid the vicissitudes of life and impatience of dishonour". In this way we should "persevere till we reach a single formula, since this will be the definition of the thing". Aristotle adds that "if we reach not one formula but two more, evidently the *definiendum* cannot be one thing but must be more than one" – i.e., is ambiguous ("homonymous", to use Aristotle's term).

Several observations can be made on the basis of this vivid example. First, it is (assuming that the *definiendum* is not ambiguous), parallel with the earlier examples, and in fact serves to explain their peculiarities. Again, the obvious truths of the case are $(\forall x)(Cx \supset Ax)$ and $(\forall x)(Cx \supset Bx)$, the former because C just covers those "instances of *megalopsychia* we know of" from which our inquiry starts, and the latter, because B is what the different puzzle cases that have been examined have been found to have in common. The success or failure of our search for a single definition is contingent on whether we can find a formula that covers all the cases of *megalopsychia*, i.e., whether we can find a B which characterizes all the cases of C and thereby enables us to convert the latter premise so as to obtain $(\forall x)(Bx \supset Cx)$. Then we will have as a regular syllogistic conclusion $(\forall x)(Bx \supset Ax)$ which vindicates B as the definition (explanation) of A. As in the example of the eclipse Aristotle discusses in *An. Post.* B 8, 93a29–b14 (cf. section 6 below), and indeed even more plainly, this is

precisely parallel with the type of induction Aristotle envisages in *An. Pr.* B 23. It is especially instructive to see how the emphasis Aristotle places in his official account on “enumerating *all* the cases” neatly matches the requirement in the *megalopsychia* example that the definition has to capture what is common to all the different types of instances of *megalopsychia*. As he puts it there, “every definition is always universal” (97b26). This helps us to understand the import of the earlier (68b28–29) statement that induction proceeds by taking into account all particular cases.

Intuitively, we might think of an investigator’s line of thought *apud* Aristotle as running somewhat as follows: Consider the situation at some nonfinal stage where we have reached a tentative definition B’ which covers some range of cases of *megalopsychia* C’, and another definition B’’ which covers another range of cases C’’. Then we obviously have

$$(8)' (\forall x)(C'x \supset Ax)$$

and

$$(8)'' (\forall x)(C''x \supset Ax)$$

for these are cases of *megalopsychia*. We also have

$$(9)' (\forall x)(C'x \supset B'x), \text{ indeed } (\forall x)(C'x \Leftrightarrow B'x)$$

and

$$(9)'' (\forall x)(C''x \supset B''x), \text{ indeed } (\forall x)(C''x \Leftrightarrow B''x)$$

because B’ was the definition (common element) in certain cases (call them collectively C’) of C so far considered, and likewise for B’’ and C’’. But we must think of C as “being made up of all particulars”, i.e., think of C’, C’’, etc., as exhausting ultimately all of C. Then *if* B is to be the correct formula, it will have to be a common element in all the different partial definitions B’, B’’, ... and still to apply to all the cases C’, C’’, ... This means that we must have

$$(4) (\forall x)(Bx \supset Cx)$$

From these we can then get the required definitory premise

$$(1) (\forall x)(Bx \supset Ax)$$

Notice how nicely this matches what was found above in our examination of the background of Aristotle’s official account. Here, too, the main problem is to get hold of the right common element of all the cases of the concept to be defined, i.e., of B. Once we have found it, there is (so to speak) no additional worry as to whether it covers all the cases, i.e., whether

$$(4) (\forall x)(Bx \supset Cx)$$

holds; for the definitive B was *chosen* so as to do this.

We can also see how easily and, as it were, naturally, the mistaken idea sneaks in that Aristotle is in his official account dealing with what modern

philosophers call complete induction. We can now see that there is even a sense in which this is true. But it is true only because the subclasses of A (e.g. of *megalopsychia*) are introduced as a means of exhausting the whole class of individuals falling under A, not because Aristotle is focusing on such cases only in which these subclasses are already there. What is also wrong in references to complete induction is that the completeness of the list of subcases is thought of as a guarantee of the *truth* of the induction, whereas in Aristotle it is a means of finding the term to be used in induction.

From the *megalopsychia* example we can also see what Aristotle means by such statements as the following:

“Similarly, too, with logical arguments, whether syllogistic or inductive, ... the latter proving the universal through what is obvious of the particular”. (*An. Post.* A 71a8–9).

“We must, however, understand C as the sum of all particular instances for it is by taking all of these into account that induction proceeds”. (*An. Pr.* B 23, 68b27–29).

“[We] show inductively by enumeration of manifest particular instances that every case is like this because none is otherwise ...” (*An. Post.* B 7, 92a37–38).

For it is by considering the different known cases of *megalopsychia* and by comparing the reasons why we so classify them that we can find the definition of *megalopsychia*.

One reason why the *megalopsychia* example is so instructive is that in it we can see how for Aristotle the certainty of the crucial conversion from (3) to (4) need not be any problem at all. The possibility of the conversion is an essentially conceptual matter. It is guaranteed, not by empirical matters of fact, but by the right choice of the term B. This term is reached by a process which is much more a conceptual analysis of the notion of *megalopsychia* than empirical investigation. This is indicative of the nature of Aristotelian induction. Of course, there are differences between different cases of induction. In the *megalopsychia* example, Aristotle is taking our familiarity of the different types of cases of the major term for granted. However, in other kinds of induction, such experience cannot be taken for granted, but can only be obtained through a special inquiry.

6. THE “OFFICIAL ACCOUNT” PARALLELS ARISTOTLE’S EXAMPLES OF DEFINITORY SYLLOGISMS

Once we have seen how one particular search for a definition in Aristotle matches his official account of induction, we can also see that the syllogism (5) is largely parallel with the syllogisms which Aristotle uses to illustrate definitions (primary premises) of type III in his general discussion of definitions in *An. Post.* B, especially *An. Post.* B 8. In one of them we are dealing with an

explanation why the moon is eclipsed. “Let A be eclipse, C the moon [sc. occurring in certain circumstances], B the earth acting as a screen”. The explanatory syllogism is again of the form (5). The further point Aristotle makes here is that giving this kind of explanation of eclipse through a syllogism at the same time serves to exhibit the definition (the essence) of eclipse. “The question ‘What is eclipse?’ and its answer ‘The obstruction of the moon’s light by the interposition of the earth’ are identical with the question ‘What is the reason of eclipse?’ or ‘Why does the moon suffer eclipse?’ and the reply ‘Because of the failure of light through the obstruction of the earth’” (*An. Post.* B 2, 90a15–18).

Notice that the minor term C is here again a mere pigeonhole for all the cases we want to explain, just as I argued it is in the official account of induction. Here we can see what Aristotle means by saying that, in the case of things that have a cause different from themselves, it is possible to exhibit through demonstration (*apodeixis*) their essential nature, although we do not thereby demonstrate it.

Both for the explanation and for the correlated definition we need the two premises of the syllogism (5). Although Aristotle does not himself offer much by way of an explanation as to how we can reach these premises, it lies close at hand to suggest that they are reached in a way essentially the same as the kind of induction described in the official account.

What are the premises that come in handy here? The statement $(\forall x)(Cx \supset Ax)$ merely says that the moon is eclipsed in certain circumstances. It is still merely a “that”, not yet a “why”. The premise $(\forall x)(Bx \supset Ax)$ says that a loss of the moon’s light by the obstruction of the earth brings with it an eclipse. It is an obvious and unproblematic truth. If so, the problem here will be to establish the minor premise of the explanatory syllogism (5), i.e., to establish that

$$(3) (\forall x)(Cx \supset Bx).$$

This means establishing that an obstruction by the earth of the moon’s light is present in all different cases of eclipse, which surely is by anyone’s book an essential part of ascertaining that an eclipse can be *defined* as such an obstruction.

According to Aristotle’s official account of induction in *An. Pr.* B 23, this should be shown by showing that the other premise is convertible, i.e., that (7) holds. Of course, this will obviously be the crucial point in any account of the situation. Ascertaining it means ascertaining that obstruction by the earth is present in all the cases of eclipse (as a causative factor). This of course cannot be ascertained without somehow taking all the cases of eclipse into account – a requirement which is the precise analogue to what Aristotle says in the official account about induction proceeding “through an enumeration of all the cases”. It does not suffice to consider for the purposes only some types of kinds of eclipse. We must make sure that B is among the features common to all kinds of eclipse (of the moon). This amounts to somehow seeing that (4) is true on the interpretation which gives rise to the present example. It is *mutatis mutandis*

completely analogous with Aristotle's official account. The differences between the two cases are obvious, and do not disrupt the analogy. First, different aspects of the situation are emphasized by Aristotle on the different occasions: reduction to syllogistic form is stressed in *An. Pr.* B 23, the relation to definition and essence in *An. Post.* B. There is also a difference in that premises of type II do not seem to fit into what Aristotle says in *An. Pr.* B 23. Furthermore, it seems that the induction that goes together with Aristotle's example in *An. Post.* B, aims at the minor premise and not at the major, unlike the example chosen by Aristotle in *An. Pr.* B 23.

Apart from such inessential differences, we can see that there need not be anything isolated about Aristotle's explicit "official account" of induction in *An. Pr.* B 23. The description of induction Aristotle gives there can be naturally extended so as to apply also to the account of how we come to know the atomic premises III in *An. Post.* B. Hence Aristotle's account of induction in the latter chapter can be taken to be representative of all "inductions" which give rise to premises of the kind III. There even seems to be a fairly good fit between the specific remarks Aristotle makes on the two occasions.

Another explicit example of how syllogisms "apparent to us" can be turned into explanatory syllogisms by converting their major premise is found in *An. Post.* A 13, 78a31–b4. It serves to confirm my analysis of the eclipse example.

7. THE "OFFICIAL ACCOUNT" DOES NOT COVER GENERIC PREMISES

One thing we can now understand is why Aristotle's official account of induction is restricted to those inductions that give rise to primary premises of type III. In both the kinds of arguments covered by the official account, we start from a class of cases to be explained which are summed up in the minor term C. The extension of C is typically the same as that of the major term A in one of the two kinds of uses (cf. the example discussed in section 3), and always the same in the other (cf. section 6). In the course of induction we must therefore consider a term, viz. the middle term B, which *a priori* could have an extension larger than C. Now it is the peculiarity of premises of type II that they deal with the widest term in a science, a term which in effect serves to define the genus which constitutes the field of the science in question. Hence such a premise can scarcely be reached by means of terms which might, for all that we initially know, be larger in scope than the genus. Hence premises of type II cannot be established by the specific procedure described in the official account.

This line of thought is highly suggestive. If it is representative of what Aristotle thought, we can now understand very well why Aristotle's discussion in *An. Post.* B 19, does not refer to syllogisms at all. It covers the finding of premises of both types II and III, and only the latter process can be explained by reference to syllogisms.

This interpretation agrees in any case with what we find in *An. Post.* B 19.

For, Aristotle discussed there both the definitions that can serve as premises III and the definitions that can serve as premises II. The concluding account of how the first premises of a science are found is obviously intended to cover both, since neither is excluded. In fact, there are a couple of specific indications that premises of type II are in any case included. The attribute Aristotle uses in *An. Post.* B 19, of first premises is *amesos*, not *atomos*.⁴ Perhaps more significantly, they are not only called indiscriminately *arkhai*, but also are once called *ta prota* (100b3) – an expression which elsewhere (76a33) is restricted to assumptions II.

First, in the *megalopsychia* example the induction does not turn on perceptual evidence, but on what one finds difficult not to call *conceptual analysis*. When Aristotle decides that Alcibiades and Achilles are *megalopsychoi* because of their impatience of insult, he is not recording any perceptual observations. Rather, he is pointing out the conceptual fact that this is the basis of our calling them *megalopsychoi* in the first place. He is not inviting his audience to carry out experiments or observations, but to reflect on the way they use their own concepts. This illustrates one of the most important and most characteristic features of Aristotle's philosophical and scientific methodology. He does not distinguish sharply *factual issues* and concepts from *conceptual ones*. The very distinction is completely absent from his thinking, not merely absent as a doctrine he would accept, but even absent as a clearly formulated alternative doctrine to be rejected.

This attitude of Aristotle's is so general and so pervasive that a further investigation of its sources and manifestations is in order. By way of an introduction to this enterprise, it is worth spelling out what specific lessons we may learn from our study of Aristotelian induction.

In one respect, we have already anticipated our own insight. By observing that the first premises of a science were for Aristotle definitions, and by taking seriously both their role as premises of syllogistic conclusions and their function as explanations of the meanings of the terms involved, we have in effect acknowledged the inseparability of conceptual and factual assumptions in Aristotle.

Another lesson is about the relation of what Aristotle practices to what he preaches. Often, scholars and students have found a strange discrepancy, as it seems, between the picture of science drawn in *An. Post.* (and to some extent also in *An. Pr.*), on the one hand and Aristotle's own procedure in his own scientific and philosophical writings on the other.

For instance, G.E.L. Owen has pointed out that there is an apparent discrepancy between the *Analytics* and many other works of Aristotle with respect to the way in which the first premises of a science are obtained. In the *Analytics* they are said to be drawn from experience. "It falls to experience to provide the principles of any subject. In astronomy, for instance, it was astronomical experience that provided the first principles of the science, for it was only when the phenomena were adequately grasped that the roofs of astronomy were discovered. And the same is true of any art or science whatever" (*An. Pr.* A

30, 46a17–22, Owen’s translation). In contrast to this, in many of his other investigations, Aristotle strives to arrive at his basic premises by analyzing, not what experience has taught us, but what we mean by certain words and expressions or even what reasonable men have thought of the matter at hand. This is strikingly illustrated by the observation Owen makes and documents, viz. that well-founded opinions, *endoxa*, were among the *phainomena* a scientific explanation was supposed to account for, according to Aristotle.

What we have found shows that in this respect there is in reality little conflict between the *Analytics* and the rest of the Aristotelian *Corpus*. If we take seriously the identity Aristotle pronounces between definitions of certain kinds and the first premises of a science, and rely on his examples to show us what this amounts to, we can see that even in the *Analytics* there is plenty of scope for inductions which turn on conceptual analyses rather than on gathering empirical observations or on direct sense-perception.

This observation is directly relevant to our investigation into the meaning of *epagoge* in Aristotle. It shows how little disagreement there really was between the different things Aristotle said of induction. (Recall the list (i)–(iv) in section 2 above.) For instance, consider Aristotle’s description (ii) of how the primary premises of a science are obtained by organizing the universal concepts which sense-perception has induced (no pun intended) in us. Aristotle compares this reorganization to the restoration of order in a retreating military unit: “If one man halts so does another, and then another until the original position is restored” (100a12–14). I do not see that this kind of process cannot according to Aristotle involve in the more difficult cases conceptual analyses and conceptual reshuffling. It is not enough for the fleeing squadron to stop in whatever disorderly state they have fallen into; it has to be restructured before each man has found his proper place in the ranks, we might say by way of continuing Aristotle’s metaphor. This process is, in other words, not incompatible with the search for a definition by analyzing and comparing conceptually different cases of a given term we are trying to define in the way indicated by the *megalopsychia* example. Nor do I see that all the perceptions Aristotle speaks of in *An. Post.* B 19, have to be had by the same man. The important things are the forms in the soul, and they can be induced in us by what we hear from others as much as by what we ourselves see directly. Hence, there need not be any real discrepancy between *An. Post.* B 19, and Aristotle’s remarks in the *Topics* on induction as being a dialectical method, or on the first principles of a science being reached by starting from well-founded opinions, *endoxa*. As Owen already points out, for Aristotle “*endoxa* also rest on experience, even if they misrepresent it” (cf. *Parva Naturalia* 462b14–18).

NOTES

1. *Noûs* vol. 6 (1972), pp. 55–69 (Ch. 5 above). For some further developments of the same ideas, see also “Aristotelian Axiomatics versus Geometrical Axiomatics” (Ch. 6, above).
2. W.D. Ross, *Aristotle’s Prior and Posterior Analytics: A Revised Text with Introduction and*

Commentary, Clarendon Press, Oxford, 1949, corrected edition 1965, pp. 49–50. Ross' interpretation is shared by most contemporary philosophers, e.g. by G.H. von Wright in *The Logical Problem of Induction*, second edition, 1957.

3. At *An. Post. A* 13, 78a34–35, induction nevertheless is contrasted with perception.
4. Cf. my *Noûs* paper (note 1 above), pp. 60–61.

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CHAPTER 8
ARISTOTELIAN EXPLANATIONS
(with Ilpo Halonen)

Aristotle's theory of explanation is usually considered either as a purely historical phenomenon or else in the framework of the received, so-called Aristotelian logic. Unfortunately, this logic is neither historically accurate nor capable of handling the issues Aristotle was explicitly or implicitly dealing with. In this paper, it will be shown that Aristotle's ideas can be illuminated on the one hand by systematic logical considerations and on the other hand by the insight that Aristotle's logic was in certain crucial respects quite unlike that hopeless conundrum referred to by twentieth-century philosophers as 'Aristotelian logic'.

There are two especially prominent aspects of Aristotle's views on explanation. First, all explanations have ultimately the same syllogistic form. This paradigm form is that of the first two syllogistic figures according to Aristotle. Second, in Aristotle the notion of explanation is even more closely related to the notion of cause than it is for us. These connections are codified in his very terminology. Aristotle's words for cause are *aition* and *aitia*. (For their early semantic history, see Frede, 1980.) These, especially the term *aitia*, are used by him in such a general way that it has been maintained that *aitia* should properly speaking be translated as *explanation* rather than *cause*. It is so rendered by, among others, Barnes, in his translation of the *Analytica Posteriora* (Barnes, 1994, p. 89). As always in reading Aristotle, it may nonetheless be safer to make a distinction between different Aristotelian terms. Then *aitia* could be translated as 'cause', while the term 'explanation' would correspond to *to dioti* and *to dia ti*, literally 'the wherefore' and 'the because of what' (cf. Barnes, 1994, p. 96.)

In this paper, we will show how these two features of Aristotle's views are connected with other doctrines he holds. We will first consider Aristotle's implicit rationale for his belief in the syllogistic form of explanations.

Aristotle discusses questions of explanation and causation mostly in a syllogistic framework, that is to say, as applied to general conditionals. In other words, both an explanandum and an explanans are for him typically of the form

(1) every C is A

Indeed, we can here restrict our attention to propositions of the form (1). One reason is that all syllogisms can according to Aristotle be reduced to the first two modes of the first figure. Their conclusions are, respectively, (1) and

(2) no C is A

What can be said of (1) can easily be extended to (2).

In using variables like C and A in (1)–(2), we are merely following Aristotle's example. Hence, what the values (and substitution values) of these variables are must be gathered from Aristotle's text. Since the details are not crucial for our argument, we are here merely evoking the Aristotelian precedent.

Aristotle maintains several things about explanations of propositions of the form (1):

- (i) The explanation (or, in Aristotle's terminology, the 'why') of (1) is the middle term B of a syllogism whose conclusion is (1), i.e. of a syllogism of the form

(3) every B is A
 every C is B
 ergo: every C is A

(For evidence, see *An. Post.* A 6, 74b32; A 33, 89a16; A 34, 89b15; B 1, 90a7; B 8, 93a8; B 11, 94a23; B 12, 95a11; B 16, 98b10.) Accordingly, the direct or proximate explanation of (1) is obtained when the syllogism (3) is minimal, in other words, when there are no terms between B and A or between C and B. The only exception is where the cause of (1) is (1) itself.

- (ii) The cause is an explanation of the existence (being) of the explanandum.
 (iii) To know the cause of something is the same as to know what it is.
 (iv) Causes of the kind (i), that is, causes brought out by minimal syllogisms of the form (3) (i.e. syllogisms where no further terms can be inserted between C and B or between B and A), are *proximate* causes. In a different direction, the *ultimate* explanations are the widest premises of any one science.

These theses (i–iv) are maintained (among other locations) in *Analytica Posteriora* B 1–2, B 8, 93a4–9 etc. For instance, in *An. Post.* B 2, 90a6–8 we read:

It follows that in all these questions we are asking either 'Is there a middle term?' or 'What is the middle term?' because the middle term is the *aitia* and that is what we are trying to find in every case.

But what is the role that the peculiarities (a)–(b), (i)–(iv) play in Aristotle's thinking? Let us begin with (a). Why did Aristotle assume that explanations must have a syllogistic form? Are there systematic ('logical') reasons in Aristotle's thought for this assumption? There are no clear-cut answers to these questions in the literature.

Yet an interesting general answer is not hard to come by. It will be shown that the only assumption we have – or, rather, Aristotle has – to make is that one can acquire the relevant knowledge of the extreme terms C and A in (1) (or (3)) independently of each other. The obvious way of implementing this idea is to say that our knowledge of one of the terms can be expressed without

evoking the other. Let these bodies of knowledge be $\Gamma_1[C]$ and $\Gamma_2[A]$. An explanation of (1) will obviously in its most general form amount to showing that the explanandum (1) follows from these two bodies of knowledge. In other words, we must have

$$(4) (\Gamma_1[C] \& \Gamma_2[A]) \vdash (\forall x)(C(x) \supset A(x))$$

But if so,

$$(5) (\Gamma_1[C] \& C(x)) \vdash (\Gamma_2[A] \supset A(x))$$

By Craig's interpolation theorem, there is a (usually complex) predicate $B[x]$ such that

$$(6) (\Gamma_1[C] \& C(x)) \vdash B[x]$$

$$(7) B[x] \vdash (\Gamma_2[A] \supset A(x))$$

Moreover, $B[x]$ is independent of C and A in the sense that neither term occurs in $B[x]$. For Aristotle, this presumably means that our knowledge of $B[x]$ is independent of our knowledge of C and A .

But (6)–(7) imply logically

$$(8) \Gamma_1[C] \vdash (\forall x)(C(x) \supset B[x])$$

$$(9) \Gamma_2[A] \vdash (\forall x)(B[x] \supset A(x))$$

Hence from Aristotelian assumptions it follows that an explanation of (1) must be able to take the form of a syllogism of the form (3) with B epistemically independent of A and C .

Thus we have reached a remarkable conclusion. We have seen that the syllogistic form of Aristotelian explanations is not arbitrary, but necessitated by certain independence assumptions he makes. We will return to the rationale of these assumptions in a moment.

Furthermore, the middle term $B[x]$ is arguably what constitutes an explanation of (1), in the sense that it can be viewed as a summary of the entire explanatory argument that takes us from $\Gamma_1[C] \& \Gamma_2[A]$ to (1). (For this, see Halonen and Hintikka, forthcoming.) This explains the first feature (i) of Aristotelian explanations listed above.

Moreover, the independence assumptions we have ascribed to Aristotle are extremely natural, not to say predictable, given his general outlook. For him C and A represent simple or complex forms. These forms enjoy real independent existence for Aristotle. They are for him real entities that can be actualized in different kinds of matter, in the soul as well as outside the soul. In *An. Post.* B 19, 100a6–7, a universal (i.e. a form) instantiated in a soul is described by Aristotle as being 'one beside the many' (i.e. beside its many instantiations outside the soul), yet 'one and the same in all those things' (in which it is instantiated). They can have actual powers even when they are merely realized in one's soul. Indeed, a form is 'a principle of skill and understanding – of skill if it deals with how things come about, and understanding if it deals with what

is the case' (*An. Post.* B 19, 100a7–10). For certain twentieth-century philosophers, reasons can be causes of behavior. For Aristotle, an artisan's knowledge codified in a form present in his soul can literally be a cause of sorts of his products. For example, an instance of a shoe comes from an instance of the same form in the soul of the shoemaker (*Metaphysica* Z 7, especially 1032a25–b15, b21–24, 1034a21–33, see Furth, 1985, pp. 14–15, 20) in a way analogous to the way in which an animal comes from another member of the same species. Needless to say, it is far from clear what this Aristotelian analogy consists in, but in the context of our argument this need of explaining the generative powers of mental instantiations of forms is Aristotle's problem, not ours.

In any case, it is not surprising if this ontological independence of different forms of each other should have implied for Aristotle their epistemic independence, in the sense that different forms can be known independently of each other. They are like different people who one can be acquainted with independently of one's relations of acquaintance with others. In this sense, the explanation of the syllogistic format of Aristotelian explanations is ultimately Aristotle's conceptual realism.

This account of Aristotelian explanations rests on the idea that forms were for Aristotle real factors that can be studied in isolation from each other, at least as far as the ultimate (atomic) premises are concerned. This Aristotelian assumption encourages, and is encouraged by, the idea that the ultimate premises of scientific syllogisms are *definitions* of the terms (forms) involved. Aristotle is clearly assuming that our basic notions can be defined independently of each other.

This independence assumption is not acceptable to a modern scientist. Both in contemporary mathematical axiom systems, e.g. Hilbert's axiomatization of geometry, and in various axiomatizations of physical theories, such as Maxwell's equations or Schrödinger's equation, different primitive notions of the theory are inextricably intertwined with each other, in sharp contradiction to the Aristotelian independence idea. Maybe there can be nominal definitions of, say, the basic concepts of a theory of electricity independent of each other and independent of the concepts of magnetism. But the fundamental laws governing the two kinds of concepts and providing the ultimate premises of scientific explanations cannot be specified without referring to the others. Hence our knowledge of different concepts cannot be disentangled from each other. In fact, the interesting methodological twist exemplified by the modern (twentieth-century) idea of *implicit definition* can be taken to be directed against the Aristotelian independence assumption.

Conversely, this line of thought also throws some light on Aristotle's ideas of the nature of irreducible (minimal or atomic) premises. They are premises between whose two terms one cannot any longer insert a middle term. What must such a premise, say

(10) every B is A

be like according to Aristotle? What has been seen is that if we can separate our knowledge of B and our knowledge of A from each other, there will be a middle term. Conversely, if there is no middle term, that is, if (10) is an immediate (atomic) premise, then our knowledge of B and our knowledge of A cannot be separated from each other. By coming to know B we come *ipso facto* to know something about A. This can be considered as a rationale of Aristotle's idea that the first premises of science are definitions. This view is thus not an independent assumption of Aristotle's, but part and parcel of his general metaphysics of forms as the objects of scientific knowledge.

Here we have an explanation of the third feature (iii) of Aristotelian explanations. For in the most basic minimal syllogism (3) an explanation of its conclusion consists in knowing its middle term B[x]. But this middle term is the definition of C, and knowing it means therefore knowing what C is.

This formulation provides another clue to Aristotle's assumptions. He rejected the Frege–Russell ambiguity thesis. For him, there was in the proper use of words like *einai* no inseparable distinction between the *ises* of identity, predication and existence. We are here using the apparently anachronistic word 'rejected' advisedly. None of Aristotle's distinctions between different uses and different senses of *estin* includes the Frege–Russell distinction. What is more, we are prepared to defend Jaakko Hintikka's suggestion (Hintikka, forthcoming) that in passages like *Met.* Γ Aristotle on reflection assimilated to one another what for us would be the distinct predicative, existential and identity senses of *estin*.

While this absence of the Frege–Russell distinction from Aristotle is scarcely controversial, its consequences are not always heeded. One of them is that Aristotle in effect likewise refused to make a hard-and-fast distinction between what for us are the different senses of *what*-questions and of *knowing what*. Knowing what X is meant for him knowing what X *is like* (predicative is), in other words, knowing the essence of X in our twentieth-century sense. (This kind of essence is what a definition of X expresses.) But it also meant for him knowing *which entity* (or class of entities) X is, in other words, knowing what X is in the sense of identifying X. Both ideas are inextricably involved in Aristotle's notion of essence (τὸ τί ἔστί) And this entanglement means more than that it is impossible to identify an entity (to know which entity it is) without knowing something about it. For this 'something' that we have to know need not be anything like an essence in the sense of essential property. Being this 'something' is not what we mean by the identity of an object. (For instance, the piece of wax in Descartes' hand now may not look at all like the lump he was fingering an hour ago, and yet continuity may show that they are one and the same physical object after all.) Undoubtedly the assimilation of the predicative and the identificatory senses of *estin* to each other by Aristotle made it easy for him to gloss over this point. Because of this assimilation, he could speak as if identification (*being what* in the sense of being this or that entity), which is his primary business, could be taken care of by 'essential' predications (*being what* in the sense of being like this or that).

This inextricability of the two senses of *knowing what* is relied on by Aristotle when he thinks of the definitions of different terms used in science as being potentially obvious. It is not so much that Aristotle thinks of the deeper natures of things as being open to the naked eye – or the naked intuition. It is rather that he assumes that reasonable men know what they are talking about in the sense of knowing what the subject matter of their discourse is, in other words, which entities they are referring to.

These observations put into an interesting perspective Aristotle's notion of definition (cf., for this, *An. Post.* B 7–10). Definitions included for him much more than nominal definitions ('explanations of the meaning of a name', *An. Post.* B 10, 93b29–31). Definitions were the first premises of a science for Aristotle (*An. Post.* B 8, 96b21–23). They were the atomic premises of scientific syllogisms, as was seen above.

This helps us to appreciate what Aristotle was doing in his own scientific treatises, such as the *Physics*. They look quite unlike modern scientific treatises and they do not seem to conform to his own picture of a syllogistically organized system. A large part of Aristotle's scientific and ethical works consists of a search of the key notions of the relevant sciences, while few syllogistic conclusions are drawn in them. An answer to this apparent contradiction is that the search for definitions was not for Aristotle a preliminary ground-clearing operation preceding the actual development of the science in question. The search of definitions is an integral part of doing science, for it is nothing but a search for the first premises of that science, that is, for one of the basic building-blocks of the science in question.

This role of definitions as substantial assumptions is foreign to the modern conception of an axiomatic science. It was not a peculiarity of Aristotle's, however. It has been noted by earlier scholars (see, e.g., Mueller, 1981, p. 38) that in Euclid definitions play an essential role in his proofs. Mueller notwithstanding, this role is scarcely explainable merely in terms of 'Euclid's respect for tradition'. It is very much in keeping with the Aristotelian picture of the role of definitions in a science.

What we have found here throws some light on the notion of explanation more generally. More specifically, we obtain here a perspective on the idea of covering law and covering law explanation. For on the face of things Aristotelian explanations are paradigmatic examples of covering law (subsumption) explanations. Indeed, Aristotle sometimes formulates his barbara-type syllogisms in a form which is precisely what the form of a covering law explanation is supposed to be; for example:

- (11) Every bileless animal is long-lived
 Mules are bileless animals
 ergo: Mules are long-lived

What makes the difference here is the contrast between particular cases and subordinate generalizations. It is not unnatural that we can obtain information

about a particular case independently of the general concepts figuring in the background theory which is the basis of the explanation. In contrast, as was pointed out, it is not possible in general to obtain information about general concepts figuring in a theory independently of each other.

Thus the nature and the shortcomings of Aristotelian explanations throw some interesting light on the limitations of covering-law explanations.

But why should Aristotle believe that all the different kinds of cause (*aitia*) are 'exhibited through the middle term' (*An. Post.* B 11. 94b26–27)? It is not surprising that a philosopher should relate the notions of cause and explanation. In another paper, working in a systematic twentieth-century context, we will argue that when an explanation is a causal explanation, the (proximate) cause is specified by the last contextual premise that is needed to derive the explanandum from a background theory, plus a number of additional *ad hoc* premises. The brunt of the onus of explanation is not a deductive derivation of the explanandum from the background theory alone, but a search for additional *ad hoc* premises together with which the explanandum can be derived from the background theory. When these premises specify states of affairs that can come about through a natural process or can be brought about by intentional action, the proximate cause of the explanandum is specified by the last extra premise. This is what ties the notions of explanation and cause to each other – when they are connected with each other.

What does all this have to do with Aristotle? The point is that it does not have anything to do with him. Aristotelian general syllogistic premises figuring in syllogistic explanation are conditionals which cannot by any stretch of the imagination always be interpreted as specifying states of affairs that any agent could bring about. If they satisfy the conditions of primary premises of Aristotelian explanations, they are eternal and immutable connections between forms which hence cannot come about through a natural process either. Hence, Aristotle's reasons for assimilating to each other the notions of cause and explanation must be radically different from ours. What are they?

An answer is obtained by putting together Aristotle's principle (ii) with his way of dealing with existence in a syllogistic context. This way is explained by Aristotle in *Analytica Posteriora* B 1–2 and by Jaakko Hintikka in a number of recent and forthcoming publications, most explicitly in Hintikka (1999). It turns on the role of existential presuppositions in syllogistic reasoning. However, by existential presuppositions in Aristotle we do not mean merely assumptions of non-emptiness but assumptions to the effect that all the entities to which a term can be applied do exist. Aristotle's explanations in *An. Post.* B 1–2 show that according to him these existential assumptions trickle from the top down in a sequence of syllogisms like (3). In other words, we could have, instead of (3), something like the following:

- (12) every B is (an existing) A
 every C is B
 ergo: every C is (an existing) A

Here existential assumptions have to be made about A but not about B. The effect of (12) is that these existential assumptions are moved down one step lower so as to hold of C, too. Moreover, it is the middle term B that conveys the gift of existence from A to C.

Such a stepwise flow of existential assumptions downwards in a chain of scientific syllogisms is one of the central ideas of Aristotle's theory of science. Its fundamental role is to some extent hidden by the fact that Aristotle never puts forward purely existential syllogisms, that is, syllogisms like (12) from which the term A is missing, even though he seems in *An. Post.* B 1–2 to briefly envisage such syllogisms. The explanation of this absence lies in the fact that in such syllogisms existence (being) would operate as a major term. This is impossible according to Aristotle because 'being is not the *ousia* of anything, for *what is* is not a genus' (*An. Post.* B 7, 92b13–15). However, this does not prevent existence being part of the content of the major term.

In any case, explanatory syllogisms like (12) provide more than a reason why something is the case. It shows why something *exists*. And if this reason for that something's existence is not its cause, it is hard to imagine what that cause could be. Of course, this is precisely what the Aristotelian principle (ii) says. Thus it is the character of Aristotelian explanations, as providing an account of the conditions of the existence of the entities to which syllogistic terms refer, that links them to causes.

Moreover, the middle term of the atomic syllogism which is closest in the chain of explanatory syllogisms to a conclusion provides the most direct account of why the minor term exists, and hence is for Aristotle the proximate cause of C's existence (cf. (i) above).

This treatment of existence in syllogistic contexts is radically different not only from modern logic, but also from what twentieth-century philosophers are wont to call 'Aristotelian logic'. It is made possible by Aristotle's rejection of the Frege–Russell claim that verbs like *is* or *est* are ambiguous between existence, predication, identity, subsumption and the veridical uses of these verbs, and to some extent also by Aristotle's practice of considering logical matters in a dialectical context.

Aristotle's treatment of existence also explains why the notion of ultimate cause was much more natural for him than it is for us moderns. There does not seem to be any reason why causal chains should lead us to a definite set of starting-points when traced backwards. It is most dubious whether the postulated 'big bang' can be considered a *cause* of anything. However, for Aristotle, the flow of existential assumptions downwards in a chain of syllogisms must start from some definite existential assumption, otherwise no syllogistic explanations are possible.

Thus the best that any one science can provide in the direction of ultimate causes are the premises that assert the existence of the generic term that defines the science in question. These terms will each lie within some one category. This explains why Aristotle had to overcome the division of beings into categories before he could claim that there can be truly universal explanations.

(This is his agenda in *Met. Γ*.) For instance, in order to trace all these separate yet apparently ultimate causes to one source, Aristotle must somehow overcome the division of beings into different categories in order to find a single ultimate cause for everything.

