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Title	Aristotele on Explanation : Demonstrative Science and Scientific Inquiry Part I
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Citation	北海道大學文學部紀要, 40(1), 1-110
Issue Date	1991-11-15
Doc URL	https://hdl.handle.net/2115/33580
Type	departmental bulletin paper
File Information	40(1)_PL1-110.pdf



Aristotle on Explanation : Demonstrative Science and Scientific Inquiry

Part I

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ABBREVIATIONS

- A belongs to all B . = $A \varphi\alpha B$
 A belongs to no B . = $A \varphi\epsilon B$
 A belongs definitionally to all B . = $A \varphi\alpha_{df} B$ B is the definition of A .
 A belongs immediately to all B . = $A \alpha\varphi\alpha B$
 A belongs properly to all B . = $A \varphi\alpha_{id} B$
 A is predicated of all B in what B is. = $A \varphi\alpha_{kat} B$

Epistēmē *simpliciter* = ES

The essence in the sense of τὸ τί ᾗν εἶναι = TEE

To have a scientific knowledge (ἐπιστάσθαι) = to know.

The thing whose cause is identical with itself. = (α)

The thing whose cause is different from itself. = (β)

Introduction

Rem tene, verba sequentur.

There has been a tendency, especially among twentieth century Aristotelian scholars to see gaps and discontinuity rather than continuity between *Posterior Analytics* and *Metaphysics* with respect to their subject matter and their methods of investigation.⁽¹⁾ Indeed, it is not the business of *Analytics* to investigate what being and substance are, employing such metaphysical explanatory principles as the distinctions between form and matter or between actuality and potentiality. The *Analytics* do not present an ontology in order to investigate being *qua* being. What Aristotle discusses in *Posterior Analytics*, my main concern in this thesis, are various issues concerned with the construction of Demonstrative Theory as the Aristotelian Theory of Explanation, for example how many principles there are and what roles they play in Demonstrative Science (ἡ ἀποδεικτικὴ ἐπιστήμη) and how one can shape demonstrations and arguments about a thing/event in such a way as to achieve proper scientific knowledge (ἐπιστήμη) about it. Unlike the science of being *qua* being, each individual demonstrative science has its own peculiar perspective in inquiring into the world, such as number in arithmetic and the movement of heavenly bodies in astronomy. However, what Aristotle presents in *Posterior Analytics* is not itself a special science like psychology in *De Anima*, which inquires into the nature and functions of soul, but the theory of Demonstrative Science as the theory of scientific explanation, which necessarily raises various philosophical and logical issues. Aristotle discusses how and why the theory of Demonstrative Science produces genuine explanation of the cause and necessity of some thing/event, so as to produce epistēmē.

Since Aristotle constructs his theory of Demonstrative Science on the basis of his ontological commitment to the causal and explanatory power of entities in the world, it is fair to say that throughout *Posterior Analytics*, Aristotle observes the world as being composed of causes and their effects. Aristotelian Demonstration, which mirrors the ontological priority among entities seen from the basis of natural perspective (τῇ φύσει), has the power

to establish both the cause of a thing/event and its necessity. This causal framework, deriving from his ontological commitments, is shared by *Metaphysics*, in that the central subject of this treatise is the search for the principles and the causes of the things that are, and obviously, of them *qua* being.⁽²⁾ There is no doubt that both these books have their own peculiar concern and tackle their problems with their own methods and procedures. But the fact that the fundamental frameworks of both books are the same suggests that there is a strong degree of connection and continuity between them. In fact, Aristotle, for instance, develops a view in *Metaphysics* Z17 that the demonstrative procedure for causal explanation characterised in *Analytics* is comparable and applicable to the account of explanation in *Metaphysics*, in terms of the form — matter relation. Moreover, with regard to the range of objects of inquiry in both books, it is not the case that, as one influential commentator puts it, substance is not a subject discussed in *Analytics*.⁽³⁾ To a certain extent, Aristotle does discuss the ontological structure of substance in its own context in *Posterior Analytics*. The world with which Demonstrative Science deals is also the world with which Aristotle is concerned throughout *Metaphysics*.

While Aristotle constructs Demonstrative Theory in *Posterior Analytics*, he discusses various philosophical and logical problems which necessarily arise in connection with that task. The intricate mixture of logic and epistemology in the structure of Demonstrative Science of which syllogistic provides the underlying logic, introduces various interesting philosophical subjects such as causation, explanation, necessity, meaning and identity. These problems cannot be discussed satisfactorily without consulting *Metaphysics*. In this thesis, I would like to put a working hypothesis that when Aristotle sets up Demonstrative Theory in this treatise, his research project takes in and prefigures the subjects discussed in *Metaphysics*. In other words, since there is a well-planned continuity between *Analytics* and *Metaphysics*, there is nothing to prevent us from looking at *Analytics* from the perspective of Aristotle's concern in *Metaphysics*, and, indeed, in terms of the discussions which are actually developed and expounded in that book. I will argue that these philosophical issues, as well as the problems peculiar to *Posterior Analytics*, will be understood more convincingly when we take the discussions in *Metaphysics* into consideration, given that the issues which Aristotle has left as yet to be discussed in *Posterior Analytics*, are followed up in *Metaphysics*. Conversely, discussions in *Posterior Analytics* will shed

light on the problems discussed in *Metaphysics*, given that foundations for their solutions are to a certain extent laid down in *Analytics*. After all there is no philosophical discussion which does not employ a theory of explanation. When we look at both books as complementing each other, our understanding of *Posterior Analytics* will be philologically more consistent and philosophically more convincing. *Posterior Analytics* is a philosophical work *par excellence* just as *Metaphysics* is.

There has been an another tendency among contemporary Aristotelian scholars to see a split between Aristotelian scientific practices and his theory of science. The various scientific practices, innocent of formalization, in his biological and zoological treatises do not seem to them to be reconcilable with the formalized theory of scientific methodology or theory of systematic science set out in *Posterior Analytics*.⁽⁴⁾ They do not seem to follow Aristotle's instructions for the ideal structure of a Demonstrative Science. One attempt to avoid this alleged incompatibility is to find an interpretation of the nature of Demonstrative Science in *Analytics* which will render it compatible with Aristotle's scientific practices. According to one attempted reconciliation, while the scientific treatises report the tentative explorations of on-going inquiries, *Posterior Analytics* provides a theory of how to present knowledge already acquired. This implies that demonstration is not a tool for scientific inquiry in the sense that the theory of demonstration does not instruct the scientist how to conduct his research.⁽⁵⁾ What Aristotle aims to construct in discussing Demonstrative Science is an axiomatized deductive system as an ideal for the final structure of a science in which theorems are validly derived from basic principles, without appealing to extra-logical forms of evidence.

Some influential commentators claim that Aristotle constructs Demonstrative Science as an axiomatized deductive system in order to give the most efficient and economical method of teaching and imparting understanding.⁽⁶⁾ This line of interpretation has been called a "new orthodoxy".⁽⁷⁾ I will argue that this manoeuvre to evade the conflict between theory and practice is no more than the recognition of a pragmatic aspect of Aristotelian Explanation. His axiomatization of Science is a result of his pursuit of the structure of genuine explanation.⁽⁸⁾ When Aristotle establishes his Theory of Demonstration as an explanatory system, it is necessary for him to adopt the natural perspective which is, as it were, the perspective possessed by an

omniscient being. Induction which follows our own perspective (*πρὸς ἡμᾶς*), if successful, may *in fact* grasp the cause of a thing/event and its necessity. But induction cannot establish its cause *as* the cause and its necessity *as* its necessity, as far as it is confined to our own perspective. Only demonstration succeeds in establishing the cause and the necessity *as such*. Hence when Aristotle develops his theory of discovery by means of employing demonstration, he considers inquiry from the viewpoint of the final stage of successful inquiry so that he can offer demonstration as the means of explaining a thing/event so as to grasp its cause *as* its cause and its necessity *as* its necessity. Discovery is justified as a means of achieving explanation in this way. Aristotle's inquiry theory is a practical aspect of his pursuit of the genuine explanation.

I will not argue directly against the alleged incompatibility between Aristotle's scientific treatises and *Analytics*, by examining passages with their own methodological pretensions in particular scientific treatises like *History of Animals*, and *Parts of Animals*, but I will confine myself mainly to *Posterior Analytics* so as to examine how Demonstrative Theory is understood in *Analytics*. This approach may implicitly provide another means of reconciliation between Aristotle's scientific practice and his theory, given that the Aristotelian enterprise of constructing genuine explanation ranges over its axiomatic, epistemological and pedagogical aspects. I will contend that, in the theoretical aspect of Demonstrative Theory, Aristotle lays down the structure of Demonstrative Science as the form of any particular science, in accordance with which any individual science must be constructed; that, in its practical aspect, Aristotle develops the theory as a theory of heuristic inquiry, by means of which we investigate into the world and achieve knowledge about the world; and that in its pragmatic aspect the theory gives pedagogical advice, relating to the way in which knowledge may be imparted to learners.

Notes.

(1). For example, W. D. Ross excludes substance as an object of Demonstrative Science. He says "He [Aristotle] never, so far as I know, makes the question whether a certain *substance* exists turn on the question whether there is a middle term to account for its existence, nor the question what a certain substance is turn on the question what the middle term is; and it would be strange if he did so. ... It is really of attributes that Aristotle is speaking ..." (p. 76, cf. p. 612) J. Barnes omits *οὐσιὰ* from B2 90a10 and

comments that "B2 makes it clear that only syllogistic propositions are in question." (p. 194) In general, Barnes vacillates in his view about Aristotle's treatment of substance. (p. 208) W. Jaeger points out differences between the psychological or intellectual characteristics and motivations found in the two books. He says "Metaphysics arose in his [Aristotle's] mind, and it arose out of the conflict of the religious and cosmological convictions that he owed to Plato with his own scientific and analytical mode of thinking." (p. 378) E. Treptow who claims that there is a connection between two books says in his Vorwort that "Da bisher keine Einzeldarstellungen über das sachliche Verhältnis zwischen der "Metaphysik" und der "Zweiten Analytik" vorliegen, ist die Aufgabe zunächst, bestimmte Hauptprobleme herauszustellen." (p. 9) G. E. L Owen makes an interesting remark that "commentators anxious for the unity of Aristotle's thought have managed to see the later metaphysics in the logical texts." ([2] p. 189)

(2). *Metaphysics* E1 1025b3-4, H1 1042a4-6, H2 1043a2-4.

(3). Ross, See (1).

(4). Cf. A. Gotthelf, pp. 65 ff.

(5). E. g. Barnes, [2] p. 65, pp. 85-87, Owen, [4] p. 153, W. Leszl, pp. 285-287.

(6). Barnes, [2] p. 85. M. F. Burnyeat, [1] pp. 115 ff.

(7). Burnyeat, [1] p. 116.

(8). One may be able to extract the axiomatic theory from Aristotle's theory of Demonstrative Science as the prototype of modern axiomatics since Hilbert. But since Aristotle's axiomatic theory is entirely based on his ontological commitment concerning explanatory power, we cannot select axioms arbitrarily. In this respect, his axiomatic theory differs from modern ones.

Part I. The Structure of Demonstrative Science

Introduction

In Part I, I will discuss the structure of Demonstrative Science as it is set out in *Posterior Analytics* Book A. Firstly, in Chapter 1, I will discuss what Aristotle means by the word "science". I will show that it is not the case, as Burnyeat complains, that Aristotle is not aware of the contemporary distinction between philosophy of science and epistemology, by arguing that Aristotle has a clear conceptual and terminological distinction between demonstrative knowledge and Demonstrative Science.

In Chapter 2, I will discuss how many principles (*ἀρχαί*) there are and what roles they play in Aristotelian Demonstrative Science. In Section A, I will consider what are the questions which provide the background for

Aristotle's presentation of Demonstrative Science as his own method for grasping *epistēmē simpliciter*. Then, I will analyse the conditions for Demonstrative Science in A2. We will discover that in the A2 passage, Aristotle sets out the conditions governing the ultimate principles of Demonstrative Science, rather than the relative principles as the proximate premises of a demonstration, as has been claimed by commentators such as Ross and Barnes. In other words, I will show that we must trace the chain of demonstrations right up to the non-demonstrable primary of a genus, if we are to grasp *epistēmē simpliciter* regarding a particular subject. In Section B, I will consider Aristotle's discussion of hypotheses and definition in A2 and A10 in order to discover what kinds of principle are involved in the acquisition of demonstrative knowledge and what roles they play in this enterprise. I will claim that the ultimate premise of a science and the proximate premise are expressed by the immediate non-demonstrable syllogistic principle which is called (A) "the hypothesis", and the demonstrable principle which is called (D) "the relative hypothesis" respectively. In Section C, I will argue that what Aristotle means by being immediate should be explained in two different ways, either as it applies to non-demonstrable immediate terms or as it applies to immediate propositions [premises] whose constitutive terms are demonstrable, except when they constitute (A) the hypothesis. I will claim that because commentators have not distinguished immediate terms from immediate propositions, they have failed to understand the structure of Aristotelian Demonstrative Science. This discussion will provide some arguments in support of my claims in Sections A and B. In Section D, I will argue how the four *per se* predications in A4 apply to demonstrative principles, though Aristotle's commentators have allowed only the first two *per se* predications to constitute a demonstrative proposition.

In Chapter 3, I will make clear that in constructing the theory of Demonstrative Science, Aristotle develops both the theoretical and the pragmatic aspects of his Demonstrative Theory. I will claim that the so-called new orthodoxy, according to which Aristotle's demonstrative theory is exclusively concerned with the method according to which an achieved body of knowledge should be presented and taught, fails to see Aristotle's theoretical interest in constructing the abstract structure of his Demonstrative Science as a systematic method, in accordance with which any particular science should be carried out. The practical aspect of Aristotle's Demonstrative Theory will be discussed in Part II.

Chapter 1. Science and Scientific Knowledge

A. Epistemic and Scientific Aspects in ἡ ἐπιστήμη

Aristotle's *Posterior Analytics* may be compared to a spring, where various underground streams rise and mingle. In this treatise, Aristotle combines a variety of interests, including philosophy of science, epistemology, ontology, logic, mathematics, and philosophy of language in a single project. But O. Höffe's description of Aristotle's project in *Posterior Analytics* "eine systematische Untersuchung zur Frage, wie Wissenschaft (ἐπιστήμη) möglich sei." (p. vii) is an instructive one, in spite of some misleading Kantian overtones, in the sense that ἐπιστήμη is indeed the focus of the treatise. The fact that Aristotle employs the word "ἐπιστήμη" to denote both "science" (e. g. 76b4, 79a18, 87a38, 88b13) and "knowledge" (e. g. 78a25, 87b19, 87b39, 88a11) suggests that he is starting with two kinds of motivation or goal, which we will need to investigate.

In this Chapter, I would like to make clear that Aristotle self-consciously distinguishes the concept of Demonstrative Science which might be the subject of what is today called philosophy of science from the concept of demonstrative knowledge which might be the subject of what is today called epistemology, within his single enterprise of constructing Demonstrative Theory. This distinction is both a conceptual and a terminological one. In this Chapter, I will perform the necessary preliminary task of offering a basic conceptual clarification of various uses of the word ἐπιστήμη. For it does not seem that the conceptual distinction between demonstrative knowledge and Demonstrative Science as the method of producing demonstrative knowledge is one which has been fully appreciated by Aristotle's commentators.

Insofar as science and (scientific) knowledge are referred to by the same word ἐπιστήμη, there must be some feature common to them. What is the common characteristic which both science and knowledge share? How is Aristotle's concept of science related to scientific knowledge? The word ἐπιστήμη is said to be ambiguous between the act of knowing and what is known in the same way as other Aristotelian concepts relating to human activities, such as πράξις (action/what is done) and ἐνέργεια (activity/result or goal of the activity). (Burnyeat, [1] p. 97, D. Charles, p. 83) Burnyeat sees the characteristic which is common to science and knowledge in terms of this ambiguity. He writes as follows:

Aristotle's own term for what he is analysing is ἐπιστήμη and this, like

our word 'knowledge', can refer either to the cognitive disposition of the knowing person or to a body of knowledge, a science — a system of propositions which can be learned and known. (p. 97)

Burnyeat describes a cognitive disposition as "*ἐπιστήμη* in the subjective sense" and a proposition, treated as an item of scientific knowledge or a science, as "*ἐπιστήμη* in the objective sense". (p. 99, p. 109)

According to the views of these scholars concerning the "objective" sense of *ἐπιστήμη*, it would be the case that a proposition as an item or piece of knowledge such as $E=mc^2$, and a science as a systematic sequence of propositions, such as physics, are linked to each other by the part-whole relation. It would then result that there is not only a distinction between knowledge as a cognitive disposition (*ἐξίς*) of soul or psychological disposition and a piece of knowledge as a propositional object, but also a distinction between a piece of knowledge as a part of a science and a science as a systematic sequence of propositions; and that these distinctions must be made in accordance with the contexts in which the word "*ἐπιστήμη*" is found. In particular, if a piece of knowledge and a science are not distinguished in Greek as they are in English so that the word *ἐπιστήμη* is able to signify both the part and the whole of a body of knowledge, this would allow a serious confusion between a study of science and a study of knowledge. It would be thought that Aristotle did not have, as it were, a conceptual distinction between epistemology and philosophy of science.

In what follows, I will show that Aristotle has a clear distinction between the epistemic perspective and the scientific or structural perspective in mind. In other words, Aristotle self-consciously presents the distinction between these two perspectives so that while, on the one hand, the epistemic perspective deals with the cognitive disposition of the knower, for example, how knowledge is distinguished from comprehension (*νοῦς*) and opinion (*δόξα*), which are other types of cognitive disposition, and how demonstrative knowledge is related to non-demonstrable knowledge, on the other hand, the structural perspective or philosophy of science deals with issues concerning demonstration, such as what is the logical relation holding between a conclusion and its premises, and what is the structure of Demonstrative Science which specifies, in the abstract, the structure of any particular science. To establish this view, I will argue that Aristotle distinguishes a piece of demonstrative knowledge (e. g. $E=mc^2$) from Demonstrative Science (e. g. Physics) not only contextually, but also terminologically, by establishing that the

phrase ἡ ἀποδεικτικὴ ἐπιστήμη should not be rendered as “demonstrative knowledge” but as “Demonstrative Science”. And I will show that it is not the case that Aristotle has left undiscussed the ambiguity of ἐπιστήμη as cognitive state, propositional object and object in the world in the level of particular knowledge. Namely, when it is required to distinguish one of these possible meanings, he does so by employing non-ambiguous expressions.

In other words, my view on ἐπιστήμη contrasts with Burnyeat's view in the following ways. I take it that Burnyeat proposes the following five theses on ἐπιστήμη.

- (1) There is an ambiguity between (A) cognitive state (soul's activity) and (B) propositional object. (pp. 97, 105)
- (2) There is an ambiguity between (C) part (“a proposition counts as an item of scientific knowledge”) and (D) whole (“a system of propositions”=a science). (pp. 97, 99, 109, 115)
- (3) Aristotle did not distinguish between (A) and (B). (pp. 97, 105)
- (4) Aristotle did not distinguish between (C) and (D). (pp. 97, 99, 109, 115)
- (5) Aristotle did not distinguish epistemology from philosophy of science. (pp. 97, 138-139)

I will not deny (1). But it is not necessarily the case that (1) implies (3). I take it that if it is not necessary to disambiguate ἐπιστήμη, Aristotle leaves it ambiguous among not only (A) and (B), but also an object in the world. But if the context requires him to disambiguate it, he makes a clear terminological and conceptual distinction between (A) and an object in the world, which is described as “what is knowable”, and that in order to convey (B) he uses, not ἐπιστήμη, but the word “proposition” or “demonstration”. I will not entirely deny (2) in that a science may be in effect composed of a system of propositions derived by scientific activity. But I will argue against (4) that Aristotle's concept of science which is developed in this treatise is not merely a system of propositions, but a systematic method of producing knowledge, so that it is wrong to understand the relation between a piece of knowledge as a propositional object and a science to which it belongs in terms of the part-whole relation between entities on the same level. The relation between ἐπιστήμη as a systematic method and ἐπιστήμη as a proposition is analogous to the relation between the act of knowing and what is known. And I will also deny (5) by claiming that

Aristotle propounds the theory of Demonstrative Science as a theory of the method of producing knowledge, which does not deal directly with the cognitive state of the knower, which is an object of epistemology, but deals with the structure of science.

In this Section, I will, firstly, examine what Aristotle understands by the word *ἐπιστήμη* used to mean “science” and what characteristics are manifested by Aristotle’s concept of science. It is, in general, not difficult to distinguish *ἐπιστήμη* as science from *ἐπιστήμη* as knowledge by looking at the contexts in which it is found. Aristotle usually mentions the name of a particular science such as geometry, or astronomy along with the word *ἐπιστήμη* when using it in that sense. (e.g. 76b4, b12, 77b9, 79a18, 87a31) When he talks about *ἐπιστήμη* as science, “science” is treated not as concerned with a single piece of knowledge, but as being related to a fixed domain and its overall structure. (e.g. 76a11, 76a38, 39, 76b12, 76b16, 87a37) Aristotle describes the genus as the domain over which a science is constructed (*ἐν τῷ ὑπὸ τῇ ἐπιστήμῃ γένει*). (76a39–40) So each science is distinguished according to the underlying genus (*τὸ ὑποκείμενον γένος*) which corresponds to it. If the underlying genus is different, the corresponding science is different as well. (76a11–12) Aristotle says “A science is one if it is of one genus.” (87a38) As far as Demonstrative Science is concerned, Aristotle does not imagine the possibility of a universal science, but holds that only a particular science corresponding to its own genus is possible.

Aristotle proposes three constituent elements of Demonstrative Science: axioms, genus and its attributes. After Aristotle claims that astronomy proceeds in the same way (*ὁσαύτως*) as geometry and arithmetic which are paradigmatic cases of Demonstrative Science, he continues as follows;

For every Demonstrative Science (*πᾶσα ἀποδεικτικὴ ἐπιστήμη*) has to do with three things: what it posits (*τίθεται*) to be the genus, whose *per se* attributes it considers; and what are called the common axioms, the primaries from which it demonstrates (*ἀποδείκνυσσι*); and thirdly the attributes, of which it assumes (*λαμβάνει*) what each signifies (76b11–16)

One interesting and important thing in this passage is that Demonstrative Science is personified as the active subject, marshalling its own three constituent elements so as to make demonstration possible. In another passage, Aristotle again personifies science in this way: science(s) (*ἐπιστήμη*) “considers” (*θεωρεῖ*) the attributes of genus and “assume” (*λαμβάνουσι*) the meaning

of attributes and “prove” (δεικνύουσι) their existence through common axioms and theorems. (76b3-10) The enumeration of the constituent elements of a science and its personification in dealing with its own constituent elements show that, on the one hand, Demonstrative Science is a system which is composed of these three elements and, on the other hand, it is a system in which the scientist (ὁ ἐπιστάμενος), by marshalling its three elements in their appropriate ways, produces ἐπιστήμη. This suggests that Demonstrative Science is a systematic method in which, and by means of which, the scientist engages in demonstration so as to produce ἐπιστήμη.

When Aristotle employs the preposition κατὰ (according to) in order to link each science with the propositions or syllogisms which belong to that science, it seems to suggest the active aspect of science rather than science as a body of knowledge. Aristotle writes as follows;

If a syllogistic question and a proposition of a contradiction are the same thing, and there are propositions according to each science (προτάσεις καθ' ἑκάστην ἐπιστήμην) on which syllogism according to each science (ὁ καθ' ἑκάστην) depends, then there will be a sort of scientific question from which the appropriate syllogism according to each science (ὁ καθ' ἑκάστην) comes about. It is clear, therefore, that not every question will be geometrical (or medical...), but only those from which either there is proved one of the things about which geometry is concerned, or something which is proved from the same things as geometry, such as optical theorems. (77a36-77b2)

Here “each science” with the preposition “according to” has the role of limiting the propositions and syllogisms to the single domain to which that science corresponds. In fact, a few lines later on, Aristotle mentions “things determined according to the science” (τὰ κατὰ τὴν ἐπιστήμην διορισθέντα). (77b8-9) This phrase and his employment of the preposition κατὰ in connecting the proposition and the science in which the proposition is employed encourage us to think that what Aristotle means by “science” here is not “a sequence of sentences about the elements of some single domain” (H. Scholz, p. 52), but rather the domain itself. Hence the relation between a proposition and the science to which it belongs is not simply the part-whole relation, but rather it is the case that the proposition is totally dependent on the science as the producer of knowledge, which determines the explanatory power or effectiveness of the proposition by determining its domain.

As the preposition *κατὰ* and the personification of science suggest, science is prior to its components such as the proposition and syllogism in terms of activity. In this sense, science is a systematic method which, by using its own components such as propositions, produces *ἐπιστήμη*, rather than a simple accumulated body of pieces of knowledge. The fact that science (*ἐπιστήμη*) is personified and treated as if it is an active agent as a producer of knowledge in this way suggests that Aristotle has a basic theory of Science underlying particular sciences so that each scientist can perform his own scientific activity in his own department which has theoretically already been established by, and oriented under, the guidance of the theory of the structure of Demonstrative Science. It shows, putting it in another way, that Aristotle has a definite view of the concept of "science" itself.

Hence, if we define Aristotelian science as "a system of propositions" (Burnyeat, p. 97) or "a set of demonstrations" (Barnes, p. xvi) or "a body of knowledge systematized in a demonstrative way", this seems to overlook the active or functional aspect of Aristotle's concept of science, in that it treats Aristotelian science as merely the result or product of scientific activity. Although it may, *in effect*, be the case that any science is composed of a sequence of sentences about the elements of a single domain, this way of thinking about science is rather un-Aristotelian. Therefore, I suggest that Aristotle calls "science" *ἐπιστήμη*, because science is, as it were, the active agent, producing knowledge by its own mechanism which is characterised by the theory of Demonstrative Science.⁽¹⁾ In other words, since both science (*ἐπιστήμη*) and knowledge (*ἐπιστήμη*) are inseparable in the sense that knowledge as *ἐπιστήμη* takes place, if and only if science as *ἐπιστήμη* in the sense of a systematic method of producing knowledge is at work and vice versa, Aristotle does not terminologically distinguish one from the other.

This implies the view that, in the contexts of *Posterior Analytics* in which *ἐπιστήμη* is employed to mean "science", the epistemic elements of *ἐπιστήμη* relating to the cognitive state of the knower, seem to be weak or rather totally out of sight. Instead, in these contexts, Aristotle is concerned with the structure of Science from the structural point of view rather than the epistemic one. In other words, Aristotle does not have any sort of cognitive state in mind when he uses the word *ἐπιστήμη* in the sense of "science". What I have argued so far is no more than the suggestion that in his use of the word "*ἐπιστήμη*" Aristotle has a clear conceptual distinction in mind between "science" and "knowledge". This sug-

gestion will be established shortly with textual evidence, through the interpretation of the phrase: ἡ ἀποδεικτικὴ ἐπιστήμη.

Now then, what about the ambiguity at the level of the particular object between “ἐπιστήμη” as a psychological state of the knower, in knowing something, which occurs in his soul and a piece of knowledge which is expressed by a proposition, whether it is a propositional object or an object in the world? I take it that since it does not necessarily follow from this ambiguity, as we shall see shortly, that Aristotle confuses philosophy of science with epistemology as Burnyeat complains, there is no need to worry about this ambiguity. In fact, first of all, in the context of *Posterior Analytics*, Aristotle does not seem to have any interest in talking about a piece of knowledge which has *already* been established in and shared by a scientific community as common knowledge and which belongs to the objective sense of ἐπιστήμη, whether it is a propositional object or an object in the world; rather he is interested in how a scientist produces knowledge. Demonstration, on which his interest is focussed throughout the treatise, has the role of yielding or producing a piece of knowledge (ποιήσει ἐπιστήμην) in the human mind. (71b25, 75b1-2) That is, it is the presentation of a demonstration which is a propositional object, which fills the place which the objective sense of ἐπιστήμη is supposed to occupy. Hence one aspect of the ambiguity of ἐπιστήμη can be ignored insofar as the structure of Demonstrative Science as the mechanism of producing ἐπιστήμη is at issue.

Aristotle seems to have a clear terminological distinction in mind in dealing with this particular level of “ἐπιστήμη”. One sentence which Aristotle repeats several times is revealing with regard to the relation of cognitive disposition, proposition and reality. Aristotle says:

To know_o what is a demonstrable thing/event [or things/events of which there is a demonstration] is to have a demonstration. (τὸ ἐπιστάσθαι ἐστὶ τὸ ἀποδεικτὸν [ὃν ἀπόδειξις ἔστι] τὸ ἀπόδειξιν ἔχειν). (90b9-10, 71b28-29, cf. 90b22-23, 73a23)

Here all three dimensions are found; reality which is referred to by “what is demonstrable” in 71b28 or by “things of which there is a demonstration” in 90b10, demonstration as a sequence of propositions, and the cognitive state of having ἐπιστήμη. The cognitive disposition of knowing something is expressed by adding a verb to the word “ἐπιστήμη” such as “to have” (ἔχειν) (e.g. 72a17) or the verbal cognates of ἐπιστήμη such as “know_o”

(ἐπιστάμεθα) (e.g. 71b30, 76a4), though the noun “ἐπιστήμη” contains the cognitive disposition as well, in the case in which there is no need to stress particularly the cognitive disposition. (e.g. 87b38, 100b8) Concerning the objective sense of ἐπιστήμη, Aristotle here characterises it as “to have a demonstration”. Although Aristotle does not say that a demonstration or a sequence of propositions are an ἐπιστήμη, he clearly means that having a demonstration is identified with the cognitive disposition of having ἐπιστήμη. Here again he is not interested in talking about a piece of knowledge expressed in a proposition which has already been established as common knowledge in a scientific community such as “Boyle’s law”, but rather is interested in how *demonstration*, which is a sequence of propositions, produces ἐπιστήμη in the human mind.

