

Résumons-nous. Si les observations que nous avons présentées sont exactes, il devient impossible de considérer que le problème de la connaissance des principes a été traité avant son ouverture officielle au début du chapitre II 19; il devient impossible de tenir ce chapitre pour une première version de la résolution de ce problème, supplantée par une version définitive que les hasards de l'édition du *Corpus* nous donneraient à lire avant elle; il devient impossible de traiter comme une illusion d'optique, ou comme un accident sans signification, l'unité qu'Aristote a voulu conférer à son apodictique en l'encadrant entre la phrase initiale des *Analytiques* et la première phrase de leur dernier chapitre. Cela ne résout pas, tant s'en faut, les nombreux problèmes que soulève la structure complexe des *Seconds Analytiques*; du moins y a-t-il là, peut-être, une des données à prendre en compte si l'on veut aborder ces problèmes avec quelque chance de les résoudre.⁷⁸

d'autant plus remarquable qu'il a d'abord accepté, en tant que dialecticien, cette possibilité. Cf. *Top.* VII 3, 153 a 15-22, à quoi répond, selon toute apparence, *An. post.* II 6, 92 a 6-10. H. CHARRISS, *Aristotle's Criticism of Plato and the Academy*, I, pp. 34-36, n. 28, à nié, il est vrai, qu'Aristote ait changé d'avis sur ce point; mais cf. A. MANSTON, *L'origine du syllogisme et la théorie de la science chez Aristote*, dans *Aristote et les problèmes de méthode* (Deuxième Symposium Aristotelicum), Louvain-Paris 1961, pp. 57-81.

78. Une première version de ce texte avait été présentée aux participants du Symposium de Padoue; la rédaction définitive a grandement bénéficié des observations qui ont été faites au cours de la discussion, notamment par S. MANSTON, P. AUBRENGUE, J. BARNES, E. BERRY, Ch. KARR, W. LESZL, G. E. R. LOVY, M. MINGUCCI, P. MORAVJUX, G. PARZIG. Qu'ils en soient très chaleureusement remerciés.

Scanning

ARISTOTLE ON UNDERSTANDING KNOWLEDGE

M. F. BURNEYEAR

I

Aristotle's *Posterior Analytics* makes a single project out of two things which present day philosophy segregates into distinct areas of inquiry. On the one hand, there is a theory of the structure of a science, an account of the conditions for a proposition to belong to a body of systematic knowledge like geometry, physics or botany. For us this would be a contribution to the philosophy of science. On the other hand, Aristotle presents his theory from the outset in terms we would take to be epistemological, as an account of the cognitive state of the individual person who has mastered a body of systematic knowledge.

Aristotle's own term for what he is analyzing is *ἐπιστήμη*, and this, like our word 'knowledge', can refer either to the cognitive state of the knowing person or to a body of knowledge, a science — a system of propositions which can be learned and known. English translators of the *Analytics* have traditionally rendered *ἐπιστήμη* as 'scientific knowledge', but the results this produces can be ambiguous and puzzling. Here, to take a prime example, is the important section from A 2 where Aristotle first formulates his general project, as rendered by G. R. G. Mure in the Oxford translation¹.

We suppose ourselves to possess unqualified scientific knowledge of a thing, as opposed to knowing it in the accidental way in which the sophist knows, when we think that we know the cause on which the fact depends, as the cause of that fact and of no other, and, further, that the

1. *The Works of Aristotle translated into English*, vol. 1, Oxford 1928.

fact could not be other than it is. Now that scientific knowing is something of this sort is evident — witness both those who falsely claim it and those who actually possess it, since the former merely imagine themselves to be, while the latter are also actually, in the condition described. Consequently the proper object of unqualified scientific knowledge is something which cannot be other than it is.

There may be another manner of knowing as well — that will be discussed later. What I now assert is that at all events we do know by demonstration. By demonstration I mean a syllogism productive of scientific knowledge, a syllogism, that is, the grasp of which is *eo ipso* such knowledge.

Assuming then that my thesis as to the nature of scientific knowing is correct, the premises of demonstrated knowledge must be true, primary, immediate, better known than and prior to the conclusion, which is further related to them as effect to cause. Unless these conditions are satisfied, the basic truths will not be appropriate to the conclusion. Syllogism there may indeed be without these conditions, but such syllogism, not being productive of scientific knowledge, will not be demonstration (71 b 9-25).