These observations can be pushed further. The similarity between Aristotelian syllogistic explanations and Hempelian covering law explanations implies that some of the so-called counter-examples against the latter seem to apply also against the former. For instance, not all syllogisms of the form (3) provide an explanation even when B transports existence from A to C, i.e. when (3) is in effect of the form (10). Aristotle's own example of such a non-explanatory syllogism (*An. Post.* B 8, 93a37b4) has C = moon, A = eclipse, B = inability to produce shadows even though there is nothing evident between us. In other words, the syllogism goes as follows:

(13) Whenever the moon does not cast a shadow, it is eclipsed.

Whenever the moon is in such-and-such a state, it does not cast a shadow.

ergo: Whenever the moon is in such-and-such a state, it is eclipsed.

Clearly this syllogism does not provide an explanation of an eclipse. Equally clearly, it can be considered (assuming that it can be made scientifically respectable) a *prima facie* counter-example to the covering law accounts of explanation. (For a discussion of the resulting interpretational problem, see Goldin, 1996.)

In a well known article Brody (1972) notes the same overlap of Hempel's problems with Aristotle's. Moreover, he claims that Aristotle has a solution to these problems, a solution that can be extended to our contemporary problems with explaining explanation. The solution (or, rather, a part of the solution) consists according to Brody in requiring that the 'Explanans contains essentially a description of the event which is the cause of the event described by the explanandum' (Brody, 1972, p. 23). This is supposed to distinguish the moon-light syllogism (13) from a truly explanatory syllogism in which B is now 'screening by the earth':

(14) Whenever the moon is screened by the earth, it is eclipsed.

The moon is screened by the earth.

ergo: The moon is eclipsed.

Here the middle term gives the cause of the eclipse. Brody sees the difference between the two cases in the alleged fact that in (14) the middle term is an essential attribute, but in (13) it is not. Whatever terminology we want to use, however, this does not get us to grips with Aristotle's views. According to Aristotle, the trouble with (13) is that it is not immediate. Even though it is not immediate (atomic), it can serve to prove the fact expressed by the conclu-

sion and even the existence of the minor term. But as long as the syllogism in question is not immediate, it does not reveal to us the cause (or the explanation). This cause is revealed only by the middle term of an immediate syllogism, for only such a term serves to convey existence all the way down to the minor term (cf. above.)

It is true that this middle term of an immediate syllogism also serves to provide the definition of the major. For instance, screening by the earth is what an eclipse *is*. But we must appreciate what the function of such a definition is for Aristotle. Brody is assuming that to give the essential property of something is an account of 'what makes it tick', in other words, that 'what a thing is' (*to ti esti*) means its real nature. It was seen earlier, however, that for Aristotle 'what a thing is' also, and perhaps predominantly, means 'which entity a thing is'. What is asked for in a 'What is it?' question is in other words a means of identification, not of description or explanation, of the thing in question. This agrees with the fact that the middle term of an immediate syllogism provides *ipso facto* the closest delineation possible of where the objects to which the minor term applies are located on the map of all beings.

All told, Brody's attempt to repair Hempel's account of explanation by means of the Aristotelian notion of essence is thus unsatisfactory both historically and systematically, as soon as we realize Aristotle's reliance on the inseparability of the predicative and identificatory senses of *estin* and of knowing what. Without inseparability there is no obvious guarantee that the closest middle term is the best suited for the purpose of explaining the properties or behavior of the entities to which the minor term or the major term applies. It is perhaps not entirely inappropriate even to recall here the interesting recent view according to which good explanations are characterized by a deductive depth. (See, e.g., Chomsky, 1982.) If that view is correct, Aristotelian immediate syllogisms provide the worst possible explanations.

In fact, it is anachronistic to identify Aristotle's problem with Hempel's. Aristotle's difficulty is due to his strong belief that the object of genuine knowledge must exist, in other words, that we cannot truly be said to know anything about A unless we know that A exists. When A is a general term we have to understand existence in the sense explained above.

The *aporia* here is that according to Aristotle's own theory of science we do not have to assume that existence in the case of the terms involved in the atomic premises. (See *An. Post.* A 10, 76b15–16.) Hence we presumably cannot know them. But then it becomes questionable whether they can really function as the first premises of a science.

Aristotle's answer lies in pointing out that existence can be proved for the terms of atomic premises by other syllogisms of the form (13), even when the syllogisms by means of which we prove this existence are not atomic (immediate) and hence do not provide an explanation of the conclusion. By providing existence to the terms of atomic syllogisms these non-explanatory syllogisms restore atomic premises to the status of genuinely known first principles.

Aristotle himself formulates his point as follows, complete with an example:

When we discover it, we know at the same time the fact and the reason why – if we proceed through immediate terms (*di ameson*). Otherwise we know the fact but not the reason why: moon C, eclipse A, not being able to produce a shadow during full moon although nothing visible is between us and it B. If B ... holds of C and A ... holds of B, then it is plain *that* it is eclipsed but not yet *why*; and we know that there is an eclipse but we do not know *what* it is. (*An. Post.* B 8, 93a35–b3)

We have followed Barnes' translation except for one thing. The issues involved here have been muddled by a contradiction between different textual traditions. We have followed the one which makes the best overall sense of Aristotle's words. Barnes follows another tradition, however, that reads at a37 *dia meson* instead of *di ameson*. We do not see that this yields a satisfactory sense of the quoted passage in its context, and hence follow Ross (1949, p. 628) (and, as it happens, Barnes' own translation in his first edition) in understanding the passage.

The reason why we do not, according to Aristotle, know the 'why' is that we do not know the 'what', and the reason why we do not know the 'what' is obviously that we do not know the existence. Aristotle speaks of knowing the 'that' rather than knowing the existence, but these two are completely parallel for him.

Thus it is eminently clear that Aristotle's concerns are quite different from those Brody claims. Aristotelian premises are explanatory not because they are essential, nor yet because they are existential, but because they are immediate.

What we have found also throws some light on Aristotle's doctrine of four causes. As everyone knows, these are effective, material, formal and final. If we identify causes with (certain components of) explanations, i.e. answers to *why* questions, there is a certain *prima facie* naturalness about this four-fold distinction. If I ask why something happened, the answer might be a specification of what set a chain of events in motion, or of what an object is made of, what species it belongs to or what purpose it serves. It is to be noted, however, that we also have parallel answers to a question concerning *what* an object is. We can identify *what it is* by its origin, by its matter, by its form or by its purpose. This is in keeping with Aristotle's view that the middle term of an immediate scientific syllogism specifies at the same time the cause and the definition.

This pertains to proximate causes only, however. When it comes to ultimate (first) causes, we have seen that they are for Aristotle the most general explanatory terms of a science. Such terms cannot very well specify an efficient cause. For instance, not all animals are generated by the same parents. Nor can they specify matter, for not all the objects falling under one and the same science are made of the same matter. Nor yet can such a term specify some particular form (species) as distinguished from others. Hence the only remaining possibility is that the ultimate causes are the final ones. Thus the Aristotelian primacy of final causes is not unrelated to what we have found in this paper.

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CHAPTER 9
ARISTOTLE'S INCONTINENT LOGICIAN

Dedicated to the Memory of Unto Remes

1. IS ARISTOTELIAN SYLLOGISTIC A SCIENCE?

This paper is about Aristotle's *system* of logic, known as *syllogistic*, and about its psychological background. The ingredients of this system, the fourteen so-called syllogistic moods, are well known, and will not be explained here. I shall not explain their scholastic tags (*barbara*, *celarent*, etc.), either.

Now Aristotle would not have been Aristotle if he had been content with merely listing these fourteen valid moods, no matter how impressive the intellectual effort was that was needed to abstract them from the wealth of valid verbal arguments. Nor did he find it enough merely to classify the valid syllogistic moods in the three well-known 'figures'. Aristotle sought to develop a real theory, a science (*episteme*) of syllogistic. What I want to do here is to examine how he did this.

But is this a fair way of putting the question? It might seem that syllogistic – and logic in general – must have been for Aristotle a tool, an *organon*, of all science, but not itself a science. (This problem is connected with the question as to whether syllogisms are inference rules or conditional propositions.) This is in fact how the later Aristotelian tradition mostly looked upon the nature of logic. However, it seems to me that we should not underestimate the reasons Aristotle had for thinking of syllogistic, too, as a science. Among these reasons, there is the absence of any distinction between conceptual (logical) truths and empirical truths in Aristotle; the idea of assimilating the study of the fundamentals of logic to metaphysics (to be noted below); and his general systematizing and axiomatizing urge. And even if syllogistic were not actually thought of by Aristotle as a science, his problems in this department can profitably be discussed by comparing syllogistic to the typical structure of an Aristotelian science.

Now according to Aristotle a science consists of two main elements, the first principles of that science and the truths derived from them. Can we locate these ingredients in Aristotle's syllogistic?

At first sight, they can be recognized very easily. The valid moods correspond to derived truths, and Aristotle seeks to reduce all of them to the first two moods of the first figure, the moods *barbara* and *celarent*, which therefore seem to correspond to the basic truths. This certainly seems to match very well the structure of an Aristotelian science.

However, there are several serious problems here – problems more for

Aristotle than for his commentators, I should think. Aristotle does not appear to have either of the two main problems he is facing here under control. They are the nature of the 'first principles' of the alleged science of syllogistic and the way the other moods are reduced to these basic ones.

Let's consider them in the opposite order. Aristotle employs three methods in showing the validity of the nonbasic syllogistic moods. They are

- (i) conversion.
- (ii) *reductio ad absurdum*.
- (iii) *ekthesis*.

(i) Conversion means a one-step transformation of a syllogistic premise into another which is logically implied by it. Cases in point are the conversion of 'A belongs to no B' to 'B belongs to no A' and 'A belongs to all B' to 'A belongs to some B', the latter conversion of course relying on the existential presuppositions of universal premises according to Aristotle.

(ii) The *reductio* is simply one form of indirect proof of a conclusion, viz, by showing that an attempt to deny it leads into a contradiction with the premises.

(iii) *Ekthesis* seems to operate like the rules of instantiation in modern logic. It consist in choosing a particular individual to represent a general term (a class of individuals) or, on another interpretation, in choosing a subclass of the given class for special consideration. We shall discuss it at length later. It can already be seen, however, why this procedure, when interpreted as instantiation, is so interesting to us. Unlike all the other principles explicitly used in Aristotle's syllogistic, instantiation gives us a way of treating parts of logic which go beyond the traditional syllogistic theory as well as beyond propositional logic. Instantiation can in fact serve as the mainstay of a systematic theory of first-order logic. It is the one place where Aristotle almost comes to grips with some of the most general and most important problems in modern logic and in the modern philosophy of logic.

What's wrong with these as methods of deriving other truths from basic ones? Almost everything, I am tempted to say. First, the *reductio ad absurdum* and the *ekthesis* are apparently not methods of reducing a syllogism (syllogistic mood) to others, but methods of showing its validity directly. This already seems to spoil the idea of reduction of all syllogisms to the basic ones and hence the idea of a science of syllogistic.

Secondly, according to Aristotle the derived truths of any one science are obtained from the basic ones by syllogistic inferences. But to try to derive syllogisms from other syllogisms syllogistically is absurd. In fact, the principles Aristotle uses to relate his basic and non-basic moods are not themselves syllogistic in nature, as we just saw.

Accordingly, Aristotle does not call his basic syllogistic moods premises, but rather calls them *perfect* and the other moods *imperfect*. Nor does he usually speak of proving or deducing the imperfect moods from the perfect ones, but rather of 'perfecting' or 'completing' them. Even though Aristotle occasionally refers to an argument by means of which some syllogistic mood is reduced to

others as a proof or *apodeixis*, his terminology is a far cry from what we would expect of a 'normal' Aristotelian science.

Furthermore, there is no realistic hope of interpreting Aristotle's reduction methods as being in the last analysis syllogistic after all. In the modern terminology, some of these reduction methods involved propositional inferences which are more basic than the laws of Aristotelian syllogistic.

Further problems arise when we ask what the status of a 'science' of syllogistic might have been in Aristotle's hierarchy of sciences. Aristotle envisaged a highest master science of metaphysics or, to use his own term, 'first philosophy'. In *Metaphysics* Γ, 3, 1005b5–8 Aristotle says that the study of 'the principles of syllogisms' belongs to this metaphysics. However, neither the structure of this master science of metaphysics nor the status of 'the principles of syllogisms' within it is made clear by Aristotle. The only principles he discusses in this connection are those of contradiction and excluded middle. The methods he actually uses in building up his syllogistic theory (see (i)–(iii) above) are not as much as mentioned.

Thus one of the sources of difficulty in Aristotle's 'science' of logic may have been his indecision as to what the science of metaphysics is like. However, this is only one of the many difficulties in trying to interpret Aristotle's syllogistic theory as a science in his own sense. We have already registered several difficulties connected with the passage from perfect to imperfect syllogisms. There are even deeper problems connected with Aristotle's notion of a perfect (*teleios*) syllogism. They will show conclusively that Aristotle's syllogistic just cannot be interpreted as a science in his own sense, however clearly he might have liked to do so. At the same time, these difficulties bring to light several interesting features of the doctrinal background of Aristotle's logical theory.

2. PERFECT VS. IMPERFECT SYLLOGISMS

What makes some syllogistic moods perfect? It is not just the fact that other moods can somehow be reduced to them. Aristotle even seems to have been aware of the possibility of carrying out a reduction in the other direction, too.

Aristotle's own explanation of what a syllogism is and what it means for one to be perfect goes as follows:

'A syllogism is a form of words (*logos*) in which, certain things being given, something else follows necessarily from their being so. ... I call that a perfect syllogism which needs nothing other than what is comprised in it to make obvious what necessarily follows. A syllogism is imperfect if it needs one or more things, which are indeed necessary consequences of the terms set down, but not comprised in the premises' (*An. Pr.* A, 1, 24b18–26).

This passage shows several things. First, the imperfect syllogisms carry the same necessity as the perfect ones. They are no less valid than perfect syllogisms.

Secondly, the difference between perfect and imperfect syllogisms lies in the fact that in the imperfect ones something which has not been explicitly stated in the premises is needed to ‘make plain what necessarily follows’. In other words, the difference lies in the way in which different syllogisms are seen to be valid, not in their necessity or validity itself.

Unfortunately, Aristotle never makes clear what the things are that are ‘necessary consequences of the terms set down, but are not comprised in the premises’. We can find clues to Aristotle’s intention, however. As was already mentioned, the perfect assertoric syllogisms are in the first place the first two moods of the first figure, to the moods *barbara* and *celarent*. This is explained by Aristotle as follows: ‘Whenever three terms are so related to one another that the last is contained in the middle as in a whole, and the middle is either contained in, or excluded from, the first as in or from a whole, the extremes must be related by a perfect syllogism’ (*An. Pr. A*, 4, 25b32–35). Why? The answer must lie in Aristotle’s definition of the major premise of such syllogisms, which amounts to an explanation of what it means for a term to be contained in another as a whole.¹ It ‘is the same as for the other to be predicated of all of the first. And we say that a term is predicated of all of another *whenever no instance can be found of which the other term cannot be asserted*: “to be predicated of none” must be understood in the same way’ (*An. Pr. A*, 1, 24b27–30, my italics). Putting the different explanations together, what Aristotle is getting at can thus be seen to be the following: A syllogism of the *barbara* type, i.e., of the form

A belongs to all *B*

B belongs to all *C*

A belongs to all *C*,

is perfect because it is obvious that no instance of *C* can be found to which *A* does not apply. For if we choose any instance of *C*, *A* cannot fail to belong to this instance because *B* must belong to it in virtue of the second premise and hence *A* is virtue of the first one.

The crucial step here (which Aristotle indicates but does not spell out) is to consider an arbitrary instance of a general term instead of this term itself. The modern counterpart to this step is known as the rule or, rather, rules of instantiation. There are two of them: existential instantiation and universal instantiation. They form the backbone of some of the most important and perspicuous methods of proof and disproof in modern logic, for instance of what are known as Herbrand methods and as the method of model set construction. There is no need to describe them in detail here, for the main points we shall make are obvious enough on a non-technical level.

Thus we have reached a tentative characterization of perfect syllogisms according to Aristotle. They are the ones which can be established by a single step of instantiation.

The same tentative conclusion can be argued for in other ways, too. In an

instantiation, only such kinds of individuals can be instantiated or 'set out' as are asserted to exist in the premises. (We must of course keep in mind that for Aristotle universal statements make existential claims, too.) They may perhaps be understood to be the things 'comprised in the premises' which are mentioned in Aristotle's definition of a perfect syllogism. If so, a syllogism is certainly perfect if it can be shown to be valid by one step of instantiation with respect to such kinds of individuals, just as was suggested.

I believe that this comes close to Aristotle's intentions, or at least one type of intention of his. Admittedly, it is not what he says in so many words when making the distinction. However, when he set out to explain fully the nature of the syllogistic premises which make some syllogisms perfect, he characteristically resorted to considering certain arbitrarily chosen individual instances of whatever terms we are dealing with. The quotations given above illustrate this. Further cases in point are found elsewhere. For instance, the meaning of Aristotle's crucial locution 'A is said of all of which B is said' is explained by him as 'A is said of all the things of which B is said' (*An. Pr. A*, 41, 49b27–30).

But if this is so and if perfect syllogisms should have been for Aristotle those that can be established by one step of instantiation, it is seen that Aristotle's classification perfect-imperfect, which is the cornerstone of his syllogistic system, is itself without a satisfactory foundation. For it may be shown that *any* valid syllogism can likewise be established through one single step of instantiation. Take, say, *darapti*:

P belongs to all S

R belongs to all S

P belongs to some R .

All we have to do here is to consider any instance of S , say N . Both R and P belong to it, whence P belongs to some R , viz. N .

Little ingenuity is needed to 'prove' all the other moods in the same way by straightforward instantiation. This is not surprising, for all syllogistic moods can be proved in modern logic by using only one instantiating term. Informally, this means that they can all be seen to be correct by considering just one instance of one of the terms (or combinations of terms) mentioned in the premises.

In the sense explained, we thus do not have to go beyond the terms given in the premises in order to establish the validity of any valid syllogistic mood. In other words, all syllogisms apparently ought to have been perfect for Aristotle.

Of course, this is not what Aristotle himself said. However, what we have found suffices to cast grave doubts on the theoretical importance of Aristotle's own way of making the distinction between perfect and imperfect syllogisms and hence on his way of building his syllogistic in general.

3. SYLLOGISTIC NECESSITY AND ARISTOTELIAN PSYCHOLOGY

What has been said can be supported further – and put into a wider perspective – by considering what Aristotle says of the psychology of thinking. The main point there is that when the soul thinks of some thing, say X, it takes over the form of X and thus in a sense (*viz.* formally) *becomes* X. Thinking ‘when actually operative is identical with its object’ (*De Anima* III, 7, 431a1). There are plenty of indications that Aristotle took this kind of realization of a form very seriously. It was for him quite as good a realization of the form as one that takes place outside the soul.

Hence whatever necessarily attaches to the form is automatically present in one’s mind when one actively thinks of this form. This is the psychological basis of syllogistic necessity *apud* Aristotle. A famous passage in the *Nicomachean Ethics* illustrates this nicely. There Aristotle is comparing the psychology of decision-making (the so-called ‘practical syllogism’) with that of drawing a conclusion syllogistically. He says that when the two premises are combined so as to yield a single opinion ‘the soul must in one type of case [*viz.* theoretical syllogism] affirm the conclusion, while in the case of opinions concerned with production it must immediately act’ (*Nic. Eth.* VII, 3, 1 147a26–28). It is well known that on the practical side this view of Aristotle’s plunges him directly into the so-called problem of incontinence or *akrasia*. If a man knows what he ought to do and also how to do it, he is in the possession of all the premises of a practical syllogism that according to Aristotle should necessitate the right action. How come, then, that people in fact often act against their better judgement? I shall not discuss this notorious mess of a problem here. It has to be pointed out, however, what commentators generally have failed to mention, *viz.* that Aristotle was in reality in just as deep trouble on the theoretical side as on the practical one. An incontinent logician is quite as much an Aristotelian counterexample as an incontinent agent. In fact, the problem of telling perfect syllogisms from imperfect ones is the precise theoretical counterpart to the ethical problem of *akrasia*. For Aristotle’s description of the psychology of theoretical syllogism apparently implies that one cannot help drawing its conclusion as soon as one realizes its premises in one’s mind. For what necessarily accompanies the forms (premises) realized in the soul, however tentatively and experimentally, must also be present in the soul, that is, must also be thought of by the soul. This may be considered a partial psychological counterpart to my argument above to the effect that Aristotle never distinguished satisfactorily between perfect and imperfect syllogisms.

Furthermore, independently of how we evaluate Aristotle’s treatment of *akrasia*, it yields precious little that would help us to appreciate the possibility of a logical *akrates* within the Aristotelian framework. Aristotle’s conceptual realism or ‘sample theory of thinking’ (as we may perhaps call it) sketched above is one of the reasons why this problem is so acute to him, although he never faced it squarely.

Aristotelian psychology offers further aid and comfort to the line of thought

presented here. When a man thinks of a form, what is present in his soul is of course not an abstract universal, but a particular instance of it. (Amusingly, Aristotle even acknowledges the possibility that the form in the mind may be only a scale model of the real thing, so to speak, that is, that a spatial form need not be realized in the soul in the same size as the original.) Hence the Aristotelian idea that all thinking involves particular instances of the general concepts involved. This theory is expounded by Aristotle in *De Anima* III, 7 (among other places), but perhaps the most instructive occurrence is found in *De Memoria*, 449b29–450a7. There Aristotle compares in so many words the inevitable use of images in all thinking with the use of particular figures in geometrical proofs:

‘It is impossible ever to think without a mental picture. The same affection is involved in thinking as in drawing a diagram; for in this case we make no use of the fact that the magnitude of the triangle is a definite quantity, yet we draw it as having a definite magnitude. In the same way the man who is thinking, though he may not be thinking of a definite magnitude, still puts a definite magnitude before his eyes, although he does not think of it as such.’

It is clear from the context that Aristotle’s statement has nothing to do with magnitudes or geometry in particular, but is calculated to illustrate a general point about all thinking – the point Aristotle puts in *De Anima* III, 7, 43 1b2 ff. by saying that reasoning takes place means of ‘images or thoughts in the soul, as if seeing’. Thus the only essential difference between the use of figures in geometrical arguments and the inevitable use of images in all thinking is that in general we do not have to resort to sense-perception: ‘In thinking, images take the place of sense-perceptions.’

All this lends strong support to my account of how Aristotle ought to have viewed the perfection of such syllogistic moods as *barbara*. This mood is a perfect one because in thinking of the two premises

A belongs to all *B*

and

B belongs to all *C*

one must inevitably put before one’s mind’s eye a particular instance of the forms involved, say of an instance *c* of *C*. But one cannot think of it except as having *A* whenever one actively thinks of the two premises of the syllogism in question. Hence the perfection of this syllogism, precisely as I argued.

If I did not consider Aristotle’s views on the psychology of thought I would be open to the objection that a step of instantiation cannot be one of the things ‘comprised in the premises’ and that the use of instantiation therefore makes a syllogism imperfect. The answer is that an act of instantiation is indeed involved in the premises, but only because it is inevitably involved in all thinking.

4. THE TWO FACES OF *EKTHESIS*

This line of thought can be supported further by another kind of argument. It was already noted that Aristotle himself employed a concept which on a suitable interpretation is essentially tantamount to the process of instantiation. It was one of the three ways he had for validating imperfect syllogisms. It was called by him *ekthesis*. When it was said above that Aristotle could have established each of his valid syllogisms, ‘imperfect’ as well ‘perfect’ ones, by one step of instantiation, it could have been said equally well that he could have shown the validity of all the fourteen moods by a single step of *ekthesis* in each case.²

But can we really identify *ekthesis* with instantiation? Let us consider some examples. The proof of *darapti* above offers an example of *ekthesis* in that the step from *S* to *N* amounts to instantiation. This example is in fact taken virtually intact from Aristotle (form *An. Pr. A*, 6, 28a23–25). Another case in point is offered by Aristotle’s argument for one of his rules of conversion, viz, the one which takes us from

A belongs to no *B*

to

B belongs to no *A*.

Aristotle’s argument for this conversion is as follows:

‘For if *B* belongs to some *A*, say *C*, it will not be true that *A* belongs to no *B*; for *C* is one of the *B*’s’ (*An. Pr. A*, 2, 25a15–17).

Again, what we have here is apparently an instantiation of a term.

The interpretation of *ekthesis* is not quite unambiguous, however. Gunther Patzig (among others) has argued that the appropriate interpretation of the Aristotelian *ekthesis* should not assimilate it with instantiation but should construe it as a purely class-theoretical principle.³ Since I am going to argue that Aristotle never reached a clear theoretical understanding of the nature of *ekthesis*, it is no concession on my part to say that Aristotle’s use of *ekthesis* in his logic probably admits of several interpretations, and that the textual evidence may be insufficient to decide between them.

However, part of Patzig’s evidence is in any case mistaken. For instance, his references to *An. Pr. A*, 28 are irrelevant here, because Aristotle does not there deal at all with the principles of his syllogistic any longer, but rather with the question as to how the different syllogistic moods (which are by this time assumed to have been established and therefore unproblematic) can be used to prove different sorts of conclusions.

What is especially remarkable here is that the very same notion of *ekthesis* had interesting parallel uses outside logic in geometry. It has in fact been argued that the logical use of the term was derived from the geometrical one.

Now, in geometry *ekthesis* means the step from a general statement to the consideration of an arbitrarily chosen particular instance of it. It is one of the standard parts of an Euclidean proposition. For instance, after having made an enunciation about *every* triangle, Euclid typically goes on as follows: 'Let ABC be a triangle. I say, in the triangle ABC ...' – applying, that is to say, the content of the enunciation to a particular instance (as it seems). Furthermore, a figure is normally assumed to be drawn in connection with the Euclidean *ekthesis*.

One especially interesting fact here is that the geometrical *ekthesis* unmistakably amounts to precisely the same thing as *ekthesis* of Aristotelian syllogistic on our tentative interpretation, viz, to instantiation. A geometer does not select a subclass of geometrical objects for special attention; he is considering a particular line, point, or circle. (Hence it is a serious flaw of Patzig's interpretation that it severs all real connection between the logical and the geometrical *ekthesis*.) The prominent role of *ekthesis* in the geometrical proofs of ancient mathematicians may indeed be considered as an acknowledgement of the importance of instantiation for the kind of logic that is needed in elementary geometry – which is mainly first-order logic (quantification theory).

Instantiation has another major inroad into Euclidean geometry. It is the part of an Euclidean proposition which follows *ekthesis*. This part is sometimes known as the *auxiliary construction* or *preparation*. (The Greek term was *kataskeue*.) In it, certain new geometrical objects were 'constructed', that is, added to the figure which was introduced during the *ekthesis* part. Their existence was guaranteed by those existential assumptions known as postulates. Logically speaking, *kataskeue* again amounts to instantiation. If a postulate is written out explicitly, it says that geometrical objects of a certain kind exist. In the 'auxiliary construction' an arbitrary representative of such objects is chosen for attention and depicted in the figure or 'set out' before our mind's eye.

Logically speaking, *kataskeue* is the main non-trivial type of step in the proofs of elementary geometry. Its role was noted and strongly emphasized in Greek mathematics, so much so that geometrical proofs were often called 'constructions'. It was equally strongly emphasized by Aristotle in his remarks on geometrical reasoning. In *Met.* Θ, 9, 1051a22–23 he writes:

'It is by an activity also that geometrical constructions [meaning: proofs] are discovered, for we find them by dividing. *If the figures had already been divided, constructions [proofs] would have been obvious*, but as it is they are present only potentially' (my italics).

Aristotle thus goes so far as to claim that in some important sense *kataskeue* (plus of course the *ekthesis* which precedes it and is presupposed in it) is *all* that is not obvious in geometrical proofs.

I can now put my criticism of Aristotle's syllogistic theory in a nutshell by saying that Aristotle ought to have treated syllogistic arguments in the same way as geometrical ones. If the latter ones are obvious as soon as *ekthesis* and

kataskewe have been performed, the former should have been even more obvious without any special process of ‘perfecting’ them, for in them *ekthesis* alone suffices to establish them: not even *kataskewe* is needed.

Alternatively, if Aristotle had wanted to put the shoe on the other foot, he might have said that geometrical proofs are not any more obvious on the basis on *ekthesis* and *kataskewe* alone than the imperfect syllogistic moods are. I shall later suggest that in the latter case it is not strictly true that *ekthesis* alone suffices to establish them. Certain steps that are essentially propositional are needed to supplement it. But similar propositional steps are equally indispensable in that geometrical proof proper, *apodeixis*, which typically is the next part of an Euclidean proposition after *kataskewe*.

From a modern point of view we might say that both in geometry and in syllogistic logic the crucial step is instantiation, represented in the latter by *ekthesis* and in the former by *kataskewe* as well as by *ekthesis*. However, over and above instantiation certain propositional steps are needed in both cases. (In the geometrical case, reasoning that turns on the notion of identity may also be needed, but this is a minor point.)

From what has been said it follows that my criticism of Aristotle, though unacceptable to him, is nevertheless not anachronistic. With some exaggeration, it may be said that all Aristotle would have needed is an insight into the identity (for logical purposes) of the two senses of *ekthesis* we have discussed, the logical and the geometrical.

Ironically, Aristotle probably was aware of the kinship of the two senses of *ekthesis*. This is suggested by *An. Pr.* A, 41, 49b32–50a3, assuming that the *ekthesis* in issue there is the logical *ekthesis* we have discussed, and not any of the several other senses of the word in Aristotle.

5. ARISTOTLE SUSPICIOUS OF *EKTHESIS*

This same passage nevertheless shows at the same time some of the many reasons why Aristotle was not entirely happy with *ekthesis* in his syllogistic theory. He writes there:

‘We ... use the process of setting out terms like perception by sense, not as though it were impossible to demonstrate without these illustrative terms, as it to demonstrate without the premises of the syllogism.’

In other words, Aristotle thinks of the geometrical *ekthesis* as a merely illustrative device, not an essential part of the proof. Though this sort of emphasis may have some value as a defense of the logical validity of geometrical proofs, it shows that Aristotle’s grasp of the role of instantiation in geometrical proofs is less than complete, in spite of his insight into the role of constructions. If so, small wonder if he was suspicious of *ekthesis* in logic.

Of course Aristotle’s interpretation of the geometrical *ekthesis* as a merely

illustrative device does not square very well with his idea that a kind of instantiation is necessarily involved in all thinking. So much the worse for the consistency of Aristotle's thinking, however. This inconsistency is dramatically illustrated by the geometrical analogue we saw Aristotle employing (in *De Memoria*) for the purpose of illustrating the inevitable use of images in all thinking. As we can now see, the 'drawing of a diagram' Aristotle there mentions is simply *ekthesis*, and his point is therefore that all thinking inevitably involves *ekthesis*-like instantiation. So much more striking is therefore Aristotle's reluctance to use *ekthesis* in his logical system, and his denial of its indispensability in geometry.

We can nevertheless see how Aristotle's suspicions about the use of *ekthesis* in logic were compounded by other factors. If logical *ekthesis* really amounted to considering a special case, however arbitrarily chosen, then it is very doubtful for a good Aristotelian whether it can be a genuinely logical procedure at all. For it is sense-perception, not reason, that acquaints us with particulars according to Aristotle. Hence *ekthesis* seems not to be a principle of reasoning at all, but rather some sort of appeal to imagination – almost to perceptual evidence. This was claimed already in Antiquity by Alexander the Commentator in so many words, and has been repeated by many commentators ever since. (The ultimate historical source of this idea may be Aristotle himself. Cf. the quotation above from *An. Pr.* A, 41, 49b32–50a3.) Philosophically, it poses an interesting question, for pretty much the same things could be said – and probably would have been said by Alexander – of the modern rule of instantiation as were said of *ekthesis*. Hence Aristotle's hesitancy in applying *ekthesis* is understandable in that it is connected with deep and important systematical problems in the philosophy of logic.

Historically speaking, the connection between *ekthesis* and the idea of an individual (a particular in contrast to a universal) serves to illustrate the reasons why *ekthesis* was suspect as a logical procedure, however natural it was felt to be in geometry. All appeal to particulars in logic was deeply suspect. Even if the Aristotelian connection between particulars and sense-perception could be overlooked, there remained plenty of puzzling questions as to how *one* figure or *one* instance of a general term could represent *all* the similar (but not identical) figures or *all* the instances of the term.

The misleading influence of Aristotle's contrast general-particular is shown also by his remarks on the problem of *akrasia* and on the sources of mistake in logic (*An. Pr.* A, 32, and B, 21). These two discussions, which are closely related, will not be commented on here, however.

We can thus see that Aristotle had certain *prima facie* reasons to avoid *ekthesis* in his syllogistic theory (reasons satisfactory to himself, that is to say, though not to us). In fact, he seems to have employed as little as possible, and viewed it with considerable suspicion.

Yet he could not completely dispense with it. Although in Aristotle's assertoric syllogistic it is used only as an alternative method of establishing syllogistic moods, in his modal syllogistic it occurs as the only way of establishing certain

sylogistic moods (*baroco* and *bocardo* with two necessary premises). What is even more important, it is by means of *ekthesis* that Aristotle established his first and foremost rule of conversion, as we saw above. Moreover, it seems to me (as indicated above) that Aristotle in effect considered 'ekthetically' instances of general terms in deciding that *barbara* and *celarent* are perfect syllogisms, however reluctant he may have been to admit this.

If Aristotle thus had to use *ekthesis*, why not make the most of it? Why not use it as the sole or at least the main method of his syllogistic? For reasons indicated, Aristotle never yielded to this suggestion. If he had, he would have found that little else is needed in syllogistic. What is more important, then he would have been forced to acknowledge the most important principles which enable us to handle the whole of first-order logic and face squarely the problems on interpretation to which they give rise.

As it is, Aristotle's way of developing his syllogistic is an unhappy compromise between a full-scale use of *ekthesis* and a development which dispenses with it altogether. It is not surprising that several logicians of the later Antiquity considered all valid syllogisms 'perfect'.

6. ARISTOTLE'S SYSTEM OF SYLLOGISMS RECONSIDERED

It might thus appear that the perfect-imperfect distinction and hence Aristotle's way of developing his system of syllogisms is thoroughly confused and only explainable in historical terms. In particular, the greater evidence that attaches to those moods Aristotle classifies as perfect is only psychological. Although this seems to me to be essentially correct, there are a few additional things which can be said here and which give somewhat more systematic substance to Aristotle's distinction and to his procedures.

When a syllogistic mood is proved ekthetically, the argument is not quite exhausted by the instantiation process. Consider, for instance, *baroco*:

$$[(\forall x)(Ax \supset Bx) \ \& \ (\exists x)(Cx \ \& \ \sim Bx)] \supset (\exists x)(Cx \ \& \ \sim Ax).$$

We may reason as follows. Choose an instance of C-and-not-B, say *e*. (Existential instantiation!) Of it is true that

$$Ce \ \& \ \sim Be.$$

Now *e* must be a not-*A*, for if it were an *A*, it would have to be a *B* in virtue of the first premise, which yields when applied to *e* (universal instantiation)

$$Ae \supset Be.$$

Hence we have

$$Ce \ \& \ \sim Ae,$$

which is enough to show the truth of the conclusion.

In this semi-formal argument, we needed certain propositional steps. In effect,

we infer in it ($Ce \& \sim Ae$) from ($Ce \& \sim Be$) and ($Ae \supset Be$). It is this propositional element (here left unformalized) that for Aristotle makes in effect the difference between perfect and imperfect syllogisms. It may be impossible to establish with certainty precisely what considerations guided Aristotle here.