On the other hand, the ambiguity between knowledge and the object of knowledge in the world, which is another objective sense of ἐπιστήμη, is also in some contexts disambiguated in Aristotelian language. The object of knowledge in the world is sometimes expressed by “what is demonstrable” or “thing/event of which there is a demonstration” or, in other passages, “what is knowable” (ἐπιστήτῳ). (e.g. 73a22, 88b30) In *Metaphysics*, Aristotle explains the relation between knowledge and the knowable as follows: “All knowledge is knowable, but not all that is knowable is knowledge, because in a sense, knowledge is measured by the knowable.” (I6 1057a10–12, cf. *Cat.* 7b23ff, 11b27ff) That is, on the one hand, all knowledge corresponds to things which are knowable (known) in the sense that all knowledge depends on how things are. On the other hand, it is not necessary that the things which are knowable (known) must already be known.

Hence, in response to Burnyeat’s claim that “a proposition counts as an item of scientific knowledge”. (p. 99), we should say that, at least as far as Aristotle’s wording is concerned, he does not treat propositions as any sort of ἐπιστήμη in the sense that he can in any situation clarify matters by mentioning a proposition or a demonstration as something which produces demonstrative knowledge in the mind of the knower. In the same way, the object of ἐπιστήμη in the world can be disambiguated from the cognitive state of the knower by employing the word “what is knowable”. Following the advice of Ockham’s razor, we should not increase unnecessarily the number of entities, where there is already something which is clearly stated to correspond to what is required. We do not have to create Burnyeat’s “the objective sense of ἐπιστήμη”, given that Aristotle has given the names

“proposition” or “demonstration” to it and that Aristotelian “science” is not merely a systematized accumulation of pieces of knowledge, but rather a systematic producer of ἐπιστήμη in the human mind, through demonstration. Therefore, I claim that so long as reality, demonstration and knowledge are at issue, that is, throughout *Posterior Analytics*, Aristotle distinguishes a proposition and what is knowable from a cognitive disposition of the knower in terms of the wording he uses. But nothing prevents us from thinking that ἐπιστήμη at the particular level is still ambiguous, where disambiguation is not needed, between a cognitive state and a propositional object and between a cognitive state and an object in the world and between a propositional object and an object in the world, as long as we keep in mind that ἐπιστήμη in the context of *Posterior Analytics* always involves a cognitive state in the soul.

So far I have made clear that what Aristotle understands by the word “science” (ἐπιστήμη) is a systematic method by means of which one produces knowledge, and what Aristotle understands by the word “knowledge” (ἐπιστήμη) is, first of all, a cognitive state of the knower, though there is nothing wrong in keeping its original ambiguity. This understanding of the relation between science and knowledge explains well the act/result ambiguity which the word “ἐπιστήμη” contains.

Note.

(1). When I characterise Aristotle’s personification of “science” as “the active agent”, this is, after all, a metaphorical description. But his personification of “science” should be taken seriously to the extent that we understand by “science” not merely a system of propositions, but a systematic method by means of which the scientist engages in demonstration so as to produce epistēmē.

B. Demonstrative Science (ἡ ἀποδεικτικὴ ἐπιστήμη)

vs.

demonstrative knowledge (ἐπιστήμη ἀποδεικτικὴ, ἐπίστασθαι (ἐπιστήμη, εἰδέναι) δι’ ἀποδείξεως, ἐπίστασθαι ἀποδεικτικῶς)

In Section A, in asking what perspective Aristotle takes in understanding “Science”, I have made clear that Aristotle is concerned with the structure of Science from the structural point of view rather than the epistemic one and that “Science” is, first of all, a systematic method by means of which a scientist yields scientific knowledge. This shows that in using the word “ἐπιστήμη” Aristotle has a clear conceptual distinction in mind between as

“Science” and “knowledge”. In this Section, I will show that Aristotle holds to a terminological distinction which corresponds to the conceptual one between “Science” and “knowledge”. I will argue that the phrase ἡ ἀποδεικτικὴ ἐπιστήμη which occurs in six places should not be understood as demonstrative knowledge, but as Demonstrative Science. ((1) 71b20, (2) 73a22, (3) 74b5, (4) 76a37, (5) 76b11, (6) 84a10) This phrase has been translated as either “demonstrative knowledge” (Mure, Ross, Barnes⁽¹⁾; (1), (2), (3)) or “demonstrative science” (Mure, Ross, Barnes; (4) (5) (6)⁽²⁾) on a case by case basis. (cf Burnyeat [1], pp. 102–103). I take it, however, that Aristotle has given “ἡ ἀποδεικτικὴ ἐπιστήμη” a technical sense, meaning “Demonstrative Science”. On the other hand, “ἐπίστασθαι, (ἐπιστήμη, εἰδέναι) δι’ ἀποδείξεως” (e. g. 71b17, 83b38, 84a5, 87b19, 99b20), “ἐπίσταται ἀποδεικτικῶς” (75a12) and “ἐπιστήμη ἀποδεικτικὴ” (24a2, 75a19, 99b16) seem to have been employed to mean “demonstrative knowledge”. “Demonstrative knowledge” is described as a cognitive state of the knower “by having a demonstration” (τῷ ἔχειν ἀπόδειξιν). (73a23, 71b28–29) If this is indeed the case, it suggests that Aristotle keeps the two aspects of the word ἐπιστήμη in mind throughout *Posterior Analytics*, by making a terminological distinction between Demonstrative Science and demonstrative knowledge. Hence, it would not be the case, as some commentators claim, that Aristotle did not distinguish philosophy of science from epistemology.

Now let us examine the phrase ἡ ἀποδεικτικὴ ἐπιστήμη to see whether it signifies “Demonstrative Science” or “demonstrative knowledge”. Among the six occurrences of ἡ ἀποδεικτικὴ ἐπιστήμη or its plural cases, it is immediately evident that the three cases in (4) 76a37, (5) 76b11, and (6) 84a10 are to be translated as “Demonstrative Science(s)”. This is because in these passages Aristotle is talking about the constitutive components of particular sciences such as the genus as the universe of discourse (76b13), axioms (76b14), proper principles (76a38) and the finite sequence of predications (84a9–10) rather than about a particular kind of knowledge. In the passage in (4) 76a37, Aristotle says:

Of the things they use in Demonstrative Sciences (ταῖς, ἀποδεικτικαῖς ἐπιστήμαις) some are proper to each science and others common — but common by analogy, since they are useful in so far as they bear on the genus under the science. (76a37–40)

Here Aristotle talks about a proper principle in each science and common

principles which are available in each science, not in each kind of knowledge. In the passage in (5) 76b11, Aristotle says “And astronomy proceeds in the same way. For every ἀποδεικτική ἐπιστήμη (Demonstrative Science) has to do with three things” (76b11–16). Here Aristotle gives the reason why astronomy proceeds in the same way as geometry and arithmetic. In the passage in (6) 84a10, Aristotle says “neither upwards nor downwards can the terms predicated be indefinitely many in Demonstrative Sciences (ἐν ταῖς ἀποδεικτικαῖς ἐπιστήμας) with which our inquiry is concerned.” (84a9–11). This is because, firstly, we do not say that predications are finite *in* (ἐν) demonstrative knowledge. In such a case, we have to say that predications are finite in order to grasp demonstrative knowledge. The preposition ἐν signifies the domain of science. Secondly, there is no plural use of ἐπιστήμη to refer to knowledge. Its plural occurrences are found only when it refers to sciences. (eg. 76b16, 77a26, 79a18). In these passages, if one translates ἡ ἀποδεικτική ἐπιστήμη as “demonstrative knowledge”, it would be a complete mistranslation. Aristotle’s interest here is in constructing Demonstrative Theory as an axiomatized deductive system. (This issue is discussed in Chapter 3 in more detail.) In other words, when he talks about ἡ ἀποδεικτική ἐπιστήμη in this context, he concentrates on the elucidation of the structure of Science which produces knowledge, leaving to one side issues relating to the cognitive state of a person who grasps a thing/event in accordance with this system. So far, my view is no different from the view of Aristotle’s commentators.

The other three occurrences in (1) A2 71b20, (2) A4 73a22 and (3) A6 74b5 are found in contexts which are similar to each other. The passages in (1) and (3) occur in exactly the same type of context. The use of the phrase in (2) 73a22 is based on the passage in (1) A2. In these passages, the phrase occurs in the context of a discussion of the characteristics of “the principles” (αἱ ἀρχαί). Aristotle argues for the necessity of the principles of ἡ ἀποδεικτική ἐπιστήμη as deriving from the necessity of the thing/event (τὸ ἵκαστον, τὸ πρᾶγμα) of which there is *epistēmē simpliciter* (unqualified knowledge=ES). The relevant phrases in these passages are invariably translated as “demonstrative knowledge” by commentators. In what follows, I will show that in these passages the phrase ἡ ἀποδεικτική ἐπιστήμη should also be taken to mean Demonstrative Science. The passage in A2 (1) passage runs as follows;

If, then, to know_e is as we posited [grasping (i) the cause of a πρᾶγμα

X and (ii) the necessity of X (71b9-16)], it is necessary that ἡ ἀποδεικτικὴ ἐπιστήμη is also based on (ἐκ) the principles which are true and primary and immediate and better known than and prior to and cause of the conclusion. For in this way the principles (αἱ ἀρχαί) will also be appropriate to what is being proved. (71b19-23)

The passage in A6 (3) runs as follows;

If ἡ ἀποδεικτικὴ ἐπιστήμη is based on necessary principles, (for what one knows, cannot be otherwise) and what belongs to the things *per se* is necessary, .. it is evident that demonstrative syllogism will be based on necessary principles. (74b5-11)

It is natural to take it that what is characterised by the six conditions listed in the passage in A2 is what is expressed by the phrase "necessary principles" in A6. For, among other things, Aristotle draws the same conclusion from the description of the principles in A2 (1) and the description of the necessary principles in A6 (3); ie. that there can be a syllogism even without necessary principles, but this will not be a demonstration. (A2 71b23, A6 74b16) Now in these two passages, Aristotle gives an argument to show why ἡ ἀποδεικτικὴ ἐπιστήμη is based on necessary principles. This is because the thing/event (πρᾶγμα) which is known (ἐπίστασθαι in 71b19, ἐπίσταται in 74b6) is necessary. That is, the necessity primarily attaches to the thing/event in the world and demonstration enable us to grasp that necessity. The role of ἡ ἀποδεικτικὴ ἐπιστήμη gives us a method which allows us to grasp the necessity.

As a part of his enterprise of constructing the structure of ἡ ἀποδεικτικὴ ἐπιστήμη, because epistemological necessity is taken to be governed by ontological necessity, Aristotle puts limitations on the range of inferences which may be treated as logically valid grounds for ἡ ἀποδεικτικὴ ἐπιστήμη. Aristotle excludes the possibility of deducing something necessary from something non-necessary. Aristotle explains the ontological constraint on ἡ ἀποδεικτικὴ ἐπιστήμη as follows;

Since, then, if a man knows demonstratively (ἐπίσταται ἀποδεικτικῶς), it must belong from necessity, it is clear that he must have his demonstration through a middle term that is necessary too. (75a12-14)

Here he describes the structural necessity of the principle or premise in demonstration from the perspective of knowledge, by taking it for granted

that “to know demonstratively” is the cognitive state involved in grasping the ontological necessity of the relevant thing/event. In this sense, Aristotle considers necessity at three levels, i. e. at the level of reality, at the level of the proposition and at the level of the cognitive state. Aristotle’s claim that the principles of ἡ ἀποδεικτικὴ ἐπιστήμη must be necessary is made at the level of the proposition, on the basis of this ontological constraint.

Now I will propose several arguments for rendering ἡ ἀποδεικτικὴ ἐπιστήμη as “Demonstrative Science”. Firstly, the context in which Aristotle introduces ἡ ἀποδεικτικὴ ἐπιστήμη in A2 shows that ἡ ἀποδεικτικὴ ἐπιστήμη’s having certain principles justifies the claim that demonstrative knowledge is capable of meeting the conditions of ES. Aristotle proposes *epistēmē simpliciter* to contrast with the sophistical and incidental way of knowing. He introduces and defines it thus;

We think that we know_s *X simpliciter*, when we think that (i) we know *Y* as the cause of *X* and (ii) we know that *X* cannot be otherwise. (71b9–12)

Then, Aristotle, while leaving room for the other way of knowing, i. e. the non-demonstrable way, claims (φάμεν) that there is a kind of demonstrative knowledge (δι’ ἀποδείξεως εἰδέναι) which is grasped by having a scientific syllogism called a demonstration. (71b16–18) That is, Aristotle claims here that the scientific syllogism is the one by means of which we grasp a piece of scientific knowledge (ἐπιστάμεθα). (71b18–19) Then, Aristotle gives an argument to show why demonstration produces *epistēmē simpliciter* as demonstrative knowledge. He says “If to know_s is as we posited [grasping (i) and (ii)], it is necessary that ἡ ἀποδεικτικὴ ἐπιστήμη is also based on such and such principles.” (71b19–22) That is, since ἡ ἀποδεικτικὴ ἐπιστήμη is based on such and such principles, it makes demonstration able to meet conditions (i) and (ii) on ES. His claim for demonstrative knowledge is argued in this way. If this is the argument he meant to convey, it is impossible to render ἡ ἀποδεικτικὴ ἐπιστήμη as “demonstrative knowledge”. In that case, his argument would be that, since demonstrative knowledge is based on such and such principles, it meets conditions (i) and (ii) of ES. It is not demonstrative knowledge which meets these conditions; by grasping the cause of *X* and the necessity of *X*, but the demonstration. By meeting these conditions, demonstration produces demonstrative knowledge. In other words, by having a demonstration, we come to know_s *X*. Demonstrative

knowledge is knowledge through demonstration which satisfies (i) and (ii). Then we should take it that ἡ ἀποδεικτικὴ ἐπιστήμη, by being based on such and such principles, is the basis of the capacity of demonstration to meet these conditions. Therefore, there is no difficulty in accepting that ἡ ἀποδεικτικὴ ἐπιστήμη is a systematic method which, by being based on and containing certain principles, produces demonstration so as to grasp epistēmē. That is, ἡ ἀποδεικτικὴ ἐπιστήμη is Demonstrative Science as a systematic method which Aristotle introduces as his own means of producing epistēmē *simpliciter*.

Hence it is not the case, as Burnyeat claims, that ἡ ἀποδεικτικὴ ἐπιστήμη “merely resumes” to know_s (τὸ ἐπίστασθαι). (p. 98 n. 2) Here τὸ ἐπίστασθαι refers to the knowledge which is commonly held as grasping the cause of a thing/event and the necessity of that event/thing, leaving aside, at this stage, the issue how it is grasped. Since Burnyeat fails to see that Aristotle presents his six conditions, not in order to give “a further characterization of the cognitive state” (p. 98), but in order to meet conditions (i) and (ii) of ES in its structural or scientific aspect, he could not grasp the significance of ἡ ἀποδεικτικὴ ἐπιστήμη either.

Secondly, we should consider Aristotle’s use of the preposition “ἐκ” (from, being based on) in the sentence “ἡ ἀποδεικτικὴ ἐπιστήμη is also *based on* (ἐκ) such and such principles.” or in A6, in the sentence “ἡ ἀποδεικτικὴ ἐπιστήμη is *based on* (ἐκ) necessary principles”. This also suggests that this phrase means not demonstrative knowledge but Demonstrative Science which should primarily be understood as the method of producing scientific knowledge, rather than a sequence of propositions. The preposition “ἐκ” which I shall call the scientific preposition is sharply contrasted with “διὰ” (through) which I shall call the epistemic preposition. When Aristotle employs ἐκ with principles or premises, he always uses it with a verb denoting inference such as “to demonstrate” or “deduce” and not with the verb “to know”. For instance, Aristotle says “from truths (ἐξ ἀληθῶν) one can *deduce* (συλλογίσασθαι) without demonstrating, but from necessities (ἐξ ἀναγκάων) one cannot *deduce* without demonstrating.” (74b15–17, e.g. 75a30, 76a14, 76b14, 77b4–5, 78a5) According to Aristotle’s wording, we cannot say that one can know in the apodeictic way *from* (on the basis of) the principles, but we can say that Demonstrative Science demonstrates *on the basis of* the principles. In fact, Aristotle says “Every Demonstrative Science . . . demonstrates (ἀποδείκνυσι) on the basis of the primaries (ἐξ ὧν πρῶτων).” (76b11–

15) As far as *Posterior Analytics* is concerned, this preposition introduces the structural or scientific perspective in the sense that it relates to demonstration rather than the cognitive state.

On the other hand, ἐπιστήμη as knowledge is always accompanied not by the preposition ἐκ, but by διὰ. For instance, Aristotle says “anyone who is going to have knowledge through demonstration (τὴν ἐπιστήμην τὴν δι’ ἀποδείξεως) must not only be more familiar with the principles and better convinced because of them than of what is being proved...” (72a37-39, eg. 71b17, 83b38, 84a5, 87b19, 88a11, 99b20, cf. 79a25, 83b36, 86a36, 88b31) As far as *Posterior Analytics* is concerned, this preposition introduces an epistemic perspective rather than a scientific or structural perspective in the sense that it relates to the cognitive state rather than to demonstration. Thus if Aristotle had demonstrative knowledge in mind, he would not have employed here the preposition “ἐκ”.

Thirdly, in relation to the second argument, since demonstrative knowledge of a thing/event is grasped by having a demonstration in accordance with the appropriate system and since “the principle” is the word which is used to refer to the proposition in the system rather than to the cognitive state relating to a bit of demonstrative knowledge, it is at least not primarily the case that the cognitive state of grasping demonstrative knowledge is based directly on the necessary principles. Rather it is the case that Demonstrative Science which after all consists of a sequence of demonstrations, insofar as we look at Science from the perspective of its results, is based on the necessary principles.

Fourthly, in the passage in A6, Aristotle offers a similar argument. He infers that the demonstrative syllogism is based on necessary principles from the premises that ἡ ἀποδεικτικὴ ἐπιστήμη is based on necessary principles and that the *per se* attributes necessarily belong to the things/events. Here Aristotle is not interested in the cognitive state of the knower, but the structure of science for which the demonstrative syllogism is recruited. We cannot infer from the necessity of demonstrative knowledge that the demonstrative syllogism is based on necessary principles. The reality is just the converse. Since the demonstrative syllogism is based on necessary principles whose fundamental ground is the necessity of the starting point of Demonstrative Science, by means of which the demonstrative syllogism is made available as its constitutive tool, it follows that necessary demonstrative knowledge is produced by that syllogism.

The passage from A4 has a similar structure. Aristotle argues that demonstration is based on necessary principles on the basis of his argument in the A2 passage. This passage runs as follows;

Since it is impossible for a thing of which there is *epistēmē simpliciter* to be otherwise, what is knowable according to ἡ ἀποδεικτικὴ ἐπιστήμη (τὸ ἐπιστητὸν τὸ κατὰ τὴν ἀποδεικτικὴν ἐπιστήμην) will be necessary. (73a21-23)

The key concept in understanding this phrase consists in his use of an appositive expression: τὸ...τὸ and the preposition κατὰ which makes this apposition possible. If we take it that ἡ ἀποδεικτικὴ ἐπιστήμη means "demonstrative knowledge", we would not be able to explain this periphrasis. In such a case, Aristotle would just have said something like: "a thing of which there is demonstrative knowledge will be necessary." (ἀναγκαζον ἂν εἴη οὗ ἐστιν ἐπιστήμη ἀποδεικτική.) (cf. 71b15, 73a21, 74b6) The fact that Aristotle did not simply express the point so, tells us as such that the phrase: ἡ ἀποδεικτικὴ ἐπιστήμη conveys some technical meaning in the sense that it presupposes a more complicated background than simple "knowledge" does.

The preposition κατὰ has the role of fixing the perspective of the noun or the phrase which follows κατὰ with the accusative case and thus of delimiting the range of its applicability. For instance, when Aristotle says "All the sciences associate with one another in respect of (κατὰ) common axioms.", the preposition κατὰ proposes the perspective by means of which all sciences are somehow compared, and when he says "We should not, therefore, ask each scientist every question, nor should he answer everything he is asked about anything, but <only> those determined by the range of his science (τὰ κατὰ τὴν ἐπιστήμην διορισθέντα).", the preposition κατὰ has the role of fixing the range of the applicability of a science. (77a26-27, 77b6-9) What Aristotle has done by fixing the range and perspective of the phrase ἡ ἀποδεικτικὴ ἐπιστήμη is to make an apposition which delimits the applicable range of the knowable, (τὸ ἐπιστητὸν). In other words, Aristotle fixes the range of the object of knowledge, insofar as ἡ ἀποδεικτικὴ ἐπιστήμη deals with it. Here we see again, as it were, the active aspect of ἐπιστήμη in the sense of a systematic method of producing knowledge rather than the result of scientific activity as a sort of knowledge we acquire. The commentators have failed to see the significance of the preposition κατὰ, by means of which, as we have seen a little earlier, Aristotle conveys the systematic process

of producing knowledge as “Demonstrative Science”. (cf. 77a37)

Hence in these three passages, the contexts in which the phrase ἡ ἀποδεικτικὴ ἐπιστήμη is employed are more or less the same, and all of these three passages suggest that ἡ ἀποδεικτικὴ ἐπιστήμη stands for Demonstrative Science which produces epistēmē. Now we are entitled to claim that the phrase “ἡ ἀποδεικτικὴ ἐπιστήμη” which occurs in six places in *Posterior Analytics* signifies not demonstrative knowledge which involves a cognitive disposition of the soul, but Demonstrative Science which is a systematic method of producing epistēmē.

Now let us confirm that there are some phrases which correspond to the English expression “demonstrative knowledge”. There is no doubt that the phrases “ἐπίσταθαι δι’ ἀποδείξεως” and “ἐπίσταται ἀποδεικτικῶς” stand for demonstrative knowledge. Consider the word ἀποδεικτικὴ in 72b19, 73a23, whose gender shows that the word ἐπιστήμη is omitted; and consider the phrase ἐπιστήμη ἀποδεικτικῇ in 75a19, 99b16 which differs from ἡ ἀποδεικτικὴ ἐπιστήμη in two respects: the order is reversed and the definite article is missing. What these four passages have in common is that in all of them the definite article or the quantifier is omitted, whereas in the previous six passages the definite article in ((1)–(6) excepting (5)) or the quantifier (in (5)) is present. This suggests that in these four passages, the relevant phrases are employed in a non-technical sense and so do not refer to *the* definite system.

The abbreviated ἀποδεικτικὴ in 72b19 and 73a23 no doubt refers to knowledge. The passage 72b19 runs as follows “We claim that it is not the case that all epistēmē is ἀποδεικτικῇ, but the epistēmē of immediates is non-demonstrable.” Here the contrast is drawn between knowledge of a mediated thing and knowledge of an immediate thing, rather than between two sciences. In 73a23 Aristotle says “It is ἀποδεικτικὴ, if we have it by having a demonstration.” This sentence can be described as a paradigmatic instance of the contrast between demonstrative knowledge and demonstration. Demonstrative knowledge is acquired by having a demonstration, whereas Demonstrative Science employs a demonstration so as to produce demonstrative knowledge. Hence this word must refer to demonstrative knowledge.

Concerning the phrase ἐπιστήμη ἀποδεικτικῇ, the passage at 75a19 runs as follows, “Of accidentals which do not belong to things *per se* in the way in which the *per se* things were defined, there is no ἐπιστήμη ἀποδεικτικῇ. For one cannot prove the conclusion from necessity.” (75a18–20) Here it is

not impossible to read this phrase as suggesting both knowledge and science, because there is, after all, no demonstrative science or demonstrative knowledge about accidentals. As far as the wording is concerned, it looks as if its meaning is neutral between the two possibilities. But Aristotle explains the impossibility of having *ἐπιστήμη ἀποδεικτική* in terms of the impossibility of knowing “the reason why” (*διότι*) the accidental occurs. (75a32) Given that knowing the reason why is both the essential business of and the characteristic mark of demonstrative knowledge through a particular demonstration (eg. 78a22ff, 93a35), this suggests that it is demonstrative knowledge to which Aristotle intends to refer with this less technical phrase.

At 24a11, in the first chapter of *Prior Analytics*, Aristotle sets out the project he intends to carry out in *Analytics*. Again at 99b15–17, in the last chapter of *Posterior Analytics*, he looks back at what he has established in the two books. Here he summarises what he has achieved as follows;

Now as for syllogism and demonstration (*ἀποδείξεως*), it is evident both what (*τί*) each is and how (*πῶς*) it comes about — and at the same time this goes for *ἐπιστήμης ἀποδεικτικῆς* too. For that is the same thing. (99b15–17)

Burnschwig comments that this passage is “extrêmement vague”. (p. 70) And Brunschwig proposes that we are faced with the following dilemma: “Si c’est la même chose, pourquoi lui donner deux noms [démonstration et science démonstrative]? Si ce n’est pas la même chose, pourquoi dire que c’est la même chose?” (p. 69) But there is no such dilemma. It is quite clear what Aristotle is claiming here: to make clear the structure (*τί*) and procedure (*πῶς*) of demonstration, is, at the same time, to produce demonstrative knowledge. In other words, Aristotle here just repeats the familiar point about the relation between demonstration and demonstrative knowledge: we come to grasp demonstrative knowledge by having a demonstration. (eg. 71b28–29, 90b9–10) The words “at the same time” and “the same” suggest that Aristotle here imagines a corresponding relation holding between Demonstrative Theory as a systematic method of producing knowledge (act) and demonstrative knowledge (result). For by having a demonstration we come to have a piece of demonstrative knowledge. These are the two aspects of a single phenomenon seen as a human activity which is ultimately based on its corresponding thing/event in the world.

If these four expressions “*ἐπιστήμη ἀποδεικτική*”, “*ἀποδεικτική*” “*ἐπίστασθαι*

δι' ἀποδείξεως" and "ἐπίσταται ἀποδεικτικῶς" are, as we have seen, used not-technically, to refer to "demonstrative knowledge", this indirectly suggests that we should take it that Aristotle deliberately employs the phrase "ἡ ἀποδεικτικὴ ἐπιστήμη" in a technical sense to refer to Demonstrative Science, (given that there is no doubt that ἐπιστήμη does sometimes mean "science" and that Aristotle needs a phrase to stand for "Demonstrative Science"). I conclude that ἡ ἀποδεικτικὴ ἐπιστήμη should be translated as "Demonstrative Science" in the sense of the systematic method which enables us to grasp knowledge in the apodeictic way. Hence Aristotle makes a conceptual distinction between a discussion of how to lay down the structure of a science which, in effect, consists of sequences of propositions about the elements of some single domain from the structural or scientific perspective, and a discussion of the various conditions on the acquisition of knowledge from the epistemic perspective. In other words, the fact that Aristotle makes a verbal distinction between "Demonstrative Science" and "demonstrative knowledge" shows that he is quite aware of the distinction between one aspect of epistēmē which may, according to the contemporary classification of philosophy, be studied by philosophy of science and the other aspect of epistēmē which may be studied by epistemology.⁽³⁾

Notes.

(1). Barnes translates it as "understanding" instead of "knowledge". But Barnes offers the traditional phrase "scientific knowledge" as an alternative equivalent to "understanding" (pp. 89-90). In Burnyeat's view, "Barnes encourages us (p. 90) to read 'understanding' as no more than a way of tagging the occurrence in Aristotle's Greek of the verb ἐπίστασθαι in contradistinction to εἰδέναι, which Barnes translates 'to know', and γινώσκειν, for which he uses 'to be (come) aware of,'" (p. 103).

(2). Ross does not give a translation or a comment regarding (6) at all. But, see p. 577 line 17 ff.

(3). I wonder whether the conceptual clarification of the distinction between science and knowledge so far discussed in this Section may somewhat undermine Burnyeat's last word against *Posterior Analytics*. Burnyeat writes "One result of the impact of scepticism was the gradual separation of epistemology from the philosophy of science. ... Epistemology and philosophy of science became divorced, for better or for worse. It may be counted a permanent victory for scepticism, that, by achieving this divorce, it has made Aristotle's *Posterior Analytics* remarkably hard for us to read." (pp. 138-9). I am not sure what degree of separation Burnyeat means by "divorce".

It does not seem, however, that there is any anachronism in holding that philosophy of science, seen as an attempt to make clear the structure of scientific theory, will provide a good foundation for epistemology. *ἡ ἀποδεικτικὴ ἐπιστήμη* is not completely divorced from epistemology in the sense that it justifies a knowledge claim from a God-like perspective. (cf. Chapter 3) In other words, it seems that one's motivation for constructing a clear and ideal scientific system may still come from one's urge to grasp how the world actually stands and what the world consists of. The scientific realism of modern essentialists can be seen as making this connection in the sense that insofar as essence is understood as the fundamental physical/chemical structure of a natural kind as H₂O is to water, essence is naturally thought of as the proper object of a scientific system, such as chemistry, and thus of a branch of scientific knowledge. The history of philosophy tells us that the controversy between the sceptic and the realist is a perennial one. Rather we should say that the sceptic, while being parasitic on the realist, lives together with the realist in happy marriage.

Chapter 2. The Ultimate Principles and The Relative Principle

A. Non-Demonstrable Primary as an Ultimate Principle of Demonstrative Science

D. Frede, having given a convincing criticism of J. Hintikka's interpretation of the principles on which Aristotelian Demonstrative Science is based, goes on as follows;

I do not want to pretend to have a clear-cut solution which dispenses of all the difficulties which Aristotle's notion of a deductive science based on immediate premises presents to us. A large part of the difficulties seems to stem from the fact that we are still in the dark about any precise model of procedure which Aristotle had in mind when he suggested his *arkhai*. (p. 88)

It seems that understanding how many *ἀρχαί* there are and what roles they play in Aristotelian Demonstrative Science is one of the most important issues raised by *Posterior Analytics*. Hence, to dispel this darkness is now our most urgent task. Otherwise we will never have the correct view about how any particular Demonstrative Science is carried out so as to grasp demonstrative knowledge. This obscurity, in brief, mainly arises from the failure of previous commentators to sort out the nature and the role of the characteristics of immediacy and non-demonstrability which are said to be

possessed by the principles. More precisely, their confusion can be explained by a failure to distinguish a certain type of term and a certain type of proposition among the principles.

In this Chapter, I will discuss how many *ἀρχαί* there are and what roles they play in Aristotelian Demonstrative Science, on the basis of the preliminary work in Chapter 1 in which I have argued that Aristotle has a clear conceptual distinction between demonstrative knowledge and Demonstrative Science. In this Section, I will show under what background questions Aristotle presents Demonstrative Science as his own method for grasping *epistēmē simpliciter*. Then, I will analyse the conditions of Demonstrative Science in A2. We will find out that Aristotle lays down the conditions of being the ultimate principles of Demonstrative Science. In other words, I will show we have to trace the whole chain of demonstrations up to the non-demonstrable primary of a genus so as to grasp *epistēmē simpliciter* about a particular subject.

Now, when Aristotle proposes Demonstrative Science (*ἡ ἀποδεικτικὴ ἐπιστήμη*) as a systematic method of grasping knowledge (*ἐπίστασθαι*) in A2, he begins with a general description of *epistēmē simpliciter* (ES) i. e. unqualified knowledge (*ἐπίστασθαι ἀπλῶς*). (71b9ff) He introduces this general description in a modest way with a doxastic modality, as something that “we think” so as to convey that this is a generally accepted view. Aristotle lays down two conditions for ES as follows;

We think that we know. *X simpliciter*, when we think that (i) we know *Y* as the cause of *X* and (ii) we know that *X* cannot be otherwise, (71b9–12)

He then says that it is “obvious” that to have ES is to satisfy these two conditions, taking it for granted that nobody would deny this view. (71b12–13) Aristotle emphasizes, however, that there is a big gap between a man who merely thinks he has ES and a man who both thinks he has ES and actually has ES. Only the latter can distinguish what is necessary from what appears to be necessary but is not. Aristotle says at 71b13–15;

For both those who do not know and those who do know, the former thinks they are themselves in such a state, and those who do know actually are.

Furthermore, the latter is distinguished from the man who knows something

which in fact cannot be otherwise, by having an inductive argument, but without having the ground of its necessity. (74a25-32, cf. A13, Chapter 2, Section C) When Aristotle contrasts *epistēmē simpliciter* with *epistēmē* obtained incidentally in the sophistic fashion (τὸν σοφιστικὸν τρόπον τὸν κατὰ συμβεβηκός), it is precisely the issue of necessity with which he is concerned. (71b9-10) In A1 71a30-71b8 and A5 74a25-32, Aristotle criticises the sophistic way of acquiring knowledge as follows: when one establishes a universal quantification not by kind (κατ' εἶδος) but by enumeration (κατ' ἀριθμὸν), even if the enumeration happens to exhaust all the members of a kind, it is sophistic in the sense that one does not have any ground or warrant for the claim that such is necessarily or universally the case. For example, if one finds independent proofs which establish that the equilateral, the scalene and the isosceles triangles have two interior right angles, one does not yet know except in the sophistical sense, or by chance, that the triangle has this property — even if there is no other species of triangle.¹¹ Here immediately some questions arise. What distinguishes ES from sophistic knowledge? In other words, what makes it true that one knows the necessity of the case? What distinguishes a man who thinks he knows but does not from the man who really knows?

Aristotle, then, introduces demonstrative knowledge as his answer to these background questions. He says “we claim (φάμεν) that there is demonstrative knowledge (δὲ ἀποδεικτικῶς εἰδέναι).” (71b17) Demonstration is described by both logical and epistemological terms such as “scientific syllogism”. (71b18) By describing demonstration as “scientific”, Aristotle excludes any doxastic element, such as *thinking* that we know_e from demonstration: “by scientific I mean one in virtue of which, by having it, we know_e something.” (71b18-19) That is, Aristotle proposes demonstration as having a faculty of transforming a *claim* of knowledge into knowledge. Then Aristotle lays down the conditions governing the principles of Demonstrative Science which make demonstration capable of meeting the two conditions of ES as follows:

If, then to know_e is as we posited [grasping (i) and (ii)], it is necessary that Demonstrative Science (ἡ ἀποδεικτικὴ ἐπιστήμη) is also based on principles which are (1) true and (2) primary and (3) immediate and (4) better known than and (5) prior to and (6) the cause of the conclusion. (71b19-22)

Aristotle takes it to be a consequence of meeting these conditions that “In

this way the principles (*αἱ ἀρχαί*) will also be appropriate (*οἰκεῖαι*) to what is being proved.” (71b22-23) Thus these six conditions characterise what are called “the principles”. But since the expression “the principles” is said to be ambiguous between a particular premise of the relevant conclusion which is the object of *epistēmē* (eg. 88b3-8, 43b36) and a basic proposition concerning the primary principles of a science on which it is ultimately based (eg. 90b24-27, 76a31-36), there has been some controversy about what is meant by these six conditions. Barnes complains of “irritating imprecisions” in that “Aristotle does not distinguish clearly between (a) the principles on which a demonstrated conclusion ultimately depends and (b) the premises from which it immediately derives.” (p. 98, cf. Brunschwig, pp. 77-78) If Aristotle really mixed up these two things, his confusion would be serious. However, I believe that this is not the case, as I will argue in what follows.

What at least is clear here, is that these six conditions are set up so as to meet the two conditions which are supposed to govern ES ie. (i) grasping the cause *Y* of the thing/event *X* and (ii) knowing that *X* is necessary in the sense that *X* cannot be otherwise. (Concerning the relation between these two conditions, we will be in a better position at the end of this section to tell in what way (i) grasping the cause of a thing and (ii) grasping the necessity of a thing are related to each other.) Aristotle explains these conditions as follows: “For there will be syllogism without *these*, but there will not be demonstration; for it will not produce *epistēmē*.” (71b23-25) In what does the difference between syllogism and demonstration, which is scientific syllogism, consist? It is a matter of modality. Let us suppose the following syllogism first figure *Barbara* which is used as a paradigmatic vehicle for demonstrative knowledge. (eg. 79a24-25)

$$(A \varphi \alpha B \wedge B \varphi \alpha \Gamma) \supset (A \varphi \alpha \Gamma)$$

Both syllogism and demonstration attain the logical necessity or *necessitas consequentiae*, insofar as they are valid:

$$\Box ((A \varphi \alpha B \wedge B \varphi \alpha \Gamma) \supset (A \varphi \alpha \Gamma))$$

But in the case of demonstration, we get to an apodeictic conclusion or *necessitas consequentis*:

$$\Box ((A \varphi \alpha B \wedge B \varphi \alpha \Gamma) \supset \Box (A \varphi \alpha \Gamma))$$

There are two possible combinations of premises from which we may get to

necessitas consequentis: either (I) the major premise is necessary or (II) both premises are necessary.

$$(I) \quad \Box((\Box(A \varphi \alpha B) \wedge B \varphi \alpha \Gamma) \supset \Box(A \varphi \alpha \Gamma))$$

$$(II) \quad \Box((\Box(A \varphi \alpha B) \wedge \Box(B \varphi \alpha \Gamma)) \supset \Box(A \varphi \alpha \Gamma))$$

(A9 30a15–25, 30a37, cf. J. Lukasiewicz p. 183, p. 144)

These two forms of modality are logical requirements, in the form of necessary conditions, for demonstration. Any proposition which produces demonstrative knowledge satisfies either (I) or (II). It can be seen that the necessity of either (I) the major premise or (II) both premises in a particular demonstration is somehow based on the six conditions above. This explains the logical aspect of these six conditions.

Then what is the epistemological contribution made by the six conditions on the principles of Demonstrative Science to the production of the necessary premises either (I) or (II)? What roles does each of these six conditions take in producing demonstrative knowledge? Let us first look at less controversial conditions of the principles of Demonstrative Science, such as (1), (4), (5) and (6).

Conditions (4) “better known than”, (5) “prior to” and (6) “the cause” of the conclusion are no doubt presented from the point of view of the conclusion of a demonstration as conditions relating to what is proved by them. But this does not necessarily mean that Aristotle confines these conditions to (b) the particular premises of particular demonstrations, though there is no doubt that Aristotle often characterises (b) the relative principles in terms of these three features. (e.g. 78a24–26, 86b3, 87a17–18, B11) This is because (a) the ultimate principles of a science can also be seen from the relative perspective with respect to what is, either directly or indirectly, proved by them.

Aristotle remarks that conditions (4) “better known than” and (5) “prior to” can be described from two contrasting perspectives, either “by nature” ($\tau\eta\ \phi\acute{\upsilon}\sigma\epsilon\iota$) or “in relation to us” ($\pi\rho\acute{o}\varsigma\ \eta\mu\acute{\alpha}\varsigma$). (cf. *Physics* A1 184a16ff) In the present context, the principles are better known than and prior to the conclusion by nature, where as the conclusion is better known than and prior to its principles in relation to us. I call the former “the natural perspective” and the latter “our own perspective”.

Aristotle thinks that (4) and (5) are actually implied by (6). He says;
If the principles are causes, they are prior to and antecedently known

in a different way [from demonstration] which involves not only understanding their meaning but also knowing of their existence. (71b31-33)

Here being “better known than” is explained in terms of “antecedent knowledge” (προγνωσκόμενα) of the meaning of the terms which signify the principles and of their existence. The phrase “in a different way” (τὸν ἕτερον τρόπον) suggests that the way of understanding (ἐννοεῖν) the meaning of the principle and the way of knowing (εἰδέναι) the existence are different from the way of knowing through demonstration i.e. demonstrative knowledge.

In explaining (6), Aristotle reminds us of the first condition (i) of ES: “When we know the cause, then we know_e.” (71b30-31) But the remarkable thing here is that Aristotle does not say that “we know_e *simpliciter*”. To know something as the cause is not a sufficient condition of grasping ES. The second condition (ii), the necessity of the case, must be somehow secured as well. Aristotle’s concern in A2 is to make clear how his programme of Demonstrative Science meets the requirements on ES, in terms of structure rather than as an account of the mental process of knowing; (i) grasping the cause of X and (ii) grasping the necessity of X. In A2-3, Aristotle offers the structural basis for grasping the second condition (ii) which necessarily involves an argument in favour of his account of how one structurally secures the necessity of the ultimate starting point of demonstration.

Satisfying the condition (i) i.e. grasping a true proposition is contrasted with the vacuous proposition which does not exist (τὸ μὴ εἶναι), for example, “the diagonal is commensurate.” (71b26) Thus it can be said that in the Aristotelian theory of truth the truth of a proposition presupposes the existence of the object to which it corresponds. In other words, a true proposition has existential import concerning its two constitutive terms. How we grasp the existence of a thing or kind is not a concern of his theory of Demonstrative Science but rather the theory of inquiry which is expounded in *Posterior Analytics* B. But since the truth of a proposition and the existence of the corresponding object do not amount to the necessity of the proposition, satisfying (1) is nothing more than meeting a minimum requirement on grasping the appropriate principles (αἱ ἀρχαὶ οἰκεῖναι). A true proposition is contrasted with a necessary proposition in the following way: “from truth one can deduce without demonstrating, but from necessity one cannot deduce without demonstrating. For this is the precisely the mark of demonstration.” (74b15-18) Thus the grasp of the necessary

principles which grounds a grasp of the necessity of the conclusion is essential for demonstrative knowledge, so as to distinguish it from other ways of knowing such as the so-called sophistic kind of knowledge. (cf. 74b5-6)

In order to understand what kind of principles these are on which Aristotle places these conditions, it is essential, among other things, to have a correct view of the role of (2) the primary in making ES possible. In A2-3 he gives the structural grounds for the acquisition of a necessary proposition, especially by discussing the nature and function of (2) in the structure of Demonstrative Science. Aristotle employs the word "the primary" (*τὸ πρῶτον, τὰ πρῶτα*) to convey at least four different roles in different contexts.

Firstly, we have (2a) the primary cause (*τὸ πρῶτον αἰτιον*) or the primary middle term (*τὸ πρῶτον μέσον*) which makes clear the reason for the occurrence of a thing/event, in the sense that one particular cause is the proximate cause: that is, it is primarily responsible for its effect. (78a25, 78b3-4, 85b25-26, 95b15, 99a25) E.g. Being near is the primary cause of the planets' not-twinking. (78a39-b3) The screening of the earth between the moon and the sun is the primary cause of a lunar eclipse. (93a30-36) The solidifying of the sap at the connection of the seed is the primary middle term in the account of shedding leaves. (99a25-29)

Next, there is (2b) the primary of the genus (*τὸ πρῶτον τοῦ γένους*) or principles in each genus (*ἀρχὰς ἐν ἑκάστου γένει*) which is/are non-demonstrable. (76a31-32, 83b23, 88a8, 90b27, 96b16, 99b21) This type of non-demonstrable primary is the most fundamental primary on which a science is constructed such as number in arithmetic and magnitude in geometry. (76a31-36, 84a23, 88b28) Aristotle calls this type of primary, "proper principles" (*ἰδιαὶ ἀρχαί*) or "the primary of the genus" (*τὸ πρῶτον τοῦ γένους*), which determines the universe of discourse of a science. (88b27-29, 74b25) This most fundamental primary is convertible with (*ἀντιστρέφοντα*) all its derivatives in the science of which it is the primary. E.g. Number is the primary thing in arithmetic and is convertible with all its derivatives such as oddness and evenness, commensurability and equality. (84a23-25, *Met.* Γ3 1004b10-13)⁽²⁾

The third is, (2c) the random primary (*τὸ τυχὸν πρῶτον*) which possesses its particular attribute in the first place. The way in which the attribute is predicated of the primary is called "*per se*" (*καθ' αὐτό*) and "as such or qua itself" (*ᾧ αὐτό*) predication. These are described as the ways of grasping the necessity between subject and predicate in A4. (73b33, 39, 40, 74a5)

In A4, *per se* predication which consists in this primary relation is described as giving rise to a grasp of the analytical necessity through definition. This type of *per se* predication, “A belongs to B *per se*”, is equivalent to “A belongs to B and B belongs in the definition of A.” (73a37-38) “*Qua* itself” predication is a way of grasping this primary subject, referred to by “itself”, such that the subject itself, is, in the first place, responsible for its having the predicate. This *qua* itself predication is based on a particular viewpoint taken by an inquirer, who looks at the world in such a way that anything which can be seen from that perspective will be demarcated as the proper object of the predication. For example, physics is a science which examines things in the world from the point of view: “*qua* the principle of movement and rest”, so that everything which can be viewed from this perspective is a proper object of this science. (cf. *Met.* E1 1025b9, b20-21) In this way, *qua* predication has the role of exhausting the attributes which belong to a certain object seen from a certain perspective. These issues will be discussed in detail in Section D. This type of primary sometimes coincides with (2a) and (2b). E. g. Not only is it *qua* triangle that an isosceles has two right angles, but also its being a triangle is [2a] the primary cause of its having two right angles. (73b25-74a3, cf. 73a38-39, 76a37-40, 76b3-6)

Fourthly, we have (2d) the so-called common axioms (τὰ κοινὰ ἀξιώματα), which are non-demonstrable and “the primaries from which one demonstrates”. (72a15-18, 76b14, 76a38-39, 83b27-29) E. g. The law of excluded middle. (71a13-14) “If equals are taken from equals, the remainders are equal.” (76a41) The common axioms apply in an analogous way (καθ’ ἀναλογίαν) to each science such as geometry, arithmetic and optics. Aristotle says ;

All the sciences associate with one another in respect of the common [axioms] (κατὰ τὰ κοινά). I call common those which they use as demonstrating from them — not those about which they prove nor what they prove. (77a26-28)

The common axioms such as the law of contradiction are not assumed as a premise of any demonstration, unless its conclusion too is to be an instantiation of such an axiom. Nevertheless, all demonstrations are based on these axioms, because the common axioms such as the law of contradiction and the law of excluded middle are the ontological ground of any judgement

or meaningful expression. (cf. *Met.* Γ3 1005b32-34, Γ4 1008a20-22) Aristotle characterises the significance of the common axioms as follows: "it is necessary for anyone who is going to learn anything whatever to grasp common axioms." (72a16-17)

Now, which primary among these four kinds Aristotle does mean to convey by (2) the non-demonstrable primaries? Ross, for instance, understands (2), according to my classification, as (2a) and (2c): hence he takes Aristotle to be describing the characteristics of particular proximate premises. Ross says "*πρῶτα* here does not mean 'most fundamental', for Aristotle could not, after saying that the premises must be fundamental in the highest degree, go on to make the weaker statement that they must be *more* fundamental (*προτέρων*, a22) than the conclusion." (p. 509)⁽³⁾ And he concludes that "*πρῶτων*, then, means just the same as *ἀμέσων* or *ἀναποδείκτων* (b27) — that the premises must be such that the predicate attaches to the subject directly as such, not through any middle term." (p. 509) Barnes also says as follows: "in a demonstration each α_1 [premise] must also be true and universal and necessary and primitive and immediate, and also appropriate to and prior to and more familiar than an explanatory of σ [conclusion]. (see *An. Post.* I2 and I4)" ([1] p. 26) Now, in what follows, I would like firstly, to offer four arguments to show that the non-demonstrable primaries are not the relative principles, but (2b) "the primary of the genus" or "principles in each genus"; and secondly, to show that by means of these six conditions for the principles of Demonstrative Science, Aristotle characterises among other things, the ultimate principles of Demonstrative Science and only derivatively the relative principle.

The first argument runs as follows. In A9 Aristotle discusses the conditions on *epistēmē simpliciter* ("Ἐκαστον ἐπιστάμεθα μὴ κατὰ συμβεβηκός) or demonstration *simpliciter* (ἀποδείξαι ἕκαστον ἀπλῶς) again and he puts an additional restriction on (2) the non-demonstrable primaries. (76a4, 76a14) This undoubtedly suggests that A2 and A9 share the same context. In A9, the primary in the sense of (2b): the primary of the genus, is found in his argument that proof on the basis of "its own principles" (*τῶν ἐκάστου ἄρχῶν*) should be distinguished from proof on the basis of "common items" (*κατὰ κοινόν*) which is somehow related to (2d): the common axioms. Aristotle argues that each thing which has its own principles must be demonstrated from its own principles and that each thing and its own principles must both belong to the same genus. His argument for "its own principles"

in A9 is complementary to the discussion of the six conditions of Demonstrative Science as a systematic method of producing *epistēmē simpliciter*. In A2, Aristotle does not give a conclusive argument for *epistēmē simpliciter*. This is because, in order to convey a further condition concerning the non-demonstrable primaries, so as to distinguish (2b) the non-demonstrable primaries of the genus, from (2d) the non-demonstrable primaries as the common axioms on the basis of which demonstration comes about only incidentally (76a2, 71b28), it is indispensable to have a clear view of the theory of predication which is employed in demonstration, such as *per se* predication or *qua* predication which is discussed in A4. The further condition or restrictive condition of (2) the non-demonstrable primary in A2 is that “a syllogism must be of the same genus as the primary.” (76a29–30)⁽⁴⁾ By imposing this restriction, Aristotle rules out (2d) the primaries as the common axioms from being employed as the actual premises of a demonstration.

For this argument, Aristotle takes up Bryson’s proof about the squaring of the circle. Bryson proves that the circle can be squared by making the assumption that “things which are greater and less than the same things respectively are equal” (cf. T. Heath [2] pp. 47ff, W. R. Knorr p. 71). This proposition seems to belong to a kind of (2d) the primary as the common axiom. Aristotle described this premise as (1) true, (2) non-demonstrable and (3) immediate (ἐξ ἀληθῶν καὶ ἀναποδείκτων καὶ ἀμέσων). (75b9–10)⁽⁴⁾ This proof which is based on non-demonstrable things, however, is not scientific but sophistical (σοφιστικός) or eristical (ἐριστικός), because this premise does not genuinely belong to geometry but is much more general. (*Soph. El.* 11 171b12–18, 172a2–7) Such an argument could also be applied to matters pertaining to another genus. Thus he claims that “Thus one does not know, the subject [sc. circle] to have an attribute [sc. squaring] *qua* itself (ἥ ἐκεῖνο), but *per accidens*; otherwise the proof could not have been applicable to another genus.” (76a2–3) In this way, Aristotle contrasts the proof on the basis of the common principles which are composed of true, non-demonstrable and immediate premises, with the proof on the basis of its own principles whose conclusion belongs to the same genus as the premises. In order to secure that the conclusion and its principles belong to the same genus, Aristotle introduces *qua* itself predication and *per se* predication which are discussed in A4. These are such that they have the characteristics of a definition, and so of necessary predication.⁽⁴⁾ Thus Aristotle claims that Bryson’s proof fails to grasp the definitional relations

among terms which is to be found within any genus which determines the universe of discourse of a science. In other words, being true, non-demonstrable and immediate is not enough to guarantee that the proposition which is composed of these elements belongs to the same genus as what is proved from them. The conclusion must be proved from its own principles which are based on (2b) the primaries of the genus. Thus Aristotle says in the decisive paragraph that;

It is difficult to be aware of whether one knows or not. For it is difficult to be aware of whether we know from its own principles (*ἐκ τῶν ἐκάστου ἀρχῶν*) or not — and that is what knowing is. We think we know, if we have a syllogism from something true and primary but that is not so, but it must be of the same genus as the primaries. (76a26-31)

Here there is no doubt that “its own principles” are restricted to the primaries of the genus if one is to obtain *epistēmē* of each thing, however difficult it is. Principles derived from common features which are applicable to more than one genus, like Bryson’s, do not produce *epistēmē* but merely sophistic or eristic knowledge. This is the “difficulty” of knowing whether we know or not. Therefore, it is clear that (2) the non-demonstrable primaries in A2 must be identified with (2b) “the primary of the genus” or “principles in each genus”, given that Aristotle discusses the conditions of *epistēmē simpliciter* in both A2 and A9.

Secondly, the non-demonstrability of the primaries has a role in stopping the chain of demonstrations within a genus. In A28, Aristotle describes the relation between the primaries and a genus in terms of non-demonstrability:

A science is one if it is of one genus — of whatever things are composed from the primaries (*ἐκ τῶν πρώτων*) and are parts or attributes *per se* of these. One science is different from another if their principles (*αἱ ἀρχαὶ*) are not based on the same things nor the ones on the others. There is evidence for this when one comes to the non-demonstrables (*τὰ ἀναπόδεικτα*); for these must be in the same genus (*ἐν τῷ αὐτῷ γένει*) as the things demonstrated. (87a38-87b4)

Here Aristotle makes it clear that a science is composed of the primaries and their *per se* attributes, and that insofar as the principles are based on the same non-demonstrable primaries which constitute the unity of a science,

those principles on which the demonstrandum depends will belong to the same science. I do not see any reason why the non-demonstrable primaries in A2 should be described in a different way from the way in which they are described in this passage. In fact, when the primaries in A2 are explained in terms of non-demonstrability in 71b27, Aristotle characterises the primaries to be what stops the infinite regress of demonstrations, by saying that “For <otherwise> one will not know, if one does not have demonstration of them.” (71b26-28) Therefore, there is no doubt that in A2 Aristotle proposes, at least, the condition of being a non-demonstrable proposition which is the original starting point of the fundamental proposition of a science and thus of demonstrative knowledge (cf. *Topics* A1 100a27-29, A2 101a37ff, *Θ3* 158a33-37, 158b22-23, *Soph. E1*. 2 165b1ff)

Thirdly, when Aristotle says at the beginning of A6 that “Demonstrative Science is based on necessary principles (ἐξ ἀναγκαίων ἀρχών)”, what he means by “necessary principles” is the same as the “appropriate principles” which are characterised by those six conditions in A2. (74b5-6, 71b22-23) For in both cases Aristotle infers the same conclusion, that “On the basis of necessary [principles] (ἐξ ἀναγκαίων) one cannot deduce without demonstrating.” (74b16-17, cf. 71b23-24) In this case too, it is at least clear that “necessary principles” involve not only the relative principles but also the ultimate principles. For in the second of four arguments in A6 for demonstration’s having necessary principles, Aristotle raises a condition that one should not take a popularly accepted proposition or mere true proposition as a principle, but “what is primary in the genus about which the proof is”. (74b24-25)

Fourthly, if it is the case, as I have argued in Chapter 1, that ἡ ἀποδεικτικὴ ἐπιστήμη refers not to demonstrative knowledge but to Demonstrative Science, there seems to be no doubt that the principles which are characterized by the six conditions refer to the ultimate principles of a science on the basis of which the relative principles are derived.

Fifthly, a passage from *Topics* will give support to my view that non-demonstrable primaries in A2 stand for (2b) “the primary of the genus” or “principles in each genus”. Aristotle says:

The primaries require definition, while the last things have to be arrived at through many steps if one wishes to secure a continuous proof from the primaries (ἀπὸ τῶν πρώτων), or else all discussion about them wears the air of mere sophistry; for to demonstrate anything is impossible

unless one begins with the appropriate principles ($\alpha\pi\delta\ \tau\omega\upsilon\ \omicron\kappa\epsilon\lambda\omega\upsilon\ \alpha\rho\chi\omega\upsilon$), and connects inference with inference till the last are reached. (Θ3 158a33-37)

This passage corresponds to the relevant passage in A2 with respect to three points. Firstly, the primaries are not connected with the notion of demonstrability. (71b26-28, cf. 72b18-20) Secondly, just as the appropriate principles in *Topics* are based on the primaries, in *Posterior Analytics* A2, it is said that “the thing which is based on the appropriate principles is based on primaries.” (72a5-6, cf. 172a19) Thirdly, in both passages in *Analytics* and *Topics* the appropriate principles are regarded as being incompatible with the sophistic fashion of grasping knowledge. (71b9-10) There is a further point which is related to this third issue: in *Posterior Analytics* A6 and *Sophistical Refutations* 2, appropriate principles are contrasted with “popularly accepted opinions” ($\tau\delta\ \epsilon\nu\delta\omicron\varsigma\omicron\nu$, $\xi\kappa\ \tau\omega\upsilon\ \delta\omicron\varsigma\omega\upsilon$) in that appropriate principles are regarded as the principles which guarantee the necessity of what is derived from them. (74b24-27, 165b1-2) In other words, Aristotle uses this word “appropriate” in order to convey his conviction that unless one can trace the necessity of what is proved back through its principles up to the non-demonstrable primaries of a science, knowledge of the demonstrandum may turn out to be sophistic and thus its principles may not be appropriate to it, in the sense that other principles than these may give rise to the necessity of the demonstrandum. These correspondences between these passages in *Posterior Analytics* and *Topics* suggest that the primaries of condition (2) which are qualified as “non-demonstrable primaries” in A2 should be understood as the constituents of (1) the ultimate propositions of a science.

Therefore, we can conclude on the basis of these five arguments that since (2) the primaries have been revealed as the constituent terms of the ultimate principle, the establishment of (a) the ultimate principle is involved in his attempt to give the conditions of the principles of Demonstrative Science as a systematic method of producing epistēmē *simpliciter*. Nothing prevents us from claiming that (a) the ultimate principle satisfies all of these six conditions; true, primary, immediate, better known than, prior to and the cause of the conclusion. (cf. *Met.* 47 1015b7-9, 11-12, 41 1013a14-17)⁷⁷ At the same time, I claim that (b) the particular proximate premise of a demonstration, if successful, seems to share some of them. In many passages, Aristotle characterises the proximate premise of a particular demonstration

as being immediate, the cause of, better known than, and prior to the conclusion. (eg. 78a24-25, 84b19-22, 86b3, 87a17-18, 93a36) There is nothing wrong in thinking that some of the six conditions of the ultimate principles of Demonstrative Science may apply to the relative principles. But it is not the case, as Barnes claims, that "Aristotle does not distinguish *clearly* between" (p. 98 my italics) (a) the ultimate principles and (b) the relative principles.

Now we are in a good position to tell how the two constituents of *epistēmē simpliciter* which are (i) grasping the cause of a relevant thing/event and (ii) grasping the necessity of that thing/event are related to each other. In order to know that (ii) a thing/event which is expressed in a conclusion of a particular demonstration cannot be otherwise, one's knowledge must conform to these six conditions on being a principle, which will involve (i) grasping its cause as well.

Thus we can say that Aristotle here lays down the rather severe requirement that the whole chain of demonstrations, which involves both ultimate and relative principles, is supposed to be grasped as a set of principles in such a way as to result in the acquisition of the demonstrative knowledge of a particular object. This is his own answer to sophists and sceptics who either deny *epistēmē* or pretend to have *epistēmē* in virtue of employing sophistical methods. (71a30-71b10, 72b5-18)

In this Section, I have made clear at least that when Aristotle presents the six conditions for the principles of Demonstrative Science, these conditions elucidate, in the first place, the ultimate proposition on which a demonstrated conclusion ultimately depends. But it seems that further arguments will be required if we are to establish the other claim which seemed to lead from what I have said in this section, that is, that grasp of a piece of demonstrative knowledge requires grasp of the whole chain of demonstrations involving all the principles from the proximate immediate premise to the ultimate premise. In particular I have to make clear the relation between (2) the non-demonstrable primary and (3) the immediate. In the next Sections B and C, I will set forth the natures and functions of the ultimate and relative principles in the theory of Demonstrative Science by exploring, first, the relations among the so-called principles such as the hypotheses and the definition and then exploring the relation between (3) immediate and (2) the non-demonstrable primaries.

Notes.

(1). G. E. M. Anscombe misunderstands Aristotle by failing to grasp the nature and significance of the sophistical proof, and by wrongly interpreting the different roles of the categorical and modal syllogisms. (Cf. p. 6) Anscombe misinterprets the passage on sophistic proof in A6. Aristotle does not say there that what distinguishes scientific proof from sophistic is whether the proof "is based on the nature of things themselves" or not. Nor does Aristotle say that the sophistic proof cannot be a syllogism in *Barbara*. Furthermore, as far as the logical aspect of scientific knowledge is concerned, Aristotle does not give "the key to the nature of 'scientific' knowledge" to the theory of categorical syllogism, but to modal logic on the basis of categorical syllogism. Anscombe here takes it for granted that sophistic proof does not satisfy *Barbara* and thus cannot convey the nature of the object as a scientific proof. But both scientific and sophistic proofs can satisfy *Barbara* which is the concern of categorical syllogism. The sophistic proof in 74a28ff can be set out in *Barbara* as follows;

Two right angles [2R] $\varphi\alpha$ subclasses of triangle such as isosceles, scalene.
Triangle $\varphi\alpha$ isosceles.
2R $\varphi\alpha$ isosceles.

Here the sophistic proof exhausts all subclasses of triangle in such a way that all subclasses of triangle are simply enumerated. But the kind 'triangle' is not secured or guaranteed as a *kind* by some prior explanation, in the sense that the necessity of a triangles' having 2R is not grounded by anything. The difference between two types of syllogism consists in whether the conclusion is guaranteed by a necessary premise(s) or not, which is the concern of modal syllogism. Anscombe misunderstands the context of the example, by failing to grasp that the focus of attention in this passage, which concerns the mark which distinguishes scientific proof from sophistical proof, is necessity rather than the question of whether a proof is based on the nature of a thing. Hence, it seems that Anscombe must look for another passages, to support her claim that *Posterior Analytics* Book I is "his worst book".