It is sufficiently clear, however, which propositional steps he considered unproblematic. They were those inferences that turn directly on the transitivity of implication. For in the cases of *barbara* and *celarent* the propositional inferences needed are the following

$$\begin{array}{ll} Ce \supset Be & Ce \supset Be \\ Be \supset Ae & Be \supset \sim Ae \\ \hline Ce \supset Ae & Ce \supset \sim Ae \end{array}$$

which depends on nothing but transitivity of ' \supset '. On the level of extensions of corresponding terms – which is the level on which Aristotle probably moved – this means that perfect moods are those that depend on the transitivity of class-inclusion – and on nothing else. This, in any case, is the cash value of Aristotle's statement that in perfect syllogisms only the terms of the two premises as are needed to make the conclusion obvious. Furthermore, Aristotelian syllogistic (the reduction of all the other moods to *barbara* and *celarent*) is calculated to show how the transitivity of class-inclusion is the gist of all syllogistic inference.

Aristotle may also have thought that there is a connection between his psychological characterization of perfect syllogisms ('already comprised in the premises') and the transitivity of class-inclusion. In the case of a sequence of nested terms we quite literally do not have to go outside the major term.

My point is that any such distinction disappears if we take *ekthesis* (instantiation) seriously as a proof procedure, as Aristotle's own *Denkpsychologie* should have prompted him to do in the first place. In general, the basic role of transitivity as the hallmark of syllogistic perfection and hence the fine print of Aristotle's actual distinction between perfect and imperfect syllogisms lacks all deeper theoretical justification.

Be this as it may, Aristotle's failure to rely solely on *ekthesis* in his syllogistic is connected with his failure to systematize propositional inferences. In order to deal with those propositional inferences which are needed over and above instantiation he in effect had to transform them into specific class-logical laws. For instance, contraposition which in an ekthetic proof takes us (say) from $Ae \supset \sim Be$ (an instance of $(\forall x)(Ax \supset \sim Bx)$) to $Be \supset \sim Ae$ will have to be replaced by an application of the apparently class-theoretical conversion of universal negative premises which takes us from $(\forall x)(Ax \supset \sim Bx)$ to $(\forall x)(Bx \supset \sim Ax)$. The conversion of i-premises (i.e. particular affirmative ones) likewise reflects partially the propositional principle of the commutativity of conjunction: ($Ae \& Be$) implies ($Be \& Ae$). Again, this is masqueraded by Aristotle as the class-logical principle that takes us from 'some A is B ' to 'some B is A '. Similarly, all the other class theoretical conversion principles which

Aristotle used may be thought of as *ad hoc* devices for in effect carrying out certain propositional inferences.

We can also see now that my earlier claim that *ekthesis* alone would have sufficed in Aristotelian syllogistic is after all not strictly true, for certain propositional inferences are also needed. With these Aristotle could only deal by developing half-hearted class-logical devices to do their job. Perhaps I can nevertheless say that my earlier (intentional) inaccuracy is reproduced by Aristotle in his remarks on geometrical proofs which are (as we saw) alleged by him to be obvious on the basis of the construction and *ekthesis* alone. For of course propositional inferences are needed in a geometrical *apodeixis* just as much as in a reduction of syllogistic modes.

Because of Aristotle's tendency to replace what at bottom are propositional or quantificational inferences by class-logical ones he may even have hoped to press *ekthesis* into a class-logical mold. This is what Patzig has in effect suggested. However, even if he is right (and I consider the question open) it does not diminish the interest and importance of the other interpretation (*ekthesis* as instantiation) for the purpose of discussing and evaluating Aristotle's logic.

7. THE AFTERMATH

Perhaps the most general outcome of our discussion is a way of viewing Aristotelian syllogistic which is diametrical opposition to Kant's. Posterity tended to look at Aristotle's logic in the same way as Kant did, i.e., as a rigid, closed, ready-made system. I have argued that in reality Aristotle's logical system was very much a theory in the making. He had several different options in developing his syllogistic, each encouraged by different collateral elements of his overall philosophical and psychological theories. The compromise he chose may have been a natural one, but it was not motivated by any equally important systematical idea. The outcome was not even a science by Aristotle's own criteria. It is one of the ironies of history that this precarious compromise should have remained the most important paradigm of logical theory for most of the centuries from Aristotle to Frege and Peirce.

NOTES

1. This is in keeping with Aristotle's procedure in deciding which modal syllogisms are perfect. There, too, Aristotle bases his decision on an analysis of the meaning of the premises of such a syllogism.
2. That Aristotle could have used the method of *ekthesis* much more widely than he in fact did was already pointed out by P. Henle in 'On the Fourth Figure of the Syllogism', *Philosophy of Science*, Vol. 14 (1949).
3. See Günther Patzig, *Aristotle's Theory of the Syllogism*, D. Reidel, Dordrecht, 1968.

CHAPTER 10
ON THE DEVELOPMENT OF ARISTOTLE'S IDEAS OF SCIENTIFIC
METHOD AND THE STRUCTURE OF SCIENCE

1. PROLEGOMENA

In this paper, I shall sketch briefly and tentatively some main features of the development of Aristotle's methodological ideas, including his ideas about the structure of scientific inquiry. Before presenting the outline, however, a few methodological remarks of my own are in order.

When Werner Jaeger began the serious scholarly study of Aristotle's development, the obstacle he perceived in his way was what Jaeger termed "the notion of his philosophy as a static system of conceptions". (*Aristoteles* (1923), p. 4.) One might as well describe the same mistake simply as the fallacy of considering Aristotle's philosophy a "system." It seems to me that the full force of Jaeger's point is still not being sufficiently appreciated, even apart from the question of whether Jaeger really practiced what he preached. It may be an advance to think of Aristotle as having maintained at different times two different systems, rather than a single one. However, in a deeper sense, the same fallacy still prevails. The degree of systematicity of Aristotle's thought at any stage of his development is much lower than is usually assumed. I have argued in an earlier paper (Chapter 9 below) that even Aristotle's theory of ordinary assertoric syllogisms, far from being the definitive structure that Kant took it to be, is even according to Aristotle's own lights an unstable compromise between different ideas Aristotle entertained. If you add the modal element to Aristotle's syllogistic, you have a set of ideas that arguably is not even coherent. One argument to that effect is presented in Chapter 7 of my *Time and Necessity* (Clarendon Press, Oxford, 1973).

More obviously, but less conclusively, it can be argued that much of the difficulty of central books Z-Θ of the *Metaphysics* is due, not merely to Aristotle's mode of argumentation and exposition, but to the fact that he is himself struggling with ideas he is not yet completely in control of.

It seems to me that Jaeger really should have pushed his point further. What is needed is not only a recognition of the fact that Aristotle's thought, like that of most great thinkers, is less systematic than the true believers would like it to be. That mistake itself has a deeper root. What is still being missed is the problem-driven character of Aristotle's thought. I do not think that you can really understand Aristotle's philosophy, let alone his development, without paying much closer attention to his *problems* in contradistinction to his *doctrines*. The mistake of not doing so might be labelled the doctrinal fallacy.

Of course, on the level of actual scholarly work the two viewpoints are complementary rather than exclusive. Before we know what Aristotle said, that is to say, what his views were, we cannot even ask what the problems were that prompted him to say it. But I do believe strongly that we cannot reach a deeper understanding of Aristotle's philosophy without paying close attention to his problems and to the dynamism that these problems created.

An unprejudiced look at the actual historical texts should be enough to disabuse twentieth-century philosophers of the fallacy of assuming that great philosophers were presenting to us a well-organized system. A couple of examples will illustrate what I mean. Among the most systematic thinkers who ever lived certainly are Aristotle and Kant. And yet Kant's real premises for his best-known arguments, viz, those presented in his *Transcendental Aesthetics*, are explained by him, as I have shown (following E. W. Beth), only almost 700 pages later, in the *Critique of Pure Reason* A712–727. And in Aristotle's writings we find, not a single axiomatic system or even a succession of sketches of axiomatic systems, as Aristotle's own methodology seems to require. Instead, we find mostly a series of problems whose solution starts, not from indubitable axioms, but from well-founded opinions or *endoxa*. There is supposed to be a major interpretational problem about the relation of Aristotle's methodological doctrine to his own argumentative practice. In my considered view, the problem is only an apparent one, caused in part by an overemphasis on the systematic component of Aristotle's thought. I shall return to this alleged problem below.

Interpreters' preoccupation with the systematic aspects of different philosophers' work means that a great philosopher like Aristotle is in perennial danger of being misunderstood, or perhaps rather looked upon in a shallow perspective. What drives, not to say obsesses, a theoretically sophisticated thinker are likely to be problems rather than doctrines. Even when a philosopher is trying to realize a grand vision, this vision is not very useful in trying to understand the specific concepts he uses and the specific arguments he presents. For them, we must understand his problems. It seems to me that those who have not themselves wrestled with serious conceptual issues tend to underestimate by orders of magnitude the extent to which a great philosopher – any great philosopher – has to struggle against confusions, contradictions, and other difficulties. And these are typically problems of one's own, not questions someone else has posed in so many words.

It is here that a topical study of philosophical concepts and arguments can render a tremendous service also to purely historical study. (The term "topical" is not entirely happy here. I wish we could revive the excellent older German term "historisch-kritisch.") An interpreter usually does not spontaneously share an old thinker's problems. In order to see what they are, we first have to construct as our guide a map of the landscape of concepts and ideas in which an Aristotle or a Kant moved and on which we must locate the problems he had to cope with.

An example may be helpful here. It is argued in Hintikka et al. (1977) *Aristotle on Modality and Determination* that Aristotle's ideas about modality

constitute an instance of that problem-oriented character of an important part of Aristotle's philosophy. I have argued that Aristotle's own deeply ingrained conceptual assumptions concerning necessity and possibility pushed him toward deterministic (or perhaps rather Megarian) conclusions he could not accept. From this perspective, some of Aristotle's best known discussions of possibility and potentiality represent so many different attempts on Aristotle's part to disentangle himself from difficulties caused by his own largely tacit conceptual assumptions. These different attempts do not only rely on different ideas. There is no a priori guarantee that they even can all be reconciled with each other.

The same example also illustrates the difficulties that the problem-solving character of much of the best philosophical inquiry poses for historians' attempts to establish a chronology of a philosopher's ideas. A philosopher's different proposals for a solution of one and the same problem are often independent of each other. They do not exclude each other, nor do they presuppose one another. Even when one solution appears to us more satisfactory than others, as the *dynamis* versus *energeia* distinction seems to be in the case of Aristotle's different attempts to cope with the Megarian problems, we cannot be sure that it represents a later view than the other, seemingly less happy efforts. Indeed, Aristotle's alternative solution, a direct appeal to the primacy of temporality in definite propositions, is so deeply rooted in his ways of thinking about time that he might very well have tried it at any stage of his philosophical career.

One remarkable thing about the problems that major philosophers have typically wrestled with is that they were often left tacit, not explicitly acknowledged or articulated by the thinker in question. At their most general, the sources of philosophers' problems are due to what Collingwood would have called the ultimate presuppositions of the entire period. The fundamental role of such presuppositions makes it especially hard for contemporary thinkers to acknowledge them. An important example is offered by the problems which Greek philosophers like Aristotle ran into trying to cope with problems about being. The remarkable but largely unexploited feature of their conceptual situation is that they were trying to deal with these problems without the benefit (or the handicap) of the Frege-Russell ambiguity thesis. By this I mean the thesis that words for being like *estin* are ambiguous between the *ises* of identity, predication, existence, and subsumption. (See Chapter 2 above.) The real nature of these problems simply is not understood by anyone who fails to recognize the absence Frege-Russell distinction, much less by anyone who takes it for granted as a given fundamental truth of logic, as many of our contemporary philosophers still seem to do. This is an excellent example of how sharper insights into the actual conceptual situation can deepen our understanding of the history of philosophy.

From these remarks we can extract some interpretational advice. First, from the largely unspoken character of a thinker's conceptual problems, it follows that our understanding of those problems is not always enhanced merely by

collating and comparing his different pronouncements on the subject (or related subjects); such a comparative method is made dubious by the dynamic character of a philosopher's thought. The basic reason not to stop with such Gallup polls of pronouncements is precisely the implicit character of a thinker's basic conceptual assumptions, which makes it unlikely that those assumptions will be manifested in such "polls."

What further methods do we then have that would lead us to a deeper understanding of a philosopher's conceptual world? One possibility is to look at a philosopher's argumentation. There you can often see what assumptions he or she makes. For instance, you may look at the way in which Aristotle tries to deal with such fallacies as the following:

(1.1) Homer is a poet. Ergo: Homer is (i.e., exists). (See *De Int.* 11, 21a25–29.)

(1.2) Coriscus is different from Socrates. Socrates is a man. Ergo: Coriscus is different from man. (See *De Soph. El.* 5, 166b33–36.)

In both cases, the Frege-Russell distinction between different senses of being would have offered an easy solution. Hence, Aristotle's reliance on other modes of solution is evidence for his not having embraced the Frege-Russell ambiguity thesis.

This heuristic advice is not restricted to brief arguments like (1.1) and (1.2). It is even more important, in my judgement, to analyze carefully Aristotle's longer arguments. Aristotle's argumentation is typically dialectical in the sense that he examines comparatively and critically views and arguments that point to different directions. Without a careful analysis of the structure of such a dialectical argument, we cannot tell what Aristotle's definitive views are on any one matter, for in his actual argumentation he may be expounding *prima facie* reasons pro and con some thesis or other rather than his own settled views on the subject. A striking case in point is Aristotle's discussion of future contingents in *De. Int.* 9 (analyzed in Hintikka op. cit., 1973, ch. 8).

Further suggestions are also forthcoming here. There is no aspect of the interpretation of a great philosopher where the doctrinal fallacy rears its head more frequently than in discussions of a great thinker's relation to other philosophers. Those are typically conceptualized in quasi-legal terms, such as a rejection, refutation, and rebuttal. (Or perhaps in *anno domini* 1994 I should speak in Rortean terms of conversation and dialogue.) It seems to me that the polemical and comparative purposes of past philosophers' work are usually vastly exaggerated. It would be a much safer rule of thumb to go to the other extreme and claim that major philosophers have virtually invariably been so impatient as not to spend much of their precious time to straighten out other people's stupid misunderstandings, unless the problem they are discussing is a genuine difficulty for these philosophers themselves. I have argued this point on earlier occasions repeatedly, obvious though that it is. Perhaps the most germane example here is Aristotle's criticism of the Megarians in *Metaphysics* Θ 3. Not only was Aristotle pushed by his own presuppositions towards the

same position Megarians maintained. (Cf. Hintikka et al., op. cit., 1977.) His criticism of the Megarians is predicated on rather dubious assumptions that I believe Aristotle himself in the end was not happy with. Hence, the real target of Aristotle's criticism is as much a threatening consequence of his own ideas as any fallacy that his opponents were guilty of.

An exception to this self-centered character of great thinkers is their relationship to their own teachers, students, and friends, as well as in some cases to the members of the same school or to other philosophers whose views they respect. For this reason, it is not only relevant but crucially important to study Aristotle's relation to Plato and his background in the Academy. But even when it came to other Greek philosophers, Aristotle is looking at them through the spectacles of his own problems. Overlooking this attitude of Aristotle's to his predecessors has led to charges of inaccuracy and distortion leveled by the likes of Cherniss at Aristotle as a historian of philosophy.

In the rest of this paper I shall put these interpretational ideas to work and distinguish from each other three stages of Aristotle's methodological and conceptual development. It is important to realize that none of these three stages amounts to a ready-made system. The latter two stages are in a perfectly good sense merely further developments of the earlier one. It is hence impossible to exclude a considerable amount of temporal overlap between Aristotle's three concerns. We are in fact going to find instances of such overlap. What I am primarily trying to do is to identify some of the specific problems (or opportunities) that guided the development of Aristotle's ideas.

2. FROM DIALECTIC TO A SYLLOGISTIC MODEL OF INQUIRY

Let me sketch briefly the main outlines of Aristotle's methodological development as I see it. In the beginning there was, not *logos*, but *elenchus*, the Socratic method of questioning. Aristotle's earliest methodology is modelled on the Socratic method. This methodology is often called dialectical, and it is what we find, by and large, in the *Topica* and *De Sophisticis Elenchis*.

This point is not hard to appreciate insofar as it relates to the methods of philosophical debates that play a major role in the *Topica*. What the *Topica* is, is a handbook for the dialectical exercises practiced in the Academy as a method of philosophical training. These debates have in fact been called questioning games by such earlier scholars as Richard Robinson and Gilbert Ryle. It has to be emphasized, however, that the Socratic method of questioning in the *Topica* is also Aristotle's method of scientific and philosophical argumentation. In fact, Aristotle himself makes this point quite clear, for instance, in writing about his dialectical method that:

It has a further use in relation to the principles used in the several sciences ... This task belongs properly, and most appropriately, to dialectic. (*Top.* I 2. 101a36–b3)

This early methodology of Aristotle's has attracted relatively little attention. One reason is contemporary scholars' mistaken tendency to think of the methods expounded in the *Topica* as an earlier version of Aristotle's syllogistic, in other words, an approach to deductive (plus perhaps also inductive) logic. Another related reason is the lack of adequate conceptual tools for the purpose of analyzing it. In this respect, the interrogative model of inquiry that I have developed has changed essentially the prospects of understanding better Aristotle's early methodology. (See Chapter 13 below, with further references.) The applicability of this model is perhaps not surprising, for the model itself has been described as an updated version of the Socratic *elenchus*. The reason why it is helpful is that it has a sharp structure that can be spelled out by logical methods, indeed, often as a partial analogue to the metalogic of our familiar deductive logic. I would go as far as to claim that the interrogative model is a better rational reconstruction of the Greek techniques of logical reasoning than the conventional contemporary symbolic logic, which embodies assumptions that were totally foreign to the Greeks, such as the Frege-Russell thesis about the ambiguity of words like *to be* or *einai*. The interrogative model has already yielded insights into several subjects, among them the role of yes-or-no questions in Socratic questioning (Chapter 14 below), Aristotle's theory of fallacies, and his reliance on *endoxa* (Chapter 13 below).

A nice example of how the interrogative model enables us both to understand Aristotelian ideas and also to put them in perspective is offered by the fallacy of *petitio principii*. In its original form this mistake meant asking the "big" or principal question, which was to be answered through the entire inquiry, instead of asking one of the "small" or operative questions by means of which the principal question was to be solved. This point was made particularly vigorously by Richard Robinson in 1971. But neither Robinson nor Aristotle really tells us *why* this so-called fallacy is a mistake. Such an account is readily available from the interrogative model (see Chapter 13 below).

In case evidence is needed to ascertain the central role of questions and answers in the methodology Aristotle expounds in the *Topica*, even a casual examination of the text produces a wealth of documentation. If an example is needed here of the extent to which the method Aristotle envisaged in the *Topica* turned on questions and questioning, *Top.* I 4, 101b1–36 will fill the bill:

First, then, we must consider of what parts our method consists of ... For arguments (*logoi*) start from propositions (*ton protaseon*) while the subjects of reasoning (*syllogismoti*) are problems (*problemata*). The problem and the proposition differ in the way in which they are stated. If it is said "‘Pedestrian biped animal’ is a definition of man, isn't it?" ... a proposition results. But if it is said "‘is or is not ‘pedestrian biped animal’ a definition of man?’" a problem results. (I have modified here the Oxford translation.)

In both cases, we are dealing with questions and answers. The difference is further spelled out by Aristotle in *Top.* I 10, 104a8–11, and 11, 104b1–3. In

the case of *protasis*, the answer is universally or generally accepted, at least by the best experts and is otherwise believable, whereas in the case of a *problem*, there is a genuine choice between two attractive alternatives, only one of which can be true. The reason Aristotle is dealing with yes-or-no questions only is that he is restricting the questions that are admissible in dialectical inquiry to such questions (see *Top.* VII 2, 158a16–24).

When we realize the dialectical character of Aristotle's early methodology, we are in a position to appreciate how he was led to new ideas and through them to a new overall methodological vision. In his study of interrogative argumentation, Aristotle naturally focused especially closely on questions of strategy and of tactics. How can I lead my interlocutor to the direction I want the inquiry to go? This is easier the more accurately the respondent's responses are predictable. Now, Aristotle soon came to realize that there indeed are a number of answers that are fully predictable. They are predictable because they are necessitated by the interlocutor's previous admissions. In our latter-day terminology, these pseudo-answers are precisely those responses that are logically implied by the respondent's earlier answers. Aristotle discovered them, studied them, and systematized them. The result was his syllogistic theory, which represents a new stage in the development of Aristotle's methodological ideas.¹

This development is seen in a variety of ways. Perhaps the most instructive evidence comes from those discussions of Aristotle's that turn on a distinction between what can be said of an argument *ad hominem*, and what can be said of it *ad argumentum*. For what can be said *ad argumentum* of a step in *elenchus*-type inquiry is something that can be said of it on the basis of the argument itself, irrespective of who the respondent is, what he knows, what his game plan is, and so on. A step in an interrogative game is a logical inference (i.e., what we would call a logical inference) when it is necessary *ad argumentum*. Of course, many other answers by some particular respondent are necessary *ad hominem*, that is, necessary for that particular interlocutor. In most cases, Aristotle applies the distinction to solutions of fallacies. However, this is obviously due to the fact that such solutions are Aristotle's business throughout the entire book. In any case, in *De Soph. El.* 8, 170a13, Aristotle indicates that the distinction applies also to inferences and not only to fallacies. (Cf. *De Soph. El.* 20, 177b33–34; 22, 178b15–17; 33, 183a21–23; and 8, 170a12–19.) Logical inferences will then be those answers that are necessary *ad argumentum*. (Cf. here also *An. Post.* A 6, 75a22–27, discussed in the next section.)

3. ON THE SYLLOGISTIC MODEL IN ARISTOTLE

Aristotle did not only develop a theory of syllogistic logic. He made it the cornerstone of his conception of science. On an earlier occasion, I have tried to show how Aristotle's theory of science, prominently including his ideas of the primitive assumption of any one science, can be understood on the basis

of his syllogistic model. I cannot elaborate or even repeat that account here. (See Chapters 5–6 above.) Suffice it to say that I believe that when all the misunderstandings are removed, Aristotle's syllogistic concept of science is more pervasive and more in line with his actual scientific and philosophical argumentation than is sometimes realized. For instance, I believe that a closer analysis of the argumentative structure of his two main ethical treatises will show that it conforms rather well with Aristotle's model of syllogistically oriented science.²

The structure of the resulting conception of a science (some particular departmental science) is not hard to see. Syllogistic explanation proceeds by inserting a middle term between two others. Ultimately, in the edifice of any one science, such an insertion of intermediates must come to an end. The endpoints are atomic (*ameson*) premises. The widest premises do not have a special position except in that they delineate the field of the science in question. That field can not be the entire universe, for beings are divided in different categories.

I have dealt with the first two stages of Aristotle's methodological development in earlier papers. Hence, I may perhaps be excused if I do not elaborate on these very much here. Certain further explanations are nevertheless needed, if only to ward off misunderstandings.

First and foremost, speaking of two "stages" is already a considerable oversimplification. It is especially important to realize that Aristotle's discovery of syllogistic did not mean that he gave up the idea that scientific inquiry proceeds interrogatively, or the idea of "inquiry as inquiry," as I have called it. It means enriching the questioning model of science, not abandoning it.

Further evidence for the role of questioning in Aristotle's mature conception of science is *An. Post.* A 12, where Aristotle discusses "syllogistic questions" and questions appropriate to different sciences.

Even in his theory of logic and argumentation, Aristotle did not entirely separate conceptually steps of logical inference from others. If one has to develop a historically faithful semantics for Aristotle's logic, it would be a dialogical one, not a purely model-theoretical one. In particular, what for a modern analyst would appear as logical inference steps were not separated sharply from question-answer steps. In other words, there is no sharp concept of logical necessity in Aristotle abstracted from the context of an interrogative inquiry. Likewise, many of his logical terms originally presupposed a dialectical in order to be fully understood.

From this vantage point, several features of Aristotle's logical and methodological theory appear in a new light. For instance, it is seen from *An. Post.* A 10, 76b25–34, that both syllogisms and scientific demonstration (*apodeixis*) are matters of either external or internal discourse (*logos*).

Also, even though Aristotle's strange emphasis on the necessity of logical inferences has other sources, it may very well be connected with the strategic value of knowing which replies an answerer cannot help making. I call this emphasis "strange" because it is mistaken. Rules of logical inference do not *necessitate* the drawing of any particular conclusion. They are rules that *permit*

certain conclusions to be drawn. (In order to avoid misunderstanding, I must emphasize that I am here speaking of the necessity of *drawing an inference*, not of the necessity of the *truth of the conclusion* once it is reached, given the truth of the premises.) What *is* necessary is for the respondent to give one answer rather than the other to a yes-or-no question if this answer follows logically from his earlier admissions.

Generally speaking, dialectical terminology and dialectical ideas occur repeatedly in the *Analytica*. Here is one representative example from *An. Post.* B 5, 91b15–17:

For one must not ask the conclusion, nor must it be the case by being granted; but it is necessary for it to be the case if *those* are the case, even if the answerer denies it.³

If I am right, even Aristotle's definition of syllogism in *An. Pr.* A 1, 24b18–20 should be looked upon in this light:

A syllogism is a *logos* in which, when certain things are laid down (*ta tethenta*) something else than what is posited (*ta keimena*) necessarily follows.

Aristotle's terminology suggests a dialectical context in which an answerer has admitted certain things that necessitate an answer to a further question. Indeed, both of the two synonymous expressions Aristotle uses in the quote are part and parcel of his dialectical vocabulary. The singular *to keimemon* is used at least occasionally as a synonym for *thesis*, a word whose dialectical ancestry is impeccable (cf., e.g., VIII 5, 159b7, 23, 26, 37). Aristotle's term has a strong connection with the idea of proposing an assumption to be examined, as is illustrated by its use in the context of an indirect proof, e.g., in *An. Pr.* I 15, 34b23; 16, 36a10; 17, 37b32; 19, 38a16, etc. Similar things can be said about *ta tethenta*.

It is significant that Aristotle puts forward almost the same definition of syllogism already in *Top.* I 1, 100a25–27. On my analysis, this need not be a later change in Aristotle's original version of *Topica*. On neither occasion does Aristotle say anything about truth-preservation, which for a contemporary logician is the crux of the matter. Instead, he harps on the necessity of the transition from the premises to the conclusion. Nor does Aristotle have any notion of the analytical character of syllogistic reasoning. On the contrary, he speaks of "something different" from what is laid down as coming about in a syllogism, thereby coming close to later characterizations of synthetic reasoning.

This idea of interrogative necessity can in any case explain why the very same definition of syllogism is put forward by Aristotle in two different works in which he seems to present entirely different conceptions of what syllogistic reasoning is all about.

One of the most important conclusions from our results concerns the development of Aristotle's methodology in that the traditional picture of Aristotle's

idea of science as an axiomatic and deductive system is vastly oversimplified. This fact is perhaps seen best from an example. Smack in the middle of a book where he is explaining his full-fledged syllogistic model of a science, Aristotle writes:

Yet one might perhaps wonder what purpose there could be in asking [these questions] about such items if it is not necessary for the conclusion to be the case – [apparently] you might as well ask an arbitrary question and then state the conclusion. But we should ask questions not on the grounds that the conclusion will be necessary because what makes the conclusion necessary was asked [earlier] (*dia ta erotemena*), but rather because it is necessary for the person who accepts the proposals [i.e. answers the question in the proposed way] to state the conclusion – and to state it truly if they hold truly. (*An. Post.* A 6, 75a22–27; I have modified Barnes' translation.)

This passage is a persuasive counterexample to the idea that the kind of scientific inquiry envisaged in *Analytica Posteriora* A consisted merely in drawing syllogistic consequences from axioms, for in it Aristotle clearly assumes that we do take steps in a scientific inquiry that are not necessitated by the antecedent stages of the inquiry. What he says in the quoted passage is simply that those steps are question-answer pairs, and that they can serve a legitimate purpose in an interrogative inquiry. Notice also how reminiscent Aristotle's statement is of what he says in *De Sophisticis Elenchis*. He could have expressed his point by saying that when the conclusion is not necessary in the usual sense, it is not necessary *ad argumentum*, but that does not mean that it cannot still be necessary *ad hominem*.

In trying to force the quoted passage into the narrowly construed syllogistic mold, some earlier translators have in fact introduced arbitrarily the claim that Aristotle's point is intended to apply only to "dialectic." There is no such word in the text, however, nor any other indication that Aristotle is not talking about perfectly normal science. And if so, then even Aristotle's "syllogistic" model of science can be seen to be partly interrogative, involving questions to be responded to by an answerer. Moreover, Aristotle is clearly thinking of those steps that do not involve syllogistic necessity as being parallel to those which do. In both, earlier questions and answers are needed to provide the "premises" that lead the answerer to assent also to the conclusion. In both cases, Aristotle speaks of what the answerer "must" or "should" (*dei*) say. This is a clear suggestion that in both types of cases we are dealing with a response to a question. Aristotle's puzzle is merely to explain the choice of the earlier questions if their answers do not necessitate logically the desired conclusion. What he is doing is closely related to his own earlier contrast between what can be said *ad argumentum* and what can be said *ad hominem*.

Observations of this kind can be turned around and put to other uses. When we realize that the syllogistic structure that Aristotle ascribed to a science does not exclude interrogative (or other nondeductive) steps even in the midst of

the normal scientific process, it becomes much easier to recognize that loosened-up syllogistic structure in all sorts of inquiries Aristotle was himself engaged in. For instance, my earlier point about the syllogistic structure of Aristotle's ethical theory is not spoiled by the fact that in the midst of his ethical argumentation Aristotle uses repeatedly subarguments that are inductive (e.g., *Eth. Eud.* II 1, 1219a1–5, 19–23) or dialectical reasoning from *endoxa* (e.g., 1219a39–b12).

One can thus say that there simply is no such thing in Aristotle as a purely syllogistic model of science, in the sense that the only or the main activity of a scientist should consist in deriving syllogistic consequences from axioms. This is also shown by Aristotle's own statements. In the discovery of a scientific syllogism and in answering scientific questions, we are always moving "inwards," that is, discovering new intermediate terms. (See e.g., *An. Post.* A 22, 84a36–39; B 2, 90a6–8.) In a syllogistic argument, we are moving in the opposite direction. For instance, a *barbara* syllogism establishes a conclusion whose terms are further apart than the terms in either premise. The scientific process must hence involve both (1) steps toward the first syllogistic premises, and (2) syllogistic inferences from such premises. Of course, steps of the former kind (1) do not possess syllogistic necessity, but that does not prevent them from being perfectly genuine steps of scientific inquiry. In brief, Aristotelian inquiry appears to be like my interrogative model in that in it interrogative steps and logical inferences are not segregated, but occur interspersed.

In this respect, a great deal of confusion is here caused by a failure to appreciate Aristotle's terminology. When he speaks of the "first principles" (*archai*) or the "primary premises" (*ta prota*) – or however we should translate Aristotle's terminology – he is not speaking of temporary priority in an actual scientific process. He is speaking of priority in the syllogistic structure of science. I do not see any reason to believe that Aristotle should have fallen into the same trap as many of his commentators (and some philosophers of science) and have assumed that the *archai* of a science can all be established "dialectically" in one fell swoop prior to any logical inferences and that the rest of a science can then proceed syllogistically. This would presuppose the kind of segregation I have just warned against. The modern interrogative model of inquiry that I have developed in fact shows that to assume that a separation is always possible is to commit a fallacy. Normally, interrogative steps (which bring in new information) and logical steps (which draw deductive conclusions of earlier assumptions and answers) cannot be reordered so as to end up separated from each other. It seems to me that Aristotle was in fact on the side of the angels here, or at least on the same side as the interrogative model of inquiry.

It is instructive to see that when Aristotle does speak of temporally earlier knowledge (as in *An. Pr.* A 1), he typically uses an entirely different terminology. He does not speak of, e.g., *ta prota*, but of previous knowledge (*ta proginoskomenon*).

A few clarifying comments are perhaps in order here. What I am saying in

no way contradicts, or necessitates modifications to, what I said in an earlier article (reprinted as Ch. 5 above) on the structure and ingredients of an Aristotelian science. Of course, that structure has to be relativized to a certain stage of Aristotle's development, viz., to what I have in my oversimplified trichotomy called his middle period.

We thus have to reject the narrowly construed idea of a syllogistic science according to Aristotle, and to admit of a picture in which syllogistic inferences are but a small part of what actually happens in a science. This removes once and for all the *prima facie* discrepancy between his allegedly syllogistic model of science and the concrete argumentation in various departmental sciences.

It is instructive to realize that the syllogistic model of science does not per se exclude chains of explanatory syllogisms within any one category. But Aristotle feels called upon to warn that each such explanation is restricted to some one genus and hence to some one category. (See *An. Post.* A 7; 23, 84b17–18.) This restriction is of course a direct corollary to the basic ideas of the entire syllogistic model.⁴

4. SYLLOGISMS AND THE PROBLEM OF CHANGE

Next, I shall examine Aristotle's further development, a development that takes him beyond the syllogistic model of science.

Why could Aristotle not rest on his syllogistic laurels? Why cannot we consider the syllogistic model as his last and final word on the structure of science? An interesting answer has in effect been proposed by Daniel W. Graham.⁴ Graham is not the only writer to suggest that Aristotle's syllogistic model could not explain the actual processes in nature. For the purpose of dealing with them, Aristotle developed, according to Graham, an entirely different ontological and methodological system. In this system, a central role is played by such concepts as matter and form, substance, as well as potentiality and actuality. A paradigmatic role is played in the development of this new system (Graham's S_2) by the problem of change. Graham argues in Chapter 4 of his book for the incommensurability of the two systems, which he takes to represent two different stages of Aristotle's development.

It seems to me that Graham has made an interesting contribution to the discussion of Aristotle's development. Nevertheless, his views illustrate the inadequacies of the usual approaches to Aristotle's development mentioned in the beginning of this essay. I do not believe that Graham has come to grips with all the problems that propelled Aristotle's thinking. There are more problems, and subtler problems, motivating Aristotle's quest than what is spelled out in the literature.

First of all, Graham's main thesis needs some qualifications. I do not find that the syllogistic model could not have been put to use by Aristotle to deal with the variety of the processes of change that jointly constitute the natural world. On the contrary, Aristotle tried to account for the facts of change within

the syllogistic framework. The difficulties into which he ran are different from, and historically more revealing than, the alleged reasons for the incompatibility of the two systems that Graham rehearses. Instead of discussing the details of his argument, it is more constructive for me to try to sketch what I take to be the main lines of Aristotle's train of thought.

The crucial link utilized in Aristotle's attempted reconciliation of the syllogistic model and the realities of change is constituted by Aristotle's conceptual teleology, which Aristotle largely shares with Plato.⁵ Aristotle's point is perhaps most clearly in evidence in *Met. Z* 9, 1034a22–23. The *arche* of the coming-to-be of an instantiation of any form, Aristotle tells us, is an earlier instantiation of the same form. In the case of a member of a biological species, this form is instantiated in earlier members of the species, typically in its parents. In the case of an artifact, the *arche* is an actual instantiation of the form of the product in the artisan's mind. Conceptually, Aristotle deals with the two cases on a par.