J. G. Lennox describes the distinction between a sophistic sort of grasp and an unqualified understanding as the extensional grasp and "the intensional grasp" which is characterised by "the language of *qua* (η) and in virtue of (*κατὰ*)" (p. 92)

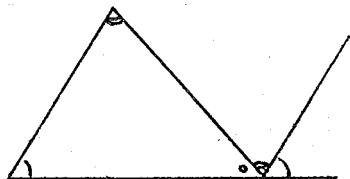
(2). It remains unclear whether Aristotle regards "the things peculiar" ($\tauὰ \zetaῆα$) to each science such as point and line in geometry and triplet and pair in arithmetic which are non-demonstrable as the primary entities of a science. (76a37, 40, 76b3-6, cf. 96b15-17)

(3). Ross seems to fail to realise the change in perspective, when he claims that in so far as $\pi\rho\omega\tau\alpha$ signifies the most fundamental thing of a science, it should not be described by “the weak statement that they must be *more* fundamental $\pi\rho\omega\tau\epsilon\rho\alpha\nu$ ”. When $\pi\rho\omega\tau\alpha$ is described as $\pi\rho\omega\tau\epsilon\rho\alpha$, it is just because it is seen from the perspective of the conclusion, so that $\pi\rho\omega\tau\alpha$, which are in effect the ultimate principles, are prior to their conclusion.

(4). In the case of subordinate sciences, however, as harmonics is to arithmetic, or optics and mechanics are to geometry, it is not necessary for the middle term to belong to the same genus as what is proved. Because there are cases in which, while the fact falls under a subordinate science, the reason for it falls under the higher science. (76a9-16)

(5). The reason why Aristotle describes it as non-demonstrable rather than primary is that he did not want to be misunderstood as meaning (2b) the primary of the genus or principles in each genus.

(6). As the second example, Aristotle considers the proof that the triangle has two right angles (2R). Aristotle concludes his second example by saying “Hence if that [2R] too belongs *per se* to what [triangle] it [2R] belongs to, the middle term must belong to the same genus as the extremes.” (76a8-9). Here he seems to be thinking of “the angles about one point” ($\alpha\lambda\ \pi\epsilon\rho\iota\ \mu\iota\alpha\nu\ \sigma\tau\iota\gamma\mu\acute{\eta}\nu\ \gamma\omega\nu\iota\alpha\iota$) as the middle term of the proof that triangle has 2R. (cf. 1051a24-25) This middle term is attained by drawing a line parallel to one line of the triangle as it is seen in the following diagram.



Then its demonstration will be as follows :

2R $\varphi\alpha$ the angles about one point.

The angles about one point $\varphi\alpha$ the triangle

2R $\varphi\alpha$ the triangle.

Aristotle takes it that the minor premise as well as the major premise is an example of *per se* predication. (76a8) For, the point, which is itself non-demonstrable, (cf. 76b5) is involved in the definition of the triangle, given that the definition of the straight line which composes that triangle is “a line which lies evenly with the point on itself”. (Health, [1] vol, 1 p. 153) In this way, by checking whether the major and minor premises constitute *per se* predications, we can tell whether the middle term belongs to the same genus as what is proved by it.

(7). “Traditionally”(traditionalmente)(Mignucci, p. 22), it has been thought that among these six conditions the first three conditions [(1)-(3)] are to be met by the principles in themselves and the latter three [(4)-(6)] are to be met by the principles in relation to the conclusion. As concerns the perspective from which one considers the principles, the distinction is well

taken. But the distinction is no more than a matter of perspectives, that is, a matter of the way in which we come to grasp the conditions. It does not determine whether a given premise is ultimate or relative. When G. G. Granger calls the first three characteristics "primitivité absolue" and the last three "primitivité relative", he is wrong. (p. 73)

B. Immediate Non-Demonstrable Syllogistic Principles: Hypotheses and Definition

In this Section, I will set out to clarify how many principles there are and what roles they play in Aristotle's enterprise of constructing Demonstrative Science, by, first, exploring the relations among the so-called principles, such as hypotheses and definition, and then, in the next section, by exploring the relation between the third condition for the principles of Demonstrative Science: immediacy and the second condition: primacy. As I pursue this issue, it should become more clear that it is not the case, as some commentators complain, that Aristotle does not distinguish the ultimate principles from the relative principles. And the conclusions argued for in the previous section, namely that the ultimate principles of a science are determined by those six conditions will receive further confirmation.

As a preliminary step in our investigation into the principles, it is essential to confirm that Aristotle employs the word "principle" to denote both a certain type of term and a certain type of proposition. Aristotle distinguishes between two basic types of principle; [P1] the proposition and [P2] the term. He explains the ontological and epistemological precedence of the primary terms of a science and of definitions as follows; "The attributes which belong to the compounds from the indivisibles (*ἐκ τῶν ἀτόμων*) will be clear from the definitions, for [P1] the definition and [P2] the simple (*τὸ ἀπλοῦν*) are principle of all things." (96b21-24, cf. 84b37-85a1, *Top.* 158b1-4) Since *ἡ ἀρχή* is a feminine noun, one cannot distinguish by its grammatical form whether it stands for the principles as the primary terms or the principle as the primary propositions, unlike "the primary" ("*ἡ πρωτῆ*", "*τὸ πρωτότου*") and "the universal" ("*ἡ καθόλου*", "*τὸ καθόλου*") which are denoted by an adjectival phrase so that one can distinguish the proposition from the term. (e.g. 72a4, 72a28, 72b5ff, 73b32, 76a32, 81b2, 85b25-26) Thus in the case of *ἡ ἀρχή*, we must rely on more than mere grammatical considerations to discover whether it stands for a proposition or a term.

Let us consider, first of all, the use of 'the principle' as [P2] the term. Principles of this type are described as "principles in each genus" (76a31) and called "proper principles" (88b27-29) Aristotle describes [P2] in A10 as follows ;

I call principles in each genus those of which it is not possible to prove the existence. Now the meaning both of the primaries and of their derivatives is assumed ; but existence must be assumed for principles and proved for the rest. For example, we must assume the meaning of the unit or the straight and the triangle, and the existence of the unit and magnitude ; but we must prove the existence of the others. (76a30-36)

Here principles are treated as non-demonstrable primaries and play the role of the underlying terms of a science such as "number" in arithmetic and "magnitude" in geometry. (76a34ff, 88b28-29) What is called "the simple ($\tau\omicron\ \acute{\alpha}\pi\lambda\omicron\upsilon\nu$)" such as "the ounce" in weight and "the semitone" in song must be counted as this type of principle as well. (84b37-39)

On the other hand, in dealing with [P1] the proposition, Aristotle sorts out three types of propositions all of which are called immediate non-demonstrable syllogistic principles ; the hypothesis, the definition, and common axioms. Aristotle writes :

Of an immediate syllogistic principle, I call thesis ($\theta\acute{\epsilon}\sigma\iota\nu$) the one which one can not prove, but it is not necessary for anyone who is to learn anything to grasp it. The one which it is necessary for anyone who is going to learn anything whatever to grasp, I call an axiom. . . Of thesis the one ($\eta\ \mu\acute{\epsilon}\nu$) which assumes either of the parts of a contradiction, i. e. either to be something or to be not something, I call hypothesis. The other ($\eta\ \delta\grave{\epsilon}$) without this, I call definition. For, on the one hand, the definition is a thesis, such as when the arithmetician posits that a unit is what is quantitatively indivisible. On the other hand, it is not a hypothesis. For what a unit is and that a unit is are not the same. (72a14-24)

(Hereafter, I will call each of three principles which are presented in this passage in A2 respectively (A) the hypothesis, (B) the definition and (C) the common axioms.)

(A) the hypothesis is called "a thesis" which is described as "an immediate

sylogistic principle which one cannot prove". (72a14-15) Unlike the axioms which are the other component of a non-demonstrable immediate syllogistic principle, in the case of a thesis i.e. either (A) the hypothesis or (B) the definition, "it is not necessary for anyone who is to learn anything to grasp it." (72a15-16) The criterion for distinguishing these from axioms is whether a given immediate non-demonstrable proposition must necessarily be grasped in order to learn anything or not. In the case of axioms such as the law of non-contradiction or the law of the excluded middle, it is necessary for anybody to grasp them in advance. Otherwise one cannot say anything meaningful. (*Met.* I 3, 4) Whereas in the case of (A) the hypothesis or (B) the definition, it is not necessary for a learner to grasp it to learn something. For if one does not know these immediate non-demonstrable syllogistic principles i.e. (A) the hypothesis and (B) the definition, the possibility of hypothetical knowledge remains.

Aristotle agrees with some sceptics who would deny that epistēmē *simpliciter* is achieved unless a non-demonstrable primary is grasped, though he is convinced that the non-demonstrable primary can be grasped in a way other than the demonstration. (72b13-15, 72b18-25 (The translation of this passage is given on p. 56 in this Section), 76b27-31, 83b38-84a1, B19) The sceptics claim that since demonstration is the only means to get epistēmē and there can be no demonstration of the non-demonstrable primary, there can be only hypothetical knowledge. (72b11-13) Aristotle says "if one cannot know the primaries, neither can one know what depends on them *simpliciter* or properly, but only on the hypothesis (ἐξ ὑποθέσεως) that the primaries are the case." (72b13-15) Hypothetical knowledge is contrasted with demonstrative knowledge *simpliciter*, i.e. ES. (83b38-84a1) In order to have demonstrative knowledge *simpliciter*, it is necessary to grasp and exhaust all the middle terms which are constitutive elements (στοιχεῖα) of the relevant original conclusion including the non-demonstrable primaries. (83b38-84a1, 84a29-33, 84b19-22) Aristotle says;

If one can know something through demonstration *simpliciter*, and not dependent on something, nor on a hypothesis (ἐξ ὑποθέσεως), it is necessary for the predication between the original two extreme terms to come to a stop. (83b38-84a1)

It seems to be obvious now that this principle satisfies all of the six conditions: true, immediate, primary, better known than, prior to and the cause

of the conclusion. (cf. *Met.* 45 1015b7-9, 11-12, 41 1013a14-17) In other words, as the example i. e. the unit which is the primary term of arithmetic shows, (A) the hypothesis is the proposition which functions as the premise on which a demonstrated conclusion ultimately depends. Thus (A) the hypothesis as an immediate non-demonstrable syllogistic principle is called "hypothesis" not only because it is a ground of hypothetical knowledge, but also because it is grasped in some way other than by demonstration and thus is assumed in the sense of not being demonstrated.

On the other hand, Aristotle seems to regard any premise of a syllogism which is also called a hypothesis as a principle as well. Aristotle writes :

Every syllogism is through three terms; and the one type is capable of proving that *A* belongs to *C* because it belongs to *B* and that to *C*, while the other is privative. . . . So it is evident that the principles (*αἱ ἀρχαὶ*), that is (*καὶ*), those which are called hypotheses (*ὑποθέσεις*) are these; for it is necessary to assume these and prove in this way — e. g. that *A* belongs to *C* through *B*, and again that *A* belongs to *B* through another middle term, and that *B* belongs to *C* in the same way. (81b10-18, cf. 24a30-31, 88b3-8, *Met.* 41 1013a16-17)

In the following chain of demonstrations, each premise is taken as a hypothesis and only *A φ α C* is not counted as a hypothesis;

⋮	⋮
<i>A φ α D</i>	⋮
<i>D φ α B</i>	<i>B φ α E</i>
.....	<i>E φ α C</i>
<i>A φ α B</i>	
<i>B φ α C</i> =	<i>B φ α C</i>
.....	
<i>A φ α C</i>	

Aristotle distinguishes (A) hypothesis from (D) this kind of relative hypothesis according to whether the relevant premise is provable or not. Hence this kind of relative hypothesis (D) is called a theorem (*ἀποδεδειγμένον*). (76b10) Aristotle describes the relative hypothesis (*οὐχ ἀπλῶς ὑπόθεσις*) as follows; "Whatever a man assumes without proving it himself, although it is provable — if he assumes something that seems to be the case to the learner, he supposes it and it is a hypothesis not *simpliciter* but in relation to the

learner.” (76b27–30) Here a contrast is drawn between teacher and learner in relation to their cognitive states. For a teacher or a scientist who presents a demonstration in a systematic way, the given premise is not a hypothesis, now that he knows that premise to be provable. On the other hand, a learner is confined to hypothetical knowledge in the double sense that “if” a given particular premise ((D) the relative hypothesis) is the case and further “if” its ultimate principle ((A) the hypothesis) is the case, he will know hypothetically that it is necessary that the conclusion follows. Thus the status of absolute hypothesis ((A) the hypothesis) can be attributed only to the ultimate principles which are non-demonstrable for both teacher and learner. But since Aristotle holds that (A) the hypothesis can come to be known in a way other than by demonstration, it is not the case, as some sceptics claim, that only hypothetical knowledge is available. (72b18–25)

It seems that we have sorted out the different varieties of principles to a certain degree so that we are now in a good position to discuss the nature and functions of (A) the hypothesis and (B) the definition in 72a14–24 in more detail. There has been much controversy among commentators on this issue. The main issues are as follows: firstly whether (A) the hypothesis which is described as “to be something or to be not something” (*τὸ εἶναι τι ἢ τὸ μὴ εἶναι τι*) constitutes (a) a truth-valued statement in the form of a predicative proposition [eg. *A* belongs to all *B*] which expresses a premise in the demonstration or (a') a truth-valued statement which expresses an assumption of existence in the form of an existential proposition [eg. *A* exists.]. Secondly, (B) the definition is contrasted with (A) the hypothesis in the following: “the thesis without this [ie. either of the parts of a contradiction as to be something or not to be something], is a definition”. Hence (B) the definition can also be understood as contrasting with (A) the hypothesis in two different ways; (B) the definition can be taken either as (b) a non truth-valued statement which has no assertive force and thus is a nominal definition in the sense of an account of what a name signifies or (b') a proposition expressing the essential nature of the subject which implies the existence of the subject and thus is a real definition.

In discussing this issue, commentators invariably quote the related passage in A10 76b35ff. The passage runs as follows;

Now *οἱ ὅροι* are not hypotheses. For nothing is said to be or not to be (*εἶναι ἢ μὴ*), whereas hypotheses are among the premises. But *οἱ ὅροι* one needs only to understand. And this is not an hypothesis,

unless one should argue that hearing is a sort of hypothesis. Hypotheses are rather premises such that, if they are the case, then by their being the case the conclusion comes about. . . Every postulate and hypothesis is either as universal or as particular, but οἱ ὅροι are neither of these. (76b35-77a4)

This passage creates other difficulties, for example, whether (B) the definition (ὁρισμός) in A2 and ὅρος in A10 are the same or different, and if they are different, what ὅρος stands for. Οἱ ὅροι in A10 has been translated as either “the definitions” (eg. Ross, p. 538, Zabarella, p. 799) or “terms” (eg. Barnes, p. 17, Fritz, p. 363). It seems that there is a consensus among commentators that Aristotle uses οἱ ὅροι to introduce the notion of a nominal definition in the sense of the account of what a name signifies. I take it that οἱ ὅροι are “definientia (predicate terms)” which express what a definiendum (name) signifies and as such they have significance, but do not assert anything which is true or false, universal or particular. Taken by itself, the function of “the definiens” is to arrest thought. Aristotle says “predicates (τὰ ῥήματα) in and by themselves are substantival and have significance, for he who uses such expressions arrests the hearer’s mind.” (*De Int.* 3 16b20-21) Thus the account (λόγος) which denotes the definiens is not yet an assertion nor judgement, until it is conjoined with a subject by means of the copula. For instance, the accounts relating to man ie. definientia such as “animal, two-footed” are not judgements and thus not truth-valued, unless they are conjoined with other constituents of a proposition; “man is a two-footed animal.” (cf. 16a13-18)

So far, there is no disagreement among the commentators. The issues relate to whether the definiens which is the nominal definition in A10 is the same as (B) the definition in A2 and what relation the hypotheses and the definitions in both chapters bear to each other. For example, B. Landor, after examining the main literatures on this issue, claims that the contrast in A2 is between hypotheses *qua* assumptions of existence and full definitions, whereas the contrast in A10 passage is between hypotheses *qua* propositions and *definientia*. (p. 313) That is, Landor gives a different interpretation to the hypotheses which feature in A2 and in A10. He ends up with the following combinations: (a’)+(b’) in A2, and (a)+(b) in A10.¹¹ This interpretation has an obvious disadvantage with regard to our understanding of the hypothesis in that it distinguishes (A) the hypothesis which is supposed to be a statement of the kind “X exists” from the hypothesis in A10 which

is supposed to be a proposition which acts as a premise of demonstration.

Commentators who take it that (A) the hypothesis is an existential proposition always cite the relevant passages in A1 71a11-17, A10 76a31-36 and B9 93b21-25. (e.g. Ross p. 504) And the first two passages are also cited in support of the view that (B) the definition in A2 is the nominal definition. However, the context of these three passages is not the same as that of our passage in A2. In the passage in A1, Aristotle is concerned with presenting two types of antecedent knowledge i.e. the existence and the meaning of a term to construct a demonstration. Aristotle says that "It is necessary to know in advance in two ways; of some things it is necessary to assume in advance the existence, and of some one must grasp the meaning... of the unit both the meaning and the existence." (71a11-16) (Concerning the passage in A10, see p. 47 in this Section and concerning the passage in B9, see Chapter 5 Section A) In these passages, Aristotle indeed talks about assuming the existence (*ᾧτι ἔσται*) of the primary terms of a science. But he is not concerned at all in these passages with the question of in what propositional form their existence must be expressed. (Concerning the use of the expression: *ᾧτι ἔσται*, see Chapter 4 Section A *Note*. (1)) Besides, in these three passages, Aristotle's discussion is concerned with the principles as [P2] the terms, whereas in the passage in A2 he is concerned with the principles as [P1] the propositions of [P2] these terms. Commentators have failed to see the difference of context between the passages in A2 and other chapters. Commentators have been misled by the fact that the same example i.e. the unit in arithmetic, is used in all four passages. Some commentators have thought that there are two kinds of hypothesis concerning the existence of the primary terms. Others have thought that the A2 passage must be read as concerned with the existential form of the proposition as well as the other three passages. This is because they have failed to see that in A2 Aristotle expresses the assumption of the existence of the primary terms such as unit in terms of the predicative form as the propositional principle called (A) the hypothesis. In other words, in the other three passages, Aristotle does not care how the existence of the primary term should be expressed, but is concerned with either what the items of antecedent knowledge in A1 are or what the items of assumption in A10 and B9 are.

I claim that (A) the hypothesis in A2 as well as (D) the hypothesis in A10 is to be understood as a premise of demonstration which is, needless to

say, a truth-valued proposition, though the hypothesis which is called “a thesis” is always an immediate non-demonstrable premise, unlike (D) the relative hypothesis. In other words, the description of the hypothesis in A10 covers both the absolute hypothesis and the relative one:

Hypotheses are premises such that, if they are the case, then by their being the case the conclusion comes about. (76b35-39)

I claim also that the difference between (A) the hypothesis and (B) the definition does not rest on whether a given immediate non-demonstrable syllogistic principle is a truth-valued proposition or a non-truth-valued sentence such as a nominal definition, but rather consists in the fact that (A) the hypothesis constitutes a premise of the ultimate demonstration of a science which concerns the non-demonstrable primaries, whereas (B) the definition, i. e. the definition which is introduced in A2, is not employed as a premise of a demonstration, but rather, is the proposition which makes clear the essence of the non-demonstrable primaries. In B10 Aristotle explains this as follows: “The definition of immediates is a non-demonstrable thesis of the essence.” (94a9-10) Thus I take it that in A2 Aristotle presents (A) the hypothesis as (a) and (B) the definition as (b’). In other words, while (A) the hypothesis is both existential in force and a syllogistic proposition in form, (B) the definition is both existential in force and an identity proposition in form. Now I will present some arguments for this claim.

First, we have to elucidate the description of (A) the hypothesis:

As regards thesis, the one which assumes either of the parts of a contradiction, i. e. either to be something or to be not something, I call hypothesis. (72a19-21)

I take it that what Aristotle has in mind is not the existential proposition, but a demonstrative premise either an affirmation or a negation. Just as there may be affirmative demonstration, which is in general composed of the first figure *Barbara*, there may also be negative demonstration. If an affirmative demonstration may express why some quality belongs to an object, so a negative demonstration may explain why some quality fails to belong to an object.⁽²⁾ Aristotle clearly explains what he means by the relevance of the phrase “either of the parts of a contradiction” in the context of a discussion of the demonstrative premise at the beginning of *Prior Analytics*

A1 in which syllogistic terms are defined; in A2 72a8-14 (the chapter under discussion) and in B3 90b33-91a6 in which definition and demonstration are contrasted in terms of predication. A "proposition" (*πρότασις*), whether it belongs to a demonstrative syllogism or a dialectical syllogism is an "account affirming or denying one thing of another" (*τινος κατὰ τινος*). (24a16-17) This may be universal, particular or indefinite. The demonstrative premise differs from the dialectical in that it is an "assumption of one part of the contradiction" (*λήψις θατέρου μέρους τῆς ἀντιφάσεως*), while the dialectical premise is a "questioning of the contradiction" in the sense that the dialectician argues for either half of the contradictory statement, for example, "justice is profitable" or "justice is not profitable". The dialectician is supposed to be able to argue about any problem which is presented to him by "reputable" propositions. (100a18-20) This is because the dialectician is the man who finds a reputable ground for either of the contradictory conclusions. That is why the dialectical premise is described as "assuming *indifferently* either part of the contradiction". (72a9-10) On the other hand, the demonstrative premise assumes "one part [of the contradiction] definitely to be true." (72a10-11)

Thus the phrase "one part of the contradiction" which is a component of both demonstrative and dialectical syllogisms must be identified with the predicative proposition rather than the existential proposition, given that it assumes either the affirmative or the negative part of the statement "A belongs to B, or not". Aristotle describes the predication in the form of one part of the contradiction with the phrase "one thing of one thing" (*ἐν καθ' ἐνός*). (72a8-9) I take it that a syllogistic proposition, whether it is a premise or a conclusion, is supposed not to be a statement of identity which comprises a definition, but "something of something" (*τι κατὰ τινος*) or "one thing of one thing". (83a20-23, 90b33-35) Aristotle contrasts the syllogistic predication with definitory predication as a sort of identity predication as follows:

Every demonstration proves something of something (*τι κατὰ τινος*); but in a definition one thing is not predicated of another (*οὐδὲν ἕτερον ἐτέρου*). (90b33-35)

In demonstrations, one assumes that this is of this (*τόδε κατὰ τοῦδε*), but not itself (*μὴ αὐτό*), and not something that has the same account and converts. (92a25-27)⁽⁹⁾

I have to leave the discussion of Aristotelian predication to Section D in this chapter, but I would like to make the following remarks with respect to the our present issue. I characterise the type of predications: “one thing of one thing” (ἐν καθ’ ἐνός), “something of something” (τι κατὰ τινος) and “this of this” (τόδε κατὰ τοῦδε) as “the underlying predication”. This is because these predications presuppose the ontological underlying of the predicates as its linguistic subject, given that the preposition κατὰ (of) is supposed to be followed by the underlying (ὑποκείμενον) in the genitive case in the case of natural predication. (83a18-23, cf. *Cat.* ch. 2-3, *Met.* 48, Z3) Aristotle distinguishes natural predication from unnatural predication in terms of whether the ontological underlying of its attributes occupies the place of the linguistic subject. For instance, “log” which is “the underlying” of its being white is supposed to be the subject of “white” and not vice versa. (83a6-7, 12, 17-18) Aristotle claims that any demonstration is based on natural predication. (83a20-22) The reason why this type of predication is non-identity or asymmetrical predication is that any predicate which is predicated of the underlying should not be identical with the underlying. This is because, insofar as the subject and its definitory predicate are convertible, both the subject and the predicate signify the same underlying thing so that the predicate part can be treated as the underlying as well. This violates the regulation of the demonstrative predication in which the underlying is supposed to be the subject of its attribute. That is, since the definitory predication involves two underlyings, given that the definiendum and the definiens are equivalent, one cannot express the definitory predication by the underlying predication which necessarily presupposes the one underlying with the preposition “of”. In other words, the definitory predication as an identity statement cannot be expressed by the underlying predication, given the definition of the underlying is as follows: “the underlying is that of which some other things (καθ’ οὗ τὰ ἄλλα) are predicated, while it is itself not predicated of anything else.”. Hence, any statement which involves the underlying is ruled out from the candidacy of being an identity statement. (*Met.* Z3 1028b36-37) We do not find any passage in which definition is supposed to involve the underlying.

In fact, on the basis of the predicability of the underlying, Aristotle draws a sharp distinction between essential predication as an identity statement and demonstrative predication. Aristotle says:

It is supposed that one thing is predicated of (*κατηγορεῖσθαι*) one thing (*ἐν καθ' ἑνός*), and that things which are not the essence (*τί ἐστι*) are not predicated of themselves (*αὐτὰ αὐτῶν*). For, .. we claim that all the attributes, (either *per se* attributes or accidentals), are predicated of some underlying (*καθ' ὑποκείμενον τινός*) and the attribute is not some underlying. (83b17-22)

The things which do not signify the essence (*οὐσίαν*) must be predicated of some underlying thing (*κατά τινος ὑποκείμενον*). (83a30-31)

Here the essential predication is treated as a sort of self predication between the identical definiendum and definies (*αὐτὰ αὐτῶν*), so that there is no room for the preposition: "of" (*κατά*) which presupposes the underlying. Given the demonstrative predication requires the underlying, this sort of identity statement is not employed as the premise or conclusion of the demonstration, but as the account which expresses the essence. (cf. B4) (I will discuss the non-demonstrability of essence in detail in the Appendix.) However a constitutive part of the essence can be cited in demonstration. For the essence (*τί ἐστιν*) is distinguished from "what is in the essence" (*ἐν τῷ τί ἐστιν*) or "what is predicated of the essence" (*τὰ ἐν τῷ τί ἐστι κατηγορούμενα*) and the latter comprises the underlying predication by means of which "demonstrations demonstrate". (83b20-23, 82b37, *Met.* Z17 1041a23) Therefore, we can conclude that the phrase "to be something or to be not something" (*τὸ εἶναι τι ἢ τὸ μὴ εἶναι τι*) is composed of the predication: "one thing of one thing", whether it is affirmative or negative, and thus is the predicative proposition which rules out the identity statement.⁽⁴⁾

Secondly, we have to decide what Aristotle is trying to convey by the phrase: "the other without this, I call definition", This is necessary if we are to make clear the difference between (A) the hypothesis and (B) the definition. An extreme view concerning this issue is provided by Hintikka's interpretation. According to Hintikka's view, hypotheses are different kinds of real definitions which can be used as scientific premises. Hintikka takes the contrast between hypotheses and definition in A2 to be between definitions which do have assertive force and definitions which do not have assertive force. ([1] p. 68) His main claim, then, is that "the different starting points [principles] of a science are as many kinds of definitions." (p. 56)⁽⁵⁾

On the contrary, I take it that (A) the hypothesis is not the definitional proposition. The underlying predication such as "one thing is predicated of

one" is not employed as a definition which manifests the identity between the definiendum and its essential elements. (cf. *De Anima*, I 6 430b26-29) When Aristotle says "the other without this, I call definition", "this" in "without this" stands for the whole of the previous phrases which describes the hypothesis: "either of the parts of the contradiction i. e. to be something or to be not something", that is, the premise of the demonstration, whether affirmative or negative. Therefore, it is natural to take it that the contrast between (A) the hypothesis and (B) the definition does not rest on whether the relevant proposition has existential import or not, nor on whether it is truth-valued or not, but rather on whether it is employed as the premise of a demonstration or not. Now I will set out to show that (B) the definition is both an identity statement and a truth-valued proposition.

Firstly, I will look at the passages in which (B) the definition appears so that we can see what kind of functions are played by this kind of definition. (B) The definition is cited as a type of definition in B10 as follows: "The definition of immediates is a non-demonstrable thesis of the essence." (94a9-10) This type of definition is called a "principle of demonstration". (75b31) He explains the function of (B) the definition thus:

The principles of demonstrations are definitions, and it has been proved earlier that there will not be demonstrations of these — either the principles will be demonstrable and there will be principles of the principles, and this will go on indefinitely, or non-demonstrable definitions will be of the primaries. (90b24-28)

Here Aristotle presents the following dilemma: either there will be an infinite regress of the chain of demonstrations, or there will be non-demonstrable definition of the primaries. This sentence makes it fairly clear what role (B) the definition plays in the system of Demonstrative Science. Since the non-demonstrable primaries here take the role of stopping the infinite regress of demonstrations just as they do in A2, there is no doubt that (B) the definition is identical with the identity statement concerning (2b) the non-demonstrable primaries: principles in each genus or the primary of the genus. This type of definition is an identity statement, because there is no other explanation or cause of the occurrence of the non-demonstrable primary.

The most suggestive point regarding the relation between the primary terms ($\tau\acute{\alpha}\ \pi\rho\acute{\omega}\tau\alpha$) and their derivatives ($\tau\acute{\alpha}\ \xi\kappa\ \tau\acute{o}\upsilon\tau\omega\upsilon$) is that they are treated

as if they are instances of the familiar Aristotelian dichotomy between substance and its attributes from *Metaphysics*. (B1 995b20, B2 997a20, a29) I take it that Aristotle describes the relation between the primary and its derivatives in Demonstrative Science as ontologically and linguistically parallel to the relation between substance and its attributes. The way in which Aristotle constructs his Demonstrative Science is based on the same ideas as those which govern the way in which he develops his argument on substance and its attributes in his *Metaphysics*. In fact, the subject matter of a science is characterised as “the underlying” (*ὑποκείμενον*) and its derivatives are “attributes” (*πάθη*) or “the *per se* attributes” (*τὰ καθ’ αὐτὰ συμβεβηκότα*). (75a42–b1, 76a12) Likewise, “the simples” which are equivalent to the primaries of a genus are treated as the unique “underlying” so that the attributes belong only to the simples *per se* (*τοῖς ἀπλοῖς καθ’ αὐτὰ ὑπάρχουσιν τὰ συμβαίνοντα μόνοις*) in the sense that it is necessary to refer to the simples in order to reveal the essence of the attributes. (96b15–25)

The ontological characteristics of “the underlying” which are presented in *Analytics* are exactly the same as we find in *Metaphysics*. “The underlying” which appears relatively seldom in *Posterior Analytics* is described in the discussion of *per se* predication [U2c] in A4, as follows;

What is not said of some other underlying subject, eg. substance ie. whatever signifies some *this* [like the form], is just what is without being something else (*οὐχ ἑτέρων τι ὄντα ἐστὶν ὅπερ ἐστίν*).” (73b5–8, cf. *Met.* 48 1017b23–26)

Here “the underlying” is characterised as “just what it is”, and this is accompanied by a phrase expressing its ontological independence or self subsistence: “without being something else”. As is suggested by the fact that the fourth type of *per se* predicate in *Metaphysics* 418 (i. e. “the thing of which there isn’t any other cause”) corresponds to [U2c], this type of *per se* being as “the underlying” is a characteristic only of “the thing whose cause is identical with itself”, like the primaries of a science. (418 1022a33, cf. B9) Aristotle says “since there cannot be anything prior to the first principle of all things, it is impossible that the principle is a principle by being something different (*ἑτέρον τι ὄντα*).” (*Met.* N1 1087a31–33) Therefore, this kind of entity is characterised only by the strict identity statement ie. “A is just what A is without being something else”. Since the primaries like unit don’t have any explanation prior to themselves, they can be defined

only by a statement of strict identity and without an appeal to its other constitutive elements which exist in the world as its causes, e.g. "Unit is what is quantitatively indivisible." or "Unit is a positionless substance." (72a22-23, 87a36, *Met.* A6 987b22-24, N1 1087a31-36) In this way the primaries of a science have the same ontological characteristics as independent or self-subsistent beings and are the ultimate cause of their attributes, in just the same way as the first substance which is the form, depicted in *Metaphysics*.

Hence, throughout his attempt to construct the structure of Demonstrative Science, Aristotle keeps in mind the fundamental ontological distinction between the things whose causes are identical with themselves and the things whose causes are different from themselves. (72b18-25, 77a5-7, 88a7-8, 90b24-27, 93a5-6, B9, 99b20-22) What is called the "principle of demonstration" is the definition which concerns the things whose causes are identical with themselves, and thus is the identity statement. Aristotle says "the principle of demonstration is not demonstration." (100b13) Thus the fact that Aristotle describes the definition as "the principle of demonstration" does not mean that it constitutes a particular premise of a demonstration. Rather this kind of definition takes the role of providing the foundation of demonstration, from which it follows that all other demonstrations are ultimately based on the identity statement ie. (B) the definition of the non-demonstrable primary which is the ontological ground of what derives from it and so stops any further regress of demonstration.

I take it that (B) the definition allows the non-demonstrative epistēmē about the non-demonstrable primary which stops the regress of demonstration. Aristotle says;

We say that neither is all epistēmē demonstrative, but epistēmē of the immediates is non-demonstrable — and that this is necessary is evident; for if it is necessary to know the things which are prior and on which the demonstration depends, and it comes to a stop at some time, it is necessary for these immediates to be non-demonstrable. So as to that we argue thus; and we also claim that there is not only [non-demonstrative] epistēmē, but also some source of epistēmē (ἀρχή ἐπιστήμης) by means of which we know the terms. (72b18-25, cf. 90b12-13)

He takes comprehension (νοῦς) which is the source of epistēmē (ἀρχή ἐπιστήμης) to be what is involved in grasping the non-demonstrable immediate

terms. (cf. 100a6-8) Aristotle clearly states here that there is not only a source of *epistēmē*, but also non-demonstrative *epistēmē* of the immediates. Unlike comprehension, every *epistēmē*, either demonstrative or non-demonstrative, is grasped by judgement with an account. (100b10, 88b36, *De Anima* Γ3 428a16-17) The immediate terms which are grasped by comprehension are brought within the scope of *epistēmē* by (B) the definition. We shall see in the next section that knowledge of the immediates (*γνώσις* or *ἐπιστήμη τῶν ἀμέσων*) in 72b19 and 99b22 is not identical with knowledge "through immediates" (*δι' ἀμέσων*). What concerns us in the present context is that Aristotle accepts that "epistēmē and comprehension are always true". (100b7-8) Although I will leave detailed discussion of the nature and role of comprehension to Chapter 6 on Induction, I would like to confirm, for the purposes of our present argument, that it possesses the characteristics which I outline below. Aristotle clearly states in *Nicomachean Ethics* that comprehension, which is always understood on the analogy of sense perception, grasps the primary terms (*ῥοοὺς*) which are unchangeable (*ἀκινήτων*), like health in medicine, unit in arithmetic and magnitude in geometry, without having any account (*λόγος*). (*Nic. Ethics* Z12 1143a35-b2, b5, Z11, 1143a4-5, cf. 100b12, b10, *De Anima* Γ6. 430b27-30) Furthermore, Aristotle clearly states in *Metaphysics* that comprehension grasps the incomposite or immaterial thing which is just what it is to be something and in actuality (*ὅπερ εἶναι τι καὶ ἐνεργείᾳ*) without suffering from falsity because it has no other function than either touching (*θιγέειν*) the object or not. (*Met.* Θ10 1051b22-26, cf. 100b7-8) In these remarks I find nothing inconsistent with what is said in the discussion of comprehension in *Posterior Analytics*. Therefore, we can conclude that (B) the definition which brings non-demonstrative *epistēmē*, based on comprehension, is a truth-valued statement, that is, an identity statement. Now we are in a position to illustrate the various functions of the principles in the process involved in the acquisition of a piece of demonstrative knowledge or *epistēmē simpliciter* as follows;

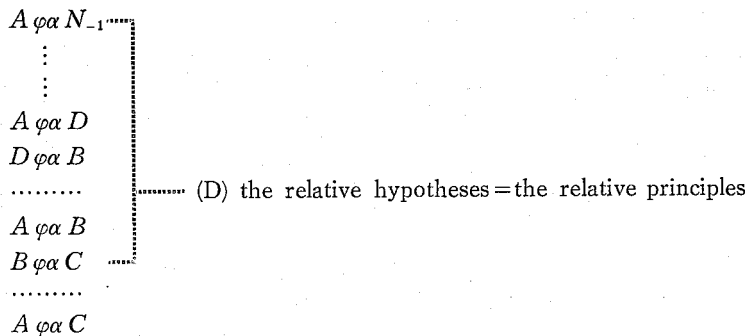
N = the essence of N : (B) the definition.

=

$A \varphi \alpha N$

$N \varphi \alpha N_{-1} \dots$ (A) the hypothesis.

.....



Now I conclude this Section by summing up how many principles are involved in Aristotle's enterprise of constructing Demonstrative Science. Aristotle is quite conscious of the distinction between (2b) the primary terms of a science which are the principles as terms and the principles as propositions about these primary terms of a science: (A) the hypothesis and (B) the definition. Aristotle also counts the premises from which a demonstrated conclusion immediately derives as (D) relative principles. (This shows that it is not the case, as Barnes claims, that Aristotle does not clearly distinguish between the ultimate principles and the relative principles.) Besides, Aristotle counts the axioms as principles as well. Thus, he has one principle as the term and four principles as the four types of proposition in mind. These principles are the main constituent of Aristotle's Demonstrative Science. Any particular science is constructed on these principles. In the next section I will discuss in more detail the content of both the ultimate principles and the relative principles from the perspective of non-demonstrability and immediacy. It seems that the relation between being immediate and non-demonstrable has not been yet made clear by Aristotle's commentators.

Notes.

(1). Cf. Ross has (a')+(b) in A2 and (a)+(b) in A10 (p. 55, p. 508), as does K. v. Fritz. (pp. 359-366) R. Robinson has (a)+(b) in A2 and (a)+(b) in A10. (pp. 101-102) S. Mansion has (a)+(b') in A2 and (a)+(b') in A10. (pp. 151-153) Barnes has (a+a')+(b') in A2 and (a)+(b) in A10. (p. 103 f, p. 137) Barnes' argument for taking (A) hypothesis as (a+a') and (B) definition as (b') in A2 is as follows; "72a19 appears to allow that any type of proposition may function as a supposition (cf. *E. E.* B10 1227a10; b28-32); and "that something is" is most readily glossed as "that something is the case". Then a definition

is a posit "without this" in that it does not suppose that anything is the case. In Book B Aristotle maintains that definitions entail existential propositions (cf. B7 92b4-11); but presumably they do not 'suppose', or directly assert, that anything is the case." (pp. 103-104)

(2). For instance, Aristotle gives the following example. (78b15-31) "Why don't walls breathe?" "Because walls are not animals. "The demonstration of this case can be given in accordance with the second figure *Camestres*.

Animals $\varphi\alpha$ things that breathe.

Animals $\varphi\epsilon$ walls.

Things that breathe $\varphi\epsilon$ walls.

(3). Similarly, in *Metaphysics* too, Aristotle distinguishes the identity statement from the predication "something of something". Aristotle says "We can inquire, why man is such and such a kind of animal. This, then, is plain, that we are not asking why he who is a man is a man. Therefore the question is: given something of something ($\tau\acute{\iota}$ $\kappa\alpha\tau\alpha$ $\tau\iota\upsilon\omicron\varsigma$), why does it belong?.. In this way the object of inquiry is something of something else ($\delta\lambda\lambda\omicron$ $\kappa\alpha\theta'$ $\delta\lambda\lambda\omicron\upsilon$)." (Z17 1041a20-26, cf. *De Anima* I'6 430b26-b31)

(4). In A2 passage, there are two expressions about (A) the hypothesis: " $\tau\delta$ $\epsilon\acute{\iota}\nu\alpha\iota$ $\tau\iota$ " (72a20) and " $\tau\delta$ $\epsilon\acute{\iota}\nu\alpha\iota$ $\mu\omicron\nu\acute{\alpha}\delta\alpha$ " (72a23-24) The issue is how we construe $\epsilon\acute{\iota}\nu\alpha\iota$ as it occurs in these expressions. A. Gómez-Lobo argues, appealing to C. Kahn's claim that a syntactically absolute occurrence of $\epsilon\acute{\iota}\nu\alpha\iota$ does not *eo ipso* guarantee that we are dealing with a case of the existential use of the verb, that these expressions are elliptical, in the sense that they have been reached by dropping certain terms from hypotheses which are actually in use. (A. Gómez-Lobo, [1] p. 433, cf. C. Kahn, [2] p. 263) Then Gómez-Lobo conjectures that the expression should be understood as " $\tau\delta$ $\epsilon\acute{\iota}\nu\alpha\iota$ ($\tau\omicron\delta\delta\iota$) $\tau\iota$ " and $\tau\delta$ $\epsilon\acute{\iota}\nu\alpha\iota$ ($\tau\omicron\delta\delta\iota$) $\mu\omicron\nu\acute{\alpha}\delta\alpha$ ". He says "both $\tau\iota$ and $\mu\omicron\nu\acute{\alpha}\delta\alpha$ in Aristotle's examples should be taken as predicates and not as subject terms." (p. 435) I agree with Lobo that these expressions are elliptical on the ground that a hypothesis is to be identified with a predication: "one thing of one [other] thing", though I take it that $\tau\iota$ and $\mu\omicron\nu\acute{\alpha}\delta\alpha$ need not be interpreted as qualifying the predicates.

(5). Hintikka quotes 90b24 and 99a22-23 in support of his view that the premises of scientific syllogisms are definitions. He translates 90b24: " $\alpha\acute{\iota}$ $\delta\rho\chi\alpha\iota$ $\tau\hat{\omega}\nu$ $\alpha\pi\omicron\delta\epsilon\lambda\epsilon\gamma\omega\nu$ $\delta\rho\iota\sigma\mu\omicron\iota$ " as follows: "the basic premises of demonstrations are definitions." ([1] p. 58). Thus he takes it for granted that the expression " $\alpha\acute{\iota}$ $\delta\rho\chi\alpha\iota$ " means "the premises" without giving any argument. It is not at all clear that all principles ($\alpha\acute{\iota}$ $\delta\rho\chi\alpha\iota$) are definitions, nor that "a principle of demonstration" is a premise of demonstration. As we have seen before, [P2] the primary terms of a science are called principles as

well. (76a31-36, 96b21-23) Hintikka needs to give an argument for this interpretation if he is to avoid begging the question.

With regard 99a22-23, both his translation: ("all sciences are based upon definitions") and his interpretation are misleading. Aristotle says there "The middle term is an account of the first extreme, therefore all pieces of knowledge come about through definition. (διὸ πᾶσαι αἱ ἐπιστῆμαι δι' ὁρισμοῦ γίγνονται)". The antecedent suggests that the definition here is the one which is described as "revealing the reason why" (ὁ δηλῶν διὰ τὸ ἔστιν) in B10. Aristotle describes this type of definition as "a sort of demonstration of the essence, differing in position from the demonstration." (94a2-3) For instance, if one answers the question "why does thunder occur? [Why does the noise occur in the clouds?]" by saying that "Because the fire is extinguished in the clouds", one gives the middle term which reveals why the major term [the noise] belongs to the minor term [the clouds]. But if one answers the question "What is thunder?" by employing the same account in the previous explanation that "A noise of fire being extinguished in the clouds", one gives the "definition". (94a4-7) In this way, grasping the middle term which accounts for the major term implies grasping its definition. (eg. 93b6, b12, 99a3-4) Therefore, it will be true of every piece of knowledge which is acquired *via* a particular demonstration whose middle term reveals the essence on the major term that "all pieces of knowledge come about through definition".

Hintikka's interpretation is wrong in that he focuses on the consequent of the sentence, while ignoring the context, in which Aristotle is talking about the middle term's being the account of the major term, and then claims that all particular definitions are employed as premises. Aristotle clearly said in B10 that this type of definition "differs in position from demonstration", on the supposition that "the same account is expressed in a different way." Thus, it is clear that the definition in 99a22-23 is not employed as a premise in a demonstration. By now it should be fair to say that I have undermined the alleged textual support cited by some commentators to back up the claim that hypotheses which comprise one type of "immediate syllogistic principle" are also one type of definition used as premises of demonstration. (cf. Landor, p. 309 f)

C. Immediate Premise, Immediate Term and Non-Demonstrability

The claims I have made in the previous sections are unusual ones. I have claimed that (A) the hypothesis in A2 plays the role of the ultimate principle, on which a demonstrated conclusion ultimately depends and that only this type of hypothesis has the property of non-demonstrability. In other words, in the system of Aristotelian Demonstrative Science, non-

demonstrability is a characteristic only of (2) the primary, which is called "the primary of the genus" or "principles in each genus". This is in sharp contrast with traditional interpretations, which take "immediacy" and "non-demonstrability" to be identical notions. However, this is only because commentators have not distinguished, firstly, the immediate term from the immediate premise and, secondly, the immediate premise which is made up of demonstrable terms, from the immediate premise which is made up of non-demonstrable terms. In this section, I will show that Aristotle clearly has these distinctions in mind. Firstly, I will discuss some etymological and grammatical issues relating to "immediacy". I will then examine various passages in which the immediate plays an essential role, so that we can sort out its two roles as term and as proposition.

The word " $\tau\omicron\ \acute{\alpha}\mu\epsilon\sigma\omicron\nu$ " is made up of the negative prefix $\acute{\alpha}$ - "without" and an expression which signifies $\tau\omicron\ \mu\acute{\epsilon}\sigma\omicron\nu$ "the middle term". The middle term is employed in *Prior Analytics* as a bit of syllogistic terminology which is originally derived from the Pythagorean theory of proportion.⁽¹⁾ The word "the middle term" ($\tau\omicron\ \mu\acute{\epsilon}\sigma\omicron\nu$) seems to have been introduced in connection with Aristotle's invention of the three syllogistic figures. This has to do with how Aristotle invents the syllogistic figures. In other words, Aristotle's use of this terminology explains why he states that there are only three figures, and why he systematically develops only these figures (41a13-18), in spite of the fact that he was aware of the content of the fourth figure. (29a19, 27, 53a9-14) Aristotle seems to construct three figures on the basis of the three positions which the middle term is able to take in the linear diagram which connects the three terms. Aristotle extracts fourteen valid moods set out in three figures from the pattern of necessary connections which may hold between the two premises and the conclusion. This is done on the basis of the ways in which the letters (i. e. the variables) may be formally combined in a linear pattern. The linear diagram may actually be seen in Aristotle's writings, when he attempts to prove the invalidity of a given mood by giving counter-examples. The invalidity of a particular mood is proved by supplying concrete examples which are set out in a linear pattern. For instance, as an example of a universal affirmative relation between extremes, we are given the linear pattern: "animal.....man.....horse" (AEA), while as an example of a universal negative relation, the terms are ordered in the following way: "animal.....man.....stone" (AEE). (26a3-9) (Hence, the pair of premises in ques-

tion does not yield a conclusion.)

The view that Aristotle constructs three figures according to the order of the terms in these linear diagrams seems to be confirmed by his description of the position of the middle term. Aristotle defines the middle term in the first figure as follows: "I call middle the term which is itself contained in another and contains another in itself, and in position also it comes in the middle (ὁ καὶ τῇ θέσει γίνεται μέσος)." (25b35-36) In the second figure, the middle term is supposed to be placed "in the first position". (26b39) In the third figure, the middle term is placed "in the last position". (28b15) Now there are only three ways in which the middle term can be ordered with respect to the two extremes, given that the major term must always precede the minor term. (cf. W. Kneale pp. 68-72)

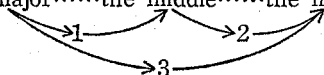
The first figure: the major.....the middle.....the minor.

The second figure: the middle.....the major.....the minor.

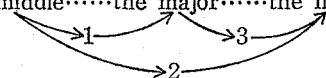
The third figure: the major.....the minor.....the middle.

Here the proposition, which is nothing but the interval (διάστημα) of two terms, is tied together in a uniform way such that the term which precedes the another term, in the sense of being placed on the left hand side belongs to (ὑπάρχειν τῷ) or is predicated of (καταγορεύσθαι τοῦ) it. Thus we will acquire the following pattern of predication.

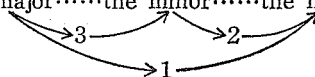
The first figure: the major.....the middle.....the minor



The second figure: the middle.....the major.....the minor



The third figure: the major.....the minor.....the middle



In this way, Aristotle derives his account of the syllogistic figures from the linear diagrams, and he discovers which moods are valid by determining the quantity — quality (so-called AEIO) of each term. The terms "the major", "the middle" and "the minor" signify differences in the extension of the terms. But the extensions of these three terms are fixed in relation to each other only in the case of the first figure. On the other hand, these

three terms are sometimes called "the first" (πρῶτον), "the middle" (μέσον) and "the last" (ἔσχατον) or "the third" (τρίτον). These two sets of terminology suggest that it is from the first figure that the terms derive their names. The second set of names fits in rather more with the linear diagram. In fact, Aristotle employs the second set without giving any explanation of the three terms when he introduces the three terms in A4. (25b32-34) Although in general Aristotle does not distinguish the two terminologies and treats them as equivalent in *Prior Analytics*, this fact suggests that Aristotle understands the figures basically in terms of the linear diagram as he does the second terminology. In either case, the middle term is treated as if it were literally in the middle. This seems to be the way in which the word "the middle term" was coined. As far as the middle term is employed as the logical i.e. formal term connecting two extreme terms, Aristotle does not charge it with any epistemological explanatory power.

The immediate (ἄμεσος, ἄμεσον) is referred to using expressions which may be either feminine or neuter in gender. It denotes a proposition when with the feminine article (ἡ ἄμεσος πρότασις). (e.g. 88b37, 84b22, 86b31, 88b20) When it is used with the neuter article or when it is used predicatively in the neuter, it denotes either a term (τὸ ἄμεσον: e.g. 86a15, 84b36, 94a9, 95b15) or the immediate interval (τὸ διάστημα ἄμεσον; e.g. 84a35, 84b14) i.e. the immediate proposition. Hence we cannot distinguish the immediate as a proposition from the immediate as a term just by appealing to its gender. But there is no difficulty in distinguishing an immediate term from an immediate interval according to the contexts. In fact, I take it that the neuter use of the immediate as the immediate interval is found only in the two places stated above.

One notable feature of the immediate term (τὸ ἄμεσον) is that there is no room for it to play a role in Aristotle's theory of syllogistic. This is because the literal meaning of τὸ ἄμεσον, which, would be "the term which lacks a middle term" is nonsensical, insofar as its logical role is concerned. When Aristotle is employing the syllogism as the vehicle of demonstrative knowledge in *Posterior Analytics*, the middle term is identified with the cause or the explanation. (e.g. 90a6-7) Thus τὸ ἄμεσον which is employed only in this context, i.e. in the context of Demonstrative Theory, means "the term which lacks an explanation or cause distinguished from itself" and is thus a self explanatory term. (cf. 93b22) On the other hand, the literal meaning of ἡ ἄμεσος πρότασις would be "a proposition/premise which

is composed of a subject and a predicate which are directly related without having any mediating term". (cf. 84a29, 84b22-23) That is why ἡ ἄμεσος πρότασις is sometimes replaced by "the immediate interval". (eg. 84a35) There is a conspicuous difference between the immediate term and the immediate proposition. In the case of ἡ ἄμεσος πρότασις which lacks an explanatory term, this does not necessarily mean that this proposition contains the immediate term (τὸ ἄμεσον) as either subject or predicate. It just means that it lacks a binding term which connects the subject and the predicate, no matter what the extremes are. The notion of an immediate proposition (premise) as such does not imply that there is no prior causal term which explains either of the two extremes. It leaves open the possibility that there is a prior term for either of the two extreme terms which comprise the immediate proposition (premise). On the other hand, in the case of the immediate term, there is no prior causal term apart from itself. (But it is not necessary for all propositions, involving immediate terms, to be immediate propositions.)

A2 contains a passage, dealing with the immediate proposition which has a bearing on this issue. In this passage, Aristotle describes a sort of principle: "A principle is an immediate proposition of demonstration, [i. e. in the sense of] an immediate proposition to which there is no other prior proposition. (ἀρχὴ δ' ἐστὶν ἀποδείξεως πρότασις ἄμεσος, ἄμεσος δὲ ἥς μὴ ἐστὶν ἄλλη προτέρα.)" (72a7-8) I take it that the latter half of this sentence is added, not to define *the* immediate proposition in general, but to qualify or describe the ultimate principle i. e. (A) the hypothesis which is a type of immediate proposition. We can confirm this claim by appealing to the context in which this sentence is found:

What is based on appropriate principles is based on primaries. For I call the same thing primary and a principle. A principle is an immediate proposition of demonstration, [i. e. in the sense of] an immediate proposition to which there is no other prior proposition. (72a5-8)

Here, what Aristotle means by "a principle" is the ultimate principle of a science. This is because this type of principle involves (2) the primary term of a science, which is the basic constituent of the appropriate principles. (cf. 71b23, Chapter 2 Section A) Thus this sentence deals with (2b) the non-demonstrable primary which stops the regress of demonstrations. That is why this type of immediate proposition is described as that "to which

there is *no other prior* proposition" which is nothing but the primary premise of a science. We should recall here that (A) the hypothesis is a thesis which is described as "an immediate non-demonstrable syllogistic principle" (72a14-15) Now I will argue that (2b) the primary terms of which there are (A) the hypothesis and (B) the definition are regarded as non-demonstrable by Aristotle.

Firstly, there is a passage in which Aristotle clearly states that in the chains of immediate premises/propositions, only some principles are non-demonstrable. The passage runs as follows;

It is evident that when *A* belongs to *B*, then if there is some middle term, it is possible to prove that *A* belongs to *B*, and the elements (στοιχεῖα) of this are as many as the middle terms (μέσα). For the immediate premises (αὐτὰς ἀμεσοὺς προτάσεις) are the elements, either all of them or the universal ones; but if there is no middle term [between *A* and *B*], there is no longer a demonstration, but this is the path to the principles. . . And there are as many elements as terms; for the premises containing these are principles of the demonstration (ἀρχαὶ τῆς ἀποδείξεως). And just as there are some non-demonstrable principles (ἔναι ἀρχαὶ εἰσὶν ἀναπόδεικτοι) to the effect that this is this (τόδε τοδὶ) and this belongs to this (ὑπάρχει τόδε τοδὶ), so too <there are some non-demonstrable principles> to the effect that this is not this and this does not belong to this. (84b19-30)

There is no contradiction in this paragraph between the chains of immediate premises and the plural number of the middle term. For Aristotle here regards the middle terms not as the middle terms of the succeeding propositions in the chain of demonstrations but as the middle terms of the initial proposition *A φαν B* of which there can be *epistēmē*. (cf. 41b39-40) The middle terms are considered as the constitutive elements (στοιχεῖα) of two terms *A* and *B* which are such that either *A* belongs to *B* or *A* does not belong to *B*; if there is anything which explains the fact that *A* belongs to *B* or *A* does not belong to *B* and which may be directly predicated of and may be directly predicate of *A* or *B* or one of their constitutive elements, without the involvement of any intermediate term between itself and another term, it constitutes an immediate premise.

This has an important connection with his description of *epistēmē simpliciter* in A2. This passage confirms that demonstrative knowledge as ES

is concerned with one particular thing/event (ἐκαστον) which is expressed as the conclusion (71b9, 71b22) and that in order to have knowledge *par excellence* of an event/thing, one has to exhaust all its elements, including the non-demonstrable primaries, which constitute the immediate premises which are regarded as “principles (starting points) of the demonstration” (ἀρχαὶ τῆς ἀποδείξεως). (84b27–28)⁽²⁾ Aristotle says;

So if one can know something through demonstration *simpliciter*, and not in a way which is dependent on something, nor on a hypothesis, it is necessary for the predication in between to come to a stop. (83b 38–84a1)

And the finite sequence of predication which come about between two terms *A* and *B* are supposed to be immediate ones (αὶ ἄμεσοι προτάσεις). (84b22) The finite chain of immediate premises which gives rise to knowledge through demonstration can be illustrated as follows: (Suppose *A φα B* (84b19) and that the terms *C–I* are the middle terms (μέσα) or the elements (στοιχεῖα) of *A φα B*. (84b21) The symbol +++ shows an immediate predication between two terms such as *A* and *C*, *C* and *D*. (84b22) *I=I* indicates that the definition of *I* which is the primary term of a science yields an identity statement. (84b29))

A
 ∴ +
 ∴ +
 ∴ +C+++D+++E+++F+++G+++H+++I=*I*.
 ∴
 ∴
 ∴
B

In this case, the chain of the demonstrations of *A φα B* will be as follows; *αφα* stands for an immediate universal affirmative premise.

A φα I
I αφα H

A φα H
 ∴
 ∴

$A \varphi \alpha D$

$D \alpha \varphi \alpha C$

.....

$A \alpha \varphi \alpha C$

$C \varphi \alpha B$

.....

$A \varphi \alpha B$

These immediate premises are regarded as “principles of the demonstration”. But among these immediate principles, only “some principles (*ἐνταὶ ἀρχαί*) are non-demonstrable (*ἀναπόδεικτοι*).” (84b28)⁽³⁾ In this case, $I \alpha \varphi \alpha H$ is the non-demonstrable principle: (A) the hypothesis. Because this premise does not have any other premise prior to it. (cf. 72a7–8) When Aristotle presents two types of non-demonstrable principles: “this is this” and “this belongs to this” in 84b29, they seem to correspond to (B) the definition and (A) the hypothesis respectively.

Then Aristotle explains the method by which one continues the chain of demonstrations. The passage runs as follows;

When one has to prove a proposition [$A \varphi \alpha B$], one should assume what is primarily (*πρῶτον*) predicated of B . Let it be C ; and let D ⁽⁴⁾ <be predicated> similarly (*ὁμοίως*) of this. And if he always proceeds in this way no proposition and nothing belonging outside A will ever be assumed in the proof, but the middle term will always be thickened, until it [the middle term] becomes indivisible (*ἀδιαίρετα*) and single (*ἓν*). It is single, when the middle term becomes immediate (*ἄμεσον*); and the immediate premise *simpliciter* is a single proposition (*μία πρότασις ἀπλῶς ἄμεσος*). And just as in other cases the principle is simple, though it is not the same everywhere — but in weight it is the ounce, in song the semitone, and in other cases other things — so in syllogism there is the single immediate proposition and in demonstration and knowledge, there is comprehension. (84b31–85a1)

There are several important points in this passage. Firstly, the expression “nothing belonging outside A ” indicates that A (the major term) continues through until the end of the chain of demonstrations. (See $A \varphi \alpha I$ in the diagram above.) In other words, what one aims to grasp by “thickening” the middle terms between A and B is knowledge concerning A , which is

predicated of *B*. Secondly, Aristotle makes clear the characteristics of the immediate term. One is supposed to “thicken” the middle terms until one reaches the immediate term. There is no doubt that the immediate term has the role of stopping the regress of demonstrations. For the immediate term as such is an indivisible (*ἀδιαιρέτα*), single (*ἓν*) and simple principle (*ἡ ἀρχὴ ἀπλοῦν*). This type of being is not the object of demonstrative *epistēmē* but of comprehension. Its paradigm examples are the ounce in weight and the semitone in song. Therefore it is natural to take it that the expression “the immediate term” is confined to (2) the primary of the genus which ultimately secures the causality and necessity of the object of *epistēmē*. In other words, “the immediate term” is equivalent to the non-demonstrable primary. Thirdly, the immediate premise which includes the primary is described as the “immediate premise *simpliciter*” and is differentiated from other immediate premises which have prior premises, in the sense of being composed of demonstrable terms. Aristotle describes this immediate premise *simpliciter* in another passage as follows: “If someone might say that it is the primary immediate premises (*τὰς πρώτας ἀμέσους*) that are principles, then [we reply that] there is one (*ἓν*) such peculiar to each genus.” (88b20–21)

Now we need to investigate whether the expression “the immediate term” is employed in other passages to denote the indivisible, single and simple principle which is nothing but (2) the non-demonstrable primary. Firstly, I will examine the passages where Aristotle discusses the immediate premise as the premise proximate to a conclusion. Aristotle states at four places that the demonstration “through immediates” (*δι’ ἀμέσων*) makes known “the reason why” (*τὸ διότι*) of the demonstrandum as well as its fact. (A6 75a12–17, A13 78a22–28, A33 89a16–22, B8 93a35–36) We cannot know from this phrases by itself in which gender *ἀμέσων* is being used for this genitive plural ending is shared by both feminine and neuter genders. As to its number, the immediate is referred to in the plural. This is because when he describes the demonstration “through immediates” (*δι’ ἀμέσων*) as the vehicle of knowledge of “the reason why” in the four passages mentioned above, Aristotle describes it in general terms, without having any particular case in mind.