And it is well known how Aristotle proposes to build a bridge from an intentional bringing-about of a result to his idea of syllogism. This bridge is highlighted by Aristotle's notion of the practical syllogism. More generally, Aristotle thinks – or at least thought for a while – that change can be conceptualized by means of a syllogism where the major premise specifies the end and the minor premise specifies the means of obtaining it.

The parallelism of productive arts and science is asserted or assumed by Aristotle on a number of occasions: for instance, *An. Post.* B 19, 100a6–9.

It is important to realize that the idea of practical syllogism was not restricted to one-shot actions. Aristotle's analysis of deliberation in *EN* aims to establish the *ergon* of man. To find it is to find the most general *arche* of the science of ethics, and if the definition of the ultimate *ergon* is the most general premise, it serves at the same time to delineate the scope of ethics.

I am not claiming that anything like the view I have sketched of practical syllogisms as bridging the gap between the syllogistic model and the phenomena of change was Aristotle's settled doctrine, let alone a part of a "system," at any time of his philosophical career. Rather, I am presenting Aristotle's attempted synthesis as a way of diagnosing the problems into which he was led and that forced him to develop his ideas further.

Admittedly, Graham does note the role of what he calls the artisan model in Aristotle's thought. It nevertheless seems to me that he underestimates the extent Aristotle was actually able to incorporate the basic ideas of that model into his syllogistic methodology.

What really propelled Aristotle's development was not any abject impossibility of dealing with the phenomena of change within the syllogistic model, but the problems Aristotle ran into in doing so. One of these problems is my next subject.

5. THE PRIVILEGED POSITION OF THE MOST GENERAL PREMISES

What were these difficulties? There were many different ones. Together, they propelled Aristotle's development beyond the syllogistic model. Here, I shall

discuss in the first place one line of thought, without claiming that it was the only, or even the most important, one. One reason that I have chosen to discuss it is that it can be documented reasonably well and yet has escaped most scholars' attention.

In order to see what this particular difficulty of Aristotle's was, it is in order to look briefly at another idea that is operative in Aristotle's thought. It is the assumption, which we encounter also in Plato, that the essence of any productive art, say the art of healing, lies in the healer's (physician's) knowledge of what the form of the end product, in this case health, really is. (Cf. Hintikka 1974.) And this knowledge of health is very nearly identical with knowing what the definition of health is. This knowledge is what is expressed by the major premise of the practical syllogism that leads to a physician's healing a patient. It typically is the most important feature of the situation.

But Aristotle's reconciliation of the two kinds of knowledge involved in production is too successful. In a strict constructivist's syllogistic model, the two will be on a par. From the purely logical vantage point, the major and the minor premise of a syllogism are equally important. Neither one is dispensable.

On the pure syllogistic model, as was pointed out and as Aristotle explains himself, a scientific demonstration always proceeds by inserting intermediate terms between the extreme (major and minor terms) (see, e.g., *An. Post.* A 22, 84a35–39; B 2, 90a6–8). Thus, in constructing an account, say, why every C is an A, we add more and more intermediate terms between the earlier ones between C and A. Hence, a wider premise is in no way privileged vis-à-vis a narrower one, and the most general premises do not occupy any particular place of honor.

Perhaps I should jokingly call a strictly syllogistic conception of science a Heraclitean one: in it, the road up and the road down are the same.

This symmetry was unacceptable for Aristotle. On the level of change and production, he wanted to maintain the primacy of the *telos*, which in terms of the syllogistic analogy meant the supremacy of the most general premises. On the theoretical level, too, Aristotle wanted to construe the widest (most general) truths as the most important ones. His own summary at the end of the *Posterior Analytics* (see B 19) conceives of the progress of scientific concept formation, not as the discovery of more and more intermediate terms that help to make the chains of explanatory syllogisms finer and finer, but as a climb upwards towards more and more general concepts and more and more general truths.

In fact, Aristotle argues at length for the superiority of more general premises as compared with less general ones in *An. Post.* A 24.

This tension between, on the one hand, Aristotle's belief in the preeminence of the most general premises and on the other hand the homogeneity of science on the strictly syllogistic model is not merely an "architectonic" awkwardness. It shows up in applications of Aristotle's ideas to different sciences. In mathematics, the most general definitions, such as the definitions of unit and of line, play relatively little role in actual mathematical reasoning. In the *Nicomachean Ethics* the most important questions philosophically are the most general ones,

dealt with in the first book. But what Aristotle says there does not seem to matter very much to the rest of the book, where the emphasis is very much on the analysis of various specific modes of excellence.

Clearly, Aristotle would have liked to have a theory according to which even in disciplines like geometry or ethics the less general truths receive their status somehow from the most general ones.

In sum, what I have found in this section shows that there is a great deal of truth in Graham's (and other scholars'; cf. Graham *op. cit.*, 117 n39) claim that Aristotle's syllogistic model was not adequate for dealing with the whole range of explanatory problems, including the problem of change. But what Graham misses are, first, Aristotle's first attempt to deal with the problems of change syllogistically and, second, many of the specific flaws that bothered Aristotle in the syllogistic model (and of which I am here dealing with but one or two).

6. THE ROLE OF EXISTENTIAL IMPORT

This, then, is one of the central points of my essay. It is not a thesis, but a problem. The problem is to understand how Aristotle tried to reconcile the supremacy of the most general premises and the most general concepts with the *prima facie* nature of syllogistically structured science where explanations amount to the discovery of intermediate terms. I cannot present a full answer in the compass of one paper. I shall instead discuss one line of thought that I find in Aristotle.

First, we must record a fact of life or, rather, a fact of logic, of which Aristotle was well aware. As was noted earlier, Aristotle simply could not get away from the brute fact that syllogistic reasoning depends on the use of intermediate terms. The solution must therefore be sought in some direction other than the denial of the role of middle terms.

Here, as in so many other historical inquiries, a systematic insight paves the way for an interpretational breakthrough.

An opening for further exploration of the dynamics of Aristotle's thought is in fact provided by a collateral insight. It is the absence of what I have called the Frege-Russell ambiguity thesis in Aristotle (together with the realization that there is nothing intrinsically wrong about dispensing with the Frege-Russell ambiguity thesis). Everybody recognized differences between different *uses* of words for being like *is* or *estin*, especially the differences between their roles in indicating existence, identity, predication, and subsumption. (Strictly speaking, we should add to this list also the veridical use of *estin*.) The Frege-Russell thesis claims that these differences are due to the ambiguity of one and the same word, in our case of the ancient Greek verb *einai*. This thesis is shared by most twentieth-century philosophers, and it is codified into the notation of our ordinary first-order logic. However, it simply is not there in ancient Greek philosophers like Aristotle. This absence is made especially poignant by Aristotle's reliance on distinctions between different senses of key philosophical

terms as an important part of his own methodological arsenal and also by the fact that Aristotle made other distinctions between different uses of *einai*, including its uses in different categories.

Because of the absence of the Frege-Russell distinction, one runs a serious risk of anachronism if one represents Aristotle's syllogistic logic by means of our own first-order notation, which has the Frege-Russell ambiguity assumption built right into it. (Cf. above, sec. 1.)

The absence of the Frege-Russell distinction in Aristotle enables him to use conceptualizations that are foreign to us. In *An. Post.* B 1–2 Aristotle explains that questions of fact, of why, of existence, and of “what it is” are all answered by means of a middle term. Aristotle typically expresses existence by the absolute construction with a verb for being in general, as in “centaurs are” meaning “there are centaurs,” “centaurs exist.” To establish existence syllogistically must therefore amount for Aristotle to a quasi-syllogism not unlike the following, where B is the middle term:

(6.1) Every B *is* (i.e., exists)

Every centaur is a B

Ergo: every centaur *is* (i.e., exists)

The parallelism with a normal syllogism is obvious. This parallelism is made possible, to use our twentieth-century jargon, by the fact that the *is* in the major premise of the relevant syllogism, i.e., the *is* in:

(6.2) Every B is an A

(which in our anachronistic Fregean eyes expresses only predication) suddenly acquired for Aristotle an existential sense when the predicate is dropped. But of course, to speak of this “sudden acquisition” is to project the Frege-Russell distinction back to Aristotle. Just because he did not presuppose the fourfold Frege-Russell distinction, there could as a matter of course be an existential force present in (6.2). Of course, there does not have to be. Aristotle is perfectly well aware that:

(6.3) Homer is a poet

does not entail:

(6.4) Homer *is* (i.e., exists).

(See *De Int.* 10, 21a25–29.) Of course (6.3) would entail (6.4) in conjunction with the major premise:

(6.5) Every poet *is* (i.e., exists).

When is an extra premise like (6.5) available? That is to say, when is it true to say the following?

(6.6) Every A *is* (i.e., exists).

This question is the same as the question as to when:

(6.7) Every B is an A

implies:

(6.8) Every B *is* (i.e., exists).

Aristotle's answer, or at least his sometime answer, seems to be: Whenever and only when we are dealing with the *is* of essential predication. Witness here Aristotle's own explanation:

Homer is something, e.g., a poet. Well, is he, therefore, or not? For 'is' is predicated accidentally of Homer, for because he is a poet, not in his own right, 'is' is predicated of Homer. (*De Int.* 10, 21a25–27)

The contrast is of course between accidental and essential being. An intriguing question that I cannot take up here is how the requirement of essentiality is related to the notion of substance. Does the requirement amount to stipulating that the A in (6.7) must be a substance? (For a discussion, see e.g., Russell Dancy, *Sense and Contradiction in Aristotle*, D. Reidel, Dordrecht, 1975, Appendix II.) A close relationship between the two conditions is suggested by passages like the following:

Substance is that which is primarily: not that which is something but that which is simply. (*Met. Z* 1, 1028a30–31)

It would be a mistaken oversimplification to take Aristotle to be identifying being a substance, being *haplos*, and existing. But something of this strange trinity is unmistakably present in Aristotle's thinking.

In contrast, we cannot even begin to formulate a quasi-syllogism where the minor premise asserts being *simpliciter*, i.e., existence. For then we would have existence (being *haplos*) as our middle term. This is impossible, for "being (*to on*) is not a genus" (*An. Post.* B 7, 92b14). And without a middle term we could not have a syllogism, not even a syllogism demonstrating existence. (Cf. *An. Post.* B 2, 89b37–a6.)

All this might strike you strange until you realize that Aristotle was not thinking primarily of subject-neutral quantifiers "ranging over" a class of entities, as we tend to do. Rather, he was taking a good many of his clues from the subtle points of the Greek language.

Admittedly, Aristotle never sets up, in so many words, quasi-syllogisms of the form (6.1). The reason is that he did not envisage such syllogisms as figuring independently in the syllogistic structure of a science. What he maintained was that existential force filters downwards from the highest premises to lower ones as a part of normal chains of syllogisms. In other words, quasi-syllogisms like (6.1) do occur in Aristotle, but only imbedded in the usual garden-variety scientific syllogisms. To this idea Aristotle was certainly committed. For if

(6.9) Every X is a Y

expresses an essential and not an accidental predication, then by Aristotle's own admissions (see *De Int.* 11, 21a25–29) (6.9) entails

(6.10) Every X is (i.e., exists).

And the atomic premises of scientific syllogisms are certainly supposed to express essential truths.

Why, then, do we need chains of syllogisms to establish existential force? Because we have to prove it, not just assume it.

Thus, Aristotle could find the kind of asymmetry within the syllogistic model he was seeking. When it comes to being *simpliciter*, that is, existence, the highest premises are in a privileged position after all. Existential force has to be assumed only for them; for everything else existential force filters down through a chain of ordinary syllogisms.

How important this result was for Aristotle is among other things shown by the fact that for Aristotle the most general premises and ordinary scientific premises are grasped by different faculties, the most general premises by *nous* and the others by other means. (See *An. Post.* A 22, 83b34; 23, 85a1; 31, 88a7; B 19, 100b8–15.)

Aristotle's belief in the asymmetry of scientific demonstration by syllogistic means is clear from a number of passages, e.g., from *An. Post.* A 22, 84a1–3:

If there is no limit, and there is always something higher than the term last taken, everything will be demonstrable ... [But] it will [then] not be possible to have scientific knowledge of anything *haplos*, only hypothetically.

It is important to realize that the pure syllogistic model by itself does not imply any such asymmetry.

This is also the background of the distinction between what I have called atomic premises and generic premises of a science (see Chapter 5 above). The former do not have an existential force, which is carried only by the latter ones.

The development of this distinction can be followed from Aristotle's writings. There is no trace of it in the *Topica*, and in *An. Post.* A 2 it does not occur, either. On the contrary, Aristotle identifies "a thesis which assumes one or the other part of a proposition" and a thesis which assumes "that something is or is not" (72a19–21); this is his dual characterization of a hypothesis. In contrast, in *An. Post.* A 10 science is said to deal with two things besides the common axioms (*ta koina*), viz., (1) the genus which is the subject of the science in question and which it posits, and (2) the attributes (*ta pathe*) whose meaning it assumes. The contrast between (1) and (2) turns out to be that the existence of the genus is to be assumed, but that of the attributes can be proved:

Proper too [to a science] are the things which are assumed to be, about which the considers what belongs to them in themselves – as e.g., arithmetic [is about] units, and geometry [is about] points and lines. For they assume them to be and to be *this*. As to what attributes of these in themselves, they

assume what each signifier – e.g., arithmetic [assumes] what odd or even or square or cube [signifies] ... and they prove that they are, through the common axioms and from what has been demonstrated. (*An. Post.* A 10, 76b3–11)

If this is not clear enough, in *An. Post.* B 1 Aristotle makes a fully explicit distinction between questions of simply being, i.e., existence (*ei esti*), and questions as to what something is (*ti estin*). He also makes it quite clear that questions of existence are answered by discovering a middle term, in analogy to the other question Aristotle lists there. His subsequent examples show that the distinction is the same as in *An. Post.* A 10:

And here one must suppose, or make apparent in some other way, both that they are and what they are (which is what the arithmetician does: for he supposes both what the unit is and that it is); but in those cases which have a middle term and for which something else is explanatory of their being (*aition tes ousias*), one can as we said make them clear through a demonstration (*apodeixis*), but not by demonstrating what they are (*An. Post.* B 9, 93b23–28).

This passage is highly instructive in several ways. It shows that existence is indeed demonstrated by scientific syllogisms, as I argued above. At the same time, it shows the close connection between Aristotle's notion of *ousia* and existence. (For this connection, see the next section.)

It seems to me unmistakable that the only way there is to understand what Aristotle means by proving existence by means of a middle term is what I explained above. What has made this point a hard one for scholars to swallow is that there is no way of construing it within the customary twentieth-century logic inherited from Frege and Russell. But this impossibility is predictable. Frege and Russell assumed the ambiguity of verbs like *estin*, while no such ambiguity was assumed by Aristotle.

My reading is confirmed in a variety of ways. It is amusing to see that Aristotle even tries to use the ideas I have discussed to explain the function of *ekthesis* in geometry. (See *An. Post.* A 10, 76b39–77a3.) Suppose a geometer draws a line in the sand and says that it is a foot long or is straight, and goes on to use that line in his argument. For Aristotle, the geometer's assumptions concerning that line would be genuine scientific premises (according to what we have found) only if the *existence* of that line (and possibly the existence of that particular manifestations of its properties) played a role in the argumentation. As Aristotle sees it (and his view is at least *prima facie* plausible), that existential dependence just is not true of geometrical reasoning relying on *ekthesis*. Aristotle's idea is that although the assumed *properties* of the geometrician's *ekthetic* line do play a role in his reasoning, the *existence* of his particular line does not.

7. FURTHER DEVELOPMENTS

Thus we can see how Aristotle was able to vindicate the privileged position of the most general premises of a science. This development is not the only relevant one. On the one hand, tinkering, as it were, with the notion of being opened a mare's nest of related problems. On the other hand, it removed only one difficulty from the syllogistic model while others, perhaps even more urgent ones, remained to haunt Aristotle.

First, the inseparability of the different Fregean meanings – and perhaps even other meanings – of *estin* from each other meant that the privileged position of the most general premises in relation to existential force tended to spill over and become a privileged position in relation to the other senses of being as well. One of them, not figuring in the Frege-Russell quartet of allegedly different meanings, is the so-called veridical sense of *estin*. Insofar as this sense of being is also involved in the alleged superiority of the most general premises of a science, they will be the ones that primarily have assertive force.

To what extent this actually happened in Aristotle needs to be examined in greater depth. In any case, such a linkage between the different uses of *estin* would go a long way toward explaining some of Aristotle's otherwise puzzling pronouncements. For instance, witness the following:

A thesis which assumes either of the parts of a contradiction – i.e., I mean, that something is or that something is not – [I call] a hypothesis; one without this, a definition (*horismos*). For definition is a thesis ... but not a hypothesis (for what a unit is and that a unit is are not the same). (*An. Post.* A 2, 72a18–24.)

Now definitions (*horoi*) are not hypotheses (for nothing is said to be or not to be). Hypotheses are among propositions, whereas one need only grasp the definitions (*horoi*); and hypotheses are not that, ... but rather [propositions] such that, if they are, then by their being the conclusion comes about. (*An. Post.* A 10, 76b35–39.)

Barnes translates *horoi* in the second quotation as “terms” rather than “definitions.” This translation misses the obvious parallelism of the two passages, however. In the first sentence of the first quotation, Aristotle seems to say that hypotheses, unlike definitions, have assertive force. But if we take his absolute constructions with *eimai* at their face value, hypotheses seem to be characterized by their *existential* rather than *assertive* force. Indeed, both forces seem to be telescoped together in the last sentence of the second quotation. The most natural view to take here is obviously that Aristotle does not distinguish the two sharply from each other.

Further observations can be made here. For instance, one can ask here what Aristotle's solution meant for the role of the Frege-Russell distinction in his thinking. *Prima facie*, the vindication of the most general premises was achieved by partially separating the existential use of *estin* and assigning to it an

especially crucial role in a syllogistically organized science. This does not mean, however, that Aristotle accepted a part of the Fregean doctrine of the *ambiguity* of verbs for being, which he did not. Indeed, a perfectly unequivocal word can have different uses.

What happened was something different and much more complicated. I feel that I understand this part of Aristotle's development incompletely. It is clear in any case that completely unqualified assertions of existence can only be made in the category of substance, for the existence of entities in the other categories depends on the existence of a substance. Hence, the liberation of the existential force of *estin* in the way Aristotle carried it out presupposed assigning substance a special role vis-à-vis the other categories.

This implied further changes. The type of question that in the Aristotelian parallelism of categories and question forms went together with the category of substance was a what-question. Now what-questions, i.e., questions of what something is, tend to assume a new force for Aristotle. Nonaccidental predication cannot any longer be simply a predication independent of how an entity is referred to, as it appears to be in Aristotle's early logical writings (see, e.g., *Soph. El.* 5, 166b28–36). What-questions can in principle be taken purely predicatively, i.e., as questions, "What is X like?" However, for Aristotle, they now begin to assume the character of an identificatory questions, e.g., "Which substance is X?" In other words, to speak with Frege, the *is* involved in such questions begins **to** assume also the force of the *is* of identity.

This leads Aristotle to complex problems as to how identificatory what-questions can – and should – be answered. Imitating David Kaplan's sometime pun, we can say that the question becomes, in terms of an example, "What is it that makes this knight different from all other knights?" Is it his matter? But that cannot be specified conceptually. Is it his form? But that is shared by other knights – and even by other members of the species *man*.

Obviously, I cannot go much further here. However, even so, we can understand a number of facts about Aristotle's development. For instance, we can now understand why questions of definition should have become central in Aristotle. This is one of the respects in which the difference between *An. Post.* A and B is quite striking.

It is in any case also unmistakable that the emergence of the special position of the category of substance is connected closely with Aristotle's views of the nature of syllogistic inference.

So that, just as in syllogisms substance is the starting-point of all things; for it's from the 'what it is' that syllogisms start – and it's from there that comings-to-be [start] too. (*Met. Z* 9, 1034a30–32; Furth translation)

Clearly, we are here being led deeper and deeper into the problematic of the most central – and most difficult – books of the *Metaphysica*, viz., E–Θ.

I must nevertheless register the fact that there are still other lines of thought that led Aristotle beyond the strict syllogistic model. I cannot discuss them

here fully, but I must mention one. It takes off from another flaw in Aristotle's attempt to reconcile the facts of change with the syllogistic model. As was seen earlier, one of the remarkable, not to say weird, features of Aristotle's idea of syllogistic inference is its alleged necessity. If you think of the premises of a syllogism clearly and distinctly, you cannot fail to see the conclusion.

Aristotle makes a few feeble efforts to explain how it nevertheless is possible in some sense or other to fail to draw a logical inference when the premises are available to the reasoner. They do not come close, however, to accounting for the possibility of a genuine "logical *akrasia*," as I have called it (see Chapter 9 above).

On the side of production and agency, the same necessity shows up in the form of the problem of the possibility of *akrasia*, which Aristotle did not really manage to solve in his famous discussion in the *Nicomachean Ethics*. Furthermore, in the direction of the problem of change and happening, syllogistic necessity pushed Aristotle toward an unacceptable deterministic, or perhaps rather Megarian, position. This was another major problem that pushed Aristotle away from the strict syllogistic model. (I have discussed this problem, and Aristotle's efforts to disentangle himself from it in Hintikka et al., op. cit., 1977.)

Graham obviously is attuned to the same problem, but for some reason he does not take any cognizance of my analysis. Hence, the ball seems to be in his court here rather than mine.

NOTES

1. The claim that the origins of Aristotle's syllogistic logic are to be found in the dialectical practice in Plato's Academy is not new. It was put forward by, among others, Kapp 1942; cf. Chapter 14 below. What I do not find in the earlier expositions of the idea is any account of precisely how it was that Aristotle was led from his analysis of dialectical argumentation presented in the *Topica* to his syllogistic logic.
2. I cannot for reasons of space argue the point here. The syllogistic structure of Aristotle's initial argument about the human good as the activity of the soul in accordance with virtue is fairly generally appreciated; cf., e.g., D. S. Hutchinson, *The Virtues of Aristotle*, Routledge and Kegan Paul, London, 1986. What is perhaps not equally obvious how easily "one can syllogistically subsume under this premise particular human virtues and the corresponding activities by first distinguishing excellence in the activity of the irrational soul from the excellence in the activity of the rational soul," to quote Simo Knuutila. Knuutila has not elaborated his point at any length, however.
3. I have availed myself liberally of Barnes's translations of the *Analytica Posteriora*, but altered them without any explicit warning.
4. See his book *Aristotle's Two Systems*, Clarendon Press, Oxford, 1987, and cf. also Graham, "Two systems in Aristotle", Oxford, *Studies in Ancient Philosophy*, vol. 7, (1989), pp. 215–213, Owen Goldin, "Problems with Graham's two-system hypothesis", *ibid.* pp. 203–213, and C. Wildberg, "Two systems in Aristotle?", *ibid.* pp. 193–202.
5. See Jaakko Hintikka, *Knowledge and the Known*, D. Reidel, Dordrecht, 1974, Chapters 1–2.

CHAPTER 11

WHAT WAS ARISTOTLE DOING IN HIS EARLY LOGIC, ANYWAY? A REPLY TO WOODS AND HANSEN

In their interesting and lucid paper “Hintikka on Aristotle’s Fallacies”, John Woods and Hans Hansen (in the sequel, W & H, for brevity) raise the question as to whether the different fallacies Aristotle discusses in *De Sophisticis Elenchis* are mistakes in logical inference or mistakes in a question-answer step of an argument. They criticize me by favoring the second alternative in too many cases, in other words, as misclassifying most of the central fallacies Aristotle distinguishes from each other as erotetic rather than logical slips. Now the very question W & H are asking is based on a presupposition which I do not accept without serious qualifications and which I consider anachronistic, even though it is apparently accepted by the majority of scholars. They assume that it makes historical sense to ask whether for Aristotle a certain fallacious step of argument is a logical inference or an interrogative (question-answer) step. It seems to me beyond any reasonable doubt that for the Aristotle who wrote the *Topics* and *De Sophisticis Elenchis* the distinction made only relative sense, and that for him what we would now call logical inferences were merely a species of question-answer steps.

The historical naturalness of this view can be seen from the background of Aristotle’s early methodology. Its obvious ancestor was the questioning method of Plato’s Socrates, in other words the Socratic *elenchus*. Scholars have described how this method was regimented into questioning games that were the main technique of philosophical training in Plato’s Academy. (W & H put the word “game” in scarequotes, as if it were a technical term of my interrogative model. In reality I simply took it over from such earlier scholars as Gilbert Ryle and Richard Robinson.) What Aristotle did was something no one had done before him, viz, to develop a genuine theory of such questioning games. Or perhaps the term “theory” is wrong here, for Aristotle’s aims were in part quite down-to-earth. He did not even hesitate to give practical advice how to confuse an opponent or keep him in the dark as much as possible. Hence it is more accurate to refer to the *Topics* and *De Sophisticis Elenchis* as handbooks of the Socratic questioning games rather than mere theories thereof. At the same time Aristotle saw in *elenchus*-like questioning procedures an important part of the scientific method.

Now in the Platonic dialogues featuring Socrates there is no distinction between inferential and interrogative steps. All the steps, including conclusions that for us are archetypically deductive ones are put forward as responses to

Socrates's questions. If you need an example, the slave-boy episode of the *Meno* is as good as any. Only rarely does Socrates say at the end of an argument something like, "Let's now add our admissions together", whereupon he draws (as we would say) some rudimentary conclusions from the answers of his interlocutor. But such explicitly indicated inference steps are at best rare exceptions.

Now the fundamental fact – as I see it – that is missed by W & H is that the same is true of the arguments studied in Aristotle's *Topics* and *De Sophisticis Elenchis*. Insofar as Aristotle has there in mind steps in an argument which twentieth-century philosophers would consider logical inferences, they, too, are considered as question-answer steps, perhaps of a special kind, but still only one species of question-answer steps. For this reason, the fundamental question W & H are asking does not make any historical sense, unless some further explanations are offered. *A fortiori*, I can respond only indirectly to the purported criticisms of W & H. In the form they are put forward, they presuppose a distinction which for Aristotle would have been without any difference.

This main point calls for explanations, evidence, and further development. As a preparation for them, I have to straighten out a couple of misunderstandings on the part of W & H. (Undoubtedly these misunderstandings are due to inadequate explanations in my earlier expositions.) As W & H recall, I have put forward a logical model of interrogative inquiry and recommended it *inter alia* as a framework for analyzing Aristotle's logic and methodology. This does not mean, however, that there are not differences between the interrogative model and the *elenchus*-like procedures Aristotle studies. The main *prima facie* discrepancy is precisely what I am discussing, viz, the lack in Aristotle's early logical works of any sharp overall distinction between interrogative steps and logical inference steps in an argument.

But if so, how come he later came to study garden-variety logical inferences in his *Prior Analytics* and draft them into the service of his philosophy of science in the *Posterior Analytics*? The answer lies in the practical purpose of the *Topics*. Aristotle did not only want to study knowledge-seeking interrogative games for abstract theoretical purposes. He wanted to show how to win in such games. He was concerned with the strategies of questioning (and answering). Now every lawyer who has cross-examined a witness knows what the most important strategic (and tactical) principle of active questioning is. It is to be able to anticipate the respondent's answers. "Never ask a question [in a cross-examination in a court of law] if you don't know what the answer will be", as lawyers' old saw goes.

Now Aristotle's great discovery was that there are yes-or-no questions whose answer is completely predictable. They are the questions whose answer is, as we would say, logically implied by the earlier answers. Because of their strategic importance Aristotle began to study them, which of course amounted to the study of logical inferences. He began to investigate what it is about the earlier answers that necessitate a new one, identify different types of such necessitated question-answer steps, formulate rules for them, and so on. This is the way in

which Aristotle was led from the study of questioning games to the study of formal logic.

Signs of this shift can be seen in *De Sophisticis Elenchis*. When the characteristics of a question-answer step such as e.g. its fallaciousness and the way that fallacy is explained, depend on the particular answerer, including his cognitive state, those characteristics are *ad hominem*. When they depend only on the earlier steps of the argument, they are *ad argumentum*. Logical inferences in our sense are answers that are necessary *ad argumentum*.

What that means is that in such a necessitated answer the interlocutor becomes irrelevant. From our latter-day perspective, we might as well dispense with the original Socratic irony (pretended ignorance). We might as well abstract away from the answerer completely and let the questioner draw the conclusion himself. This move, if we carry it out, essentially takes us from the Socratic and early Aristotelian questioning procedures to my interrogative model. But this step is not unavoidable, even though it is well motivated theoretically. There is nothing intrinsically wrong with the questioning procedures envisaged in the *Topics*.

One remarkable fact here is that Aristotle never took this step. Even though it has escaped the attention of philosophers and scholars, Aristotle is still in the two *Analytics* thinking of logical inferences as steps in a questioning process. I cannot here present the kind of evidence for this thesis that it would deserve. One single example will have to suffice.

Right in the middle of explaining the nature of logically necessary inferences (that is to say, question-answer steps where the answer is implied by earlier answers) Aristotle suddenly catches himself and warns that such inferences are not the only steps of interrogative inquiry.

Yet one might perhaps wonder what purpose there could be in asking these questions about such items if it is not necessary for the conclusion to be the case – [apparently] you might as well ask an arbitrary question and then state the conclusion, But we should ask questions not on the grounds that the conclusion will be necessary because what makes the conclusion necessary was asked [earlier] (*dia ta erotemena*), but rather because it is necessary for the person who accepts the proposal [i.e. answers the question in the proposed way] to state the conclusion – and to state it truly if they hold truly. (*An. Post.* A 6, 75a22–27; I have modified Barnes' translation.)

Most recent translators and commentators have had no inkling of what is going on in this passage. Out of desperation, some even try to insert a completely unsupported restriction to merely dialectical reasoning. Yet as soon as we realize that Aristotle is treating the entire inquiry, including deductive steps, as an interrogative process, what he says becomes crystal clear. What Aristotle is saying is that it is of course all right to ask a question even when the answer is not made necessary by earlier answers. It is especially interesting to see what Aristotle says in the last sentence about the necessity of the answers relative

to the respondent. He might as well have borrowed his earlier terminology and said that answers not necessitated by earlier ones must be judged *ad hominem*, not *ad argumentum*.

This example illustrates vividly how futile it is to ask without qualifications whether some mistake in reasoning is a bad inference or an answer to a badly chosen question. Whatever distinction one can draw here is a distinction between different kinds of interrogative steps.

This general point is applicable to a number of more specific issues. In a number of places, including *De. Soph. El.* 165a3, W & H interpret Aristotle's word 165 a3, *sylogismos*, as deduction or logical inference. This is highly tendentious. Aristotle's definition of syllogism (*An. Pr* I, 1, 24b 19–21; *Top.* I, i, 100a25–27) is not only compatible with logically necessitated answers in an interrogative game. The question can be raised to what extent it was originally calculated to apply to every answer in an interrogative game in that the necessity in question could also be of an *ad hominem* variety. The latter is strongly suggested by the end of the quote from *An. Post.* A 6, 75a22–27.

Be this as it may, it is far from clear that Aristotle's "syllogisms" were restricted to deductive inferences. In *Top.* I, i, 100 Aristotle identifies dialectical syllogisms as those that proceed from *endoxa*. But in Aristotle's later philosophy of science we are supposed to argue dialectically from *endoxa* back to the first deductive premises of a science. Hence the dialectical "syllogisms" of *Top.* I, i, 100a31 can scarcely be deductive.

And what are the deductive "syllogisms" of the *Topics* supposed to consist in? Propositions (protaseon)? But according to *Topics* I, iv such "propositions" are in reality questions of a certain kind.

It is thus historically misleading to ask whether the fallacies Aristotle studied were bad inferences or mistakes in questioning. There is a sense in which inferences, too, were for Aristotle question-answer steps. Systematically, too, there are plenty of reasons to emphasize the close ties between questions and inferences. It seems to me that I have done myself injustice by speaking of an interrogative model of inquiry, as if it were an ad hoc construction somehow imitating certain special kinds of knowledge-seeking processes. There are plenty of reasons to think of the interrogative model as the general theory of ampliative reasoning. In any case, even formally questioning steps and logical inferences are very close to each other. For instance, a propositional question can take us from its presupposition

$$(1) (A \vee B)$$

to either *A* or *B* as its answer. This can be compared with the disjunction rule in a tree method, where the construction is divided into two branches according to which *A* or *B* is added to the construction. Likewise, a simple wh-question can take us from its presupposition

$$(2) (\exists x)A[x]$$

to an answer of the form

(3) $A[b]$

while a rule of existential instantiation in logic takes us from the same formula to a formula of the form

(4) $A[\beta]$

where β is not a real name but a new variable-like symbol (“dummy name”). As the reader can see, (3) and (4) are identical except for the status of the instantiating term (name).

This parallelism is not merely formal or architectonic. It shows that in implementing a strategy we are facing the same choice in the case of question selection and in the case of selecting a formula to apply deductive rules to. W & H think that the rules of logic are seen [in the interrogative model] as definitory of the game, determining what is and what is not a ‘permitted’ move. However, such rules do not tell us how to play the game well. This is the job of the interrogative rules. More generally, the interrogative rules fall under the heading of strategy. (W & H, Sec. 1). This is a radical and pernicious misunderstanding of the nature of the logic of questioning in general and of the role of strategies in it in particular. Of course rules of logical inference and the rules of questioning are completely on a par when it comes to the distinction between definitory and strategic rules. Of course must there be definitory rules for both kinds of steps in an argument. And of course an inquirer faces a strategic choice in both kinds of moves. In a logical inference move, the problem is which of the so far established propositions to use as a premise of an inference. In an interrogative move, the problem is which of the already reached truths to use as the presupposition of a question. Thus there are strategic choices about deduction quite as much as there are strategic choices about questioning. Indeed, the most exciting results concerning strategy selection in interrogative inquiry concern the relation of the two kinds of strategic choices.

Admittedly, Aristotle came to recognize some difference between on the one hand moves in an interrogative game which are necessitated by earlier answers, that is, between what for us are logical inference steps, and on the other hand moves that depend on the respondent and hence correspond to question-answer moves. However, this distinction was never articulated very sharply by Aristotle. And in any case it does not seem as if he ever came to think that the two kinds of moves are associated with different kinds of fallacies. For instance, fallacies of language can beset questions and answers as well as inferences. Admittedly, Aristotle made a distinction between dissolving fallacies by reference to the argument (*ad argumentum*) and by reference to the respondent (*ad hominem*). This distinction is found in *Topics* VIII, 11, 161a17–21; *De Soph. El.* 8, 170a12–19; 20, 177b33–34; 22, 178b15–17; 33, 1 83a21–23. But this distinction does not seem to be correlated with the distinction between the two kinds of steps. Hence it does not even seem to make much sense to ask in Aristotelian terms whether some particular fallacy is a mistake in inference or in questioning. Indeed, his null hypothesis seems to have been that the same mistakes can

happen in the two kinds of steps, just because they were after all both question-answer steps. For instance, as was pointed out earlier by Richard Robinson (1971), the fallacy of begging the question began its career as a clear-cut mistake in questioning but was later pushed by Aristotle into the format of a mistake in logical inference.

If we are operating in the contemporary framework of logical vs. interrogative steps of argument and definitory rules, we can correspondingly classify fallacies as logical vs. interrogative, definitory vs. strategic. We can even discuss which slot some particular Aristotelian fallacy fits best when his views are rationally reconstructed. But there is no hope finding hard-and-fast classifications of that sort in Aristotle. Hence it is not possible to give categorical, historically correct answers to questions whether this or that Aristotelian fallacy was “really” mistakes in inference or reasoning. If my earlier papers have given the impression that I expect such answers to be forthcoming, I want to correct them on this point.