Now I will argue that what Aristotle means by the phrase: “through immediates” (*δι’ ἀμέσων*) which is found in the four passages mentioned above, is not “the immediate terms” but “the immediate premises”. When

Aristotle compares two sorts of demonstration "through immediates" (*δι' ἀμέσων*) in A13, the nature of the comparison makes clear that "immediates" in "through immediates" refers not to terms but to premises. Aristotle says:

Knowing the fact and the reason why differ, first in the same science [unlike in optics and geometry], and that in two ways: in one fashion, if the syllogism does not come through immediates (*δι' ἀμέσων*) (for the primary cause is not assumed, but knowledge of the reason why occurs in virtue of the primary cause.); in another, if it is through immediates (*δι' ἀμέσων*) but not through the cause but through the more known [to us] of the converting terms. (78a22-28)

The point here is that there are two sorts of knowledge according to whether one grasps the primary cause or not. More precisely, the syllogism of the reason why is distinguished from the syllogism of the fact according to the way in which the primary cause is grasped, given that the primary cause and its effect are convertible. It is one thing to grasp the cause *in fact* and another thing to grasp the cause *as* the cause. Aristotle describes the difference between grasping something *as* and grasping something *in fact* as corresponding to the difference between "knowing the reason why" (*τὸ διότι ἐπίστασθαι*) and "knowing the fact" (*τὸ ὅτι ἐπίστασθαι*). (78a22-23) (1*) "knowing the reason why" is identical with "knowing through the cause". (75a35, 98b20) If so, it will be natural to understand (2*) "knowing the fact" as "knowing through the fact". A syllogism which conveys (1*) is called (S1) "the syllogism of the reason why" (78a36-37), whereas a syllogism which conveys (2*) is called (S2) "the syllogism of the fact". (78a36, 78b32) (S2) must meet three conditions;

- (a) It must be through an immediate proposition.
- (b) It must not be through the cause.
- (c) It must be through that one of the convertible terms which is more familiar to us.

On the other hand, a proper syllogism like (S1) must meet condition:

- (b') It must be through the cause as well as (a).

The combination of conditions (a) and (b') makes clear the primary cause in the sense of the proximate cause for a thing/event. Aristotle says "To know,

the reason why occurs in virtue of the primary cause.” (78a25-26) The cause in (S1) which occurs in the position of the middle term must be prior and better known in nature than the conclusion. (cf. 71b21-22, Chapter 2, Section A) In the case of (S2), since one does not grasp the cause as the cause by putting it in the premises in the correct way, even if one may in fact know the cause, one cannot claim that one has a syllogism of the reason why and thus knows why this phenomenon occurs. The arrangement of terms in (S1) and (S2) are as follows; (eg. not-twinkling: (S1) A . (S2) B . being near: (S1) B , (S2) A , the planets: (S1) and (S2) Γ .)

- (S1) Not-twinkling $\alpha\varphi\alpha$ being near.
 Being near $\varphi\alpha$ the planets.
 Not-twinkling $\varphi\alpha$ the planets. (78a39-b3)
- (S2) Being near $\alpha\varphi\alpha$ not-twinkling.
 Not-twinkling $\varphi\alpha$ the planets.
 Being near $\varphi\alpha$ the planets. (78a30-32)

The difference between (S1) and (S2) is not simply the way in which these three terms are arranged. The difference is that in the case of (S2), the demonstrator does not grasp “being near” as the cause of the “not-twinkling” of “the planets”, whereas in the case of (S1), he demonstrates the conclusion through the cause so that he knows the reason why the planets do not twinkle. The difference can be seen in Aristotle’s remark that in the case of (S2):

Let this (Being near is predicated of not-twinkling.) be got through induction or through perception. (78a34-35)

There is no doubt that (S2) is not an inductive syllogism, but a sort of demonstration in *Barbara*. But the fact that Aristotle does not make this remark with respect to (S1) shows that (S2) is yielded in such a way as being more familiar and more prior to our sense-perception than (S1). In (S2) the grasp of the phenomenon is not, as it were, polished up enough to fit into the explanatory structure of Demonstrative Science. In (S1), the premise is obtained not simply through perception or induction but also by meeting the other condition: (b’) which establishes something as the primary cause.⁽⁹⁾

In both cases, the syllogisms are formulated “through immediates” ($\delta\epsilon'$ $\alpha\mu\epsilon\sigma\omega\nu$). (78a24-30, 78a39-78b4) Nevertheless, the syllogism (S2) fails to

grasp the reason why. In (S1), the term "being near" is the middle term, whereas in (S2) the term "not-twinkling" is treated as the middle term. Although both major premises include the primary cause "being near", in (S2) the term "being near" is not grasped as the cause of the planets' not-twinkling. Aristotle describes this syllogism as "through immediates but not through the cause" (*διὰ τοῦ αὐτίου*). (78a26-28) This shows that "immediates" in the "through immediates" refers not to the immediate terms which are the causes but to the immediate premises. In other words, if the expression means "immediate terms" and if the immediate term is not the cause, the syllogism which is not through the cause would not be called the syllogism "through immediates", because grasping "the primary cause" is a sufficient condition for the syllogism "through immediates". (78a24-26) Apart from this particular passage, there are three more passages in which the phrase "through immediates" is taken to convey the reason why, in that it is taken for granted that the cause is in the position of the middle term in the syllogism.

Aristotle describes the middle term which produces the syllogism of the reason why as "the primary cause" or "the necessary middle term" or "the account of the major term". (78a25, 75a13, 93b6) We cannot find any passage where this kind of middle term is replaced by the immediate term. Instead, we find in many passages that the middle term is identified with the reason why or the cause which is made clear by the syllogism through immediate premises. (89a16, 89b14-15, 90a6-7, 94a20-23) For instance, when Aristotle says "Since we think we know, when we know the cause, and there are four causes, .. all these four causes are proved through the middle term (*διὰ τοῦ μέσου*).", the phrase "through the middle term" is concerned with the same kind of explanatory power as the phrase "through immediate premises", given that both phrases refer to what makes clear the cause and the reason why. (94a20-24) Furthermore, we find some passages in which the middle term(s) is contrasted with the immediate term(s) which is referred to in the neuter gender. For instance, the things which are immediate terms and principles (*ἄμεσα καὶ ἀρχαί*) are sharply contrasted with things which have a middle term (*τῶν δ' ἐχόντων μέσον*) with regard to their causes. The former is self-explanatory, whereas the latter is different from its cause. (93b21-28, cf. 88b14) Hence, I take it that the immediate proposition implies the immediate term only in the case of (A) the hypothesis and (B) the definition. This view will be confirmed in what follows.

In the other three passages in which the phrase “through immediate [premises]” ($\delta\epsilon'$ $\acute{\alpha}\mu\acute{\epsilon}\sigma\omega\nu$) is found, Aristotle contrasts the syllogism “through immediate premises” with the syllogism “through middle terms” ($\delta\iota\alpha$ $\tau\acute{\omega}\nu$ $\mu\acute{\epsilon}\sigma\omega\nu$)⁽⁶⁾ in the A6 passage, and with the syllogism “not through immediate premises” ($\mu\eta$ $\delta\iota\alpha$ $(\tau\acute{\omega}\nu)$ $\acute{\alpha}\mu\acute{\epsilon}\sigma\omega\nu$) in the A33 and B8 passages. While the former syllogism produces knowledge of the reason why as well as of the fact, the latter syllogism does not produce knowledge of the reason why but only knowledge of that fact. (75a16–17, 89a15–23, 93a35–37)

Aristotle gives an example of both (S3) the syllogism “not through immediate premises” and of (S4) the syllogism “through immediate premises”. Aristotle says “When we discover the cause, we know at the same time the fact and the reason why, [(S4)] if it is through immediates; [(S3)] if not, we know the fact but not the reason why.” (93a35–37) The example of the syllogism (S3) runs as follows;

(S3) Eclipse $\varphi\alpha$ inability to cast shadow at full moon with nothing obvious in between.

Inability to cast shadow at full moon with nothing obvious in between $\varphi\alpha$ the moon.

Eclipse $\varphi\alpha$ the moon. (93a37–93b3)

The example of the syllogism (S4) runs as follows:

(S4) Eclipse $\alpha\varphi\alpha$ screening of the earth.

Screening of the earth $\varphi\alpha$ the moon.

Eclipse $\varphi\alpha$ the moon. (93a30–36)

From the syllogism (S3), it is clear *that* the moon is eclipsed but not yet *why*. (93b2–3) This is because the middle term: “inability to cast shadow..” does not manifest the primary cause of the eclipse. Not only are the terms “eclipse” and “inability to cast shadow” demonstrable in the sense that they have prior terms which explain their existences, but also the major premise, which is composed of these two terms has a prior premise, which grasps the primary cause of the fact that eclipse belongs to the moon. The prior premise is “Eclipse belongs to the screening of the earth.” in (S4). Since the middle term: “screening of the earth” manifests the primary cause of eclipse, this premise is regarded as an immediate one. However, according to the view which I have expounded so far, it is not necessary that the immediate premise implies the immediate term. I take it that “screening

of the earth" is neither an immediate nor a non-demonstrable term. It is important to confirm here that in spite of Aristotle's claim that "the demonstration is a probative syllogism of a cause and the reason why." (85b23-24), the syllogism of the reason why as such does not produce *epistēmē simpliciter*, but only knowledge (*εἰδέναι*) or at most *epistēmē*. (cf. 93a4, 93a36, 78a22, 94a20-24) In the passages where it is the reason why which is at issue, Aristotle never employs the expression "*epistēmē simpliciter*", which necessarily involves knowledge of the non-demonstrable primary. So far I have argued that the "immediates" in the phrase: "through immediates" stands for the immediate premises. The characteristic of the immediate premises is to grasp the primary cause and the reason why of a thing/event, given that the cause is grasped as the middle term. Then it is fair to say that the immediate premise which grasps the primary cause is the ideal relative principle, given that it makes clear the reason why of a thing/event.

Now it seems that what we have manufactured so far has a by-product, but it is a very important one. "Immediates" are sometimes accompanied by the preposition "from" (*ἐκ*) and at other times accompanied by the preposition "through" (*διὰ*). Aristotle seems to be quite aware of how these prepositions should be employed. When "through" is used, he is looking at the proof from our own perspective or the relative perspective, from the point of view of the conclusion, whereas "from" is used, when he is looking at the proof from the natural perspective or the absolute perspective, from the point of view of the principles.

The one striking thing is that the expression "the principle(s)" is never preceded by the preposition "through" (*διὰ ἀρχῆς(ων)*), but always by "from" (*ἐκ ἀρχῆς(ων)*). This is because "the principle(s)" is always stated from the absolute perspective as being self-subsistent. In general, when he looks at demonstration from the point of view of the expression "the principles", he has the ultimate principles in mind; and that he is also thinking of the relative principle which is a proximate premise for the conclusion is implied by the fact that the expression "the principles" is in the plural. (e.g. 72a6, 74b5-6, 76a27) On the other hand, "the middle term(s)" is never preceded by the preposition "from", but always by "through", because the middle term(s) is considered from the relative perspective so that the middle term always presupposes the two extreme terms which constitute the conclusion. (eg. 75a12, 17, 80b18, 81b17, 86a14, 94a23) In this way, there is a regularity lying behind Aristotle's use of the prepositions "from" and "through". Thus

it is not the case, as Brunschwig complains that “Il paraît malheureusement difficile de différencier clairement l’usage de *διὰ* et celui de *ἐκ* dans les textes logiques d’Aristote.” (p. 77 n. 39)⁷⁷ One important implication of the distinction between the preposition *διὰ* and *ἐκ* is that by employing *διὰ* in “through immediate [premises]” Aristotle has in a mind a proximate premise for the given conclusion, seen from our own perspective, whereas when he employs *ἐκ* in “from immediates” what he has in mind are the ultimate principles, whether the immediate terms or the immediate premise *simpliciter*, seen from the natural perspective.

Now I will examine some passages in which the immediate terms are discussed so that we can know whether the immediate term is confined to the non-demonstrable primary, as being a single and indivisible and simple principle as Aristotle claimed in A23. Apart from the passage in A23, Aristotle discusses knowledge of the immediate terms in A3, B9, B10, and B19. (Concerning the passages in B19, I will argue in Chapter 6 that B19 squares perfectly with the other passages on immediate terms.)

In A3 72b18–25 which was quoted in the last Section (p. 56), Aristotle argues that the chain of demonstration ends up at the immediate terms (*τὰ ἄμεσα*) which are identified with non-demonstrables (*ἀναπόδεικτα*) from which it follows that there is non-demonstrative knowledge about the immediate terms (*τὴν τῶν ἀμέσων ἀναπόδεικτον*) as well as a source of *epistēmē* (*ἀρχὴν ἐπιστήμης*) which is comprehension.

In B9, he argues, following the outcome of the discussion in 56, that there are two types of entity. The first is (*α*) things whose causes are identical with themselves, which are described as “immediate and principles” (*ἄμεσα καὶ ἀρχαί*). The other is (*β*) things whose causes are different from themselves and which are thus described as “things which have a middle term”. The first type of entity (*α*) is nothing but (2b) the primary of the genus or principles in each genus, regarded as the non-demonstrable underlying which is the object of the identity statement. (cf. 73b5–8)

In B10 94a9–10, Aristotle offers a definition of the immediate terms. It runs as follows: “The definition of the immediate [terms] (*ὁ δὲ τῶν ἀμέσων ὁρισμός*) is a non-demonstrable thesis of the essence.” Although the expression “the immediates” is here used in the genitive so that we cannot tell from its grammatical form whether it refers to immediate premises or terms, nevertheless, since the object of definition must be a term, there is no doubt that it refers to the immediate terms. This definition is called the

“principle of demonstration”. (75b31) And the principle of demonstration is supposed to be connected with the non-demonstrable primary. (90b24-27) Here I take it that Aristotle describes a thesis called (B) the definition which is the vehicle of non-demonstrable *epistēmē* in the form of an identity statement, given that it conveys the essence of (2b) the non-demonstrable primary which is (α) the entity whose cause is identical with itself.

These three passages match each other perfectly. The immediate and non-demonstrable terms are identical as the primaries of the genus; and these entities are grasped as the terms by comprehension and grasped as (B) the definition by non-demonstrative *epistēmē*.

Thus I must conclude that there has been a serious mistake making Aristotelian scientific investigation impossible for commentators such as Philoponos (p. 371), Waitz (p. 396) and Barnes ([1] p. 31) who take being immediate and non-demonstrable to be equivalent to each other. Philoponos takes the major premise of (S4) “Eclipse *φα* screening of the earth” to be an example of the non-demonstrable case which, in 93a6, is included among the things whose causes are different from them.⁽⁸⁾ These commentators confuse the immediate premise which appears in the syllogism through immediate premises and which can be made up of two demonstrable terms, with the immediate proposition concerning the immediate terms which are non-demonstrable. In other words, they could not distinguish knowledge through immediate premises (*δι’ ἀμέσων*) (eg. 93a35, 75a12) from knowledge of immediate terms (*τὴν τῶν ἀμέσων [ἐπιστήμην]*) which is characterised as non-demonstrable *epistēmē* and is conveyed by (A) the hypothesis and (B) the definition. (72b18, 94a9) Aristotle leaves room for an “absolute” (*ἀπλῶς*) immediate premise in the case of the simple (*ἀπλοῦν*) ie. the immediate primary term of a science. (84b36ff, 88b20-21) Otherwise, the terms which make up the immediate premise are demonstrable. If “the screening of the earth” which is the primary cause of the moon’s eclipse was a non-demonstrable or non-explicable term, it would be ridiculous from the point of view of contemporary science. Aristotle’s Demonstrative Science would be quite unacceptable as an explanatory system, leaving the world full of inexplicable entities. As I shall show when I discuss this passage again in detail in the context of the whole of B8, the reading given by Philoponos and others is not only philologically inconsistent, but also philosophically unconvincing. I conclude that Aristotle confines non-demonstrability to (2b) the immediate primary terms of a science.⁽⁹⁾

Notes.

(1). As regards the influence of contemporary mathematics on the formation of Aristotelian syllogistic theory, B. Einarson has made clear that most of Aristotle's terminology is originally derived from the Pythagorean theories of proportion and of music. (pp. 33-54, 57-72, cf. Ross, p. 290, Heath, [1] vol. 2 p. 112)

(2). Since Aristotle here has relative principles as well as ultimate principles in mind, he employs "*ἀρχαί*" in the plural in connection with "the demonstration". The fact that Aristotle refers to "the demonstration" in the singular and using the definite article suggests that he has a particular proof of a specific thing/event in mind. Thus these principles should be distinguished from (B) the definition which is also called a "principle of demonstration". (75b31, 90b24, 100b13)

(3). Someone might argue that "some" in this phrase is introduced to make the affirmative principles exclusively contrast with the negative principles to the effect that among the principles, just as all the affirmative ones are non-demonstrable, so too are all the negative principles. If so, Aristotle would have said something like "*Τῶν ἀρχῶν, αἱ μὲν εἰσιν ἀναπόδεικτοι, οἳ ἐστὶ τόδε τοῦ καὶ ὑπάρχει τόδε τοῦδε, αἱ δὲ εἰσιν ἀναπόδεικτοι*" οἳ οὐκ ἔστι τόδε τοῦδε." Aristotle must have introduced "some" (*ἐνίαι*) here in order to express that just as some affirmative principles are non-demonstrable, [though some other affirmative principles are not non-demonstrable], so too are some negative principles. (cf. 84b24-26)

(4). I read "D" with Ross and Barnes according to a manuscript *n*, instead of the "A" of the MSS' *ABd*. I prefer *D* to *A*, because it is hard to find an example which contains two immediate premises which are indicated by *πρῶτον* and *δμοίως* in this sentence in a single demonstration. Since Aristotle takes it for granted that the same chain of demonstrations as is found in the previous passage which is quoted just above, with the same order of terms is at issue, he does not bother mentioning *A* at first.

(5). We can confirm our view that the difference between (S1) and (S2) is not simply the way in which the three terms are arranged but lies in their explanatory power by looking at the relevant passages in B16 98b19-24. There Aristotle, quoting his favourite case: the eclipse, explains why (S2) is restricted in explanatory power, comparing it with (S1) to the effect that (S2) "the syllogism of the fact" establishes "the fact" that the earth is in the middle between the sun and the moon, but does not establish "the reason why" the eclipse occurs. Aristotle explains why (S2) does not establish that the earth's being in the middle is the cause of the eclipse, by appealing to its failure to meet a condition of universality: [U2b] analytical necessity through definition as well as the condition of the explanatory priority in

nature. (cf. Chapter 2, Section D)

(6). The literal translation of “διὰ τῶν μέσων” would indeed be “through the middle terms”. Since this phrase is likely to be confused with the phrase “through the middle term” (διὰ τοῦ μέσου) which, as we have seen in the previous paragraph, refers to the primary cause and thus is a component of the immediate premise (94a23), Aristotle’s choice of this phrase in two passages is an unhappy one. The phrase “not through immediate premises” is a more cautious choice, given the need to mark the contrast between them. However, since its explanatory power is restricted to clarifying only the fact, it follows that this type of middle term is not to be identified with the primary cause or the reason why and thus its contextual meaning is not “through the middle terms which make clear the primary causes” but “through the middle terms which do not make clear the primary causes and thus constitute not the immediate premises but the mediable premises”.

(7). Commentators have been embarrassed by the fact that the axioms are expressed using both the prepositions “from” and “through”. (Mignucci, p. 141) The axioms, which are the most fundamental principles, are usually proposed from the natural perspective, using the preposition “from” (eg. 75a42, 76b14, 88b27). But in two passages they are proposed from the relative perspective using the preposition “through”. (76b10, 88b3) This shows that axioms such as “if equals are taken from equals, the remainders are equal.” are sometimes seen from our own perspective, as being actually employed to prove something, as far as they have a bearing on the genus. (76a41–42, 77a11–12, cf. Ross p. 531) As long as we recognise that the differences between these prepositions are connected not with the distinction between the ultimate principles and the relative principles, but with the distinction between absolute and relative perspectives, there is no risk of being embarrassed by the fact that the axioms are accompanied by both the prepositions “from” and “through”.

(8). Since Barnes fails to distinguish immediate premise from immediate term, he is obliged to take it that any immediate premise is identical with the primary premise of a genus. He says “Aristotle can only say that $A \times B$ [A belongs to all B] is immediate if there are no *prior* propositions, from which it is Syllogistically derivable, ie. if it is Syllogistically primitive. In sum, the immediacy condition is merely a specification of the primitiveness condition.” ([1] p. 31) R. Smith also fails to distinguish them. He says “Every immediate proposition can be known without demonstration.” (p. 54) E. Tugendhat as well confuses the immediate term and the immediate premise. (p. 126) Waitz also says that “Et rem esse causam per quam sit intelligimus, si propositiones, ex quibus demonstravimus, ipsae aliunde probari non possunt; si possunt, rem esse cognoscimus, causam vero ignoramus.”

(p. 396) Here Waitz describes a demonstration through immediates as follows: "demonstrations as such cannot be proved in another way." Recently, Bolton's confusion on this point is a serious one. He says "What of the objects of a given science other than the primary ones, for instance thunder in meteorology or eclipse in astronomy? Do Aristotle's remarks in II. 9 show that there is *no* immediately knowable account of eclipse by contrast with the unit? *They do not.* [my italics] All that Aristotle requires is that the basic essence of *anything* [my italics] is such that both the existence and nature of this essence must be *either* taken as given *or* made clear... in some other manner than 'through demonstration'. This requirement fits the case of the unit... It also fits the eclipse, however, since its basic essence is taken as given without proof and the existence of this made clear in some other manner than by demonstration." ([2] p. 142 (cf. Ross, p. 509, Granger, p. 74)

(9). Hence, when Aristotle raises the third condition of the principles of Demonstrative Science in A2 that it is based on "immediates" (*ἐξ ἀμέσων*) (71b21), I take it that what he has in mind are primarily the immediate terms which I have characterised here and secondarily the ultimate immediate proposition.

D. Essential and Necessary Predications

In order to elucidate the structure of Demonstrative Science, it is now essential to make clear what kinds of predication are employed as the principles and their conclusion in Demonstrative Science and how the sequence of demonstrative predications proceeds, so as to produce *epistēmē simpliciter*. In other words, given that we have made clear how many principles there are and what roles they play in Demonstrative Science, it is now essential to make clear what elements constitute a necessary predication. This is because (A) the hypothesis and (D) the relative hypothesis must be necessary if they are to produce a demonstration. To do this, we must put the unsystematic discussions of various kinds of predication given in the previous sections into some kind of order. In this section, I will examine the nature and functions of demonstrative predication, a matter which is systematically discussed in A22, A19 and A4.

In A22, Aristotle characterises the three kinds of predication which can connect the underlying and its attributes in order to establish which kind of predication is employed in establishing demonstrative knowledge. The first is accidental predication, while the second and third are two kinds of essential predication; the second involves a full statement of the essential

elements, while the third involves a partial statement of the essential elements. In order to introduce these kinds of predication, Aristotle first draws a distinction between two basic kinds of predication, in a general way (*καθόλου*), from the linguistic point of view (*λογικῶς*). We may call the two kinds of predication "natural" (*ἀπλῶς*) and "unnatural" (*κατὰ συμβεβηκός*) respectively, following a tradition going back to ancient commentators. (cf. Barnes p. 116) Aristotle's examples of natural predication (NP) and unnatural predication (UNP) are as follows;

(NP) "The log is large." "The man is walking."

(UNP) "That large thing is a log." "The white thing is walking."

"The white thing is a log" "The musical thing is white" (83a1-11)

The criterion by means of which these two types of predication are distinguished is whether the subject-place is occupied by that which underlies the subject's attributes or not. In other words, it depends on whether the subject accepts its predicate "without being something other" (*οὐχ ἕτερον τι εἶναι*) than its essence or itself, or by "being something else". In the cases of (UNP), the applicability of these four descriptions to their subjects is dependent on the nature of the underlying objects, such as log or man, not on the way in which the subjects are in fact characterised. That large thing is a log not because of its being large, but by being a log that is large. Likewise the musical thing is white not because of its being musical, but because of its underlying nature ie. being man to which the property of being musical happens to belong. In other words, in the case of a (UNP) like "The musical thing is white", it is no use appealing to the essence of the subject, say, "being musical" in order to explain the fact that the predicate "white" belongs to the subject "the musical". For it will not follow from the subject's essence that the predicate belongs to the subject. This is because the subject's being musical is not what underlies its being white, in that being musical is predicated of or belongs to another thing, ie. man, which is what underlies it. That is, (UNP) is unnatural just because the subject-place is not occupied by what underlies the predicate.

On the other hand, "The log is large" or "The log is white" is a natural predication (NP), because the log is what underlies (*τὸ ὑποκείμενον*) its being large or white. (83a6-7) In other words, it is not the case that something else is large or white and that it is incidentally a log, but rather, it is in virtue of its essential elements, including its spatial magnitude, that

the log is able to be large or white. For it is possible for the log, which has spatial magnitude essentially, to be large or white. Aristotle writes "The log is the underlying subject which came to be [large or white] without being something other than just what is a log or a particular log (ὄχ' ἔτερόν τι ὅν ἢ ὅπερ ξύλον ἢ ξύλον τί)." (83a13-14) C. J. F Williams comments on (UNP) and (NP) as follows:

It is not that the musical thing is different from the man: on the contrary the musical thing has to be the same as the man. Rather, being musical is something different from being a man. The difference is a difference, not between things, but between two ways of picking out one and the same thing. (p. 68)

If this means that any Aristotelian predication presupposes the underlying, I agree with him. This suggests that Aristotle's metaphysical distinction between substance and attribute gives a ground for the linguistic distinction between (UNP) and (NP). (83a21-23) In fact in the case of (UNP) Aristotle does not pick anything from the category of substance as the subject, but takes his examples from the categories of quantity, like large, and of quality, like white, or musical.

We should remark, however, that the force of the expression "the underlying" is relative in the sense that it has different ontological characteristics, depending on what kind of substantial entity is taken to be "the underlying". When, in A22, Aristotle explains the linguistic structure of "the underlying" and the expression "whithout being something else" which characterises it, he has the relativity of "the underlying" in mind. Hence he is cautious enough to say "We argue in a general way" (καθόλου) (83a1) or "from the linguistic point of view" (λογικῶς), which concerns how we speak, but is not directly relevant to how the world actually is. (82b35, cf. *Met.* Z5 1030a27-28) The parallels between the nature of "the underlying" with respect to a composite object and its nature with respect to the primaries of a science can be set out in the following way:

The underlying; The log	The number
Its attributes; White	Odd, Even etc.

But despite this parallelism, Aristotle clearly states the ontological difference. The log became white, without being something other than "its essence" (ὄχ' ἔτερόν τι ὅν ἢ ὅπερ ξύλον ἢ ξύλον τί). (83a13f)⁽¹⁾ But the number becomes odd, without becoming something other than itself. A composite being like

a log is dependent for its being on its essence, which is something other than itself. Whereas the simple being ($\alpha\pi\lambda\omega\varsigma$), like the unit in arithmetic or the soul in psychology exists as itself by itself without being something else. A genus term is just what it is, and does not owe its existence to any other thing, just as substance which is described as signifying some "this" i.e. the pure form. (cf. *Met.* 418) In his attempt to construct Demonstrative Science, Aristotle holds that the genus term and its *per se* attributes are the genuine instance of the relation between the underlying and its attributes. Genus terms and some entities whose cause are identical with themselves i.e. the type of entity (α) have the right to be called "the underlying" *par excellence* in his Demonstrative Science.

Having discussed the different kinds of expression involving (NP) and (UNP) in this way, Aristotle claims that it is (NP) which should be employed in demonstration:

Thus let it be supposed that what is predicated is always predicated naturally ($\alpha\pi\lambda\omega\varsigma$) of what it is predicated of, and not unnaturally ($\kappa\alpha\tau\grave{\alpha}\ \sigma\upsilon\mu\beta\epsilon\eta\kappa\acute{o}\varsigma$). For this is the way in which demonstrations demonstrate. (83a18-21)

Then he characterises the categorical predications between the underlying and its ten kinds of predicate which are developed in *Categories* (NP) and thus should be employed as predications in demonstration.

The most important thing to note about (NP) for our present concerns is that Aristotle mentions two types of essential predicate, that is "just what is an X" ($\delta\pi\epsilon\rho\ X$) and "just what is a particular X" ($\delta\pi\epsilon\rho\ X\ \tau\iota$). Aristotle says "Things signifying the essence of what they are predicated of are just what is X ($\delta\pi\epsilon\rho\ \acute{\epsilon}\kappa\epsilon\iota\lambda\upsilon\omicron$) or just what is a particular X ($\delta\pi\epsilon\rho\ \acute{\epsilon}\kappa\epsilon\iota\lambda\upsilon\omicron\ \tau\iota$). (83a24-25, cf. 83a27, 83a14, 83a29, Furth p. 45) The first type of expression: "Y is $\delta\pi\epsilon\rho\ X$ " usually means "X is the genus of Y" (eg. 83a30, 89b4, Barnes p. 168) so that this use indicates a part of the essence of the subject. On the other hand, I take it that the second phrase: $\delta\pi\epsilon\rho\ \acute{\epsilon}\kappa\epsilon\iota\lambda\upsilon\omicron\ \tau\iota$ may signify both the identity predicate, in the case in which the thing and its cause are identical, and the full enumeration of the subject's essential elements in the case in which the thing and its cause are different. This is because in both cases the definiendum and definientia are convertible and thus self-predicative. The indefinite particle $\tau\iota$ (a particular) plays the role of place-holder, to be replaced by the concrete elements of the essence

of the subject. Hence, I take it that the difference between the two essential predicates: “just what is *X*” (ὅπερ ἐκεῖνο) and “just what is a particular *X*” (ὅπερ ἐκεῖνό τι) corresponds to Aristotle’s distinction between “the things predicated in the essence” (τὰ ἐν τῷ τί ἐστι κατηγορούμενα) and “what it is something to be (TEE) (τὸ τί ᾗν εἶναι) or the essence (τὸ τί ἐστὶ)” (83a27)⁽²⁾

Aristotle identifies “just what is a particular this” (ὅπερ τόδε τι) with TEE of which there is definition *simpliciter* and contrasts it with “something being said of some other thing” (ἄλλο κατ’ ἄλλον λέγεσθαι). (*Met.* Z4 1030a3–7, 1030a10–11, 1030b4–5) We must not take the definition of TEE or a self-predication as a proposition of a demonstration. Otherwise we would be committing *petitio principii*: Aristotle says “in demonstrations <one assumes> that this is of this (τόδε κατὰ τοῦδε), but not itself, and not something that has the same account and converts.” (92a26–27) This is a reason why, as we have pointed out in Section B of this Chapter, the kind of predication involved in demonstration is described as “one thing of one” (ἐν καθ’ ἐνός), “this of this” (τόδε κατὰ τοῦδε) and “something of something” (τὶ κατὰ τινός). (83a22–23, 90b34, 91a2, 14–15, 92a26) For the preposition κατὰ (of) indicates that in such predications, the predicate is predicated of some underlying object which is different from it. Thus, since a definition (ὁρισμός) which is “a peculiar account” (ἴδιος λόγος) is convertible between definiendum and definientia so that a natural predication does not necessarily result, the kind of predication which is employed in definition cannot be used in demonstration. (*Top.* Z1 139a31, H4 154b2–3, 90b35) In other words, since the kind of predication involved in definition is self-predication, so that both definiendum and definientia are treated as “the underlying”, it commits *petitio principii*. (Cf. the Appendix) Hence this kind of predication is not eligible for demonstration.

Thus the appropriate kind of predication for demonstration is ἐν καθ’ ἐνός and this involves two types of predicates of “the underlying” i.e. *per se* attributes and accidental attributes. And only the former attributes are employed in demonstrative knowledge. (cf. 84a11, A30) On the other hand, self-predication is confined to the kind of predication which concerns the essence (τὸ τί ἐστὶ) which should be differentiated from the elements of the essence (τὰ ἐν τῷ τί ἐστι κατηγορούμενα). (cf. 83a21–23) Aristotle writes:

Demonstration is of what belongs to the objects *per se* — *per se* in two ways: both what belongs in them in the essence (ὅσα. ἐν τῷ τί ἐστι),

and the things which have what they themselves belong to <belonging in> the essence (*οὗς. ἐν τῷ τί ἐστίν*). (84a11-14)

Thus the *per se* predicates are not identical with the "self-predicates". The distinction between the essence and the elements predicated in the essence which constitute *per se* predicates is found in a number of passages, where Aristotle characterises elements of the essence like "animal of man" as not "the essence" (*τὸ τί ἐστίν*) but "[elements] in the essence" (*ἐν τῷ τί ἐστίν* or *τὰ ἐν τῇ οὐσίᾳ*). (83b21, 83b5, 83b15, 83b26) It is now clear how these three kinds of predication differ from each other. The relation of the underlying and its predicates will be as follows;

(1) Self-predication (*αὐτὰ ἀὐτῶν*) — the essence (*τὸ τί ἐστίν*) = TEE.

(2) "One thing of the other" — predication (*ἐν καθ' ἐνός*);

(a) *Per se* predication; involving either:

(a1) A *per se* attribute *A* which is an element of the essence in such a way that *A* belongs to *B* and *A* belongs (or is predicated of *B*) in the essence (*τὸ ἐν τῷ τί ἐστὶ κατηγορούμενον*) of *B*. or

(a2) A *per se* attribute *A* such that *A* belongs to *B* and *B* belongs (or predicated of) in the essence of *A*.

(b) incidental predication — the accidental attributes.

Therefore, it seems to be clear that among natural predications, (1) corresponds to *ὑπερ ἐκείνο τι* and (2) (a1) and (a2) correspond to *ὑπερ ἐκείνο*. And as far as TEE can be defined, its elements (*τὰ ἐν τῷ τί ἐστὶ κατηγορούμενα*) are not infinite, so that demonstration must stop at some point. (82b 37-83a1, 84a8-11)

In A19, Aristotle discusses whether the sequence of predications can be infinite or not. Aristotle examines three different cases. In the first case (1) the ultimate subject is fixed, and in the second case (2) the ultimate predicate is fixed, and in the third case (3) both the subject and predicate are fixed. Schematically, these will be as follows: (81b30-82a8)

(1) ...←E←F←B←C [The ultimate subject]

←more universal more individual→

(2) [The ultimate predicate] A→H→G→B→...

←more universal more individual→

(3) [The fixed (*ὁρισμένον*) predicate] A→B→D→...→C [the fixed subject]

Aristotle takes only (3) to represent the sequence of demonstrations.

(82a2-14) For needless to say, in producing a demonstration, it is necessary that the original two extreme terms are fixed.⁽⁴³⁾ When the sequence of demonstrations is discussed, the insertion of middle terms between the original two terms is always at issue. (81b10-18, 84b3-13, b19-27, b31-34) The question in case (3) is whether demonstrations go on indefinitely and whether there is demonstration of everything or whether the predications in between are limited by one another. In A22, he gives the answer that insofar as the subject and the predicate are picked up from the terms which keep the essential relation each other, the sequence will terminate. Aristotle writes :

Now in the case of things predicated in the essence, it clearly terminates. For if it is possible to define, or if the essence is knowable, but one cannot go through indefinitely many things, it is necessary that the things predicated in the essence are finite. (82b37-83a1, cf. 83a18-20, 83b4-8))

The predications (1), (2) (a1) and (a2) are discussed in A4. He characterises the three types of predication, so as to establish the kind of necessary predication which he characterises as “universal” (καθόλου). The universal predicate, and thus universal predication, is defined as follows :

I call universal whatever belongs to something [U1] of every case (κατὰ παντός) and [U2] in itself (καθ’ αὐτό, *per se*) and [U3] as such (ᾧ αὐτό, *qua* itself). (73b26-28)

Each component of the universal predicate or predication is characterised as follows. (73a28ff)

[U1] universal quantification (κατὰ παντός) eg. “Animal belongs to all men.” This is the minimum requirement for necessary predication.

[U2] the four *per se* (καθ’ αὐτό) predications.

[U2a] analytical necessity through definition: *A* belongs (ὑπάρχει) to *B per se* = *A* belongs (ὑπάρχει) to *B* and *A* belongs (ἐνυπάρχει) in the definition of *B*.⁽⁴⁴⁾ Eg. “Line belongs to triangle *per se*.” “Point belongs to line *per se*.”

[U2b] analytical necessity through definition: *A* belongs to *B per se* = *A* belongs to *B* and *B* belongs in the definition of *A*. Eg. “Straight and curved belong to line *per se*.” “Odd and even belong to number *per se*.”

[U2a] and [U2b] are obtained from the “analytical” (ἀναλυτικῶς) point of

view. (84a8–17) This type of necessity is grasped by formulating a definition of the subject matter. In *Metaphysics* Aristotle says, in relation to [U2b]:

Such attributes are those which involve either the account or the name of the subject of the particular attribute, and which cannot be made clear (*δηλωσαι*) without this, eg. white can be made clear without man, but not female without animal. (Z5 1030b23–26)

[U2a] and [U2b] correspond to (a1) and (a2) which are discussed in A22. This analytical approach or analysis of a concept seems to be effective especially in mathematics. In A4 Aristotle takes examples of [U2a] and [U2b] from mathematics alone. This is because “In mathematics things convert more because they assume nothing accidental, .. but definitions (*δρισμούς*).” (78a10–13) Thus it is fair to say that this type of definitional predication involves analytical necessity, though as we have made clear before, definitional predication as such is not employed in the premise.

The other two *per se* predications: [U2c] and [U2d] go as follows:

[U2c]: What is not said of some other underlying belong to itself *per se*. (73b5–8)

[U2d]: What belongs to something because of itself belongs to it *per se*. (73b10–11)

Ever since Philoponos, it has been taken for granted that the other two *per se* predications ([U2c] and [U2d]) are irrelevant to Demonstrative Science. Philoponos says “It is not the case that all these *per se* predicates take part in demonstrative method (*τὴν ἀποδεικτικὴν μέθοδον*), but only the first two fashions are useful for the present purpose.” (p. 64, cf. Barnes p. 114) Zabarella (p. 708) and Pacius (Mure, *ad locum*) take the same view as Philoponos. Ross also says “the last two are irrelevant to his present purpose and are introduced only for the sake of completeness.” (p. 60) Tredennick even conjectures that they have been “added by another hand”. (*ad locum*) In what follows, I will argue how the predications: [U2c] and [U2d] are employed in Demonstrative Science.

First, consider [U2c] (necessity through an identity statement): *A* is *per se* just what it is without being something else (*οὐχ ἕτερόν τι ὄντα ἔστιν ὅπερ ἔστιν*), given that *A* is the underlying subject (*ὑποκειμένον*) eg. the genus or the primary terms of a science, like unit, or magnitude, and the first substance as the specific form which signifies some “this”, like soul.

In *Metaphysics* A18, Aristotle classifies *per se* predication into five kinds. (1022a24-36) I take it that [U2c] corresponds to the fourth: (4) “a thing of which there is no other cause”. (1022a33) When Aristotle explains (4) by saying that “man has more than one cause — animal, two-footed — but yet man is man *per se*”, he refers to the soul within man using this identity statement: “man is man *per se*”. This is because Aristotle believes that the specific form and its essence as its cause are identical. He says “soul’ and ‘to be a soul’ are the same, but ‘to be a man’ and ‘man’ are not the same, unless ‘soul’ is meant by ‘man’.” (*Met.* H3 1043b2-4, cf. M3 1078a23-24) Soul does not have any cause which is identical with its essence other than itself, given that it is a form. (*Met.* H6 1045a30-b5) Within a demonstrative science, Aristotle takes it that the primaries or the subject matter of a science like number, unit and magnitude are the things of which there are no causes other than themselves. (93b21-25, 93a5-6) That is why they are non-demonstrable and thus the underlying subject (*ὑποκείμενον*) of a science. (76a31-33, cf. *Met.* N1 1087b34-36) In the case of the primaries whose causes are not different from themselves, their essential predicates are not predicated of some “underlying”, but create an identity statement. “The underlying” e.g. a substance which signifies “a particular ‘this’” (*τὸδε τι*) like the soul, in general, has a linguistic structure such that “it is not said of any other underlying” (*ὃ μὴ καὶ ὑποκείμενον λέγεται ἄλλου τινός*). This is because “the underlying” is, ontologically speaking, “just what it is without being something else” (*οὐχ ἕτερόν τι ὄντα ἐστὶν ὅπερ ἐστίν*). (73b5-8)⁽⁶⁾ Thus the third *per se* predication, which is identical to (1) the self-predication in A22, is not employed in demonstration, but in the definition of the primary terms of a science as (B) the definition. In his attempt to construct Demonstrative Science, Aristotle treats the genus term as well as the specific forms in *Metaphysics* as the underlying subject. (75a42-b1, 76a12, cf. *Met.* H1 1042a29, 1042b1-3, H3 1043b1-2, H4 1044b7-9) Thus one can engage in *per se* predication [U2c] in relation to magnitude which is the genus term of geometry such that “magnitude is just what magnitude is without being something else.”

In this way, this type of predication sets up the subject matter of Demonstrative Science and thus determines its universe of discourse. The universe of discourse of a science is exclusively dependent on its primaries so that “it is necessary that everything belongs to the primary term e.g. number, and number to them, so that they will be convertible and will not

exceed it." (84a22-24) It is said that the objects of Demonstrative Science are "*per se* attributes" (*καθ' αὐτὰ συμβεβηκότα*) of the subject matter of each genus. (75b1ff, 76b12-13, 75a28-31) As the phrase "the *per se* attributes" indicates, the *per se* relation holds between the subject matter of a science which is described as "underlying" (*ὑποκείμενον*) like number and magnitude, and its *per se* derivatives. The reason why Aristotle employs the word "attribute" (*συμβεβηκός*) as well as "underlying" (*ὑποκείμενον*) is, as we have seen in Section B, that he understands the relation of the primary of a science and its necessary attributes as parallel to or as based on his main device for metaphysical investigation: the notion of substance (*οὐσία*) whose main characteristic in *Metaphysics* is that it underlies its attributes (*συμβεβηκότα*). (eg. Z3 1029a1-2) If this is the case, given that the ontological status of genus in *Analytics* and substance in *Metaphysics* are the same, there is no doubt that his labour in *Analytics* contributes somehow to his investigation of substance in *Metaphysics*.

This type of *per se* relation between the primaries and their *per se* attributes is an example of [U2b], for the primary never fails to appear in the definition of its necessary attributes, unless it is omitted as being taken for granted as implicitly involved in the proximate definitional elements of the attributes. The expression "the *per se* attributes" implies that the *per se* predicate is relative to its subjects. For example, line belongs to triangle as an instance of [U2a] but belongs to its subject matter, magnitude as an instance of [U2b]. That is, line is an essential component of triangle but an attribute, albeit a necessary one, of the primary term of the science ie. magnitude.⁽⁶⁾ This kind of *per se* predication is employed wherever a non-demonstrable premise is at issue so that it can be established through hypothesis or inductive argument. (B9 93b23) (This issue will be discussed in more detail in Chapter 6)

Now I will turn to [U2d] (causal necessity through empirical investigation): *A* belongs to *B* because of *B* itself (*δι' αὐτό*) = *A* belongs to *B per se*. Eg. if a beast dies when its throat is being cut, then its death is because of the cutting itself. That is, "Death of a beast belongs to cutting its throat because of itself." This *per se* predication is grasped from the viewpoint of empirical inquiry. "Because of itself" is contrasted with "because of another thing" (*δι' ἄλλο*). One starts an inquiry, whether its object belongs to mathematical or empirical sciences, by grasping *A* by means of an explanation in terms of other things like *C*, *D* and continues up to the point

where one grasps it as having “no other further reason” (*μηκέτι διότι ἄλλο*) than *B* (86a2) or as “no longer because of another thing” (*οὐκετι δι’ ἄλλο*) (48a35) than *B*. “Because of itself” (*δι’ αὐτό*) is equivalent to “not because of any other thing” (*οὐκετι δι’ ἄλλο*). Aristotle gives examples from ethics and mathematics. (85b30–86a3) The mathematical example is this. When we are aware that the external angles of a figure are equal to four right angles because it is an isosceles, it still remains to ask why the isosceles is so — because it is a triangle, and that because it is a rectilinear figure and no longer because of something else. That is, “The external angle’s four right angles belong to the rectilinear figure because of itself.”

Nothing prevents us from taking it that this inquiry which starts by grasping *A* in *C* because of something other than *B* amounts to grasping *B* as a component of a definition. In other words, the predication “*A* belongs to *B* because of *B* itself” corresponds to [U2b] “*A* belongs to *B per se*” so that “*B* belongs in the definitions of *A*”. Aristotle says:

As to the object of *epistēmē simpliciter* what is said *per se*, in the sense of [U2b] the subject’s belonging in the [definition of] the predicates or in the sense of [U2a] the predicates’ belonging in the [definition of] the subject, holds both [U2d] ‘because of themselves (*δι’ αὐτά*)’ and from necessity. (73b16–18)

The fact that he gives only examples of [U2b] such as the relation between straight or curved and line in what follows, implies that he seems to have the correspondence between [U2b] and [U2d] in mind. (73b18–21) For it is unimaginable that we should find any example of [U2a] which would be incompatible with [U2d]. For the essential components of the subject which take the role of *per se* predicates in the sense of [U2a] are also the causal components of the subject, since it is the subject of [U2d], and not its *per se* predicates, which takes the role of the causal component of the *per se* predicates. It is, in fact, possible to read the disjunctive conjunction: “or” in 73b18 as excluding [U2a]. It is clear at least that in [U2d] Aristotle is concerned with the major premise in which the middle term, ie. the subject, is the account of the major term and thus involves [U2b]. (eg. 99a21–23, 93b6)

This kind of predication corresponds to [U2b], in the sense that the final point which inquiry reaches is the primary cause of the relevant attribute or thing/event and the primary cause is eventually involved in their definition.

Though the procedure involved in grasping the necessary relation is different from the one in [U2b], insofar as this kind of inquiry provides the definitional component of the predicate, [U2d] and [U2b] coincide. In this way, these four types of *per se* predication produce necessary predications.

Now consider [U3] (necessity through predication *qua* itself (ἐν αὐτῷ)): *A* belongs to *B qua B* itself. Aristotle does not give this its own explanation, but just remarks that [U3] is identical with (ταὐτόν) [U2]: *per se* predicates. (73b28–29) Eg. “Point belongs to line *qua* line.” ([U2a]) “The straight belongs to line *qua* line.” ([U2b]) “The internal angle’s two right angles belong to triangle *qua* triangle.” ([U2b]) This idiom “*qua* itself” or “as such” must have a particular role in characterising universal predication, apart from signifying the definitional relation which is also seen in [U2]. Otherwise it would be of no use to Aristotle to mention [U3] alongside [U2] as a condition of universal predication in 73b26–27 (quoted above). The one clear characteristic of this phrase is, as we have seen before, to introduce the perspective from which one may view all the things which belong to that perspective. In *Topics* and *Categories* Aristotle employs this idiom in his discussion of “property” (ἕδω) and “being appropriately” (οἰκείως), to characterise the possession of the property which in the first place makes its attribute come into existence and thus to characterise the commensurate or convertible relation between the subject and the predicate. Aristotle gives the following examples:

- (1) Not appropriate and convertible: “Wing” — “Of a bird”.

Grasping the first thing so as to be appropriate and convertible:
“Wing” — “Winged creature”.

For there are many things that are not birds but which have wings. He says “It has not been given appropriately (οἰκείως) in the first place (τὸ πρῶτον) as the wing of a bird. For the wing is not said to be relative to the bird *qua* bird, but *qua* winged creature.” (ch. 7 6b38–7a5)

- (2) Possessing the property so as to be convertible: “A living creature receptive of knowledge” — “Man”. (*Top.* E4 132a36–b3) “To possess a tripartite soul” — “Man” (E4 133a30–32)

In order to construct a proposition about a property, Aristotle proposes a perspective or rule of argument (τόπος) through which one can examine the given proposition. He says:

For a constructive argument, you must see whether the same thing is a property of something which is the same as the subject, in so far as (ξ) it is the same; for then what is stated not to be a property will be a property. (E4 133a28-32)

In this way, in both (1) and (2), grasping a subject under [U3] is what characterises the first thing appropriately or characterises the property (ξδov). Thus the following propositions will come about. "Wing belongs to winged creature *qua* winged creature." "A living creature receptive of knowledge belongs to man *qua* man". These propositions are instances of [U2b] too, given that the subject is necessarily involved in the definition of the predicate.

This characteristic of [U3] matches very well with Aristotle's second description of universal predication and the examples he gives in A4 and A5. For, when he talks about [U3] as a demonstrative proposition, he seems to have [U2b] in mind. After enumerating the three conditions [U1] [U2] and [U3] of universal predication, Aristotle gives two conditions of universal demonstration. He says "It holds universally whenever it is proved in a random and primary case (ἐπὶ τοῦ τυχόντος καὶ πρώτου)." (73b32-33) He gives an example of a triangle's having two right angles [2R] which satisfies [U2b] as well as [U3] and [U1]. Although 2R indeed belongs to a bronze isosceles triangle (74a38), it does not satisfy Aristotle's conditions of universal demonstration: being random and primary. Even if one discards the properties of being bronze and being isosceles, the isosceles can still be '2R'. On the other hand, if one removes the properties of being a 'figure' or having a 'limit' by which the figure is surrounded, then the property of having 2R cannot exist any more. But the properties of 'figure' and 'limit' which are components of the property of being a 'bronze isosceles triangle' are not primary in having '2R'. For if one removes these, one destroys not only the property of having '2R' but also the property of being a circle, a triangle or any other thing which is called a 'figure'. What is, then, the primary thing which brings '2R' into existence simultaneously with its coming into existence and makes '2R' disappear simultaneously with its destruction? It is nothing but 'triangle'. (74b2) If any figure is a triangle, whatever it is, it has '2R' as a primary component. Thus the proposition "The internal angle's two right angles belong to triangle." satisfies [U1], [U2b], [U2d] (cf. 48a35) and [U3]. Hence, it is a universal predication.

Aristotle explains the second condition of universal demonstration, during a discussion of a fallacious proof that two straight lines do not meet each other. (74a13-16) When one proves that there is a property of not meeting each other belonging to two straight lines, if one tries to prove it on the basis of a complementary line which crosses two lines in such a way as to make a right angle with both lines, it will indeed be the case that all straight lines which make right angles with a line which crosses them have that property. But it will not be a universal proof, given that it proves it in a particular way ($\alpha\delta\delta\iota$) which depends on a particular condition, such as the fact that two lines are such as to make right angles with a line that crosses them. (74a15) This property comes into existence whether the angles which are made by a complementary line and two straight lines are acute or obtuse, "as long as they [the alternate angles] are equal in any way at all ($\eta\ \delta\pi\omega\sigma\sigma\omicron\upsilon\nu\ \zeta\sigma\alpha\iota$)."

(74a15-16) Since this proof is dependent on the equality of any alternate angle which is the random and primary thing for two lines' being parallel, this satisfies [U1], [U2b] and [U3]. Thus such a demonstration is called grasping "the primary universal ($\pi\rho\omega\tau\omicron\nu\ \kappa\alpha\theta\acute{o}\lambda\omicron\nu$)". (74a11-12) We can shape this proof in the following way: (cf. Heath [1] vol. 1 p. 309)

Two straight lines $\varphi\alpha$ the equal alternate angles which are composed by a crossing line.

The equal alternate angles which are composed by a crossing line $\alpha\varphi\alpha$ parallel lines

Two straight lines $\varphi\alpha$ parallel lines.

In this way Aristotle argues for his view of how we are to establish the proper demonstration on the basis of universal predication in A4 and A5.

At the outset of A4, as we saw earlier, Aristotle confirms, on the basis of his arguments in A2, that demonstration depends on necessary principles as premises. Then, Aristotle makes clear what kinds of predication are involved in the necessary principles. (cf. A6 74a5-12) To do this is just to get clear about the principles from the perspective of predication. Hence, one can conclude that Aristotle makes it clear that the immediate premises are instances of universal predication ([U1], [U2], [U3]). It was said in Section C that demonstration through immediate premises makes clear the reason why. This sort of immediate premise was described so as to show that the middle term or the primary middle term [the cause] is the account

of the major term [the effect ($\tau\delta\ \sigma\delta\ \alpha\lambda\tau\iota\omicron\nu$)]. I take it that the predication between the major term and the middle term which is the account of the major term consists of [U1], [U2b] and [U3]. This is because the predication composed of the conjunction of [U1], [U2b] and [U3] produces the primary universal which makes the subject and the predicate necessary and sufficient for each other. For instance, Aristotle believes that in the following demonstration, the middle term is the account of the major term:

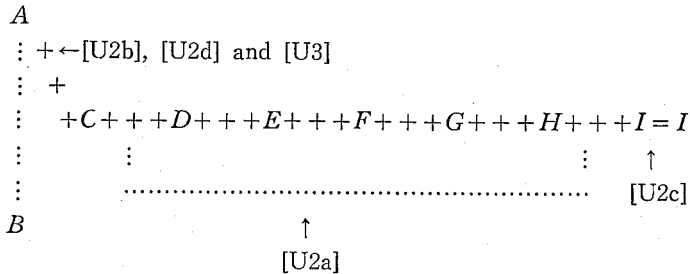
Shedding leaves $\alpha\varphi\alpha$ the solidifying of the sap at the connection of the seed.

The solidifying of the sap at the connection of the seed $\varphi\alpha$ broad-leaved trees.

Shedding leaves $\varphi\alpha$ broad-leaved trees. (99a21-29)

In this demonstration, the middle term makes clear why all broad-leaved trees shed leaves. The middle term satisfies [U2b], because this is implied in the definition of the major term. Likewise, it satisfies [U3], because anything which suffers from the solidifying of the sap at the connection of the seed sheds leaves *qua* the solidifying of the sap at the connection of the seed. Thus the middle term is primarily responsible for the occurrence of the major term and so is entitled to be called "the primary middle" ($\tau\delta\ \pi\rho\omega\tau\omicron\nu\ \mu\acute{\epsilon}\sigma\sigma\omicron\nu$). (99a25) Here the middle term is at least a sufficient condition for the shedding of leaves. As Aristotle may have taken for granted, if we are allowed to rule out as accidental the cases, in which broad-leaved trees shed leaves because of strong wind or heavy rain or the movements of animals, without suffering from the solidifying of the sap at the connection of the seed, then the middle term which satisfies the [U1], [U2] and [U3] conditions in this way can be regarded as being both a necessary and a sufficient condition for the vindication of extreme terms. If and only if the solidification of the sap takes place, broad-leaved trees shed leaves. Hence, we can say that this syllogism goes through a necessary premise, which incorporates the primary cause and is thus an immediate premise. There is no middle term between the major and the middle terms, though nothing prevents the middle term from having a prior explanatory term such as the cessation of the absorption of nutrition at the roots. Insofar as this new term is not supposed to be placed outside the major and minor terms, this term will be called a middle term as well. This new middle term and the previous middle term constitute a [U2a] predication. This is because cessation of the absorp-

tion of nutrition belongs to the solidifying of the sap and is implied in the definition of the solidifying of the sap. Let us recall the diagram of the chain of immediate premises in Section C and apply the types of predication which have been investigated in this section to it. [U1]: the universal quantification is satisfied in all propositions.



strative Science, simply because they have failed to distinguish knowledge *through* immediate premises from knowledge *of* the immediate terms which are non-demonstrable. While non-demonstrable terms and immediate terms are identical, it is not necessary for the relative principle which is a type of immediate premise to be comprised of non-demonstrable terms. Non-demonstrable immediate entities are identical with the things whose causes are identical with themselves. Entities in the world can be seen from the causal perspective as classified into two groups depending on whether they are identical with their causes or not. Aristotle constructs his Demonstrative Science from the causal perspective, arguing that it is made up of the non-demonstrable primary entities of a science whose causes are identical with themselves and their derivatives whose causes are different from themselves. Hence Demonstrative Science is made of causal chains leading to the non-demonstrable primaries of a science. The causal chains are expressed by the chains of demonstrations whose predications are supposed to meet the *per se* and *qua* conditions as well as the condition of universal quantification. Therefore, one can say that Aristotle constructs Demonstrative Science as a systematic method of producing *epistēmē simpliciter* by mirroring the causal structure of the world.

Now it seems that we are in a good position to organise the various aspects of the theory of Demonstrative Science, as an explanatory tool, by means of which one grasps demonstrative knowledge.

Notes.

(1). When J. Engmann says "But when I say "the log is white", it is not that something else is white, .. but the log is what underlies, and is what came to be, being nothing other than a log or a sort of log." (p. 142, cf. p. 147), he is confused in identifying something which is called underlying with its essence. The log and its essence should be counted as (β) a thing whose cause (essence) is different from itself.

(2). *Tl' ousi* is sometimes used as a synonym of *to ti hn einai* (91a25, 91b10, *De Anima* Γ6 430b25, *pace* J. Tricot p. 174 and C. Arpe p. 23), where there is no need to distinguish it from *ta en to ti ousi kategoroumena* (the elements predicated in the essence). (91a15-16, 92a7-9, 91a25, *Met.* Z4 1030a19-20) J. Schröder is quite right on this point. (p. 227) The fact that *to ti ousi* is treated as being composed of and being divided into its component elements, whereas TEE is not being divided (*adialipton*) into its component elements and thus is not found in phrase like a "*ta en to ti hn einai kategoroumena*", shows the difference in function between TEE and *to ti ousi*. (*Met.* Z17

1041a18, H3 1043b1, H6 1045b3) I take it that TEE is the essence which is employed so as to show itself as the ground of the unity of the thing. In other words, where a thing can be treated as a unity, this is because its essence (TEE) is unitary. That is why TEE can be identified with the specific form which is exempted from any alternation. (cf. 428 1024b29, Z13 1038b14-15, Z17 1041a18-19, H3 1043b1, cf. Furth pp. 241 ff)

(3). In the other two cases he discusses the sequences of predications without using any syllogistic terminology. For example, when he describes the relation of immediacy between *B* and *C* in the case of (1), he says "there is nothing else between (*μεταξύ*)" instead of using the expression "the middle term" (*μέσον*). (81b30, cf 82a4)

(4). The fact that while Aristotle employs a copulative verb "*ἐνυπάρχειν*" to express the definitional relation between two terms, he uses "*δπαρχεῖν*" to express the *per se* relation between two things indicates that he approaches the world in such a way as to make clear its necessary components through language. (73a34-73b2, 84a11-17 (See apparatus criticus 13 *δπαρχει* dPT))

(5). Literally speaking, *ὅπερ ἐστίν* here is not the same as *ὅπερ ἐκεῖνο* or *ὅπερ ἐκεῖνο τι*. But the use of "*τόδε τι*" to characterise substance in an example of this kind of being, suggests that we should take it as being equivalent as *ὅπερ ἐκεῖνο τι* which shows that "the underlying" and its account of the essence are convertible. When Aristotle writes in *Topics* "The being just what is (*τὸ εἶναι ὅπερ ἐστίν*) is single for each being", this phrase is taken to signify the essence rather than part of the essence. (141a35, cf. 91a39-b1)

(6). Barnes fails to see the relativity involved in Aristotle's view of the *per se* attributes ie. the fact that Aristotle is looking at the objects of Demonstrative Science as the attributes of the primaries. Hence he fails to distinguish necessary predication from incidental or attribute predication. Barnes says "Aristotle cannot have both (3) (All propositions are either I-predications [my [U2a] and [U2b]] or incidental predications.) and (4) (No incidental predications are necessary): (3) is true if "incidental" is defined as "non-I" (A4 73b4); but then (4) is false, since predications of properties and 'in itself incidentals [my *per se* attributes]' are necessary but not I-predications. (4) is true if "incidental" is defined as "non-necessary" (*Top* A5, 102b6-7); but then (3) is false." (p. 124) These are his comments on A6 74b5-12. J. E. Tiles agrees with Barnes with respect to Aristotle's treatment of "the *per se* attributes": "I do not believe it is possible to exonerate Aristotle from the charges of error and confusion over these matters..." (p. 2)

When Aristotle makes claims (3) and (4) in 74b11-12, the expression "incidental [my "accidental attribute"] (*συμβεβηκός*)" has nothing to do with

"*per se* attributes" in 75b1, 76b12. "Attributes" in "the *per se* attributes" are those of the underlying subject or primary of a science. Thus this type of attribute includes even man and two footed animals, as well as triangle and two right angles. When Aristotle makes Barnes' claim (4) i.e. "The attributes are not necessary", the type of attributes he means are ones which are taken from categories other than substance, such as white, heavy and so on. (cf. Barnes, p. 115, J. E. Tiles, p. 2)

Chapter 3. Theoretical and Pragmatic Aspects of Explanation :

A. Natural and Our Own Perspectives : Epistemological Justification of The Principles

As Aristotle develops his Demonstrative Theory as the theory of Demonstrative Science by making clear what conditions must be met by the principles on which demonstration is based, he keeps his contemporaries' views on demonstration, and especially their epistemological views on the principles, in mind. (cf. Ross, [MI] p. 234) In other words, the views of contemporary sceptics on demonstrative knowledge act as a driving force behind his Demonstrative Theory, as we now see it, as an antidote to their views. In this Chapter, I will begin by examining some of the epistemological characteristics of his Demonstrative Theory which are introduced mainly in A1, 2 and 3. Then I will conclude Part I by examining some particular aspects of the Demonstrative Theory itself, such as its theoretical and its pragmatic characteristics.