This does not mean that one cannot usefully discuss the question whether Aristotle’s fallacies should be rationally reconstructed this way or that way. The most constructive construal of what W & H are trying to do is undoubtedly to read them in the spirit of such rational reconstruction. But if so, one cannot expect to end up with an unequivocally true historical interpretation. What one can aim at is enhanced understanding of the logico-linguistic phenomena Aristotle was concerned with.

If what one is trying to do is such a rational reconstruction, the case for or against W & H depends crucially on how illuminating their analysis is when it comes to the two “hard core fallacies”, as W & H rightly call them, the fallacy of many questions and that of begging the question. In both cases I am prepared to stand on my ground.

As far as the fallacy of many questions is concerned, I do not see many insights ensuing from their rational reconstruction, at least in comparison with mine. One criticism of what W & H say is that they do not give an accurate account of the interrogative interpretation, according to which the fallacy lies in asking a question whose presupposition has not been established. For one thing, they do not realize the precise meaning of “presupposition” in the interrogative model, as witnessed by their blithe assertion that inferential premises have presuppositions, too. Sure, in some pretheoretical sense, but that sense has nothing to do with presuppositions in my sense. Indeed, in the fascinating analogy sketched above it is the premises of an inference that correspond to the presuppositions of questions.

Likewise, W & H take the designation “many questions” in a naive unanalyzed sense in which an ambiguous question is really “many questions” in one. On my account, Aristotle’s phrase has a specific meaning. Asking a question without having established its presupposition can be labeled a fallacy of many questions because whoever answers such a question gives an implicit affirmative answer to the tacit preliminary question which would have been needed to establish the presupposition of the overt one. Of course, in the light of hindsight,

Aristotle's term is not accurate within the framework of the interrogative model, for the presupposition could perhaps have been established by an inference rather than another question.

The usefulness of this viewpoint is illustrated by the fact that there is another kind of use of "many questions" which is not noted by Aristotle or by most twentieth-century analysts of questions. Aristotle's reason is undoubtedly that this use of tacitly dual question is not fallacious. Here is an example:

He turned back to his witness. "Is there any explanation that you can think of for this extraordinary bonding of slug and wadding?" "It could happen if there were some sort of obstruction in the barrel or muzzle of Ferry's gun." (A. Lewis and H. MacDonell, 1984, p. 23.)

Here a yes-or-no question is answered as if it were a wh-question. The reason is obvious on my presuppositional analysis: The explicit question is calculated to establish the presupposition of a certain wh-question (What was an explanation?) that the answerer know the questioner wanted to ask. Answering the latter the respondent tacitly answers the presuppositional question affirmatively. Thus the asking of "multiple questions" can be elliptical rather than fallacious.

There are plenty of insights of this kind, both systematic and historical that ensue from my analysis. I do not see anything comparable being yielded by the rational reconstruction of W & H.

As far as the fallacy of *petitio principii* is concerned my prescription was in anticipation followed by Richard Robinson in his witty skit "Begging the Question 1971". I have little to add to Robinson's argument, but a historical reminder is perhaps still in order. We have to take seriously the down-to-earth (or down-to-agora) character of Aristotle's *Topics*. He was trying to say something that was actually relevant to, and potentially useful for the participants in, the actual questioning games played in the Academy. Now you cannot seriously envisage a clever, ambitious young student of Plato's, Theaitetos or one of his rivals, as being tempted to employ a circular deduction in his argument. There would not have been any earthly reason for Aristotle to warn his friends about arguing the way W & H think: P, Q, ergo P. In contrast, when the inquirer is trying to answer a "big" or principal question by means of answers to a number of "small" or operative questions, it is far from clear why the inquirer must be satisfied with the latter and not raise the former immediately. It is so far from clear that Aristotle never tells us why it is that one must not "petition" (i.e., ask) the principal question, in other words, why begging the question is a fallacy.

As far as we are talking about the merits of different rational reconstructions of the fallacy of *petitio principii* is concerned, my interpretation is connected with one of the most fundamental insights into the role of questions and answers in rational inquiry, viz, their dual role. The aim of the entire enterprise may be to answer a principal question by means of answers to a number of

“small” (operative) questions. This insight has served as the basis of an explicit theory of why-questions (Hintikka and Halonen 1995) plus a large number of other specific applications.

But why is begging the question a fallacy on this view? Aristotle never tells us why. An explanation is nevertheless implicit in what has been said. Not all questions can be answered by the inquirer’s source of answers. The only case in which a question needs an inquiry for its solution is when it is not answerable directly. And then it is futile to raise it.

I do not see that the inferential construction W & H favor yields comparable insights. What W & H try to do is to seek to relate the “begging the question” problematic to the rules of inference in certain recent systems of nonclassical logic. I am thoroughly unconvinced both of the existence of any real connections and also of the value of merely tinkering with the rules of inference of a logical system.

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CHAPTER 12

CONCEPTS OF SCIENTIFIC METHOD FROM ARISTOTLE TO NEWTON

In this paper, I shall not try to present any results concerning the history of philosophy or concerning the history of philosophers' ideas about the scientific method in the middle ages. Instead, I shall comment on the conceptual frameworks which have been used, or can be used, in such historical studies. It seems to me that our understanding of what actually happened in the middle ages can be greatly enhanced by a suitable conceptual framework in which the specific historical problems can find their appropriate niche. I shall also suggest that in the study of the history of the scientific method, as in so many other walks of philosophical scholarship, the best way of finding the right framework (in the sense of the historically relevant and useful framework) is to go back to the main Greek philosophers, especially to Aristotle, and to try to reach a deeper understanding of their ideas. Their philosophy was the most important backdrop of medieval thought, which often can be looked upon as a gradual transition from Greek ideas to ours. In other respects, too, will an appropriate map of the conceptual situation help to fit different actual historical developments together as pieces of a larger overall picture.

In this spirit, I am led to ask: How do we twentieth-century thinkers view the scientific process, and how do our ideas differ from Aristotle's ideas in this respect? This question might seem to be too general and ambiguous to admit of a clear response, but in reality there is a clear and yet informative answer to it. A twentieth-century philosopher is likely to think of scientific inquiry as consisting of making observations (and gathering other kinds of empirical evidence) and then of using them as a stepping-stone to general explanatory theories. The step from data to theories is sometimes called a (species of) scientific inference. It is generally agreed that this so-called inference cannot be deductive. The main watershed between different overall conceptions of science is the question whether there is a nondeductive kind of inference, usually called inductive inference, to mediate the step from observations to general theories or whether this step is in principle a matter of hypothesis. According to the latter idea, we cannot infer theories or other general truths from phenomena, but we can test them by comparing their deductive conclusions with observations. Thus we obtain two of the main types of modern models of scientific inquiry: the inductivist model and the hypothetico-deductive model. Although these two models do not quite enjoy any longer the monopoly they used to have among philosophers of science, they are being widely used tacitly or explicitly by historians of philosophy as a part of their conceptual framework.¹

The basic idea of the Aristotelian conception of scientific inquiry can also be indicated very simply. Aristotle conceives of scientific inquiry literally as inquiry, that is, a questioning procedure. This is shown amply by the *Topics*, among other things. One precedent for such a procedure were the Socratic questioning games practiced in the Academy.²

Originally, even deductive inferences were simply special kinds of moves in these questioning games, viz, answers that every rational person would have to give, given his earlier admissions. Aristotle soon realized the special role of such preordained answers or admissions and tried to systematize them in his syllogistic logic. He even tried to make syllogisms the only vehicle of putting the first principles of a science to use for the purpose of explaining various phenomena. But even then the road to these first principles remained a dialectical one.

The interrogative or erotetic concept of inquiry is thus amply in evidence in Aristotle. In a more traditional terminology, it would be called the dialectic method. I am avoiding this label, however, because on the long way to twentieth-century philosophy it has acquired all sorts of misleading associations.

It is fairly clear that something like the interrogative model of science remained influential in the middle ages. For instance, the various commentaries on Aristotle freely use Aristotle's interrogatively loaded terminology of "admissions", "acceptances by the learner", etc.

This fact is enough to put one facet of medieval thought into a new light. If there indeed was a relevant element of interrogative knowledge-seeking in medieval epistemology and philosophy of science, it is to be expected that the logic of such interrogative procedures should have been studied in so many words. This expectation is fulfilled by the important but incompletely understood *obligationes* tradition.³ Whatever detailed problems there is about the interpretation of these question-answer dialogues, in their standard form (*antiqua responsio*) they were not, and could not have been, a form of counterfactual deductive reasoning, as has been claimed. For in them one was not examining what follows logically from the initial *positum* or what is inconsistent with it, but rather what follows logically from, or is inconsistent with, the *positum* plus the responder's earlier admissions. This is in fact characteristic of interrogative or "erotetic" knowledge-seeking. Admittedly, later in the fourteenth century obligation-games were given a more deductive twist by some logicians. But this merely illustrates my recommendation of viewing medieval thought as a transition from the Greek to the modern viewpoint.

Admittedly, at first sight the *obligationes* might not seem to have a great deal to do with conceptions of scientific method. However, their close link with the *sophismata* provides a bridge, for problems concerning knowledge-seeking and science were frequently dealt with in the form of *sophismata* in logic, theology, and natural philosophy, and in this context the obligations terminology was largely employed.

In general, obligation-games illustrate several features of interrogative knowledge-seeking. We can study this kind of knowledge-seeking by means of what

I have called the interrogative model of inquiry.⁴ This codification of the dialectical conception of knowledge-seeking is the main conceptual framework I am recommending to the historians of scientific method.

The interrogative model seems at first sight to be simplicity itself. In it, an idealized inquirer starts from a given initial premise T. The inquirer may put questions to a source of information. Depending on the intended application, we may call this source of information “the oracle” or nature. The inquirer may draw deductive conclusions from T together with the answers. The aim of the game (or the inquirer’s aim) is to prove a given conclusion C or (in another variant of the model) to answer a question “B or not-B?” Normally, the presupposition of a question must have been established before the question may be asked.

How does this model, applied to scientific inquiry, differ from the received models of science? It turns out to be more flexible than its rivals in several respects.

For one thing, the Oracle’s answers need not be observations. In some of the most interesting variants of the model, controlled experiments are conceived of as a scientist’s questions to nature. But the oracle’s answers may instead be intuitions of innate ideas or, as in Aristotle, well-established general opinions, *endoxa*.⁵ They need not even be all true, just as *endoxa* sometimes are deceptive. But all that happens then is that the inquirer has to ask further questions to establish the veracity of the oracle’s particular answers.

One especially important corollary of this wider conception of what nature can tell us or what we can otherwise establish interrogatively is the following: An important parameter in the interrogative model is the logical complexity of the answers that the oracle can provide to the inquirer. In the received models of science, both in the inductivist and in the hypothetico-deductive model, it is assumed that nature (who in the game of science plays the role of the oracle) can only provide particular (i.e., quantifier free) propositions as answers to the inquirer’s questions. In the wider model, there is no longer any reason to accept this “Atomistic Postulate”, as I have called it. And if the Atomistic Postulate is not assumed, the rationale of both of these models collapses. For then there is no reason to conclude that general theories could not be arrived at deductively from nature’s answers to the inquirer’s questions or, as Newton puts it, could not be deduced from the phenomena.⁶

Now there are at least two historically important ways in which a scientist can be thought of as being able to obtain general truths as immediate (non-inferential) answers to his or her questions.

The first way is post-medieval. It is the way of controlled experimentation. For the typical outcome of a successful controlled experiment is to find a dependence between two variables, the controlled and the observed one. The codification of such an “answer” is no longer a quantifier-free proposition. It has at least one existential quantifier dependent on a universal one.⁷ This was essentially Newton’s way.⁸

The other way is Aristotle’s. It is deeply rooted in his psychology of thinking

according to which to think of X is for one's soul to take on the form of X. This is as genuine a realization of the form as any external one. And if so, any other form Y which necessarily accompanies X will also be present in the soul. Thus any necessary connection between forms can be ascertained simply by thinking about them, according to this Aristotelian psychology (and metaphysics) of thinking.⁹

This means that for Aristotle general truths can be seen immediately in one's own soul, of course after suitable preparation. In terms of the interrogative model, this means that the oracle is assumed to give an Aristotelian scientist general answers, and not only particular ones. In the light of what was said earlier, it is therefore small wonder that neither the inductivist nor the hypothetico-deductive model of science played any appreciable role in medieval philosophy.

This does not mean, however, that the Aristotelian idea of direct access to general truths was universally accepted in the middle ages. As soon as scientific inference was conceptualized as involving a step from particulars to a general truth, it became clear that such a step was not unproblematic, and could not be thought of as nature's direct answer to a scientist's question. In the middle ages, the rise of nominalism seems to mark an important watershed in this respect. This is only to be expected in view of Aristotle's idea of the realization of universal concepts in the form of "forms" in the human soul as a source of scientific truths. Indeed, this Aristotelian background helps us to understand why the rejection of universals was as crucial a development in medieval thought as it in fact was. This helps us to understand the impact of nominalism in general. For instance, nominalism cannot be construed as a skeptical philosophy, as several speakers at this very congress will emphasize. Its impact is seen by comparison with Aristotle's methodology which in effect means giving up, at least partly, the idea that nature can give us *general* answers to suitable questions by means of a realization of the relevant forms in one's mind.

Did this mean a radical change in philosophers' idea of the scientific process? The interrogative model suggests an interesting answer, which is *no*. For the interrogative model shows that you can often compensate for the effects of an additional restriction on the oracle's (nature's) answers by strengthening the initial theoretical assumption T.¹⁰ In fact, logicians know that even if answers to questions are restricted to (negated or unnegated) atomic propositions, there can be theories T which jointly with nature's answers to questions enable the inquirer to establish *any* true proposition. (These are the theories that are known as *model-complete* ones.)

These observations throw highly interesting light on developments in the medieval period. The very same philosophers who began to think of scientific inference as a passage from particular observations to general truths were also among the first ones to evoke prior general propositions to back them up. Duns Scotus is an especially interesting case in point. He writes as follows:¹¹

As for what is known by experience, I have this to say. Even though a

person does not experience every single individual, but only a great many, nor does he experience them at all times, but on frequently, still he knows infallibly that it is always this way and holds for all instances. He knows this in virtue of this proposition reposing in his soul: "Whatever occurs in a great many instances by a cause that is not free, is the natural effect of that cause." This proposition is known to the intellect even if the terms are derived from erring senses, because a cause that does not act freely cannot in most instances produce an effect that is the very opposite of what it is ordained by its form to produce.

This quotation is interesting in that it illustrates what for a thinker like Duns Scotus was the alternative to the idea that nature can answer questions concerning universals. Even though nature doesn't do so *apud Scotum*, the intellect knows certain completely general truths like the regularity of nature with a certainty that is not derived from sense-experience. They are therefore of the character of initial premises of the scientific enterprise rather than answers (new facts) contributed by nature.

What is important here is that this novelty does not turn Duns Scotus away from the interrogative conception of inquiry. What it does is to shift the focus from nature's answers to initial theoretical premises. One symptom of this is what Duns Scotus says in so many words in the quoted passage, viz., that the results based on the principle of the regularity of nature are infallible, even though they are based only on a sample of the individuals covered by the generalization. In this respect, I can say, they are just like the results of an interrogative inquiry. Thus Duns Scotus does not anticipate Hume's doubts about induction nor even the twentieth-century conception of induction, even though one recent author refers in this context to Duns Scotus's "inductive evidence".¹² Admittedly, soon afterwards Duns Scotus says that in this way we can only reach "the very lowest degree of scientific knowledge".¹³ But this inferior degree does not mean a lower level of certainty, for the principle of the regularity of nature is said to remove in such cases all "uncertainty and infallibility".

Thus it is in principle misguided to see in medieval thinkers like Duns Scotus anticipation of Hume's problems or even anticipations of the hypothetico-deductive or the inductivist models of science. These models came about only when the skeptical ideas found two different inroads into the interrogative conception of scientific inquiry. It was not enough to restrict nature's answers to negated or unnegated atomic ones. One also has to eliminate in principle all nontrivial initial premises. This is the reason why it was crucially important for modern empiricist philosophers like Locke and Hume to attack the doctrine of innate ideas.

The same observation explains why Newton's overall conception of the structure of science bears striking resemblances to Aristotle in spite of its mathematical character.¹⁴ For according to Newton nature can yield general answers to a scientist's questions, of course not answers concerning necessary

connections between “forms” as in Aristotle but answers taking the form of functional dependence between variables, typically obtained through a controlled experiment. No wonder Newton, too, believed that general truths can be deduced from phenomena.

It is of interest to see a little bit more closely what is involved in the abandonment of the Aristotelian idea of direct access to general truths. One corollary to the Aristotelian theory of thinking as a realization of forms in the soul is that whatever follows as a matter of the nature of things in question, that is, as a matter of their essential forms, can be established in thought. There is therefore no distinction in Aristotle between logical and natural (“formal”) necessity. This conclusion, which has of course been misunderstood time and again, is shown to be a genuine Aristotelian doctrine in my monograph on Aristotle’s theory of modality.¹⁵ Another corollary is that whoever does realize the premises clearly and distinctly in his or her mind, cannot avoid drawing the conclusion. Full-fledged *akrasia* is as impossible in logic as it is in rational action (i.e., in a practical syllogism).¹⁶ All these Aristotelian views have their echoes in medieval thought.

Of course, in order to be able to see what necessarily accompanies a form one must first realize fully the form in one’s mind. Hence the crucial task for an Aristotelian scientist is not inference from particulars to general truths, but the formation of general concepts (“forms”). Accordingly, the first premises of an Aristotelian science are definitions, and the way to reach them is the dialectical process which leads up to the definition of a concept (i.e., a full grasp of its essential “form”).¹⁷

All this is part and parcel of what I meant by saying that for Aristotle questions concerning general propositions were (directly) answerable. To give up this answerability assumption can therefore take the form of giving up the identification of logical (metaphysical) necessity and natural necessity. In so far as this natural necessity is construed as nomic necessity, the step away from Aristotle took the form of denying the identification of unrestricted generality and metaphysical (conceptual) necessity. As Knuuttila and others have spelled out, this step was taken most resolutely by Duns Scotus.¹⁸

Now we can see that this step was not an isolated change in scholastic philosophers’ ideas about necessity and other modal concepts. It affected their outlook on the entire structure of the scientific search of knowledge.

These general observations can be illustrated by applying them to the history of one particular concept, that of induction. There exists a useful study of the history of this concept by Julius Weinberg, but unfortunately he assumes throughout his essay something essentially tantamount to the twentieth-century notion of induction as an inference from particulars to general truths.¹⁹

At first sight, the story of induction within an interrogative framework might look rather like the “curious incident of the dog in the night-time” in Sherlock Holmes: the dog didn’t do anything. Likewise, there does not seem to be any niche for the notion of induction in the interrogative conception of scientific investigation. Even if we relax our model and allow for answers by nature that

are true only with a certain probability (and hence can be false), the result is not the inductivist model of science but its mirror image.²⁰ In inductive logic, we study uncertain (nondeductive) inferences from data that are typically assumed to be unproblematic. In the loosened interrogative model we are studying deductive (and hence certain) inferences from uncertain answers by nature.

This negative finding is nevertheless itself quite remarkable, just as its counterpart was in Conan Doyle. It is indeed remarkable how little the medievales had to say about induction in anything like the twentieth-century acceptance of the term.

There is more to be said of this concept, however. Even if the twentieth-century notion of induction is an uninvited guest in the house of interrogative inquiry, there is a historically important namesake notion that arises naturally from the idea of scientific inquiry.²¹

This can be seen as follows: Even if nature's answers can be general truths, they can be partial. For instance, in an Aristotelian search for a definition of pride or magnanimity (*megalopsychia*, cf. *An. Post.* B 13), we can directly find out only what characterizes each of a number of subclasses of pride. Likewise, an experimental scientist can find what functional dependence obtains between the variables he or she is interested in over a number of intervals of values of the controlled variable. The experimentally established dependence can even be different over the different intervals. Such general but restricted answers lead to the problem of reconciling these partial answers with each other. Thus Aristotle writes:

I mean, e.g., if we were to seek what pride is we should inquire, in the case of some proud men we know, what one thing they all have as such. E.g. if Alcibiades is proud, and Achilles and Ajax, what one thing do they all [have]? Intolerance of insults; for one made war, one waxed wroth, and the other killed himself. Again in the case of others, e.g. Lysander and Socrates. Well, if here it is being indifferent to good and bad fortune, I take these two things and inquire what both indifference to fortune and not brooking dishonour have that is the same. And if there is nothing, then there will be two sorts of pride.

This reconciliation procedure, I have shown elsewhere, is precisely what Aristotle elsewhere calls *epagoge* or induction.²² What I did not know when I wrote my earlier paper was that essentially this interpretation of Aristotle's concept of induction was fairly common among subsequent Aristotelians. Thus Aquinas assimilates to each other induction and the method of looking for definition by means of the method of division. "... the same thing happens in the method of division as happens in the method of induction."²³ Here the method of division is "used in obtaining the *quod quid* of a thing". The context makes it clear that Aquinas is thinking of an interrogative search for definitions. This is shown by statements like the following:²⁴

For one who induces through singulars to the universal does not demonstrate or syllogize from necessity. For when something is proved syllogistically it is not necessary to make further inquiry concerning the conclusion *or ask that the conclusion be conceded*; what is necessary is that the conclusion is true, if the premises laid down are true. [Emphasis added.]

However, Aquinas mistakenly thinks that the search for definitions described in *An. Post. B 13* (by means of magnanimity example) is intended by Aristotle to be a method different from division and alternative to it. It is nevertheless significant that, in discussing the famous last chapter of *An. Post. B*, Aquinas assimilates induction and the search for definitions along the lines of *B 13* to each other, and even refers to one of the examples employed there.

This identity of the two apparently different processes of definition-seeking (seeking for the *quod quid* of a thing) and induction throws some light on the history of the notion of induction. For instance, we can see in what sense Aristotelian induction must be complete: the different kinds of *megalopsychia* whose definitions have to be reconciled with each other must collectively exhaust the entire field of all instances of magnanimity. This means at one and the same time to exhaust different subclasses of magnanimity and all the particular instances of magnanimity. Of course, in Aristotle the real action in induction lies in the reconciliation of the definitions of the subspecies, not just in the exhaustion of all instances.

This shows how thin the line is from Aristotelian induction to the modern conception. This line was repeatedly transgressed as early as in the middle ages.

What is the inductive reconciliation process like? An answer to this question is facilitated by a comparison with the quantitative version of the extension and reconciliation problem. In this problem, different partial functions with exclusive ranges of definition are to be subsumed under one single comprehensive functional dependence. I have shown elsewhere that this kind of reconciliation problem occurs often in the history of science and at crucial junctions in the development of science.²⁵

It is easily seen that the reconciliation cannot be subject to simple rules. It involves experimentation with the mathematical expressions of the different functions to be reconciled with each other, and hence has a definite element of conceptual analysis to it. It represents a type of scientific reasoning, including the use of mathematics in science, that has not been discussed very much by philosophers.

Here the similarity between the reconciliation problem in modern science and Aristotelian induction is particularly close. For, as the *megalopsychia* example shows Aristotle understood inductive search of definitions to contain a heavy dose of conceptual analysis and even conceptual reorganization, including the partial rejection of some of the relevant *endoxa*. One is tempted to say that Aristotelian induction is merely a qualitative version of the modern reconciliation process.

Here a couple of challenging tasks open both to systematic and to historical

research. One is to try to understand what goes into the inductive reconciliation process, both in its quantitative and its qualitative forms. Another problem is to understand the development of the concept of induction in its Aristotelian sense into an integral (though not always explicitly recognized) part of the methodology of modern science. I have argued that the functional extrapolation and reconciliation task is what Newton meant by induction. But where he got his ideas from and, more generally, what happened to the notion between Aristotle and Newton largely remains to be investigated.

Certain things can nevertheless be said. It is unmistakable that the modern conception of induction began to rear its ugly head in the fourteenth century. Such writers as Ockham, pseudo-Scotus etc. discuss induction unmistakably as a step from particular cases to a general law that falls short of necessity. This is for instance stated explicitly by pseudo-Scotus who says that incomplete induction cannot provide necessity, only evidence.²⁶ This is a far cry from the Aristotelian idea of induction sketched earlier.

In a wider perspective, an especially interesting point seems to be a connection between this change in philosophers' concept of induction and the rise of nominalism. This connection is shown by the Aristotelian background mentioned above, and it helps us to understand why nominalism meant such a break with earlier ideas of human knowledge-seeking. A nominalist could not conceptualize thinking as a realization of a form in one's mind and therefore could not assume that necessary connections between forms could be seen simply by realizing them in one's mind. A nominalist, in brief, could not assume that nature answered general questions, at least not directly, only particular ones. This helps us to appreciate the impact of nominalism in general.

This is an instructive example of how observations of the kind proposed here can throw light on major issues in the history of philosophical thought.

NOTES

1. Their restrictive character is shown by the difficulty of fitting major historical figures into either pigeonhole. Was Newton an inductivist or a hypothetico-deductivist? Neither shoe fits very well. And the same question can be raised about the medievals.

What is needed is a wider and more realistic conceptual framework for understanding the actual history of philosophical, scientific, and theological thought. That is what I shall try to provide here for the history of the scientific method, just as I have (with several others) tried to provide a new framework for studying the history of the concept of being. That earlier attempt is documented in Simo Knuuttila and Jaakko Hintikka, editors, *The Logic of Being: Historical Studies*, Synthese Historical Library, D. Reidel, Dordrecht, 1986.

2. See here my paper, "The Fallacy of Fallacies", *Argumentation* vol. 1 (1987), pp. 211–238, and the literature referred to there.
3. Here the work of Simo Knuuttila and his associates promises to be decisive. I am here relying on their results. See, e.g., Simo Knuuttila and Mikko Yrjönsuuri, "Norm and Action in Obligational Disputations" in O. Pluta, ed., *Die Philosophie am 14. und 15. Jahrhundert*, B. R. Grüner, Amsterdam 1988, pp. 191–202.
4. The work on this model is largely still in progress. For interim expositions, cf., e.g., my "Knowledge Representation and the Interrogative Model of Inquiry", forthcoming in a volume of new papers on epistemology, edited by Keith Lehrer and Marjorie Clay; Jaakko Hintikka

- and Merrill B. Hintikka, "Sherlock Holmes Confronts Modern Logic", in E. M. Barth and J. L. Martens, eds., *Argumentation: Approaches to Theory Formation*, Benjamins, Amsterdam, 1982, pp. 55–76; and "The Logic of Science as a Model-Oriented Logic", in P. Asquith and P. Kitcher, eds., *PSA 1984*, vol. 1, Philosophy of Science Association, East Lansing, 1984, pp. 177–185. See also the work referred to in other notes.
5. For the concept of *endoxa* and for their role in Aristotle's argumentation, see. G. E. L. Owen, "Tithenai ta Phainomena", in S. Mansion, ed., *Aristotele et les problèmes de méthode*, Louvain, 1961, and. cf. my "The Fallacy of Fallacies", op. cit.
 6. Cf. note 4 above.
 7. See here my paper, "What Is the Logic of Experimental Inquiry?", *Synthese* vol. 74 (1988), pp. 173–190.
 8. See here Jaakko Hintikka and James Garrison, "Newton's Methodology and the Interrogative Logic of Inquiry", unpublished contribution to the April 1987 symposium on Newton in Jerusalem.
 9. This peculiarity of Aristotelian psychology of thought is so striking that it has barely been acknowledged in its full strangeness (strangeness from our twentieth-century viewpoint, that is to say). For indications of it, cf. my paper "Aristotelian Infinity", *Philosophical Review* vol. 75 (1966), pp. 197–219. (See also Chapter 3 above.)
 10. Cf. here my "The Logic of Science as Model-Oriented Logic", op. cit.
 In general, the possibility of partial trade off between strong assumptions as to what is answerable and strong a priori premises is an extremely interesting fact which can throw light on several other historical phenomena.
 11. Duns Scotus, *Opus Oxoniense*, i, d.3, q.4, translated in Wolter, *Duns Scotus: Philosophical Writings*, p. 109.
 12. See N. Kretzmann, A. Kenny and J. Pinborg, eds., *The Cambridge History of Later Medieval Philosophy*, Cambridge University Press, Cambridge, 1982, p. 511.
 13. Op. cit., i, d.3, q.5; Wolter, p. 119.
 14. See Hintikka and Garrison, op. cit. The view we reject is represented, e.g., by I. Bernard Cohen, *The Newtonian Revolution*, Cambridge University Press, Cambridge, 1980.
 15. Jaakko Hintikka (with Unto Remes and Simo Knuuttila), *Aristotle on Modality and Determinism* (Acta Philosophica Fennica, vol. 29, no. 1), Societas Philosophica Fennica, Helsinki, 1977.
 16. See here my "Aristotle's Incontinent Logician", *Ajatus* vol. 37 (1978), pp. 48–65.
 17. Cf. "The Fallacy of Fallacies", op. cit.
 18. Cf. Knuuttila's own contribution to Simo Knuuttila, ed., *Reforging the Great Chain of Being*, Synthese Historical Library, D. Reidel, Dordrecht, 1981.
 19. Julius Weinberg, *Abstraction, Relation, and Induction: Three Essays in the History of Thought*, The University of Wisconsin Press, Madison and Milwaukee, 1965.
 20. See here my paper, "The Interrogative Approach to Inquiry and Probabilistic Inference", *Erkenntnis* vol. 26 (1987), pp. 429–442.
 21. See here my paper, "The Concept of Induction in the Light of the Interrogative Model of Inquiry", in John Earman, ed., *Inference, Explanation and Other Frustrations*, University of California Press, Berkeley, 1992, pp. 23–43.
 22. In "Aristotelian Induction", *Revue Internationale de Philosophie*, vol. 34 (1980), pp. 422–439.
 23. Thomas Aquinas, *Commentary on the Posterior Analytics of Aristotle*, Magi Books, Albany, N.Y., 1970, p. 177.
 24. Thomas Aquinas, loc. cit.
 25. See op. cit., note 21 above.
 26. *Super Pr. Anal.* II, 9, 8.

CHAPTER 13
THE FALLACY OF FALLACIES

1. ARISTOTELIAN FALLACIES WRONGLY SO-CALLED

The title of this paper does not mean that I am proposing to add a new superitem to the list of traditionally recognized fallacies.¹ What I shall do instead is to show that these so-called fallacies originally were not fallacies at all in our twentieth-century sense of the term, that is, in the sense of being mistaken inferences. They are not mistaken inferences, not because they are not mistaken, but because they need not be inferences, not even purported ones. The error in thinking that the traditional fallacies are faulty inferences is what I propose to dub “the fallacy of fallacies”. It is the fallacy whose recognition will, I hope, put a stop to the traditional literature on so-called fallacies.

Instead of being mistaken inference-types, the traditional “fallacies” were mistakes or breaches of rules in the knowledge-seeking questioning games which were practiced in Plato’s Academy and later in Aristotle’s Lyceum.² Accordingly, they must not be studied by reference to codifications of deductive logic, inductive logic, or informal logic, for these are all usually thought of as codifications of inferences. Such inferences have much less to do than is generally recognized with the kinds of *faux pas* that, e.g., Aristotle dealt with under the heading of sophisms in refutation. Instead, the so-called traditional fallacies are best studied by reference to the theory of information-seeking questioning processes (interrogative games) which I have defined and studied elsewhere.³ The kinds of discussions of “fallacies” which are found in textbooks of traditional and informal logic do not do this. Hence they are both systematically and historically speaking but a colossal mistake, a super-fallacy worth the title of this paper. The best way of exposing this fallacy is to show that traditional fallacies can be discussed from the vantage point of the interrogative model in a more interesting way than in conventional expositions. That is what I shall try to show in this paper, using as my primary case study material the most traditional of all traditional fallacies, those discussed by Aristotle in *De Sophisticis Elenchis*. As a bargain the reader will thus also receive a crash course in the basic theory of interrogative inquiry.

2. WHY A SEPARATE THEORY OF FALLACIES?

This does not mean, of course, that no Aristotelian fallacy can be interpreted as a false pretender to the throne of valid logical inference. Several of them

can often be thought of as mistaken logical or conceptual inferences. Cases in point are perhaps most clearly the fallacy of the consequent and the fallacy of accident (*De Soph. El.* iv, 166b20–27). Other so-called fallacies are not related especially closely either to mistakes in inference or to mistakes in questioning. In this case the mistakes due to different kinds of ambiguity or multiplicity of senses, more generally, with the fallacies which Aristotle says are related to language. However, the hard core of Aristotelian fallacies includes in any case several mistakes which have insinuated themselves into the lists which are found in virtually all textbooks of “Aristotelian”, “traditional”, or “informal” logic. This group of fallacies is especially important in that it alone motivates from a philosophical viewpoint the treatment of fallacies as a special chapter of logic, separate from the study of deductive inferences. For mistaken inferences like affirming the consequent are more naturally treated as a part of deductive logic. It is after all only there that we can find ways of actually proving the fallaciousness of such fallacies. In brief, if traditional fallacies were in fact mistaken inferences, the study of such fallacies would be nothing more and nothing less than one particular way to approach the theory of inference.⁴

Likewise, purely linguistic mistakes, such as the use of ambiguities, are most appropriately dealt with in the context of meaning theory, and hence do not motivate a separate theory.

Construed as a separate study, the traditional theory of fallacies depends for its *raison d'être* on the treatment of nondeductive and non-linguistic fallacies. If they, too, really ought to be studied in a different chapter of logic, the entire complex of inherited “fallacies” should be broken up and its different ingredients be assigned to their natural places elsewhere. And this is what I shall try to show in this paper. The critical group of so-called fallacies should be studied in the theory of interrogation which in turn is a part of the logic and semantics of questions and questioning processes.

3. ARISTOTELIAN ELENCHUS

An even more sweeping point can be made here. It is not just that some Aristotelian fallacies are naturally thought of in inferential terms and others as mistakes in questioning procedures. The entire study of so-called fallacies in Aristotle is part and parcel of his discussion of the theory and practice of interrogative games. For that is what *Topica* and *De Sophisticis Elenchis* together amount to. As the very title of the second of these treatises shows, Aristotle strives in these works to be the Hoyle of Socratic *elenchus* or, rather, of its academic descendant. Thus in a sense all Aristotelian fallacies are essentially mistakes in questioning games, while some of them are accidentally mistakes in deductive (more generally, logical) reasoning.

Aristotle indicates this by saying that the non-verbal fallacies all “arise because no definition has been given of what a syllogism is and what a refutation (*ἔλεγχος*) or that there is some defect in their definition” (167a21–23).

Or, as Aristotle also sometimes puts it, all the fallacies here relevant can be thought of as variants of a single one, of the *ignoratio elenchi*, i.e., as being due to “a false conception of refutation (*ἔλεγχος*)”. Now no perceptive reader of the *Topica* and of *De Sophisticis Elenchis* can fail to realize that *elenchus* comprises much more than logical inferences in any sense of inference (deductive, inductive, abductive, statistical, or whatnot), however wide. Indeed, it is clear that *elenchus* was for Aristotle quite as genuinely a questioning procedure as the Socratic *elenchus* had been. I shall return to this matter in sec. 19 below and provide further evidence for it there.⁵

4. THE INTERROGATIVE MODEL AS A CODIFICATION OF ACADEMIC *ELENCHUS*

The first item on my agenda is obviously to outline the interrogative model of inquiry which will serve as the conceptual framework of my examination of some of the main traditional fallacies. This model follows in fact closely its Socratic paradigm. What is the structure of the famous Socratic *elenchus*, as it is illustrated by the early Platonic dialogues or, for that matter, what is the structure of the dialectical exercises practiced in Plato’s Academy? The outlines of an answer are fairly obvious.⁶ Two persons are involved. One is the questioner, the other answerer. I shall call the two parties, anachronistically, “the Inquirer” and “the Answerer” or “the Oracle”, sometimes “Nature”, respectively. The Inquirer can put questions to the Answerer, who will answer them best he can.