In the previous Chapter we have established that Aristotle has elucidated the fundamental principles of Demonstrative Science by enumerating the six conditions and that, by imposing those conditions on the ultimate principles, he has indirectly made clear the relative principles as well. In investigating these conditions, one can say that Aristotle makes two epistemological claims: Firstly, in connection with condition (2) ("primary") which introduces the non-demonstrable immediate term and thus stops the regress of demonstration, there is a further kind of knowledge concerning the primary in addition to demonstrative knowledge. Secondly, in connection with condition (5) ("better known than"), a principle is prior to the conclusion in terms of both chronological order and degree of certainty.

The first claim is Aristotle's answer to the two proposals of his contemporaries concerning the primary principle of demonstration which are mentioned in A3. One can say that Aristotle's claim that knowledge of the

primary is not demonstrable is established through his rejection of two possible objections. (72b5-18) Someone like Antisthenes may think that there is no *epistēmē*, because one must have demonstrative *epistēmē* of the primaries. Others like the successors of Xenocrates may think that there is *epistēmē*, but that there are demonstrations of everything.⁽¹⁾ With regard to the first view, Aristotle agrees with it as far as the claim that, if there are no primaries, an infinite regress will follow. Then a chain of demonstrations will take the following form;

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow \dots \rightarrow \infty$$

Thus both Aristotle and (allegedly) Antisthenes agree that there must be a primary. But the objector claims, if the regress stops at some point i.e. the primary, since the only way of having *epistēmē* (*τὸ ἐπίστασθαι μόνον*) is by having a demonstration, there will be no *epistēmē* at all. Aristotle refutes this view, by proving that there is a non-demonstrable *epistēmē*, as we have seen in Section B and C of Chapter 2. (72b18-25, cf. Chapter 6)

The second view claims that there are demonstrations of everything, in the sense that the process of proving the conclusions from the premises eventually circles round to the point at which the premises may be proved from conclusions already established. Then there will be a circle of demonstrations as follows;

$$A \rightarrow B \rightarrow C \rightarrow D \rightarrow \dots \rightarrow A$$

Aristotle rejects this view as a creating a vicious circle. If indeed demonstration must depend on what is prior and better known by nature, it is impossible for the premise *A* in this illustration to be simultaneously both prior and posterior to *B*, *C* and *D*. Hence Aristotle, by claiming that there is a primary of which there is a non-demonstrable *epistēmē*, avoids the risk both of an infinite regress and of a vicious circle of demonstrations.

With regard to the second epistemological characteristic of the principles, Aristotle argues in A2 that all or some premises which are expressed either by "the primaries" or "principles" on which their conclusions depend must be not only "known antecedently" (*προγινώσκειν*), but also be "better known" (*μᾶλλον γινώσκειν*) and "more convincing" (*μᾶλλον πιστεύειν*). (72a27-29, 72a36-37) Aristotle's argument for the priority of the principles to the conclusion in these two respects consists primarily in the ontological priority of the principles rather than in their epistemological priority in the sense that the causes which are expressed in the premises produce the effects

which are expressed in the conclusions. In other words, the ontologically explanatory elements such as the causal entity are in themselves epistemologically prior to the things which they explain. (cf. *Met.* A2 982b1ff) For example, a thing which causes us to love is better loved. This illustration should be taken as an example of this kind of ontological priority. (cf. *Met.* a1 993b25-26)

Someone might object that if one falsifies the conclusion by proposing a counterexample against it which is drawn from its premises, then any hypothesis which acts as premise on which the conclusion depends is also to be rejected. Hence one cannot claim that the primary, whether ultimate or relative, is better known than its conclusion. In other words, one may claim that the degree of knowability or certainty of both premise and conclusion must be equal, or even that the conclusion must be more convincing and better known than premises, given that the falsehood of conclusion also falsifies its premises. But we should recall that the phrase "better known than" can be described both from the natural perspective and from our own perspective. (71b34) This objection is raised from our own perspective. This is because insofar as any counterexample will be a perceived particular, no matter how it is observed, whether by telescope or microscope, its knowability and certainty is a matter of our own perspective. What is closer to observation, and hence a particular thing, is thought to be prior and better known to us. (72a1-5) This implies that Aristotle does not deny that insofar as one looks at things from our own perspective, one is entitled to claim that if a counterexample to the conclusion is found, its premises must be false. This is because the conclusion is better known than its premises from our own perspective. In other words, *de jure*, principles are prior to and better known than their conclusion, whereas *de facto*, it is the conclusion which takes precedence. Hence, when Aristotle claims that the primaries or principles are more certain and better known than the conclusion, it does not matter whether one has better observational knowledge of the principles than of the conclusion. It is a matter of *de jure* supposition, whose perspective is set not on our cognitive abilities, but on the order of reality.

The reason why we have to employ these two perspectives: (the natural perspective and our own perspectives or in his words "by nature" (*τῇ φύσει*) and "in relation to us" (*πρὸς ἡμᾶς*) is the weakness of our reason. (cf. *Met.* a1 993b7-9, 71b34-72a4, *Top.* Z4 141b15-19) If we can know the

world as such, we do not have to employ our own perspective. Aristotle writes;

The cause of the present difficulty is not in the facts but in us. For as the eyes of bats are to the blaze of day, so is the reason in our soul to the things which are by nature most evident of all. (α1 993b8-11)

If we could see the blaze of day directly without any difficulty, we would not have had to let our eyes gradually accustom themselves to light, starting from darkness.⁽²⁾

In this context, however, Aristotle is not interested in establishing a condition by means of which one can know that a given proposition is true or false, i. e. justification or verification, but in clarifying the epistemological characteristics of the principles from the natural perspective, without considering our actual cognitive situation. This undoubtedly suggests that Aristotle constructs the method of Demonstrative Science from a backward-looking perspective which sets in advance the logically, epistemologically and ontologically antecedent elements as the principles rather than the elements of what is proved by them. Even if the premise is considered and fixed in relation to its conclusion, insofar as the syllogism is employed to produce demonstrative knowledge, it is supposed to be set up within an overall system which is governed by those six conditions. In other words, Aristotle takes up the position of an omniscient being and presupposes all kinds of knowledge on which the current issue depends. From this position, all he has to do is to explain the current issue, by setting out this presupposed knowledge in the proper way according to the rules of syllogistic and Demonstrative Theory which is based on the six conditions. That is, what Aristotle tries to do when he enumerates the six conditions for the principles of Demonstrative Science as his proposed method of grasping *epistēmē simpliciter*, is to present the ideal and final structure of Demonstrative Science as the explanatory system for any particular science.

What I have established so far regarding the structure of Demonstrative Science which produces demonstrative knowledge as *epistēmē simpliciter* can be illustrated schematically as follows:

A subject grasps *epistēmē simpliciter* of *C* which is expressed by a conclusion if and only if he grasps a sequence of syllogisms $S_1, S_2 \dots S_{n-1}, S_n$ within the same genus such that;

(i) the conclusion of S_1 is *C*.

- (ii) the conclusion of S_i for $i > 1$ is identical with a premise of S_{i-1} .
- (iii) S_n meets the six conditions: (1) true, (2) primary, (3) immediate, (4) prior to, (5) better known than, and (6) the cause of C in S_i .
- (iv) each premise of S_j for $j \geq 1$ meets, at least, (1) in itself, (4), (5) and (6) for C and either major or minor premise of S_j meets the immediate interval in itself.

In this way, one grasps a piece of *epistēmē simpliciter* if and only if one constructs the whole sequence of demonstrations within a well formalized axiomatic system which consists of the primaries and their derivatives. In other words, unless any particular piece of knowledge is backed up by all of its constitutive antecedents in a science to which it belongs, one is not entitled to claim that one has grasped *epistēmē simpliciter*. The reason why such a sequence of demonstrations is required is so that one can establish the necessity of C : the object of *epistēmē*, by grounding its being and necessity on the non-demonstrable primary. This is because the requirement for grasping *epistēmē simpliciter* was to grasp (i) the cause of a thing/event C and (ii) the necessity of C . (cf. Chapter 2 Section A) The non-demonstrable primary here has a role which is comparable to that of substance which is the ontological and epistemological ground for its derivatives or attributes. I conclude that the fact that Aristotle constructed his theory of Demonstrative Science, which may be called an axiomatized deductive system, from the natural perspective in this way is the result of an attempt to follow and to map the structure of the real world. His epistemological mechanism is governed entirely by his ontological commitments. And I conclude that as the theoretical aspect of his Demonstrative Theory, Aristotle makes clear the abstract feature of Demonstrative Science which is common to any particular science, by putting the general constraints on what the structure of any science should be.

Notes.

- (1). Of the two objections raised in A3, H. Cherniss takes that the former view is ascribed to Antisthenes and the latter is ascribed to successors of Xenocrates. (H. Cherniss pp. 64-68)
- (2). In *Topics* Aristotle gives advice to the people whose intellectual ability is low. (Z4 141b15-19)

B. Axiomatic Deductive System and Pedagogical Advice

Now, the backward looking or natural perspective which is essentially embedded in Aristotle's theory of Demonstrative Science, according to which any particular science is constructed, is employed in the context of the imparting of knowledge by a teacher to a pupil as well as in constructing that explanatory system. The teacher is, as it were, the person who has overcome the weakness of reason so that he has acquired a piece of *epistēmē simpliciter* by acquiring the whole chain of demonstrations from the primary to the theorem on which the relevant conclusion directly depends.

On the presupposition that pre-existing knowledge (*προϋπαρχούσης γνώσεως*) is necessary for all teaching and intellectual learning, Aristotle describes in A1 three possible combinations of pre-existing knowledge about both the meaning of a term and the existence of its referent. (71a1-2, 71a11ff) In the case of "attributes" in a science, e.g. triangle, it is necessary "to assume in advance" (*προϋπολαμβάνειν*) the meaning of a term. In the case of "axioms" like the law of the excluded middle, its existence, in the sense of its being the case is what must be known in advance. An axiom is described in A2 as what "it is necessary for anyone who is going to learn anything whatever to grasp." (72a15-17) In the case of "the ultimate principles" of a science, e.g. unit, it is necessary to assume both what it signifies and the fact that it exists. (71a11-17) Then what the teacher has to do on these assumptions is to present the demonstrations from the ultimate principles to the relative principle on which the existence of the relevant attribute is directly based. Therefore the man who can explain to his pupils the reason why or the cause of the occurrence of the subject along with its necessity on the basis of the ultimate principle has an *epistēmē simpliciter* of a given subject. To know something is to be able to explain it from its cause and from the ground of its necessity. In this sense, Aristotelian Demonstrative Theory is "an explanatory art". (L. A. Kosman p. 380)

In the last two decades, there has been a stress on the pedagogical aspect of Aristotelian Demonstrative Theory. Barnes, who is the main advocate of this view, claims that in constructing his notion of a Demonstrative Science, Aristotle was not telling the scientist how to conduct his research by describing a process or methodology of scientific inquiry, but

He was giving the pedagogue advice on the most efficient and economic method of bettering his charges. The theory of demonstration offers

a formal account of how an achieved body of knowledge should be presented and taught. (p. 85)

The system characterised in this “formal account” is, according to Barnes, nothing but the notion of an axiomatized deductive science. (p. 87) In other words, Barnes takes it that Aristotle’s motivation for establishing an axiomatic system in *Posterior Analytics* is a desire to formalise the didactic conversation between the teacher and the learner. Barnes says that “the theory of demonstrative science is concerned exclusively with the teaching of facts already won”. (p. 77) Then Barnes concludes his paper as follows;

The glory of the *Posterior Analytics* is that it represents the first, and for many centuries the only, attempt to characterise and investigate the notion of an axiomatized deductive science.⁽⁴⁾ . . . If the clouds of false interpretation, that turn the *Posterior Analytics* into an essay in scientific methodology, are dissipated, then the sun may shine out again. (p. 87)

This movement, which takes demonstration as a method of teaching or imparting knowledge on the basis of an axiomatized deductive system is called “a new orthodoxy” by Burnyeat. ([1] p. 116) Before we examine the claim that a theory of an axiomatized deductive science and a method of scientific discovery are incompatible and that the latter should not be read into *Posterior Analytics*, I would like to present and examine Burnyeat’s view on the relation between the pedagogical aspect of Aristotle’s account and the process of axiomatization.

Although Burnyeat is more cautious and pays more attention to other features of Aristotle’s theory of the axiomatized deductive science than Barnes, he regards himself as belonging to the “new orthodoxy” as well as presenting “a caveat or a corrective” to Barnes’ proposal. (pp. 115–116) Burnyeat understands that the pedagogical contexts in *Posterior Analytics* are not those in which “a teacher [imparts] new knowledge to virgin minds” (p. 118), but are more akin to “an advanced university course in mathematics or biology . . .” wherein “the scientist aims to display and share his principle understanding of the field.” (p. 118)

One of Burnyeat’s main claims in his paper is that “epistēmē is to be translated as “understanding” rather than “(scientific) knowledge”. His main argument for this claim is as follows. (pp. 101–102, p. 127) Aristotle knows that the requirement that demonstration should proceed from primary princi-

ples is not a requirement of justification or evidence, but of scientific explanation. Concepts such as justification, certainty and evidence which are absent in *Posterior Analytics* are central to the theory of knowledge. Hence Aristotle's epistēmē is not knowledge as knowledge is normally conceived of in philosophy. Whereas explanation and understanding go together in a way that explanation and knowledge do not. This is because understanding depends on explanation. And what gets explained in the science which produces that understanding are *general* regularities and connections: lawlike regularities in the modern jargon, necessary connections in Aristotle's. (p. 109) In other words, the generality which is produced by explanation does not fit in with knowledge, especially not perceptual knowledge. (p. 114)

On the basis of his account of understanding, Burnyeat observes that a distinction between knowledge and understanding can be "helpful" in making clear the pedagogical interpretation of *Posterior Analytics*. Aristotle's lack of concern with evidence, certainty and justification, concepts which are central to the present-day theory of knowledge, encourages him to interpret Aristotle's theory of demonstration as a theory of explanation. Hence the theory of demonstration should be taken as a theory of explanation which is essential to teaching in order to impart understanding to students. Burnyeat sees the link between teaching and understanding as such that teaching can take place at one stage higher than the mere imparting of knowledge. He says "teaching may also be designed to impart understanding of knowledge which the pupils already have, or a deeper understanding of a science which they already have some acquaintance with but in an unsystematic way." (p. 118) Then axiomatization will play a key role in teaching, as Burnyeat argues, "to the extent that we believe that full understanding requires axiomatization, to that extent we shall propose demonstration as the means to convey understanding. If we agree with Aristotle about the benefits of axiomatization, our pedagogy will follow suit." (pp. 125-126)

Burnyeat's views can be summed up as follows. Although he differs from Barnes in supposing that Aristotle is concerned with a higher level of education than Barnes, so that it involves imparting not knowledge but a deeper understanding of the subject to students who may have some disorganized knowledge, Burnyeat agrees with Barnes that Aristotle's axiomatization of the demonstrative theory is motivated by his pedagogical concerns. If that motivation is not an "exclusive" motivation for axiomatization as

Barnes contends, it seems to be at least clear that axiomatization and pedagogy are regarded by Burnyeat as inseparably related to each other: the more axiomatization, the more pedagogy. In what follows, I would like to consider firstly whether *ἐπιστήμη* should be translated as “understanding” rather than “(scientific) knowledge”. Then I would like to consider the position of the new orthodoxy which advocates demonstration as a method of teaching in Aristotle’s overall project of constructing the demonstrative theory.

I will contend for several reasons that we should not translate *ἐπιστήμη* and its cognates as “understanding” (“understand”) but retain the traditional rendering “(scientific) knowledge” (“know_s”). As a preliminary, I would like to establish that some Greek words are employed by Aristotle to mean “understanding”. It has traditionally been thought that Aristotle uses the word *ξυνίεναι* (or occasionally *μανθάνειν*) to signify “understand”. The word *ξυνίεναι* is, in some contexts, employed to express the understanding of the meaning of a term or sentence. For instance, “if what is said (*τὸ ρηθέν*) is not clear, he ought not to hesitate to say that he does not to understand (*μὴ συνίεναι*) it”. (*Top.* *Θ*7 160a22–24, cf. 71a13, 71b32, 76b37, 160a18ff) This use seems to be equivalent to a contemporary English use of the word “understanding”. We say something like “I understand what you mean, though I do not know whether it is the case”. In this context we do usually employ the word “understand” in place of “know”. In some other contexts, it is counted as “an intellectual virtue” as in “man of understanding” (*συνετός*) along with philosophical wisdom and practical wisdom. Unlike practical wisdom, understanding does not command, but only makes judgements concerning the subjects of questioning and deliberation. (*Nic. Ethic.* Z11 1142b 34–43a10) This use is also another of our uses of “understanding”. This shows that it is at least not the case that Aristotle does not possess a word which more or less corresponds to the contemporary English usage of the word “understanding”. So what Burnyeat wants is to enlarge the application of the word “understanding” in order to cover not only *ξυνίεναι* (*σύνεσις*) but also *ἐπιστήμη*.

In some other passages, however, Aristotle describes one sort of “learning” as “understanding by the use of *ἐπιστήμη* (knowledge)” (*τὸ ξυνίεναι χρώμενον τῇ ἐπιστήμῃ*). (*Soph. E1.* 4 165b33, cf. *Met.* H2 1043a14) This seems to be exactly what happens in the teaching — learning situation. The pupil understands what the teacher explains by using his knowledge. This use of *ξυνίεναι* clearly shows that although Aristotle regards understanding

and knowledge as quite closely related mental states, he does not identify *ξυνίεναι* and *ἐπιστάσθαι*. So far I have confined my discussion to Aristotle's terminology in relation to understanding. Now I would like to raise some arguments against Burnyeat's translation.

Burnyeat is in a sense right in claiming that *Posterior Analytics* lacks some essential elements of a theory of knowledge such as evidence, certainty and justification. Aristotle does not bother to cite perceptual evidence or justification as particular instantiations of a general regularity from our own perspective. This is because, as we have seen before, Aristotle proposes his Demonstrative Theory from the natural perspective. Nevertheless, we can say that Aristotle's enterprise in constructing his Demonstrative Theory is an attempt to characterise a type of epistemological evidence, justification and certainty applicable to demonstrative knowledge of a conclusion of a sequence of demonstration(s).

When Aristotle presents two conditions on having *ἐπιστήμη*: grasping (i) the cause of a thing/event X and (ii) the necessity of X, he stays at the level of subjective judgement, in that he employs a doxastic term namely "*οἴομεθα*" (we think). (71b9, 11, 14 cf. 76a28, 85b28, 94a20) That is, while he takes it for granted, on the one hand, that his proposal concerning the definitory content of *ἐπιστήμη* is generally accepted, he confirms, on the other hand, that the objective methods of grasping *ἐπιστήμη* are as yet to be specified. Then he contrasts two kinds of mental state of people who claim to have *ἐπιστήμη* in claiming that for both those who do not know or understand (*μὴ ἐπιστάμενοι*) and those who do know (or understand [according to the new orthodoxy] (*ἐπιστάμενοι*), the former think that they are themselves in such a state, and those who do know (or understand) (*ἐπιστάμενοι*) actually are. (71b13-15) Aristotle takes demonstration as having the function of making such a subjective judgement or *doxa* irrelevant, by saying that "To know, (or understand) (*τὸ ἐπιστάσθαι*) that of which there is a demonstration non-incidentally is to have a demonstration." (71b28-29, cf. 73a23, 90b21-22) Hence his demonstrative theory can be said to be his proposal of a method or an objective criterion of grasping *ἐπιστήμη*. I have made clear that the conclusions of a sequence of demonstrations up to the ultimate principle of a science so as to grasp a conclusion are required in order to confirm the necessity of the conclusion. The ultimate principles are supposed to be better known and more convincing than their theorems. In other words, nobody is sure whether he grasps *ἐπιστήμη simpliciter* or

not, no matter how well he is subjectively convinced of the necessity of a relevant issue, until he fits it into the full structure of a science. If this is the case, we can draw several conclusions regarding the present issue from this claim about the structure of Demonstrative Science.

Firstly, Aristotle constructs his Demonstrative Science in order to justify a belief in the necessity of a conclusion or give the final ground of its certainty. And the sequence of demonstrations itself offers objective evidence for its necessity. In this sense, Aristotle does offer concepts of evidence, justification and certainty which are allegedly central to the theory of knowledge from the natural perspective. Hence the Aristotelian Demonstrative Theory is a theory of knowledge from Aristotle's point of view. Aristotle's awareness of his motivations in constructing his Demonstrative Theory implies that it is not the case that he neglects these concepts or that he cannot characterise these concepts from our own perspective as well, given that the natural perspective and our own perspective are not contradictory or incompatible, but rather complementary. (71b34ff).⁽²⁾ Aristotle says "These perspectives are opposite to each other." in the sense that both are as it were the same road which is seen from up and down. (72a5)

Secondly, the pedagogical aspect of demonstration is no more than the pragmatic aspect of Aristotle's Demonstrative Theory. Aristotle constructs his Demonstrative Theory with various concerns in mind, including the theoretical project of constructing an axiomatic theory, the practical project of establishing a theory of inquiry in which demonstration is employed as a tool of scientific investigation, which I will discuss in Part II, and the pragmatic project of constructing an economical and effective system of pedagogical instruction. When Aristotle introduces *ἐπιστάσθαι ἀπλῶς* with its conditions in A2, he does not presuppose the situation of the teacher and learner, so that he can explain how *ἐπιστάσθαι ἀπλῶς* comes about, when the teacher imparts it to his pupil. Rather he imagines a general epistemological situation, in which one might claim to possess *ἐπιστάσθαι ἀπλῶς*. The fact that Aristotle does not confine Demonstrative Theory to the pedagogical aspect is confirmed in the context where *epistēmē simpliciter* is introduced in A2. There Aristotle distinguishes a mental state in which someone, regardless of who he is, thinks he has *ἐπιστήμη* but does not, from the one in which someone thinks he has *ἐπιστήμη* and actually does. If Aristotle is just interested in how the teacher presents *ἐπιστήμη* which has already been somehow acquired by the pupil, he would not be concerned with the contrast

between such mental states. In fact Aristotle introduces *ἐπιστασθαι ἀπλῶς* as an antidote to the sophistical or incidental way of grasping *ἐπιστήμη* which has been put forward by contemporary epistemologists, for instance, as a solution to Meno's paradox which is a matter of epistemology rather than understanding. (71b9-10, 71a17-71b8) In constructing his Demonstrative Theory, Aristotle has some background questions in mind which are raised as objections to sophistical knowledge. When Aristotle contrasts unqualified knowledge with knowledge obtained incidentally in the sophistic fashion, the contrast centres on the issue of necessity. What distinguishes a man who thinks he knows but does not from the man who really knows? What makes it true that one knows the necessity of the case? In other words, his presentation of Demonstrative Theory was motivated by a desire to sort out what distinguishes unqualified knowledge from sophistical knowledge. That epistemological motivation was no doubt inherited from Plato. (cf. 71a29) This suggests that Aristotle takes up the issue of *ἐπιστήμη* primarily in the context of the traditional epistemological questions how we grasp *ἐπιστήμη* and what is a criterion of grasping *ἐπιστήμη* rather than in the context of imparting *ἐπιστήμη* as "understanding".

Thirdly, I agree with the proponents of new orthodoxy that the theory of demonstration is regarded as the theory of explanation, and that explanation fits in well with understanding rather than with knowledge. But it does not follow from this that explanation never produces knowledge. Insofar as the object of *ἐπιστήμη* is not a sentence but a thing/event in the world, no matter how one attains *ἐπιστήμη*, through explanation or perception, a subject who is entitled to claim that he has grasped *ἐπιστήμη*, must, as it were, have contacted reality through his own intellectual capacities. I do not see in this situation why we cannot say that he knows it. Insofar as reality is concerned, grasping reality is better expressed by "knowledge" than by "understanding". For these reasons, I claim that *ἡ ἐπιστήμη* should be translated as "(scientific) knowledge".

I take it that Aristotle uses the words "inquiry" (*ζητήσις*) which is a main topic of Part II and "learning" (*μαθήσις*) as convertible, insofar as both are concerned with the attempt to grasp *epistēmē*, though he seems to have a tendency to use "learning" in the case of mathematical studies due to its Platonic tradition. (cf. 71b6, 71a21, *De Memoria* 2 451b8) Aristotle regards the word "learning" as ambiguous. He says "it signifies both 'to understand (*ἐννοεῖν*) by the use of knowledge', and also 'to grasp knowledge (*ἐπιστήμη*)'"

(*Soph. El.* 4 165b33-34) Nothing prevents us from taking inquiry to belong to the second category of learning, insofar as the inquirer aims to grasp knowledge through his efforts, whether he has a teacher or not. Aristotle in fact contrasts teaching with both learning and inquiry. (*Met.* Z17 1041b9-11, 71a1, cf. *Met.* A9 992b24-25) And both the learner and the inquirer as well as the teacher proceed in their research by employing demonstration and induction. (81a39-40, 91b34-35, 100b3-4) The difference between the way in which one acquires knowledge and the way in which one should present that knowledge is just a matter of the difference between the road up and the road down, just as the road from Athens to Thebes and the road from Thebes to Athens are the same. After all the learner or the inquirer who acquires knowledge can become a teacher. (cf. *Phys.* Γ3 202b10-16) Hence, when Aristotle lays down the structure of Demonstrative Science, he does not distinguish the method used by the learner and the inquirer in conducting their investigation through demonstration from the method of presenting an achieved body of knowledge through demonstration.

Now I would like to conclude Part I, by assessing the new orthodoxy which construes the theory of demonstration exclusively or mainly as the form of an axiomatized deductive system as a method of teaching or presentation of an achieved body of knowledge. Should the Aristotelian Demonstrative Theory be regarded as a formalized didactic exchange? Is it concerned only with giving pedagogical advice on how an achieved body of knowledge may be presented and taught? Is it nothing to do with an account of how an inquirer carries on a scientific investigation? (Barnes, [2] pp. 82-85 A. Edel, p. 205) This seems to be an excessively narrow interpretation of the nature and function of Aristotle's project. Although one cannot deny the pedagogical aspect of the Demonstrative Theory, it seems to be no more than a single aspect or one consequence of Aristotle's attempt to construct a theory of Demonstrative Science. I take it that this aspect of demonstration is just its pragmatic aspect.

I have been arguing that we should sort out Aristotle's enterprise in *Posterior Analytics* into its theoretical, practical and pragmatic aspects, according to his various goals. I contend that Aristotle is quite aware of the theoretical significance of his axiomatization of Demonstrative Theory, independently of its pragmatic significance. Aristotle presents the model of Demonstrative Science which is common to any particular science, in a

purely general, abstract way. By putting general constraints on what the structure of any science should be, Aristotle presents the axiomatized deductive system as the model of Demonstrative Science. If this is the case, we should discuss his theory of demonstration as far as possible in abstract terms, independent of its pragmatic aspect. In fact, "explanation" can be seen in both its theoretical and pragmatic aspects. In the pragmatic context, the verb "explain" is a triadic predicate, that is, "Someone explains something to somebody". On the other hand, in the context of theoretical interest such as metamathematics, a theorist considers the sentences of the proof as an abstract structure of explanation only from the viewpoint of whether they are a correct deduction from axioms and theorems, while abstracting it from the question of the effects of proofs on audiences.⁽³⁾ I will discuss the practical aspect of Explanation in Part II.

Notes.

(1). Barnes understands the axiomatization as follows: "The sciences are to be axiomatized: that is to say, the body of truth that each defines is to be exhibited as a sequence of theorems inferred from a few basic postulates or axioms. And the axiomatization is to be formalized: that is to say, its sentences are to be formulated within a well-defined language, and its arguments are to proceed according to a precisely and explicitly specified set of logical rules." (Introduction xi)

(2). Burnyeat is aware of this sort of criticism. (p. 127) But still he sticks to the allegedly contemporary theory of knowledge. He says "There is a sense, I think, in which this objection is correct, but it is not a sense that would normally interest philosophers who analyse knowledge as justified true belief." (p. 127) I take it that he adheres to, according to Aristotle's terminology, "our own perspective". Here I have to repeat that this perspective is not incompatible with the natural perspective which is mainly employed in *Posterior Analytics*, so that there is a room for Aristotle to discuss knowledge as justified true belief from our own perspective.

(3). This task can be compared to what C. G. Hempel tried to do in his theory of explanation, as a reaction against some philosophers such as M. Scriven who stresses only the contextual and pragmatic aspects of explanation, such as the removal of puzzlement. Hempel concentrates on a concept of explanation which is defined in terms of its logical form, and on a concept of correct explanation which depends also on the truth of its premises. That is, Hempel tries to give an account of explanation in terms of syntax and semantics. (C. G. Hempel, Chapter 12, M. Scriven, pp. 170-230, cf. J. J. C. Smart pp. 56 ff.)

北大文学部紀要

(This is Part I of my D. Phil. thesis submitted to Oxford University in Michaelmas Term 1989 with some alterations. Part II will be followed.)