In Aristotle’s work on such interrogative “games”, he came to realize that the answers to certain questions do not really depend on the Answerer, on what he knows, believes, or hopes. They are the questions which any rational being must answer in the same way. Those are the questions whose answers logically follow from what has been established before. In getting such questions answered, the Answerer is in this sense irrelevant.⁷

Hence in my interrogative model I have given such steps a special status, even though they did not originally enjoy one in ancient Greek dialectic. I am allowing, at each stage of the interrogation, the Inquirer the option of forgetting the Answerer and, instead of asking a question, of drawing a logical inference from what had been initially assumed or established earlier in the course of the questioning process.

The Answerer’s replies are in the simplest version of the interrogative model assumed to satisfy the conclusiveness condition I have discussed in my theory of questions and answers. For instance, it does not help to answer the question

(4.1) Who robbed the bank?

by saying

(4.2) The richest man in town

if the questioner doesn't know who the richest man in town is. In general, a who-question

(4.3) Who, e.g., x , is such that $S[x]$?

will have as its conclusive answer "b" only if it is true that the questioner knows who b is.⁸

In more complicated versions of the questioning model, partial answers may also be admitted. They are not needed in this paper, however.

5. THE AIM OF THE GAME. THE DUAL ROLE OF QUESTIONS

It is in the spirit of the spirited Platonic encounters to call these dialectical exercises "games" and use game-theoretical terms and game-theoretical concepts in discussing them. Thus I can formulate my slightly artificial dichotomy by saying that, at each stage of the interrogative game, the Inquirer has a choice between two kinds of moves, *interrogative* moves and *deductive* moves. In an interrogative move, the Inquirer addresses a question to the Answerer, who provides an answer if he (she, it) can. In a deductive move, the Inquirer draws a deductive conclusion from the theses so far obtained.

It is natural to formalize such a questioning process by means of a Beth-like *tableau*.⁹ The Answerer's replies are entered into the left column, and the *tableau* construction rules (deductive rules) are set out in such a way that no traffic or formulas between the two columns take place. The usual *tableau* terminology will be used in the following, and some suitable set of *tableau* construction rules (deductive rules) will be assumed. It is assumed that these rules conform to the so-called subformula principle.¹⁰

The purpose of an interrogative game could be to prove a given conclusion C . Then C would be the lone initial entry in the right column of the *tableau*. In a typical ancient Greek setting, what the questioner was trying to establish was the falsity of an initial thesis H which he had undertaken to defend. Then $C = \sim H$.

In another variant, the aim of the game is to establish either B or $\sim B$ for a given B , i.e., to answer the question "B or not-B?" (This might be called the Shakespearean variant of a questioning game.) Then the Inquirer will have to keep an eye on two lines of reasoning, each of which can be formalized by a separate *tableau*.

Notice that in Shakespearean interrogation questions play a dual role: the Inquirer is trying to answer a "big" initial or principal question by putting a lot of "small" questions to the Answerer and by using their answers as additional premises. Thus a distinction between "big" and "small" questions is needed in order not to trivialize the process completely. (Otherwise the Inquirer could simply put the principal question to the Answerer and be done with the entire process).

6. PRESUPPOSITIONS OF QUESTIONS. INITIAL ASSUMPTIONS

One important way in which different questions differ from each other is in terms of their respective presuppositions.¹¹ Before the Inquirer may ask a question, its presupposition must have been established, i.e., must occur in the left column of the game *tableau*.

An interrogative game may also involve an initial theoretical assumption T, which will be the sole first entry into the left column of a game *tableau*. It plays an especially important role in the questioning process in that it is the ultimate source of the presuppositions of most questions. It is sometimes assimilated to presuppositions. Yet it is important in principle to keep the concepts of initial premise and presupposition clearly distinguished from each other.

Both of them have to be distinguished from the conditions which conclusive answers have to satisfy and which were touched on in section 4 above. You might perhaps want to call these conditions, too, "presuppositions". But then it is advisable to draw a clear line between the presuppositions of questions and the presuppositions of answers. The two are not unrelated.¹² For instance, for multiple questions, the conclusiveness condition which the first part of an answer a question like "For whom did Mary buy what?" has to satisfy, is that the presupposition of the remaining question, e.g., "For whom did Mary buy this book?", is fulfilled. In other words, it must be true that Mary bought this book. Yet, in spite of these interrelations, the two kinds of presuppositions have to be kept apart in the interest of clarity. (Cf. sec. 18 below.)

7. INTERROGATIVE MODEL AND ARISTOTELIAN SCIENCE

Even though my idealized interrogative games thus involve some amount of regimentation, they are very close to their historical predecessors. They can even be used to discuss actual historical questioning games.

For instance, contemporary logical theory of interrogative games shows its usefulness by prompting corrections to the detailed views of even those scholars who have in general terms recognized the role of questioning games in Greek logic and philosophy. Thus Gilbert Ryle writes of the dialectical exercises practiced in the Academy:

So the questioner's questions have to be properly constructed for "yes" or "no" answers. This automatically rules out a lot of types of questions, like factual questions, arithmetical questions, and technical questions. Roughly it leaves us only conceptual questions, whatever these may be. (*Collected Papers*, vol. 1, p. 90.)

This is a *non sequitur*. It may or may not be true that the only acceptable questions in, say, Plato's Socratic dialogues are yes-or-no questions. However, there is no reason why yes-or-no questions could not be factual, mathematical

or technical. More importantly, at least in the case of Aristotle, it is not true that questioning processes were addressed exclusively to conceptual problems. On the contrary, it is important to realize that for Aristotle the first premises of each science were arrived at by means of a kind of interrogative process.¹³ Then the questions of the Inquirer could not any longer be thought of as being addressed to an actual interlocutor, even though such an idea is not far below the surface of Aristotle's *Analytica Posteriora*.

Indeed, this hidden agenda surfaces occasionally in a manner which would otherwise be hard to understand. For instance, in *An. Post.* I 10, 76b23–34 Aristotle distinguishes between a hypothesis and a postulate (*αἴτημα*) according to whether the learner accepts the assumption in question or not. The only way in which this distinction can be relevant to Aristotle's study of how the first premises of a science are arrived at is to realize that Aristotle thinks of a scientist as being logically speaking in the same position as a student who sometimes has to work on an interim hypothesis which he does not accept. Indeed, this generalization is signalled by Aristotle by saying that a postulate can also be "any provable proposition that is assumed and used without being proved" (b32–34). Small wonder, therefore, that some perceptive Aristotelians have maintained that *Analytica Posteriora* really deals with the way in which science is to be taught according to Aristotle.¹⁴ Though perceptive, this view is mistaken, for the questions Aristotle is really dealing with are not a teacher's questions to a student but a scientific inquirer's questions to his source of information.

How closely connected Aristotle's remarks on hypotheses and postulates are with the theory of fallacies is, is shown by the fact that *αἴτημα* was later often translated into Latin as *petitio*, as in *petitio principii*. (Cf. secs. 10 and 13 below.)

The questions which in Aristotle lead one to the *arkhai* of a science may be addressed to the established body of *endoxa*, to our natural environment, or even to reliable witnesses, who for Aristotle included his own main predecessors.¹⁵ In other words, Aristotle uses the interrogative approach in the same way as I have done, not only to analyze interrogative dialogues between actual persons, but also as a model of scientific knowledge-seeking. The main difference is that for us the knowledge-seeking questions are addressed to nature. In Aristotle, they are addressed to the established body of information which an inquirer has available for critical examination and which is codified in the *endoxa*.

When it comes to the details, it is admittedly a difficult question as to how precisely Aristotle thought the first premises of a science to be obtained. Later, after having developed his syllogistic theory, Aristotle seems to have emphasized more the role of the method he called induction (*epagoge*) in reaching at least one class of *arkhai* of a science and less the role of dialectic. It is not clear, however, that this emphasis is incompatible with the role of questioning in reaching the basic assumptions of any one science, especially in reaching its highest generic premise. The entire matter requires further examination.

8. THE VERSATILITY OF THE INTERROGATIVE MODEL

This illustrates in fact one of the most important features of the interrogative model. The Answerer need not be a human interlocutor; the source of an answer can be an empirical observation or a controlled experiment. Then the Answerer might as well be called "Nature". But the source of answers can also be the database stored in a computer, in one's own memory, or in a clinical handbook. Equally well it can be a witness in a court of law or a patient engaged in a diagnostic consultation with a physician. The remarkable fact (which I am trying to demonstrate and to illustrate elsewhere) is that the interrogative model applies in all these different situations.

The following example may illustrate this versatility of the interrogative model. Aristotle's procedure in eliciting the first principles of some one science from a body of *endoxa* may be compared to an application of the interrogative model to a situation in which the Answerer is a database stored in the memory of a computer which the Inquirer elicits step by step by putting to it suitable questions. This example resembles Aristotle's enterprise also in that the contents of a database are initially known by the Inquirer only tacitly. For Aristotle clearly thinks of the process of finding the first principles of a science as a process of activating potential knowledge already present, albeit only potentially. "All teaching and learning that involves argument proceeds from pre-existing knowledge." (*An. Post.* A 1, 71a1–2.) This observation is closely connected with the fact that the process in question had for Aristotle the character of conceptual analysis whose product is a definition. "Moreover, the basic premises of demonstrations are definitions." (*An. Post.* B 3, 90b23–24.) Thus we can see that the true reasons for the conceptual-analysis character of Aristotelian *elenchus* are far subtler than the one Ryle suggested for it.

The distinction made above between interrogative and deductive moves is calculated to facilitate applications in which the Answerer is nature. For nature does not carry out our deductions for us; the Inquirer has to draw his logical inferences himself.

However, the interrogative model need not have precisely the same fine structure in all of its different applications. In fact, what I have called "the interrogative model" is merely a framework of constructing a number of closely related but not identical models. For instance, one possible further specification concerns the maximal logical complexity of the available answers, as measured by the quantifier prefix of the answers.¹⁶ We are dealing with a long spectrum of different logics of questioning here. At the one end, we have the unlimited case where no structural restrictions are imposed on answers. (They may of course be subject to other restrictions.) At the other end is the case in which answers are restricted to quantifier-free propositions, which in effect means a restriction to (negated or unnegated) atomic propositions. This case is characterized by what I shall call the Atomistic Postulate. Between the two extremes, there are, e.g., the A-case (the maximally complicated quantifier is of the form $(\forall x_1)(\forall x_2) \dots (\forall x_i)$) and the AE-case, in which the prefix cannot be more complicated than $(\forall x_1)(\forall x_2) \dots (\forall x_i)(\exists z_1)(\exists z_2) \dots (\exists z_j)$.

Modern philosophy of science is characterized, by and large, by the Atomistic Postulate, whereas Aristotle believed also in the availability of A-answers in empirical science. The unlimited case is what is the most interesting one here. It is approximated in real life, e.g., by clinical inquiry where a physician can look up his handbook for general laws governing biological processes and use them in his reasoning over and above the patient's answers and clinical test results. Even though Aristotelian science is most naturally thought of as being characterized by A-answers, in discussing the various kinds of question-answer dialogues he was considering it is safest to construe them as cases of unlimited questioning.

9. DEFINITIONS AND QUESTIONING

One possible further development of the interrogative model is to allow the Inquirer or perhaps the Answerer to introduce definitions into the argument, subject to suitable presuppositions.¹⁷ This does not detach the interrogative model from its ancient precedents, for in them ample cognizance was frequently taken of the role of definitions in the academic questioning duels. This is illustrated, e.g., by *Top.* VI 4.

Admitting definitory moves into interrogative games is much more interesting than might first appear. The reason for their importance is that the introduction of an explicit definition of a new term may actually enhance the power of an interrogative argument. In this respect, interrogative arguments differ significantly from purely deductive arguments, for the scope of deductive inference cannot be increased by the introduction of (explicit) definitions. This result might in fact serve as a basis of a reconstruction of the traditional distinction between nominal and real definitions.

10. ARISTOTELIAN FALLACIES ANTICIPATED: *PETITIO PRINCIPII*

On the basis of the interrogative model, it is possible to predict what some of the Aristotelian fallacies were, assuming that they were violations of the rules of questioning games not unlike the ones which are codified in my model. Perhaps the most important feature of interrogative games which is easy to get confused about is the dual role of questions registered above in sec. 5. On the one hand, the aim of the entire game can be to answer a "big" initial or principal question; on the other hand, this "big" question is to be answered by means of a number of replies to "small" questions the Inquirer puts to his or her interlocutor. If a distinction between the two is not maintained, one can try to trivialize the entire questioning procedure by posing the "big" question to the Answerer without further ado. If a conclusive answer is forthcoming, the entire game is reduced to one single move.

It is therefore important to enforce a sharp distinction between the two kinds of questions. What happens if the Inquirer asks ("petitions") the principal

question instead of raising a number of “small” ones? The pun provides the answer: the Inquirer is guilty of *petitio principii*. That this so-called fallacy was for Aristotle indeed not a fallacy in our sense but a breach of the rules of interrogative games has been shown convincingly by Richard Robinson.¹⁸ Here I shall try to push his line of thought further and also straighten a couple of points which are not made satisfactorily in Robinson’s paper.

After having pointed out, correctly, that by *petitio principii* Aristotle meant primarily a violation of “a rule in an old-fashioned competitive game”, Robinson concludes that an injunction against this alleged fallacy is as irrelevant in the scientific search of truth “as to obey the Queensberry rules when attacked by a murderer.” This is a mistake on Robinson’s part. On the contrary, interrogative games turn out to be an excellent model of the scientific search of truth. What is more, the very dimension of restrictions on available answers which can be taken to be exemplified by a prohibition against *petitio principii* (restrictions in terms of logical complexity) can be shown to be crucial for understanding the actual methods of science. Thus Richard Robinson is a useful guide to Aristotelian interpretation, but not to the contemporary logic of science.

Secondly, Robinson does not bring out fully the etiology of *petitio principii* as a confusion between two kinds of questions. In other words, he does not emphasize that what Aristotle forbids is the asking of the initial question. This is what *begging* the (initial) question means. Indeed, Aristotle’s term for “begging” is *αἰτέω*, which means asking for or demanding something, not taking something for granted. Admittedly, Aristotle also uses sometimes the verb *λαμβάνω* (e.g., 166b25, 167a36, 168b22, etc.) which is normally translated as “assuming”. However, this term is ambiguous in that it can as its literal meaning have “to receive” and not only “to take”. Hence it can mean only that an initial premise has been given to the inquirer as an answer to the principal question. Be that as it may, in any case Aristotle uses the unequivocal term *ἑρωτῶν* (questioner) in discussing *petitio principii* in *Top.* VIII 13, 162b31–32.

11. FROM INTERROGATIVE GAMES TO DEDUCTIVE LOGIC

The so-called fallacy of *petitio principii* illustrates several interesting features of Aristotle’s views on the nature of the traditional “fallacies”. As Robinson noted, Aristotle does in *An. Pr.* B 16 treat *petitio principii* as if it were a *bona fide* inferential mistake, and in *Top.* VIII 13, 162b31–33 he even refers to the *An. Pr.* B 16 as his official account of “begging the question”. Now there is nothing strange or surprising that Aristotle should have looked upon the same sort of breach of rule sometimes in interrogative terms, sometimes in inferential terms. For it is fairly obvious that Aristotle’s theory of logical inference developed as a special case out of his treatment of interrogative games.

It is in fact easy to see, both in terms of the interrogative model and in historical terms, how this development took place and what the special position

is that deductive arguments occupy as a result. They are the arguments one can carry out in accordance of the interrogative model without putting any questions to one's interlocutor. Or, perhaps I should say more cautiously that such deductive conclusions are the ones which any rational interlocutor will agree to, when asked. As Evans puts it,¹⁹ "It is impossible for something to be a proof if it is such that it could be conceived not to be convincing to *anyone*." Hence such steps do not depend on any particular interlocutor or on that interlocutor's answers. Such deductive arguments were important for Aristotle to recognize and to study, for it is very handy to be able to establish one's conclusion independently of one's opponent's answers (if any). This is how deductive logic grew out of Aristotle's earlier and much more general theory of interrogative argumentation.²⁰ Aristotle indicates this special role of what he calls demonstrative (*apodeiktikon*) arguments by saying that in them one reasons "from the principles appropriate to each branch of learning and not from the opinions of the answerer" (*De Soph. El.* ii, 165b1–3).

12. INTERROGATION AND DEDUCTION PARTLY ANALOGOUS

But it is not only the genesis of Aristotle's theory of deduction out of his more general theory of interrogative argumentation that makes it difficult to keep the two apart in his writings. There is an interesting intrinsic reason why the theory of deduction (logicians' "proof theory") and the theory of interrogative games cannot be completely disentangled from each other. The main point is clear enough, and can be brought home by considering the two different ways in which the Inquirer can use, e.g., an existential sentence $(\exists x) S[x]$ that has been established, i.e., that occurs in the left column of a *subtableau*.

- (i) This sentence can be used either as the target of a purely deductive move of existential instantiation. Such a move results in the introduction of a formula $S[\alpha]$ where a new dummy name " α " replaces the variable.
- (ii) However, $(\exists x) S[x]$ can also serve as the presupposition of a wh-question. If an answer is forthcoming, it is of the form $S[b]$, where "b" is the proper name of some individual in the world where the game is played.

The latter case (ii) is *ceteris paribus* more advantageous to the Inquirer than the former (i). For instance, the Inquirer can, e.g., hope to ask questions later in terms of the real name "b" which one cannot do in terms of a mere dummy name.

Since other kinds of moves prompt similar observations, we can conclude that each non-trivial deductive move has a parallel interrogative move.²¹ Moreover, if this interrogative move actually yields an answer, it is the preferable move for the Inquirer to make.

Hence there obtains a striking parallelism between deduction and interrogation. This parallelism is the closer, the more kinds of questions there are that the Answerer will actually provide (conclusive) answers to. One of the manifestations of this structural kinship of interrogation and deduction is that in an

interrogative game with structurally unrestricted answers the strategy selection in interrogation and in deduction follows closely similar principles. As far as strategies are concerned, the logic of unrestricted questioning (i.e., questioning where the logical complexity of answers is not restricted) is proof theory (deductive logic). Now Aristotle is keenly interested in the strategies of interrogative argumentation. Even in his syllogistic writings, Aristotle frequently pays attention to strategies of argumentation.²² Since it is not very natural to assume that any sharp structural restrictions were imposed on answers in the Academic questioning games, we can thus see that it was not only possible but almost inevitable that Aristotle should have considered the principles of deduction and those of questioning together and that he should have failed to make any sharp distinction between the two.

I shall return to this point after having diagnosed *petitio principii* somewhat more fully.

13. AVOIDING *PETITIO PRINCIPII*

How is petitio principii to be exorcised from the interrogative games? Not only one but two possible ways of doing so are implicit in what I have said. On the one hand, structural or other interesting restrictions on answers may prevent the Inquirer from receiving an immediate answer to the initial question, e.g., when this question has an appreciable quantificational complexity. On the other hand, the presupposition of the initial question is seldom available to the Inquirer.

Which one of these weighed most heavily on Aristotle's logical mind? The answer is not clear. Aristotle was fully aware that asking the initial "big" question is a mistake, but he never offers a real diagnosis of the reasons why this is not acceptable. The closest he comes is in his remarks on self-evidence in *An. Pr.* B 16; see sec. 20 below.²³

The status of the objection to *petitio principii* which turns on restrictions on answers, especially restrictions on their quantificational complexity, naturally depends on what the restrictions are that Aristotle in effect operated with. His own preference seems to have been an A-logic, which does in fact rule out many "beggings of the question" because the answers to the "begged" initial questions would have too great a quantificational complexity. However, the fact was also registered above that the general tenor of academic questioning games seems to have been against quantificational restrictions. Hence the verdict is not unequivocal, and *petitio principii* may have been ruled out by Aristotle in the end because it violated the need of the presupposition which has to be established before a question is asked.

Both these ways of ruling out *petitio principii* are intrinsically interesting. The former, i.e., the complexity restriction that may have to be imposed on available answers, is also closely related to what Aristotle says about avoiding *petitio principii*. For in discussing this mistake apparently as an inferential

mistake, Aristotle blames it on the original premise's not being self-evident: "... whenever a man tries to prove what is not self-evident by means of itself, then he begs the original question" (*An. Pr.* B 16, 64b36–37). If the premise in question is obtained as an answer to an actual or notional question, then restrictions on premises in terms of their self-evidence are equivalent to restrictions on questions in terms of the obviousness of their answers. For this obviousness can of course be thought as the answerability of the questions in question. Hence Aristotle's discussion of *petitio principii* apparently construed as an inferential mistake need not in the last Aristotelian analysis differ essentially from treating *petitio principii* in interrogative terms, that is, by diagnosing the mistake as a violation on the general conditions on the answerability of questions in the special case of the initial (principal) question of an interrogative game.

14. PETITIO PRINCIPII AND PROOF THEORY

There is also a great deal of potential interest in the other way of avoiding *petitio principii*, viz, by claiming that the presupposition of the "big" initial question of an interrogative game usually is not available. This way out seems to be virtually vacuous for any interesting propositional question can surely be answered by means of a series of yes-or-no questions. For instance, in order to answer the question

$$(14.1) S_1, S_2, \dots, \text{ or } S_k?$$

it surely suffices to answer the yes-or-no questions

$$(14.2) S_i \text{ or } \sim S_i? \quad (i=1, 2, \dots, k).$$

While (14.1) has a nontrivial presupposition

$$(14.3) (S_1 \vee S_2 \vee \dots \vee S_k),$$

the yes-or-no question (14.2) seems to have only the vacuous presupposition

$$(14.4) (S_i \vee \sim S_i).$$

The interesting fact here is that, while tautological premises (14.4) do not increase the deductive power of any given premise T , they do increase what can be derived from T interrogatively.²⁴ Hence Aristotle's strictures against *petitio principii* are from a systematic viewpoint related closely to the important role of premises of the form (14.4) in interrogative knowledge-seeking.

Paradoxically enough, we are also in the vicinity of the central ideas of proof theory, in spite of the fact that in pure deduction tautological premises (14.4) do not enable us to prove any new conclusions. The use of such arbitrary tautological disjunctions (14.4) is in proof theory the greatest common denominator which characterizes those inference rules not satisfying the subformula principle. Such rules include unlimited *modus ponens*, the cut rule, etc. The first

major result of modern proof theory, Gentzen's first *Hauptsatz*, establishes the eliminability of such inference rules as violate the subformula principle.²⁵ This result is significant because the forbidden rules otherwise have a great deal of power, enabling a logician to shorten and to simplify his or her proofs.

As the reader can see, forbidding *petitio principii*, construed as introducing illicit extra premises of the form (14.4), is the interrogative counterpart to restricting deductive arguments to methods satisfying the subformula principle. This ancient pseudo-fallacy thus turns out to be a veritable next of kin to the basic ideas of twentieth century proof theory.

Admittedly Aristotle never points out in so many words the role of tautological premises (14.4) in questioning. His remarks on *petitio principii* nevertheless shows amply his sensitivity to the issues discussed in this section. Even if he did not anticipate Gentzen's problem, he came remarkably close to it.

15. "MANY QUESTIONS"

Other Aristotelian fallacies likewise allow for a "transcendental deduction" on the basis of the interrogative model. The breach of the rules of questioning games which undoubtedly is the most common in actual questioning procedures is to disregard the need of presuppositions. This is common, because by so doing the questioner can extract from the answerer unintended and damaging admissions. Aristotle calls such a violation of game rules the "fallacy" of many questions and illustrates it as follows (*De Soph. El.* v, 168a7–9):

Or again, where part is good and part bad, [asking] "Is the whole good or bad?" For whichever answer he gives, it can be taken to expose him to an apparent refutation.

Logically speaking, the trouble here can be traced to the fact that the presupposition of the question had not been secured, viz, that the whole thing is either all good or all bad.

It is not clear in Aristotle's writings that the so-called fallacy of many questions is thought of by him just as a violation of presuppositions of questions. This role was given to the "fallacy of many questions" later in the history of philosophy in much firmer terms.²⁶ One indication of this is the appearance of the notorious leading wh-questions of the type "When did you stop beating your wife?" as examples of the "fallacy" of many questions. Aristotle clearly did not yet have a cut-and-dried conception of presupposition. Maybe such a requirement was too genteel, too Marquis-of-Queensberry, to be applicable to the rough-and-tumble of ancient questioning games. In fact, there need not be anything wrong with such a disregard of the requirement of antecedently established presuppositions. It is perfectly possible to set up interrogative games in such a way that a question may be asked even though its presupposition has not been ascertained by the Inquirer. Then the Answerer must be offered

a chance of denying the presupposition of the question instead of answering it. Such a variant seems to be eminently congenial to Aristotle who (in the context of other “fallacies”) considers “demolishing the original question” as a viable way of dealing with his problems. (See, e.g., *De Soph. El.* xxiv, 179b7 ff.)

Besides revealing the absence of a fully developed idea of presupposition in Aristotle, the history of the fallacy of many questions shows other things. In giving it the name “the fallacy of many *questions*”, Aristotle tacitly thought of the missing presupposition as being obtained (in a fallacy-free argument) as an answer to an antecedent question. (This need of an antecedent answer is what makes the objectionable question “many” and not “one”.) But if one assumes this, one does not obtain a fully general treatment of presuppositions. For a missing presupposition may very well be obtained by means of a deductive step and not only an interrogative step. Hence a codification of violations of presuppositions in a “fallacy” of many *questions* cannot be a complete or completely satisfactory one in the last analysis.

However, one thing is clear of the so-called fallacy of many questions. It cannot by any wildest stretch of the imagination be construed as a mistake in inference. It will thus bring home to the most hardened skeptic the impossibility of seriously construing Aristotelian “fallacies” as fallacies in the twentieth-century sense, i.e., as tempting but invalid inferences.

16. “BABBLING”

Even the least interesting-looking of the Aristotelian pseudo-fallacies, the so-called fallacy of babbling (*ἄδολεροχέειν*) suddenly makes sense. (See *De Soph. El.* xiii, 173a32 ff. and xxxi 181b25 ff.) What it amounts to is a closed loop (as computer scientists would say) else a fruitless or infinite regress in the questioning process. Aristotle’s examples of this fallacy are typically from the field of definitions, e.g.:

Again, “Is not ‘desire’ the same as ‘desire of pleasure?’” Now desire *is* an appetite for pleasure; therefore [the answer amounts to] “desire is an appetite for pleasure of pleasure” [and so on]. (*De. Soph. El.* xiii, 173a38–40.)

Once again, no mistakes need occur at any one move of the game, but the purpose of the game has nevertheless been frustrated. This alleged fallacy is especially interesting in that it does not even mean a breach of any of the questioning rules (rules of the game), much less of any of the deductive rules. It means using a bad questioning strategy, a strategy which does not further the purpose of the game. As Talleyrand might say, it’s worse than a crime, it’s a mistake. As such, it bears eloquent witness to Aristotle’s concern with the strategies of questioning over and above the correctness of particular interrogative moves.

Aristotle’s warning against “babbling” is not entirely trivial, either. In purely

deductive arguments, the possibility of moving in a circle is easily ruled out, e.g., by requiring conformity with the subformula principle. However, in interrogative games it is not equally easy to see how moving in a circle can always be avoided. For one thing, we cannot always conform to the subformula principle in such games without reducing the strength of the interrogative procedures. This subject matter has even been discussed recently from the modern viewpoint.²⁷

17. ARGUMENTS *AD HOMINEM*

Other traditional fallacies, not explicitly listed by Aristotle, likewise begin to make sense in the light of the interrogative model. For instance, what is supposed to be wrong with the so-called *ad hominem* fallacy?²⁸ Surely it is fair game to use a man's admissions in an argument against him – at least after you have warned that “anything you say will be used against you”. This was precisely what Socrates was doing: “he used to ask questions but never answered them” (*De Soph. El.* xxxiv, 183b7–8). Aristotle himself admits that “accordingly it sometimes becomes necessary to attack the speaker and not his position”, if only as a last resort against an abusive answerer (*Top.* VIII 11, 161a21–22).

But what is meant by an allegedly fallacious *argumentum ad hominem*, anyway? Some scholars have tried to trace it back to Aristotle more specifically, to *De Soph. El.* xx, 177b33–34; xxii, 178b17; and xxxiii, 183a21.²⁹ But what is at issue in these passages is not an argument that might or might not be *ad hominem*, but the status of solutions to fallacy-like puzzles. What is interesting about these passages is that they illustrate the development of deductive logic from a more general theory of interrogative games which was briefly discussed in sec. 11 above. (I owe this observation to Russell Dancy). Aristotle is in these passages making a distinction between such solutions of “fallacies” as are addressed to a particular person and such solutions as are addressed to the form of the argument. But a diagnosis of a mistaken answer can refer solely to the respective forms of the question and of the answer only if the same answer must be given by any rational answerer to anybody who asks that question. And this is the case only if the answer follows logically from the theses adopted earlier. Addressing a solution to the form of the question or of the answer therefore means moving from the sphere of interrogation to the ambit of logical inference. What these Aristotelian passages hence foreshadow is not the so-called *ad hominem* fallacy in any size, shape or form, but rather the idea of deductive (inferential) validity.

In a wider perspective it is nevertheless possible to see what the point of an alleged *ad hominem* fallacy is in its later sense and in what sense Aristotle was in fact dealing with such fallacies. Suppose, for the sake of argument, that I conduct a Socratic discussion with Theaetetus and end up concluding on the basis of his answers that knowledge is true belief accompanied by *logos*.³⁰ Have I proved this conclusion? Only *ad hominem* (*ad* Theaetetus). Admittedly, it is

in principle by this very kind of questioning procedure that Aristotle derives the *arkhai* of the various sciences he studies. But in order for such an *elenchus* to yield intended conclusions, Aristotle's imaginary interlocutor must both be a repository of all the *endoxa*, of the entire relevant collective experience that has crystallized in our predecessors' and contemporaries' well-founded opinions, and also be free from misperceptions and other mistakes. No actual *homo* can do this, not even that Frank Ramsey of Plato's Academy, Theaetetus. To assume that he could, would be to commit the mistake of arguing *ad hominem*.

Even though Aristotle does not use a special label for this "fallacy", he shows what he thinks of it at the end of *De Soph. El.* In order to explain the rationale of both *Topica* and *De Soph. El.* he writes that he "proposed as the purpose of our treatise ... also the discovery how ... we are to defend a thesis by means of the *most generally accepted principles* in a consistent manner" (*De Soph. El.* xxxiv, 183b1–6). Here we can also see why Aristotle did not list *argumentum ad hominem* as one type of fallacy among many. For the only way of dispelling it would be to give an account of how the first premises of a science can be reached dialectically. And this cannot be done by any one neat recipe which would uncover the mistake in one fell swoop and show what an inquirer should do instead. Aristotle's attempt to exorcise *ad hominem* reasoning is the entire *Analytica Posteriora*.

It is also interesting to see that Aristotle himself characteristically begins the examination of any one problem *ad hominem*, that is to say, by listing his predecessors' opinions about the problems and by using them as raw materials for his own solution.³¹ Is this to argue *ad hominem*? Only if Aristotle does not in the end succeed in exposing the biases and contradictions that lurk in the *endoxa* he is studying or if the body of *endoxa* he is relying on is not comprehensive enough.

18. MENO'S PARADOX

But what about the other side of the interrogative coin, answers to questions? Do their precise character and the requirements that have to be imposed on them (cf. sec. 4 above) figure in Aristotle's thinking? They do not seem to enter Aristotle's discussion in *De Soph. El.*, but the conditions that have to be imposed on satisfactory (conclusive) answers do play a major part in another famous ancient conceptual puzzle, known as Meno's paradox.³² The "paradox" is in fact a corollary to what was said in sec. 4 above of requirements that have to be imposed on conclusive answers, when applied to the special case of definitory or identificatory questions. Suppose Meno asks

(18.1) What is b?

and receives the reply

(18.2) b is d.

As I pointed out in sec. 4, (18.2) is a completely satisfactory (conclusive) answer only if the questioner (in the example, Meno) can truly say

(18.3) I know what d is

But if so, no progress seems to be possible. For, in order to profit from the reply (18.2) to the question as to what b is, Meno has to know what d is, that is has to know what the entity b is whose definition or *logos* he was seeking. In brief, you have to know already what you are seeking. This is a natural reconstruction of Meno's puzzle as one can find, and it seems to be a mere corollary to the criterion of conclusive answerhood that ensues from my theory of questions and answers.

The fallacy – if that is the appropriate word – in Meno's "paradox" lurks in the innocent-looking word "already". For *when* is it that Meno must know what d is, i.e., be in a position to utter (18.3) truly? Meno's paradox would indeed be a genuine difficulty if he had to know what d is *before* the reply to the question (18.1) is given. But there is no reason to require this. The resolution of Meno's puzzle lies in an important insight into the semantical and logical role of replies to wh-questions. It is not always sufficient for the answerer to provide the kind of information which in the case of definitory answers is codified in a response like (18.2), that is, to name or otherwise specify an entity of the desired kind. The answerer is also responsible for making sure that the conclusiveness condition, in my example (18.3), becomes true (if it is not already) in the mouth of the questioner.³³ Thus replies to questions have two distinct functions, which may perhaps be called providing an answer and making sure that it is conclusive. Meno's paradox arises when the second function is overlooked or, rather, thought of as a precondition of the question rather than as a part of the answerer's task. Thus in a way Meno's paradox is due to confusing the presuppositions of questions and the "presuppositions" of (i.e., conclusiveness conditions on) answers.

Once again we can thus see how close interesting ancient puzzles are to the leading ideas of the interrogative model.³⁴

19. THE INTERROGATIVE MODEL AND ARISTOTELIAN INQUIRY

We have seen that several of the traditional "fallacies" and other traditional conceptual problems can be put to an interesting light by means of the interrogative model. But that is not the end of my ambition in this paper. What I want to show is that Aristotle's entire enterprise in *De Sophisticis Elenchis* belongs to the study of interrogative dialogues. Since *De Soph. El.* is topically speaking (no pun intended) but a part of the *Topica*, the same will be true of that larger work, too.

This thesis was in effect put forward above in sec. 3. Here I shall provide some evidence for it. One source is Aristotle's conception of argument. In *De Soph. El.* ii, 165a38 ff. he lists four kinds of arguments (or reasonings, *logoi*)

used in discussion, viz, didactic, dialectical, examination-arguments, and contentious arguments. None of these types of arguments as much as resembles a series of deductive inferences; all of them are dialogical; and the examination-arguments (*πειραστικοί*) Aristotle mentions are nothing but familiar Socratic examinations where an interlocutor's views are put to test by means of questioning. Aristotle discusses dialectical arguments in the *Topica*. They are not deductive arguments; what Aristotle is dealing with in the arguments he mentions are interrogative games played in the Academy (knowledge-seekings by questioning another person or another source of information), their rules, and the strategies to be used in them.³⁵

Further evidence is easily forthcoming. For instance, the nature of Aristotle's inquiry in *De Soph. El.* is seen clearly when he gives specific tactical rules for the kinds of exercises he is examining. This happens *inter alia* in xv, 174a17 ff. Then it quickly becomes patent that what he is studying are academic questioning games, for his advice is squarely focused on the choice and formulation of tactically advantageous questions.

Perhaps the most telling passage is *De Soph. El.* xxxiv, 183a37 ff., where Aristotle summarizes what he thought he had accomplished in the *Topica* and *De. Soph. El.* He says that his purpose was to discover "the *dynamis* which enables one to reason on the problem set before us from the most generally accepted premises that exist; for that is the *ergon* of dialectic in itself and of the art of examination (*πειραστική*)". What that involves in practice becomes clear when Aristotle says that he has indicated the different cases of dialectic and the materials used in them, "moreover also how questions must be asked and ... the arrangement of questions in general, and about answers and solutions applicable to the reasoning employed" (183b10–12). This quote shows, not only that in his theory of dialectic Aristotle was essentially concerned with interrogative argumentation, but also that he was interested in the strategies of such argumentation (i.e., in "the arrangement of questions in general" or, in his words *τακτέον τήν ἐρώτησιν πᾶσαν*).

Thus Aristotle's entire discussion of so-called fallacies is an integral part of his theory of question-answer dialogues.

20. FALLACIES AND LOGICAL *AKRASIA*

A few further comments may help the reader to appreciate what has been said. It is highly significant that Aristotle does not characterize his "fallacies" as mistakes about what follows from what, as he could have done perfectly easily. Instead, he says that they are in effect violations of the definition of refutation.³⁶ Now if this process involves essentially wh-questions, then it only has to be expected that the fallacies will turn out to be for the most part violations of the rules on questioning.

In order to put the entire matter of Aristotelian fallacies in perspective, it is relevant to recall that Aristotle does in fact discuss a closely related matter in

the case of syllogistic inferences. In *An. Pr.* B 21 and in *An. Pr.* A 32 Aristotle discusses the question whether, and if so in what sense, one can have premises of a valid syllogism and yet fail to draw the conclusion. This problem is in Aristotle precisely parallel to the problem of *akrasia*, that is, the problem as to whether (and if so, how) a person can act against his or her better judgment. For Aristotle construes this problem as a question concerning a person who knows both the major and the minor premise of a practical syllogism and yet does not draw the conclusion, i.e., not do what the *akrates* knows he or she ought to do.³⁷ This is parallel with the case of a man who knows the premises of a theoretical syllogism but does not draw the conclusion.

The most interesting aspect of Aristotle's discussion of the possibility or, rather, of the impossibility of logical *akrasia* in *An. Pr.* B 21 and A 32 is what is *not* said there.³⁸ For one thing, Aristotle does not evoke the distinction between perfect and imperfect syllogisms, contrary to what his own explanations of these concepts might make us to expect. What is even more relevant, Aristotle does not as much as mention his precious "fallacies". This would be incomprehensible if Aristotelian "fallacies" were mistakes in inference. For then such fallacies would constitute a partial answer to Aristotle's question in these two chapters, viz, to the question: How can one fail to believe the consequence of a valid syllogism when one believes its premises? The expected answer which Aristotle does not give is: by committing a fallacy.

This silence is not fortuitous, either. For, as I have argued on an earlier occasion, the basis of Aristotle's theory of logical inference is his theory of thinking.³⁹ To think of X means for the form of X to be realized in one's soul. Hence, whatever necessarily accompanies X must likewise be realized in the soul. Hence, if one knows in the fullest active sense of the word the premises, one cannot fail to know its necessary consequences. Hence there cannot in an important sense be any fallacies in connection with strictly deductive (logically necessary) inference, quite as little as, according to Aristotle, there can be cases of moral *akrasia* other than those in which the agent is like a madman or drunk.

Hence Aristotle's general thinking about thinking and about logical inference prompts the expectation that according to him fallacies must all be traceable either to the factors that might cloud one's knowledge of the premises or of the conclusion or else to the dialectical processes which are needed to find the premises of a purely logical (syllogistic) inference. What I am arguing (on grounds independent of the general perspective just sketched) in this paper is that this expectation concerning the nature of Aristotelian "fallacies" is amply justified.

21. FALLACIES AND KNOWLEDGE-SEEKING

In sec. 1 above, it was suggested that the traditional treatment of fallacies as inferential mistakes ought to be replaced by a theory based on the interrogative model of inquiry. The examples I have given of what such a theory can

accomplish nevertheless might still leave a critical reader cold. For there might seem to be little unity in my treatment of the different so-called fallacies. Some of them have turned out to be, *prima facie*, violations of the reasonable rules of interrogative games, some others instances of bad strategy in the same games. This does not seem to amount to a unified theory. Moreover, what is so special about the rules of questioning games? Are they not at least partly arbitrary?

We have seen that the interrogative games are not arbitrary past-times, but realistic models of knowledge-seeking processes. Thus breaches of rules of these games will in practice amount to trying to do the impossible.

This idea can be used to bring together the different so-called fallacies, interrogatively interpreted. Instead of disallowing certain kinds of attempted moves altogether, it is often more instructive to associate such a heavy “cost” (negative influence on the payoffs of the game by certain types of attempted moves) that in practice no reasonable player will make them. For instance, one might require that the Inquirer is allowed to “buy” the presupposition of any question, but only for a very stiff fee which may, e.g., grow rapidly with the quantificational complexity of the presupposition.

Such a procedure would lend flexibility to the interrogative model and make the discussion of strategy selection more general. It would also make the interrogative theory of fallacies more uniform. For then all so-called fallacies discussed in this paper could be interpreted as strategic mistakes. Thus the spirit, if not necessarily the letter, of the theory of fallacies presented here is an epistemic one: fallacies are mistakes (instances of a bad strategy or a bad tactic) in knowledge-seeking. There will no longer be any crimes left, only mistakes.

By so extending the interrogative model, we can also leave the door open for the identification of previously unnoticed strategic mistakes, in other words, of new “fallacies”.⁴⁰ We can also see that a taxonomic theory of fallacies, understood as a classification of certain particular moves or kinds of moves as exemplifying certain “fallacies” cannot be more than a partial or approximative theory of mistakes in knowledge-seeking. For we know from game theory that in the last analysis we can associate definite values (payoffs) only with entire strategies, not with particular moves (except via the strategies which that move can be a part of). Hence a move-oriented rather than strategy-oriented theory, like the traditional theory of fallacies, can only yield partial truths.⁴¹ The real basis of any satisfactory theory of fallacies can only be a strategy-oriented theory of knowledge-seeking like the interrogative model of inquiry.

22. INTERROGATIVE GAMES AND ARISTOTLE'S METHODOLOGY

The character of interrogative games as knowledge-seeking procedures can be thrown into a sharper relief by spelling out how it can throw light on Aristotle's theory and practice of scientific and philosophical argumentation. Aristotle describes his method in *Topica* I 2, 101a25–b4 (cf. note 13 above). According to Aristotle, the “ultimate bases of each science” are arrived at dialectically

“through the generally accepted opinions on each point”. This alleged role of *endoxa* as the source of the first principles of each science was emphasized by G. E. L. Owen (op. cit., note 15 above) but has scarcely been fully appreciated. It must be admitted that *prima facie* this role of *endoxa* seems paradoxical. How can the opinions of the multitude serve as the foundation of the first premises of each science? In terms of the interrogative model, this means that the *endoxa* serve as answers to an Aristotelian inquirer’s questions. But, surely, they are far too unreliable guides to basic scientific truths, it might appear.

The role of *endoxa* as *phainomena* in Aristotle has in fact prompted puzzlement and denials. For instance, Martha Nussbaum has sought to modify and fill in Owen’s account.⁴² But even in her perceptive account the precise way in which *endoxa* enter into Aristotle’s argumentation eludes us. What lends Aristotle’s dialectical enterprise its characteristic flavor is not just that Aristotle’s notion of experience is wider than ours (or Bacon’s) in that it also includes well-established communal beliefs or that Aristotelian *phainomena* are concept-laden and belief-laden. Their peculiar nature lies in the role they play in the interrogative process by means of which Aristotle arrives at his conclusions.

In order to see what this role is, I have to extend the interrogative model further in one crucial respect. We have to give up the initial assumption that all of the Answerer’s replies are true. We have to countenance the possibility of their being true only with a certain probability. Then we also must allow the Inquirer to retract one of his or her earlier moves, of course together with all the subsequent moves dependent on it, and even to re-accept the same answer if and when further evidence (further answers) turn out to support it. Then the Inquirer’s best strategies will depend on the probabilities of the truth of the Answerer’s answers and on the interdependencies of these probabilities.

The resulting embarrassment of conceptual riches mostly remains to be examined. Certain general features of the extended interrogative games are nevertheless obvious. In spite of allowing for the uncertainty of the knowledge-seeking, the resulting processes differ sharply from the usual inductive inferences. Inductive steps are uncertain (nondeductive) inferences from what is taken to be (at least for the sake of the inductive argument) certain premises; in extended interrogative games we are dealing with certain (deductive) inferences from uncertain premises.

The relevance of this extension of the interrogative model to Aristotle’s methodology is amply clear. Aristotle is indeed treating *endoxa* as answers to the questions by means of which he is conducting his inquiry. But they are not accepted uncritically by Aristotle. On the contrary, the real philosophical inquiry typically begins from the contradictions and other *aporia* to which *endoxa* give rise. For “if we are able to raise difficulties on both sides, we shall more easily discern both truth and falsehood on every point” (*Top.* I 2, 101a35–37).

This is in fact the typical structure of Aristotle’s own discussion of any one philosophical or scientific problem. He begins by surveying the doctrines of his

predecessors plus other well-founded opinions and well-known facts. They give rise to various problems. Sometimes the different opinions of Aristotle's predecessors contradict one another. Sometimes one of them is hard to reconcile with well-known *phainomena*. Aristotle arrives at his own views by solving these problems, often by making a conceptual distinction or some other kind of conceptual point. One of the *desiderata* of the solution is that it has to do justice to the different *endoxa* that led to the problem situation.

Now we can see what the logic of Aristotle's method is: interrogative reasoning extended by allowing answers that are true only with a certain probability. Even though the details of this interrogative logic have not yet been systematically investigated, the match with Aristotle's argumentative practice is unmistakable. For instance, understanding this logic shows us that Aristotle's dialectical theory in the *Topics* and his actual philosophical and scientific argumentation agree with each other remarkably closely. For another thing, it is obvious that in the interrogative games false but probable answers may still have to be taken into account. Moreover, the interrogative model enables us to understand the characteristic role of *endoxa* in Aristotle's thought. They are for him "evidence", but not incorrigible evidence; they are a source of problems, rather than indubitable premises; and yet they are the source material on the basis of which he arrives at his conclusions, prominently including the first principles of different sciences. In particular, neither the acceptance nor the rejection of any particular *endoxon* need be final.

An example will illustrate this point. Nussbaum calls attention to Aristotle's rejection of Socrates's view that nobody does wrong willingly, only through ignorance: "This *logos* is obviously at variance with the *phainomena*."⁴³ What lends this apparent rejection of the Socratic view its peculiar flavor is that Aristotle himself ends up asserting as his own conclusion a version of the very same Socratic paradox, in that *akrasia* is according to him impossible if the agent really knows what he ought to do, and not only knows it in a lower-level potential sense in which even a madman or a drunk can know something. Is this conclusion any less contrary to the relevant *phainomena* than the Socratic paradox? Surely not. But why does Aristotle then accept it? Not because it squares with the *phainomena*, since it disagrees with them almost as blatantly as Socrates's view, but because it is the conclusion of his entire argument.

Here we are beginning to see how a deeper understanding of Aristotle's theory of so-called fallacies can lead to a deeper understanding of his entire methodology. Of course, the same understanding could be reached by examining Aristotle's positive advice to the players of the knowledge-seeking interrogative games, not just by analyzing his negative maxims. The positive advice is largely codified in the *topoi* which lent the *Topica* its name. Examining them goes beyond the purview of this paper, however.⁴⁴

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NOTES

In quoting Aristotle's *Topica* and *De Sophisticis Elenchis* I shall use the Oxford texts and the Loeb Library translations (Harvard University Press, 1960 and 1955).

1. The best general discussion of traditional fallacies is C. L. Hamblin, *Fallacies*, Methuen, London, 1970. Cf. also here Douglas N. Walton, *Logical Dialogue – Games and Fallacies*, University Press of America, Lanham, 1984, and John Woods and Douglas N. Walton, *Argument: The Logic of the Fallacies*, McGraw-Hill, Toronto & New York, 1982.
2. For these games, see, e.g., Gilbert Ryle, "Dialectic in the Academy", in R. Bambrough, editor, *New Essays on Plato and Aristotle*, Routledge & Kegan Paul, London, 1965, pp. 39–68; J. D. G. Evans, *Aristotle's Concept of Dialectic*, Cambridge University Press, 1977; G. E. L. Owen, editor, *Aristotle on Dialectic*, Clarendon Press, Oxford, 1968; E. Kapp, *Greek Foundations of Traditional Logic*, New York, 1942.
3. See here my papers "Knowledge Representation and the Interrogative Approach to Inquiry", in M. Clay and K. Lehrer, editors, *Knowledge and Skepticism*, Westview Press, Boulder, pp. 155–183; "What is the Logic of Experimental Inquiry?", *Synthese*, vol. 74 (1988), pp. 173–190; "A Spectrum of Logics of Questioning", *Philosophica* vol. 35 (1985), pp. 135–150; "The Logic of Science as Model-Oriented Logic", in P. Asquith and P. Kitcher, editors, *PSA 1984*, vol. 1, Philosophy of Science Association, East Lansing, Michigan, 1984, pp. 177–185; (with Merrill B. Hintikka) "Sherlock Holmes Confronts Modern Logic", in E. M. Barth and J. L. Martens, editors, *Argumentation: Approaches to Theory Formation*, Benjamins, Amsterdam, 1982, pp. 55–76. For the theory of questions and answers, see Jaakko Hintikka, *The Semantics of Questions and the Questions of Semantics* (Acta Philosophica Fennica, vol. 28, no. 4), Societas Philosophica Fennica, Helsinki, 1976.
4. This view is in fact adopted in such old-fashioned works as Alfred Sidgwick, *Fallacies. A View of Logic From the Practical Side*, Kegan Paul, Trench & Co., London, 1883. – What this observation means is that the very concept of logic was originally so wide as to comprise all of the theory of knowledge-seeking by means of question-answer dialogues.
5. In *De Soph. El.* ii Aristotle distinguishes from each other four types of refutations, viz. didactic, dialectical, examination-arguments (*peirastikoi*) and contentious ones. Didactic arguments are said not to proceed from the opinions of the answerer (*ἀποκρινόμενος*). *The answerer?* Where does he come from? Clearly Aristotle is in all these kinds of arguments thinking of a questioning procedure. The differences between the four types pertain to the different sources of answers. For instance, examination-arguments are said to be "based on opinions held by the answerer" (165b4–5). Hence Aristotle recognizes in his very definition of "arguments used in discussion" that they are essentially questioning procedures.
6. Cf. here Richard Robinson, *Plato's Early Dialectic*, second edition, Clarendon Press, Oxford, 1953; G. X. Santas, *Socrates: Philosophy in Plato's Early Dialogues*, Routledge and Kegan Paul, London, 1979, Part II.
7. Aristotle once describes a special class of answers by saying that they are "necessarily known to one who claims knowledge of the subject involved" (*De Soph. El.* ii, 165b5–6). When the subject matter is left unlimited, this special class of answers becomes the set of replies that any rational person would have on tap. Thus Aristotle argues (*Met.* Γ 4) for his basic logical principle, the law of non-contradiction, not by trying to prove it, but by refuting its critics. For this, Aristotle says, we only need that "our opponent answers our question" (1007a8).
8. This condition on conclusive answers is obviously but a special case of the restrictions that have to be imposed on existential generalization in epistemic logic. These restrictions are in turn little more than consequences of the adoption of a model-theoretic approach to epistemic concepts. The question as to how the conditions of conclusive answerhood is to be extended to questions more complicated than (4.1) nevertheless requires further discussion.

9. Beth's original exposition of the *tableau* method is still the freshest; see E. W. Beth, "Semantic Entailment and Formal Derivability", *Medelingen van de Koninklijke Nederlandse Akademie van Wetenschappen*, Afd. Letterkunde, N. R., vol. 18, no. 13, Amsterdam, 1955, pp. 309–342; reprinted in Jaakko Hintikka, editor, *Philosophy of Mathematics*, Oxford University Press, 1969, pp. 9–41.
10. Applied to the *tableau* method, this principle says that each formula F_2 introduced in the course of *tableau* construction by a rule must be a subformula of the formula F_1 to which the rule was applied (or a substitution-instance of such a subformula).
11. For the presuppositions of questions, see *The Semantics of Questions* (note 3 above), especially ch. 2, sec. 5.
12. See *The Semantics of Questions* (note 3 above), ch. 8, sec. 2.
13. In *Top.* 12, 101a36–b4 Aristotle writes:

Further, it [Aristotle's inquiry in the *Topics*] is useful in connection with the ultimate bases ($\tau\acute{\alpha}$ $\pi\rho\omega\tau\alpha$) of each science; for it is impossible to discuss them at all on the basis of the principles peculiar to the science in question, since the principles are primary with respect to everything else, and it is necessary to deal with them through the generally accepted opinions ($\tau\omega\delta\nu\zeta\alpha$) on each point. This process belongs peculiarly, or most appropriately to dialectic; for, being of the nature of an investigation, it lies along the path to the principles of all methods of inquiry.

Now the dialectic Aristotle mentions here involves studying "how questions must be asked and ... the arrangement of questions in general, and ... answers and solutions applicable to the reasoning employed" (*De Soph. El.* xxiv, 183b10–12; cf. Aristotle's reference to dialectic in 183a39 and to "the most generally accepted premises" in 183b5–6).

14. See Jonathan Barnes, "Aristotle's Theory of Demonstration", *Phronesis* vol. 14 (1969), pp. 123–152; reprinted (with revisions) in Jonathan Barnes et al., editors, *Articles on Aristotle*, vol. 1, Duckworth, London, 1975, pp. 65–87.
15. See here G. E. L. Owen, "Tithenai ta Phainomena" in S. Mansion, editor, *Aristote et les problèmes de méthode*, Louvain, 1961, pp. 83–103; reprinted in Barnes et al. (note 14), pp. 113–126.
16. Cf. here "A Spectrum of Logics of Questioning" and "What Is the Logic of Experimental Inquiry?" (note 3 above).
17. These are of course precisely the usual requirements on explicit definitions. For instance, if

$$(*) (\forall x)(\forall y)(f(x) = y \leftrightarrow D[x, y])$$

is to be a definition of the function f , the following conditions have to be satisfied:

- (i) The only free variables in $D[x, y]$ are x and y .
- (ii) f does not occur in $D[x, y]$.
- (iii) The following must have been proved or otherwise established:
 $(\forall x)(\exists y)D[x, y]$
 $(\forall x)(\forall y)(\forall u)((D[x, y] \& D[x, u]) \supset y = u)$

18. Richard Robinson, "Begging the Question 1971", *Analysis* vol. 31(1971), pp. 113–117. For recent discussions of this fallacy, see, e.g., John Woods and Douglas Walton, "Petitio principii", *Synthese* vol. 31(1975), pp. 107–127; John Biro, "Rescuing 'Begging the Question'", *Metaphilosophy* vol. 8 (1977), pp. 257–271; D. Sanford, "Superfluous Information, Epistemic Conditions and Begging the Question", *Metaphilosophy* vol. 12 (1981), pp. 145–158; John Biro, "Knowability, Believability, and Begging the Question", *Metaphilosophy* vol. 15 (1984), pp. 239–247; J. A. Barker, "The Fallacy of Begging the Question", *Dialogue* vol. 15 (1977), pp. 241–255.
19. Op. cit. (note 2 above), p. 74.
20. The details of this development need a lengthier discussion than what can be undertaken here. (Cf. sec. 17 below for a couple of items of additional evidence.)
21. This parallelism breaks down if it is extended beyond those deductive procedures which conform to the subformula principle.

22. See, e.g., *An. Pr. B* 1,52b34–53a1.
23. Aristotle's discussion of *petitio principii* in *An. Pr. B* 16 is often taken to be his official account of this so-called fallacy. Moreover, this discussion is sometimes claimed to show that the *petitio* was for Aristotle really a fallacy, that is, a mistake in inference. Whatever the truth is in the former matter, the latter claim is not proved by the text of *An. Pr. B* 16. What Aristotle actually says there is that it is a mistake in the selection of the proper premises. It consists in something to be "knowable through itself" which isn't. Now a proposition's, say S's, being knowable through itself can be taken to amount to its being knowable as an answer to the question "S or not-S?", while its not being knowable through itself means that answers to other questions are needed to come to know it. Indeed, this way of reading Aristotle lends his words a much better sense than on the assumption that he is thinking of coming to know S through an inference. For to infer to S from S is not even to do anything.
24. Cf. here "Knowledge Representation and the Interrogative Model of Inquiry" (note 3 above).
25. For Gentzen's result, see any introduction to proof theory or M. E. Szabo, editor, *The Collected Papers of Gerhard Gentzen*, North-Holland, Amsterdam, 1969.
26. See here Hamblin (note 1 above), pp. 38–40.
27. John Woods and Douglas Walton, "Arresting Circles in Formal Dialogues", *Journal of Philosophical Logic*, vol. 7 (1978), pp. 73–90.
28. The twentieth-century sense of *ad hominem* argumentation (see Hamblin, op. cit. note 1 above, pp. 41–42) is a complete anachronism. The correct sense is given by John Locke in a passage quoted by Hamblin, op. cit. p. 160:

A third way is to press a man with consequences drawn from his principles or concessions. This is already known under the name *argumentum ad hominem*.

Notice that this characterization refers to something like an interrogative game, as is seen from words like "concessions" and "principles".

29. Cf. here Hamblin, op. cit. (note 1 above), pp. 161–162.
30. Cf. Plato, *Theaetetus* 201 D.
31. Cf. here G. E. L. Owen, note 15 above, and Jaakko Hintikka, "Aristotelian Infinity", *Philosophical Review* vol. 75 (1966), pp. 197–212, reprinted in Jaakko Hintikka, *Time and Necessity*, Clarendon Press, Oxford, 1973, ch. 6.
32. See Plato, *Meno* 80 D–81 A. There exists an extensive literature on Meno's paradox.
33. See here *The Semantics of Questions* (note 3 above), ch. 3, secs. 2–3.
34. Indeed, Aristotle's solution to Meno's puzzle is not entirely unrelated to the one offered by the interrogative model. This solution is expounded by Aristotle in *An. Post. I* 1, 71a29 ff. It is a variant of Aristotle's often-repeated idea that we may ask *why* something is the case only after we have ascertained *that* it is in fact the case. (See, e.g., *An. Post. II* 1, 89b29–3 1.) This idea is the closest Aristotle came to the realization of the need of satisfying the presupposition of a question before asking it.
35. This is seen most quickly in Book VII of the *Topica*, which Aristotle begins by saying:

Next we must speak about the arrangement and the way to ask questions.

36. Cf. sec. 3 above. There it was argued that the cash value of the failure to abide by the definition of refutation a syllogism that Aristotle mentions is a violation of the rules of interrogative games.
37. See *Eth. Nic.* VII 1–9.
38. Cf. here Jaakko Hintikka, "Aristotle's Incontinent Logician", *Ajatus* vol. 37 (1978), pp. 48–65.
39. Op. cit. (note 38 above).
40. Some of these previously unrecognized and unnamed fallacies (in a wide sense of the word) have a great deal of relevance to the actual practices of argumentation. The proper framework in investigating such argumentative fallacies is often offered by the symmetrical questioning games proposed and studied, e.g., in Jaakko Hintikka, "Rules, Utilities, and Strategies in Dislogical Games", in Lucia Vaina and Jaakko Hintikka, editors, *Cognitive Constraints on Communication*, D. Reidel, Dordrecht, 1984, pp. 277–294.

There is, for instance, what might be called "the fallacy of the snowjob", where a player in an

interrogative game keeps on introducing facts (i.e., obtains “small” answers from his or her interlocutor) which do not constitute steps toward an answer of the initial “big” question. The fallaciousness of this “fallacy” is shown by the strategic uselessness of the attempted snowjob.

One way of coping with attempted fallacies of this kind is to allow the fallacier’s opponent to challenge the questioner and to say, in effect, “What’s the relevance of your question?”. It might, e.g., be stipulated that a successful challenge of this sort will induce a change of sides and perhaps give the challenge an additional penalty turn at questioning.

Here we can see once again what a close connection there is between bad questioning strategies and breaches of suitable rules in questioning games, when these games are formulated appropriately, so as to capture the structure of certain information-acquisition procedures.

41. In this respect, the traditional theory of fallacies is on a par with Grice’s theory of conversational maxims. These maxims, like the concept of fallacy with its different subspecies, apply to particular moves in conversational “games”, not to strategies. Hence they can at best be approximative generalizations, but not in principle strict or fully explanatory principles. This point is argued in Jaakko Hintikka, “Logic of Conversation as a Logic of Dialogue”, in Richard E. Grandy and Richard Warner, editors, *Philosophical Grounds of Rationality*, Clarendon Press, Oxford, 1986, pp. 259–276.
42. Martha Craven Nussbaum, “Saving Aristotle’s Appearances”, in M. Schofield and M. Nussbaum, editors, *Language & Logos: Studies in Ancient Greek Philosophy Presented to G. E. L. Owen*, Cambridge U.P., 1982, pp. 267–293.
43. Quoted by Nussbaum, *op. cit.*, p. 268.
44. It might very well turn out that the traditional *topoi* are less interesting philosophically than their modern counterpart which can be “deduced” from the interrogative model. For instance, the vindication of the old idea of consilience which is given in my paper “The Interrogative Approach to Inquiry and Probabilistic Inference” (note 43 above) might be said to establish a new “*topos* of consilience”.

CHAPTER 14
SOCRATIC QUESTIONING, LOGIC AND RHETORIC

1. SOCRATIC ELENCHUS AND THE INTERROGATIVE MODEL OF INQUIRY

The most important thing for one's health, my physician once informed me, is to choose one's parents carefully. In the same way, I have come to think, one of the most important factors in diagnosing the health and the illnesses of logical, methodological and rhetorical theory throughout their history is to understand their parentage. That is what I shall try to do in this paper.

I shall begin by asking: How did formal logic come about in the first place? The story, as I see it, begins with Socrates and his method of *elenchus*, or in other words, his questioning method. We all think we know what this method is all about. In reality, however, Socratic *elenchus* is full of logical subtleties even though on the surface it proceeds deceptively smoothly. Socrates is engaged in a question-answer dialogue with an interlocutor. He begins with an initial thesis which is often obtained as a response to Socrates' initial or, as I shall call it, principal question put to his dialogue partner. Socrates then addresses further questions to the other party, and eventually the subsequent answers lead him to a conclusion concerning the initial thesis, typically, to the rejection of this thesis.

Treatises and essays have been written about the Socratic method, but so far we have not had any real conceptual tools for analyzing the Socratic method of questioning with a sharp eye on its logical structure.

Here comes the first main point of this paper. The interrogative model of inquiry which I have developed over the past several years offers to the first time satisfactory framework for understanding the nature of the Socratic *elenchus*. In fact, the interrogative model can almost be thought of as an updated and sharpened version of the Socratic method, as *elenchus* as it would be practiced by John von Neumann, as a commentator once said. Indeed, the overall similarity is obvious. In the interrogative method, too, all the new information enters into the inquirer's line of reasoning as a response to a question the inquirer has put to a given source of answers, called in my jargon an *oracle*. (This locution is to be taken merely as a *terminus technicus*.) By means of the answers, the inquirer tries to establish a given conclusion or to answer a given question. The main apparent difference between my interrogative games and Socratic *elenchus* is that at any stage of the line of argument the inquirer may, instead of putting a question to a source of answers, draw a logical inference from the results so far obtained, whereas a Socratic inquiry proceeds practically exclusively through questions and answers.

Both in Socratic inquiry and in an interrogative game, if the available answers are not all known to be true, the inquirer may at least tentatively discount (“bracket”) one of the answers (plus all logical conclusions and other answers dependent on it).

Even before specifying the precise rules of the questioning games, which are codified in my interrogative model, it may be in order to illustrate its relevance to the Socratic method by means of an example. One of the *prima facie* characteristics of Socratic questioning is described by Gilbert Ryle as follows:

The questioner can only ask questions; and the answerer can, with certain qualifications, answer only ‘yes’ or ‘no’. So the questioner’s questions have to be properly constructed for ‘yes’ or ‘no’ answers. This automatically rules out a lot of types of questions, like factual questions, arithmetical questions, and technical questions. Roughly, it leaves us only conceptual questions, whatever these may be. (Ryle, *Collected Papers*, vol. 1, p. 90.)

The interrogative model shows that Ryle is completely wrong here. It shows that, with certain qualifications, you can replace all other kinds of questions by suitably chosen yes-or-no questions and still prove the same conclusion as before. These ‘other kinds of questions’ include propositional whether-questions and wh-questions of any complexity. Yes-or-no questions are all you need to reach the same conclusion you reached by means of these more complex questions, with one important provision. You have to know which entities to ask you yes-or-no questions about; you cannot wait to have these entities (of the appropriate logical type) introduced by your answerer’s replies.

This observation, though based on state-of-the-art conceptualizations, is not anachronistic. Indeed, Aristotle was not unaware of this point. In *Top.* VIII, 2, 158a14–20 he writes:

It is generally agreed that not every universal can form a dialectical proposition (protasis) for example ‘What is man?’ or ‘In what various senses can *the good* be used?’ For a dialectical proposition is one to which it is possible to answer ‘yes’ or ‘no’ whereas to the above questions this is impossible. Therefore such questions are not dialectical unless the questioner himself makes the divisions or distinctions before he asks them, saying, for example, ‘Is *the good* used in this or that sense?’

As promised, my observations throw sharp light on the Socratic method. They show, first of all, that Ryle is wrong. Restricting oneself to yes-or-no questions does not exclude us from any particular type of inquiry be it factual or mathematical. Second, they explain why Socrates was able to operate by means of yes- or-no questions, as he typically did, even though he was interested in questions which are most appropriately queried by a wh-question. Indeed, the Platonic Socrates does occasionally forget Ryle’s instructions and raises

wh-questions. (See e.g. *Phaedo* 105 C-D “What causes the body in which it is to be alive?”)

The third observation is the subtlest one. The interrogative model puts in an interesting perspective Socrates’ *eironeia*, pretended ignorance. Even though the line of argument in a Socratic inquiry depended only on the interlocutor’s answers, it was Socrates who introduced the entities into the discussion that enabled him to ask the appropriate yes-or-no questions. This is nowhere clearer than in the slaveboy episode of the *Meno* (82A-85E). There the crucial questions which Socrates addresses to the unlearned slaveboy pertained to certain geometric figures which were constructed by Socrates, not the slaveboy. Logically speaking, the construction of a figure amounts to a choice of the new individuals about which yes-or-no questions are to be asked. And it was an ability to choose these new individuals propitiously that enabled us to replace wh-questions by yes-or-no questions.

It is of interest to note that by the ‘divisions’ Aristotle mentions in the quoted passage from *Top.* 158a14–20 he elsewhere means geometrical constructions. (See *Met.* IX, 9, 1051a21–26.)

One historically useful service the interrogative model can perform is to provide a framework for distinguishing different but related kinds of interrogative games from each other. For instance, a Socratic *elenchus* can be construed as aiming at proving or, more likely in the Platonic dialogues, disproving a given thesis, typically the interlocutor’s answer to the principal question. But it can also be construed as attempting to answer the principal question itself. That the latter construal was a live option for Aristotle is shown by his injunction not to confuse the principal question with the “small” questions by means of which it is to be answered. This injunction is codified in Aristotle’s discussion of the fallacy of *petitio principii*.

Aristotle is apparently also considering symmetrical situations in which the answerer, too, is defending a thesis of his own. All these different kinds of questioning games can be conceptualized and analyzed by means of suitable extensions of the simple version of the interrogative model sketched above.

Thus the interrogative model proved to be a most useful conceptual tool in trying to understand the dynamics of the Socratic method. Within the general framework provided by the interrogative model, one can nevertheless note differences between the Socratic question-answer dialogues and other types of interrogative inquiries. For instance, in many types of interrogative inquiry, e.g., scientific ones, the questioner can have a variety of different oracles that she or he can consult, including observations, experiments, sundry witnesses’ reports, earlier results codified in treatises and handbooks, etc. In *elenchus*, all these answers have to enter the argument via one’s interlocutor’s replies.

This tension between Socratic questioning and interrogative inquiry in science does not render the interrogative model useless historically. On the contrary, awareness of this very tension can be historically instructive. For instance, when Aristotle developed his first theory of the scientific method as a version

of the dialectical method of questioning, he was faced by this very need of finding some one uniform source of answers. This is what underlies Aristotle's *prima facie* quaint idea that a scientific inquiry uses as its starting-points *endoxa* or generally accepted opinions.

2. QUESTIONING AS A STRATEGIC GAME

But the Socratic questioning technique did not remain his peculiarity, if it ever was one. In Plato's Academy, the technique was formalized into a method of philosophical training and philosophical inquiry by means of question-answer games. The term "game" is not mine; it was used by scholars like Richard Robinson and Gilbert Ryle before me. The precise rules of these interrogative games do not have to be investigated here.

Of course, we all know what happened next. An ambitious young member of the Academy called Aristotle undertook to write what Ryle has called "a training manual" for the interrogative games. This manual is of course the *Topics* together with its appendix, *De Soph. El.* It is a most practical, down-to-earth handbook, full of advice as to keep your opponent in the dark but not *vice versa*. For instance, in *Top VIII*, 1, 156a12–14 Aristotle advises an inquirer as follows:

Further, you should not state the conclusions, but establish them by reasoning all at the same time at a later stage; for then you would keep the answerer as far as possible from the original thesis.

We should not dismiss even Aristotle's little ruses, however, as being philosophically unimportant. They illustrate an important conceptual distinction which is all too frequently neglected by philosophers and historians. Even if we look away from all contingent psychological and sociological features of the players of games like Academic questioning games, the "game" of deductive logic or the game of chess, we can still on this purely structural level make a distinction between the definitory rules of the game and its strategic rules (or principles). The former are in deductive logic called "rules of inference"; they merely tell us what is not permissible in a "game" of deductive reasoning. They do not tell which moves (or sequences of moves, ultimately complete strategies) are good ones, that is, likely to lead to the desired result or "win." The latter task belongs to strategic rules. Here the term "strategy" can be taken either in the strict sense employed in the mathematical theory of games, where a player's strategy determines completely her or his decisions in any situation that may come up in a game, or in a looser everyday sense. Small-scale strategic rules may also be called tactical ones. Independently of these details, however, the distinction between definitory and strategic rules is a most helpful one in many walks of philosophy and its history.

The distinction between violations of definitory vs. strategic rules of a game,

in this instance the “game” of international power politics, is illustrated by a comment attributed to Talleyrand *apropos* Napoleon’s decision to kidnap and to execute one of his *emigre* enemies: “It’s worse than a crime, it is a mistake.”

In the *Topics*, Aristotle is studying both the definitory and the strategic rules of Platonic questioning games. The strategic angle is in evidence for instance when Aristotle acknowledges that he is in the *Topics* speaking (among other things, of course) “about the arrangement and the way to ask questions” (*Top.* VIII, 1, 155b3–4). The theme of the entire *Topics* is “to discover a method by means of which we shall be able to reason from generally accepted opinions about any problem set before us ...” (*Top.* I, 1, 100a18–20). And the method Aristotle envisages is unmistakably a method of questioning. For instance, the first premises are recognized according to Aristotle from the fact that in their case “it is unnecessary to ask any further question as to ‘why’” (*Top.* I, 1, 100b18–22).

Elsewhere Aristotle is concerned also with the definitory rules of the questioning games. Now an especially important part of the definition of any game is the specification of its payoff structure, which in practice amounts to specifying the players’ aims in the game. This is important because the relative merits of different strategies depend crucially on the payoff structure of the game. Among other things the payoff structure determines whether the game is one of pure conflict, as in zero-sum two-person games, or whether it is a cooperative one, that is, whether it is rational for the players to cooperate.

Thus one of the crucial tasks in the theory of any kind of game is to examine how its strategic principles depend on its definitory rules. An inquiry of this very kind is carried out by Aristotle in *Topics* VIII, 5. There Aristotle first distinguishes from each other different kinds of interrogative games: games of teaching and learning; contentious games; and games of inquiry “for the sake of inquiry” (i.e., search for truth), making it clear that the difference between them lies in their respective aims. Aristotle allows us an interesting glimpse into his own historical situation and into the nature of his own enterprise when he writes that

where the disputants argue not in competition but for the sake of experiment and inquiry, no formal rules have yet been laid down as to the aim which the answerer ought to seek and what sorts of things he must offer and what not, so as to maintain his thesis properly or otherwise – traditions handed down by others, let us try to say something ourselves on the subject. (159a32–38.)

Thus Aristotle considers it his main novel contribution to develop a theory of truth-seeking interrogative procedures in contradistinction to eristic and pedagogical ones. This is interesting in several respects, not the least because Socratic question dialogues belonged to the same noncompetitive and nonpedagogical category. Apparently they had been given a competitive turn when they began to be used in philosophical training exercises.

In *Topics* VIII Aristotle then proceeds to examine in a fascinating way the proper strategies and tactics in such truth-seeking questioning games. His discussion will be commented on by Simo Knuuttila elsewhere, and I shall therefore forego further comments on Aristotle's strategic *topoi* presented in *Topics* VIII, 5–6. Suffice it to say here that the truth-seeking character of the dialogues Aristotle has in mind is shown by the nature of the determinants of the questioner's and the answerer's strategies, viz, by the greater or lesser plausibility of their respective theses. Aristotle's keen eye for strategic considerations is shown by his remarks on how a player's tactics are affected by what his opponent is likely to do. Another item of evidence of Aristotle's keen eye for the strategic situation is pointed out by Knuuttila, viz, that Aristotle is considering at least some of the truth-seeking games as cooperative rather than games of contention (zero-sum games).

Even more detailed little definitory rules of the Platonic questioning games make an appearance here and there in the *Topics*. For instance, in *Top.* VIII, 7, 160a18–20, he says that

the answerer is always allowed, if he does not understand to say, 'I don't understand'.

It is of interest to note the cute distinction Aristotle is in effect making here between not understanding and making the formal move in a game of saying "I don't understand."

These examples suffice to show the general similarity between the methods of inquiry Aristotle was studying and the technique of reasoning articulated by the interrogative model. More examples can easily be given to the same effect. This similarity is not merely a vague general one, either. Over and above the examples just given, I have shown how the interrogative model can be put to use to analyze Aristotle's discussion of many of the so-called fallacies in *De Soph. El.* I carried out this task in my paper "The Fallacy of Fallacies." Suffice it to say here that several traditional fallacies are in this way put in a new perspective, for instance the "fallacy" of *petitio principii* mentioned above.

3. INTERROGATIVE GAMES AS MODELS OF METHODOLOGY

But what does Aristotle think that this (his) interrogative method can establish? A part of the answer was in effect provided in the preceding section: it was for him a general method of truth-seeking inquiry. This implies that Aristotle's earliest methodology of science was an interrogative one. Some of its features were pointed out in sec. 1 above, and a few further remarks are made in my paper, "The Fallacy of Fallacies." In this direction, the parallelism between Aristotelian games of truth-seeking inquiry and my interrogative model is at its clearest. For the interrogative model, too, can be developed further so as to be a framework for studying and evaluating different kinds of scientific methodology, among which we can in fact locate Aristotelian science.

Another similarity between the interrogative model and Aristotelian methodology is the wide scope of the intended applications of the model. In the intended applications of the interrogative model, the oracle can *inter alia* be nature as a source of observation or as the target of a controlled experiment, witness in a court of law, a medical test, patient in a diagnostic interview, computer memory, or even one's own tacit knowledge. In Aristotle, the most important class of *prima facie* answers were *endoxa* or generally accepted opinions. Their role in Aristotle's scientific and philosophical methodology can be appreciated only by reference to the dialectical (interrogative) character of Aristotelian methodology. Indeed, from what has been said, it can be seen that something like an appeal to *endoxa* was virtually inevitable for Aristotle. It is not hard to accommodate a variety of answerers ("oracles") in a sufficiently general version of my interrogative model. But Aristotle was in his early methodology trying to construe even the scientific method as a two-person interrogative game. How can we possibly assimilate to each other people's reported observations, one's own experiences, scientific experiments, our shared *anamnesis*-like a priori truths, among others? Somehow Aristotle has to try to integrate all the sources of initial direct answers into some one store of information. This, for Aristotle, is precisely the totality of *phainomena* available to the inquirer. And *endoxa* seem to be those phenomena that resemble closest initial answers to an inquirer's question.

Another facet of Aristotle's general methodology which finds a niche within the interrogative approach is his notion of induction. As I have spelled out in my forthcoming paper "The Concept of Induction in the Light of the Interrogative Approach to Inquiry," this model gives rise to a problem of reconciling several partial generalizations and extrapolating them, and from my study of Aristotelian induction it can be seen that this is indeed what Aristotle meant by *epagoge*.

In order to uncover the next twist of the plot of our Socratic story, I have to raise further questions. So far I have not yet said anything at all of serious formal logic. How does it come in? All that there is to a Socratic or Academic interrogative game is apparently a sequence of questions and answers.

Admittedly, at the end of a dialogue, the Platonic Socrates sometimes says, "Let us now add one admission together", but such "adding up" (which obviously amounts to drawing logical conclusions) seems to play a minor role in the method of *elenchus*.

At this stage of my discussion, I can provide only a kind of formal analogy between interrogative arguments and logical proofs. An interrogative inquiry starts from a given initial premise T and ends up with a conclusion C, reached with the help of answers that pertain to a certain possible world (model of the underlying language) M. This relation symbolized by

$$(1) M:T \vdash C$$

turns out to behave metalogically very much like the relation of logical consequence

(2) T⊢C

For instance, an interpolation theorem can be proved for (1) in parallel to the usual interpolation theorem for the deductive consequence relation (2). It is not on my agenda to present a proof of this theorem (or even a full formulation of it) here. However, one of the tasks of this essay is to examine how such metalogical relations manifest themselves in the actual historical material. An example was provided above concerning the (conditional) replacability of other kinds of questions by yes-or-no questions.

More can be said here. The seeds of an answer to my question concerning the role of logic in Socratic inquiry lie in Aristotle's interest in the strategic principles of interrogative games. There the overall task is clear. By choosing his or her questions appropriately, the inquirer tries to steer the argument in the right direction. (This idea is not a monopoly of the Greeks, either. When Kant compares scientific experiments to questions put to Nature, he obviously has in mind the role of the choice of appropriate questions in guiding the inquiry in the right direction.)

4. FROM DIALECTIC TO LOGIC

But this possibility of steering the direction of inquiry in the right direction is the easier the more closely the inquirer can anticipate the answers that the oracle will yield. Accordingly, Aristotle had a keen strategic eye on the possibility of anticipating the interlocutor's answers. And in looking at the possibilities of such an anticipation, he made a momentous discovery: Sometimes the answer could be predicted completely on the basis of the respondent's earlier answers or "admissions." Such answers were of course those that we would say are logically implied by the earlier replies. Aristotle was quick to realize their importance, even though he does not seem to have articulated his realization fully. For instance, after he had moved to consider merely logical inferences, the original *fallacy of petitio principii* should have become irrelevant. Yet Aristotle tries to discuss it, too, within the framework of syllogistic logic, thereby changing the import of the "fallacy" and sowing the seeds of subsequent confusions. (Cf. *An. Post.* B 4.)

Not only did Aristotle realize, however implicitly, the importance of such predetermined and hence predictable answers. He began to study them and developed a theory of them. That theory is the first deductive logic in existence, Aristotle's syllogistic logic. Of course, as we all tend to do, Aristotle ran away with the idea and began to use syllogistic logic as a paradigm of reasoning in general. In doing so, he merely anticipated the subsequent history of logic which has all too often tended to forget its own roots in the theory and practice of interrogative inquiry.

I can at this point say a little bit more also about the precise relation of the interrogative model to the questioning games of Plato's Academy. The main technical difference is that while in Socratic dialogues everything is done by

means of questions and answers, in the interrogative model there is a separate category of interrogative moves. But this difference is not essential. The introduction of a special class of logical inference steps (deductive moves) is merely an implementation of Aristotle's observation. (It also sharpens Aristotle's observation way beyond what Aristotle did himself.) It is also a systematization of the Platonic Socrates' realization that we sometimes have, so to speak, to add together the answers so far obtained.

The rationale of the new category of moves in an interrogative game is implicit in Aristotle's insight. If the answer to a question is determined by earlier answers the answerer plays no strategic role in such a move. Such a move is completely independent of what the respondent knows or believes and of what his strategy is. Such a move is as impersonal as Socrates' "adding up" in a Platonic dialogue. Hence there is no reason, so to speak, to bother the oracle with such a move at all. The inquirer can make it on his or her own. Hence in the interrogative model such moves are separated from question-answer moves and turned into a separate class of moves made by the inquirer on his or her own. This explains the main difference between Socratic questioning and the interrogative model, and it also explains why the difference does not matter for our purposes.

Aristotle himself explains the difference between logical and interrogative steps in a dialectical inquiry in *An. Post.* A 6, 75a18–27:

Attributes which are not essential in the sense which we have defined do not admit of demonstrative knowledge, since it is not possible to give a necessary proof of the conclusion ... Yet one might perhaps wonder what purpose there could be in asking [these questions] about such items if it is not necessary for the conclusion to be the case – [apparently] you might as well ask an arbitrary question and then state the conclusion. But we should ask questions not on the grounds that the conclusion will be necessary because what makes the conclusion necessary was asked [earlier] (*dia ta erotemena*), but rather because it is necessary for the person who accepts the proposals [i.e. answers the question in the proposed way] to state the conclusion – and to state it truly if they hold truly. (*An. Post.* A 6, 75a22–27; I have modified Barnes' translation.)

This statement of Aristotle's belongs to a period when he has developed his syllogistic theory, and uses it as a paradigm. At this stage, logical inferences are not any longer thought of merely as a special kind of question-answer steps, viz, steps in an argument where the answer is necessitated by the earlier "concessions." Here Aristotle is already working within the syllogistic framework, looking back and raising the question as to why one should move to a new "conclusion" in an interrogative move when it is not necessitated by all of the above. But apart from this change of perspective (and to some extent also terminology) Aristotle's basic view remains the same as in the *Topics*. As Aristotle reminds his audience, even though answers (viz, non-syllogistic ones)

are not necessitated in their antecedents, they can still introduce new truths into an inquiry.

This, in any case, is one of the central theses of my paper: the origin of deductive logic in the dialectical games of Plato's Academy. As a general thesis it is not new. For instance, Ernst Kapp argues for a similar general thesis in his *Greek Origins of Traditional Logic* (Columbia U.P., 1942). However, the precise diagnosis of Aristotle's motivation is new, as far as I can tell. In particular, Kapp makes a distinction without any substantial difference when he claims that Aristotle's logic was developed through empirical observations concerning actual arguments rather than as a product of abstract constructions. Of course Aristotle's starting-point was the actual practice of interrogative argumentation in Plato's Academy, and he may in fact be led to his specific logical rules through observations of the strategic feats of particular arguers. But Aristotle was himself perfectly well aware that in the cases he was especially interested in the discussion can be directed completely *ad argumentum*, not *ad hominem*. This is witnessed by Aristotle's remarks on the frequent cases where "the person questioned is the cause of the argument not being properly discussed, because he does not concede the points which would have enable the argument against his thesis to have been properly carried out" (*Top.* VIII, 11, 161a 17–21). What Kapp may have had vaguely in mind was more likely the absence of another distinction in Aristotle. As shown by the quotation just given, Aristotle does not distinguish between an interlocutor's failure to yield the proper answer because he refuses to acknowledge a logical consequence of his earlier replies and his failure to do so because he refuses to admit what he believes to be the case.

In the earlier studies of the genesis of Aristotle's logic, much of the evidence is focused on concerns of the detailed precedents of Aristotelian logical rules in Plato's writings. It seems to me that such precedents, however striking, are relatively superficial. What is crucial is not where Aristotle found this or that particular rule, but his realization that there is a whole set of rules which enable us to predict an opponents answer to a specific question, given his earlier admissions. It may be that the particular form which Aristotle's logical theory took was determined by the antecedents of his syllogistic rules in Plato, but without Aristotle's insight into what logic is and does in the wider context of interrogative inquiry there would not have been any theory to incorporate those pieces in.

Kapp in any case provides useful evidence for the thesis proposed here. His historical argumentation needs some tightening, but I cannot possibly marshal fully conclusive evidence myself within the scope of a single paper. Instead, I must restrict myself to pointing out certain telltale signs of the ancestry of Aristotle's logic.

Perhaps the most interesting and most intriguing symptom is the absence in Aristotle of any hard-and-fast distinction between what can be said of syllogistic deductive inferences and what can be said of steps in an interrogative game. This ambiguity of Aristotle's position is seen in his central definitions. For

instance, consider his definition of a *sylogismos* as a “*logos* in which, certain things having been laid down, something other than these things necessarily, results through them” (*Top.* I, 5, 100a25–27). We tend to take this as a description of a solitary *cogitator* who utters to himself certain propositions and is thereby forced to assent to something else, too. Undoubtedly, this is a part of what Aristotle had in mind. But there is every reason to think that he also, and primarily, wanted the formulation to cover an interlocutor who was provided a number of earlier answers and is thereby committed to giving only one possible answer to a fresh one. Indeed, in *An. Post.* A 1, 71a5–7, Aristotle says that in a syllogism we obtain knowledge by “making assumptions as though granted by an intelligent audience.” In such a case, if the interlocutor refuses to draw the conclusion, he has not defied logical necessity, but the rules of the interrogative game.

In general, in the *Topics* the term *sylogismos* is unmistakably used to cover steps of interrogative inquiry.

Perhaps the most direct evidence for my main thesis consists of indications of Aristotle’s growing awareness of the distinction between what can be said of an argument as such and what can be said of it by reference to a particular answerer. I have already quoted *Topics* VIII, 11, where this matter is discussed by Aristotle. Other food for thought is provided by those remarks of Aristotle’s in *De Soph. El.* which have sometimes been taken as acknowledgements of the fallacy of *argumentum ad hominem*. They are *De Soph. El.* 20, 177b33–34; 22, 178b15–17; 33, 183a21–23 and 8, 170a12–19.

This is not the place to analyze these passages in full detail. They all hang together very well, and serve to clarify each other. Aristotle himself relates the first two to each other in so many words. The clearest is perhaps the last one. There Aristotle discusses fallacies due to equivocation. An alleged inference that turns on equivocation simply is no inference, and no resolution of a fallacy is needed. But if a particular opponent assimilates the different meanings to each other, a fallacy is being committed. However, it can be resolved only *ad hominem*, by pointing out that this particular person falls prey to that particular mistake.

The other passages make similar observations about what it is to deal with a mistake in inference *ad hominem* as distinguished from solving it *ad argumentum*. In the former case, the treatment depends on a particular mistake by a particular arguer, in the latter, on the form of the argument alone (e.g. on what we would now call scope ambiguity).

On the face of things, all these passages pertain, not to arguments, but to ways of resolving fallacies. They do not concern directly different kinds of steps in an argument. But in 170a13, Aristotle does say, “and so likewise is a *sophistical proof*,” and a little later he indicates that we might have a proof which is possible relative to the answerer but not absolutely. Hence dialectical (interrogative) arguments *ad hominem* need not be fallacious. They are merely arguments against an opponent that work only against that particular answerer. They turn on answerers not implied by earlier answers (or by premises everybody shares). Incidentally, this line of thought shows that it is hopeless to try

to find an anticipation of *ad hominem* fallacy in Aristotle's remarks, for a perfectly successful argument can according to him be *ad hominem*.

Thus, even though Aristotle perhaps is not quite as explicit as we would hope him to be, the upshot of his remarks is unmistakable. In a dialectical argument, a step is *ad argumentum* if it depends only on earlier admissions (answers) by the interlocutor. Such a step has the nature of a logical inference. In contrast, an *ad hominem* step depends on the interlocutor, and hence has the character of a question-answer move. This is in an excellent agreement with what Aristotle says himself in *An. Post.* A 6, 75a18–27 (quoted above in sec. 3).

5, WHAT IS THE RATIONALE OF LOGIC?

The interrogative model thus offers a useful conceptual tool for systematic as well as historical purposes. It might nevertheless seem to be only part of the story, systematically speaking. As a full-fledged formal semantics in the twentieth-century sense, the interrogative model is indeed seriously incomplete for it leaves a number of things unanalyzed. For one thing, it leaves the nature of the logical inference steps open. What is the ground of their validity? Aristotle makes a number of interesting points in this connection. For instance, he recognizes quite explicitly that logical (syllogistic) inferences are truth-preserving. It is not obvious, however, that Aristotle managed to integrate this insight into an overall theory of interrogative games.

However, in a historical perspective the incompleteness of the interrogative model as a semantical theory is a strength and not a weakness. For the very incompleteness enables us to capture – or at least leave room for – the ambiguities of the historical problem situation.

For one thing, it might be asked why Aristotle did not handle syllogistic necessity in the way we are wont to do in twentieth-century philosophy. Now a contemporary formal semanticist might account for the validity of logical rules in terms of truth-presentation in every possible world. This idea could then be integrated into an overall theory of interrogative games. For instance, an interrogative inquiry starting from T and aiming at C can be viewed as a thought-experiment, that is to say, as an attempt on the one hand to describe consistently a possible world or scenario in which T is true but C false and, on the other hand, to align this imaginary world with the known facts about the actual world. The former is what the logical inference steps (*tableau* construction steps) serve to do, the latter is the job of the interrogative steps.

One reason why this kind of understanding of the interrogative games was not possible for Aristotle (or for other philosophers of the antiquity) is that they lacked completely the idea of a possible but unrealized world. For instance, the only reality that there is for Aristotle is the succession of “nows,” each of which will sometimes be reached (unless it was realized sometime in the past). No other possible cosmic world history has a niche in Aristotle's ontology.

For this reason, no possible-worlds analysis of logical inference was feasible for Aristotle. Either he had to leave the deeper nature of logical inference steps unanalyzed or else offer some other kind of backing for them. Many Aristotelian texts are best approached as if the former were the case. However, Aristotle's "statistical" interpretation of necessity and possibility can be viewed as a tentative analysis of the cogency of necessary inferences. It is structurally very close to the possible-worlds idea, with different contemporary states of the history of the universe playing the role of the "possible worlds" of twentieth-century semanticists. Philosophically, however, the two conceptions belong to entirely different ballparks (or, properly speaking, to different stadia).

This well known (though strangely enough not universally acknowledged) Aristotelian idea need not detain us here for long, even though it is closely related to some of the most interesting and important features of Aristotle's entire way of thinking. The most interesting of them is probably a corollary to the statistical analysis of logical necessity. It is the fact that Aristotle has no clear-cut conception of logical necessity as distinguished from factual necessity or even completely general factual truth.

Furthermore, the statistical analysis of necessity could not completely satisfy Aristotle. Even though he never officially gives up (least of all in the passages where he has been claimed to do so) this conception, it occasionally was subjected to considerable strain.

It is thus possible to make a virtue out of necessity and to argue that the interrogative model offers the best possible semantics for Aristotelian logic and dialectic. Any attempt to explicate it further, in particular, any attempt to provide a deeper backing for logical inference steps, is bound to be historically inaccurate. At the positive side of the ledger is the fact that the interrogative model offers a conceptual tool for analyzing and discussing a wide variety of methodological issues in Aristotle.

A facet of this rock-bottom character of interrogative games in Aristotle's general theory of argumentation is that he never disassociates his syllogistic theory completely from this more general theory. Aristotle, so to speak, always considered syllogistic inferences, too, as steps of some interrogative dialogue or other.

The merits of the logico-interpretational abstinence (abstinence, that is, from the analysis of the semantical justification of logical inference steps in a dialectical argument) should be fairly obvious. For instance, it seems to me that we can now understand and in a sense vindicate Kapp's strangely formulated thesis that the rules of Aristotelian syllogistic were empirical generalizations from actual real-life arguments. One's first reaction to such a thesis is to grant Kapp his account of how Aristotle chanced upon the different patterns of syllogistic inference. Quite likely he simply noticed certain patterns of terms in the unavoidable answers and in the earlier answers that necessitated them. But a contemporary philosopher is apt to go on to accuse Kapp of a genetic fallacy. For the way in which Aristotle first discovered his syllogistic of course in no way prejudices the philosophical perspective in which he subsequently viewed them.

What Kapp means is nevertheless probably correct. Although terms like “empirical generalization” are inappropriate, the fact remains that Aristotle never developed either a satisfactory analysis of the nature of syllogistic necessity or even a clear-cut conception of logical necessity as distinguished from nomic necessity. Syllogistic inference patterns in a sense remained for Aristotle, if not on the level of empirical generalizations, then on the level of general truths about the world. Or should I try to put the shoe on the other foot and argue that natural laws had for Aristotle a character of conceptual necessity? I am prepared to do so, even though this is not the right occasion.

In any case, Kapp’s examples and arguments are easily adapted so as to constitute evidence for the more cautious (and yet extremely consequential) thesis propounded here.

6. RHETORIC AS A BRANCH OF DIALECTIC

The same kind of dialogical semantics is also the natural framework in trying to understand Aristotle’s rhetorical theory. In a sense, after all that has been said about Aristotle’s dialectic and logic, one can deal with his rhetorical theory very simply. All that one needs to do is to say: The same holds for rhetoric according to Aristotle. In particular, the interrogative model serves as excellent framework also for the purpose of understanding Aristotle’s theory of rhetoric. The main differences between Aristotelian dialectic and Aristotelian rhetoric are merely external, difference in the stage setting, as it were. An orator is speaking continuously to a public, trying to persuade his audience, instead of carrying on a dialogue with a respondent or a chain of reasoning in the “inward dialogue carried on by the mind itself without spoken sound” (*Sophist.* 263E; cf. *Theaetetus* 190A). Otherwise, much of what there is to be said of Aristotelian dialectic applies *mutatis mutandis* to his rhetoric. For this reason the same framework of interrogative inquiry which was seen to serve as the semantics of Aristotelian logic and dialectic is usable also in his rhetorical theory.

I would label this point one of the main theses of my essay if it were not in effect highlighted by Aristotle himself in the opening words of the *Rhetoric*: “Rhetoric is the counterpart of Dialectic.” It is nevertheless in order to see precisely what is involved in this counterpart relation and to tease out some of its consequences.

For one thing, it helps us to identify the historical *locus* of Aristotle’s rhetorical theory. It is an attempt by Aristotle to bring the Socratic dialectic to bear on traditional questions of forensic speech-making and political oratory. The interesting thing is that Aristotle is not dealing with traditional rhetoric in its own terms, but imposing a completely new viewpoint on it. It is a measure of the boldness of Aristotle’s enterprise that, notwithstanding his habitual commonsensical realism, he takes a strong stand against considering rhetoric merely as a means of emotional persuasion. As Aristotle himself describes the situation (*Rhet.* I, 1, 1354a11–18):

Now hitherto the authors of 'Arts of Speaking' have built up but a small portion of the art of Rhetoric truly considered; for this art consists of proofs [persuasion] alone – all else is accessory. Yet these writers say nothing of enthymemes, the very body and substance of persuasion and are concerned in the main with matters external to the direct issue. Thus the arousing of prejudice, of pity, of anger, and the like feelings in the soul, does not concern the facts, but has regard to those who decide.

Thus Aristotle is in effect accusing earlier rhetorical theoreticians of the concentrating on *ad hominem* methods of persuasion and failing to address their theorizing *ad argumentum*. (Cf. sec. 3 above.)

This point cuts deeper than one might first realize. Aristotle is not merely trying to exclude psychological factors from the study of rhetorical argumentation proper. In his own terms, Aristotle is not just comparing rhetorical argumentation to interrogative games, he is assimilating it to truth-seeking interrogative arguments. His accusations against earlier theorists of rhetoric echo his complaints that his predecessors had not developed any theory of noncompetitive and nonpedagogical types of interrogative dialogues. (Cf. sec. 2 above, especially the quote from 159a32–38.)

Admittedly, Aristotle does not signal the assimilation of rhetorical arguments to truth-seeking interrogative inquiry in so many words. However, I find the cumulative evidence provided by numerous similarities amply persuasive. Several such similarities are documented in the rest of this essay.

One implication of the observations is that Aristotle's *Rhetoric* cannot be adequately studied in terms of conventional rhetoric; it can only be understood against the background of Aristotle's general ideas about logic, argumentation and methodology. It is nevertheless important to realize that the dialectic to which rhetoric is a counterpart does not operate only by means of syllogisms in the full technical sense used in *An. Pr. A*. The relevant kind of dialectic consists, rather, of the truth-seeking dialogues in the sense of *Top. VIII, 5*. It follows that the enthymemes of the *Rhetoric* are not formal syllogisms from partly suppressed premises, but interrogative arguments where certain steps are left tacit.

Keeping this qualification in mind, the observations we have made in any case strongly suggest an approach to the entire Aristotelian treatise. What we have to do is to see the analogy between rhetorical arguments and truth-seeking interrogative arguments – and also the qualifications which this analogy needs, perhaps even including its limits.

Aristotle himself tends to emphasize the similarity (perhaps even the partial identity) of rhetorical and dialectical arguments. Hence they are easier to document than the dissimilarities. In order to be as clear about the overall situation as possible, I shall therefore discuss first the subtler discrepancies between the two types of argument.

One of the differences between dialectic and Aristotelian rhetoric is that parts of a rhetorical discourse are tacit. In the move from dialectic to rhetoric,

sylogisms become enthymemes and the use of induction becomes the use of examples. This is obviously due to the format of a public speech as distinguishable from a Socratic dialogue. Even if a speaker had the time to evoke all the premises of his logical inferences, or to list all the substanses through which an Aristotelian induction proceeds, doing so would detract from the impact of a speech.

Another apparent difference between a rhetorical discourse of the kind Aristotle has in mind and the interrogative model is that an orator does not interrupt his delivery to consult sources of information in the form of putting a question to an interlocutor. But this difference is only skin deep, for the speaker appeals constantly to what he hopes his audience will accept as facts. This is tantamount to relying on tacit questions addressed to suitable sources of information to provide new premises for one's argument in the form of answers to them.

Indeed, Aristotle realizes that the choice of such facts is the key to the rational strategy selection in rhetorical persuasion. He even defends rhetoric "as the faculty of observing in any given case the available means of persuasion" (1355b26–27). This is of course nothing but a special application of the leading idea of the interrogative model, which is to guide the course of inquiry through a suitable choice of questions.

In a Socratic or Academic interrogative game, the questions are nevertheless not addressed directly to an outside source of information, but to one's interlocutor. And herein lies an interesting problem. In a rhetorical argument, the speaker does not emulate Socrates and stop intermittently to ask whether the audience agrees with him. Does that mean a breakdown of the analogy of rhetoric and dialectic? No, it does not. For we can perfectly well think of a rhetorical argument as relying tacitly on the audience's assent to the speaker's successive propositions. A bad rhetor is one who cannot elicit an affirmative answer to his rhetorical questions (hence the locutor) – or perhaps he is like a Socratic questioner who refuses to take no for an answer.

Hence I do not take the absence of explicit answers by the audience as marking any real difference in the structure between rhetoric and dialectical arguments. Rather, what we find here is an instance of the general tension between, on the one hand, the variety of sources of information ("oracles") in effect consulted in an inquiry and, on the other hand, the format of Socratic questioning with its one and only interlocutor. This tension was pointed out in sec. 1 above.

In practice this means that we can apply the interrogative model to rhetoric arguments *à la* Aristotle in two different ways. The tacit answers can be thought of as being provided either by the audience or by sundry sources of information, chosen in effect by the speaker. It may be in order to provide an example of how the latter viewpoint can be used to throw light on certain features of Aristotle's rhetorical theory. In *Rhet.* I, 2, 1356a1 ff., Aristotle writes:

Of the modes of persuasion furnished by the spoken word there are three

kinds. The first kind depends on the personal character of the speaker; the second on putting the audience into a certain frame of mind; the third on the proof, or apparent proof, provided by the words of the speech itself. Persuasion is achieved by the speaker's personal character when the speech is so spoken as to make us think him credible. We believe good men more fully and more readily than others: This is true generally whatever the question is, and absolutely true when exact certainty is impossible and opinions are divided.

This is all fine and dandy, but how on earth is the speaker's character and reputation relevant to rhetorical theory? Character looks like something that is determined before the speaker even opens his mouth. Yet Aristotle writes:

This kind of persuasion, like the others, should be achieved by what the speaker says, not by what people think of his character before he begins to speak.

But what can it mean for a speaker to establish his reputation by means of what he says himself? Here one of the most interesting characteristics of the interrogative model of inquiry comes into play. When uncertain answers are admitted into interrogative games, one of the crucial strategic questions is the reliability of the different oracles. The degree of this reliability does not always have to be known *a priori*, but can in suitable circumstances be estimated on the basis of the interrogative inquiry itself. For instance, we can sometimes test a given oracle's answers against the answers provided by another oracle.

In a rhetorical discourse, the speaker can be thought of as acting as his own oracle or at least as choosing the oracles consulted. Hence his reliability can in principle be tested by reference to what he says, not just by what the people know or believe of his veracity *a priori*. In this sense, a speaker's character (at least his reliability) can be revealed, not just by what the audience knows of him *a priori*, but literally by what he says in the course of an interrogative argument.

7. APPLICATIONS

On this basis, we can at once understand why Aristotle's *Rhetoric* looks as it does. In an interrogative inquiry, the crucial questions concern the available oracles and the answers the inquirer can hope to extract from them. In the same way, much of Aristotle's treatise is developed to surveying the facts an orator can enlist in support of different kinds of arguments, political or legal. As Aristotle notes himself, this inevitably takes him to the realm of particular departmental sciences; for instance, in the case of a political orator to the sphere of political science. (Cf. *Rhet.* I, 4, 1359b17–18.) If we look at the table of contents of Aristotle's *Rhetoric* we can see that the bulk of the treatise does

in effect consist of an inventory of the facts that an orator should try to have available.

It is, in fact, eminently natural to construe Aristotle's "means of persuasion as oracles" in the sense of the interrogative model, that is, as sources of new premises to be imported into an argument. This naturalness is among other things shown by Aristotle's list of what he call "non-technical means of persuasion" in *Rhet.* I, 15, 1375a21–24.

They are five in number: laws, witnesses, contracts, fortunes, oaths.

In fact, the entire chapter 15 is devoted to advice as to what to expect of the different "oracles" just listed and as to how to use their answers. Likewise, Aristotle's list of such "points which it is of practical importance to distinguish" (1359b 17–18) is in part a list of questions a speaker should address to different oracles, in part a list of the relevant oracles, and in part a list of the kinds of answers to be expected. The main qualification needed here is the generality of rhetoric, matching the generality of dialectic.

But rhetoric we look upon as the power of observing the means of persuasion as almost any subject presented to us; and that is why, as a *techne*, it is not concerned with any special or definite class of subjects (1355b32–36).

In principle, notwithstanding Aristotle's lists of particular oracles, rhetoric thus should be as general as "the science of logic." Aristotle nevertheless does not appear to overcome completely the tension between the intended generality of rhetoric and the need of specialized knowledge noting that "the more we try to make either dialectic or rhetoric not what they are, practical faculties, but sciences, the more we shall inadvertently be destroying their true nature" (1359b11–14). However, it is difficult to develop a theory of rhetoric on the level of "arguments and forms of reasoning" (I 359b 16–17), and this difficulty is but a special case of the general difficulty of formulating completely general strategic principles of all interrogative games, irrespective of subject matter and limitations on the set of available answers.

The interrogative model makes understandable many other features of Aristotelian rhetoric, albeit sometimes through more abstract similarities between rhetorical argumentation and theoretical argumentation in general in Aristotle. For instance, the corruptions of legal argumentation (in the sense of argumentation concerning particular court cases, not in the sense of arguments concerning legislation) are blamed by Aristotle on their particularity. As he puts the point (*Rhet.* I, 1, 1354a31–b8):

Now, it is of great moment that well-drawn laws should themselves define all the points they possibly can and leave as few as may be to the decision of the judges ... The weightiest reason of all is that the decision of the lawgiver is not particular but prospective and general whereas members of

the assembly and the jury find it *their* duty to decide on definite cases brought before them.

Again (*ibid.* 1354b29–30):

Political oratory is less given to unscrupulous practices than forensic because it treats of wider issues.

This view of Aristotle's is closely related to his explanations as to how mistakes are possible in syllogistic inference and in a practical syllogism. Ultimately, it is probably due to the Platonic (and probably general Greek) ideas that the knowledge of the end or aim of an activity is in principle the crucial element in a skill in reaching that end, even though it is limited by the imperfections of the agent's knowledge of the material in which the end is to be embodied.

Once again, Aristotle was not recording the practices of his time, but trying to reform them. For what was actually going on in Greek courts of law was much more like an adjudication of the competitive claims of one individual defender or litigant and of the state (even "of the law") than an application of a general rule to a particular case.

Indeed, in a historical perspective, the interrogative model, and likewise its ancestor, the Socratic *elenchus*, applies even better to a criminal case under the common law system, with its cross examination of witnesses and arguments offered by the opposing counsels to the jury, than to the procedure under the Roman law system, where the administration of justice is conceived of (ideally) as an application of the general rules of law by the judge to particular cases. Hence what Aristotle has to say in the *Rhetoric* of the role of the judge is much more closely applicable in the common law system to the reasoning of the jury.

Another link with Aristotle's general methodology is his emphasis on definitions in listing rhetorical "topics." This is connected with Aristotle's (sometime?) view that "the starting-points of demonstrations are all definitions" (*An. Post.* B 3, 90b24–25; this view also echoes *Top.* VIII, 14, 163a20–22). For instance, definitions are explicitly mentioned in a large number of places, including 1360b14, 19 and 1361b35. Even more often they are offered without evoking the term. Examples are offered among others by passages like 1360b37–1361a3.

Even more importantly, Aristotle's concept of induction in the *Rhetoric* can be shown to be precisely the same as I have diagnosed it to be in the *Analytics*. (See Hintikka 1980.) Earlier, it was pointed out that the latter naturally finds itself a niche in an interrogative framework. (See Hintikka, 1992.) The nature of induction in Aristotle's rhetorical theory will be examined more closely by Simo Knuuttila.

These similarities between Aristotle's rhetoric and his general methodology are in the last analysis related to Aristotle's conception of dialectic and hence to the interrogative model. Therefore, they, too, indirectly show the crucial role of the interrogative model as an appropriate conceptual framework for the study of Aristotle's rhetorical theory.

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