It is not unimportant that no separate word in the Greek corresponds to the qualifying epithet 'scientific'. Aristotle first advances a quite general thesis about a cognitive state he calls *ἐπιστάσθαι*, to the effect that in its unqualified version it involves knowing the cause or explanation of something and knowing its necessity, and from this he concludes that what one can have *ἐπιστήμη* of is that which cannot be otherwise. He then gives a further characterization of the cognitive state: it centrally involves the possession of apodictic proof or demonstration (cf. A 2, 71 b 28-9, 72 a 25-6; A 4, 73 a 21-3) — centrally, because Aristotle leaves aside for later discussion the question whether there is another mode of *ἐπιστάσθαι* (sc. for the first principles on which demonstration rests) — and from this comes a second conclusion about the objects of *ἐπιστήμη*?. De-

2. The structure of the argument is made plain by *xal* at 71 b 20. This emphasizes not the immediately following *την ἀποδεικτικῶν ἐπιστήμην*, which merely resumes *τὸ ἐπιστάσθαι*, and the

monstrative *ἐπιστήμη* depends on things which are true, primary, immediate, better known than and prior to and explanatory of the conclusion.

At this point Mure's translation falls apart. He speaks of 'the premises of demonstrated knowledge', but a cognitive state cannot be said to be demonstrated, nor does it have premises; these attributes belong to knowledge in the other sense of what is known, to the propositions making up the body of a science. The things which are true, primary, etc. are indeed expressed as the premises of demonstration, but the dependence in question here is the epistemological relation of a cognitive state (demonstrative *ἐπιστήμη*) to its grounds, not the logical relation of conclusion to premises. Because *ἐπιστήμη* involves grasping the demonstration of necessary conclusions, it is grounded epistemologically on the premises of that demonstration.

Nevertheless, Mure's mistranslation is instructive. He evidently felt the pressure of the thought that Aristotle's conditions for demonstrative *ἐπιστήμη* are more naturally read as conditions for a proposition to be a proven theorem within a science.³ It sounds natural enough to say that a proposition counts as an item of scientific knowledge (in the objective sense of that phrase) only if it is demonstrable from the first principles of a science. It seems

point that this must be of necessary truths, but rather the whole subsequent specification of the premises from which these necessary truths are derived. (Here I am indebted to Jacques Brunschwig). Cf. W. J. VERBURGH, *xal belonging to a whole class*, «*Mnemosyne*», 4th Ser. 29, 1976, p. 181.

3. The conditions are explicitly so read by H. SCHOLZ, *Die Axiomatik der Altes*, «*Blätter für deutsche Philosophie*», 4, 1930, pp. 266-7 = p. 56 in the English translation in Jonathan BARNES, Malcolm SCHOLEFIELD and Richard SORABY, edd., *Articles on Aristotle 1*, London 1975. But the argument and the context in A 2 require that *ἐπιστήμη* be in the first instance the cognitive state of a person (as also at 71 b 15, 25, 72 a 37-8); we see shortly that the *ἀπὸ ἀνάγκης/κατὰ συνβεβηκότος* contrast on which the discussion depends is epistemic rather than logical, to do with a person's relation to a proposition, not the proposition's relation to other propositions.

less credible that a person has knowledge of the proposition only if he has derived it from first principles. By that demanding standard most of us who are not professional mathematicians do not know simple truths of arithmetic or Pythagoras' theorem. The ambiguous phrase 'scientific knowledge' covers, and reveals, an understandable embarrassment.

There is, of course, that use of the phrase in which a man said to possess scientific knowledge is a man who knows, is familiar with, a whole science or branch of knowledge: 'He knows mechanics', 'He knows calculus'. But Aristotle is concerned with the cognitive state such a man has to particular propositions within the science, as comes out when he distinguishes unqualified *ἐπιστήμη* with respect to a theorem of a science from various qualified or accidental versions of *ἐπιστήμη* in relation to the same theorem (A 2 as quoted, A 5; cf. *Eth. Nic.* vi 3, 1139 b 34-5)⁴. Take, for example, the theorem that every isosceles triangle has angles equal to two right angles. According to A 5, if a man knows this in virtue of knowing that it belongs to every triangle as such to have angles equal to two right angles, then he has *ἐπιστήμη* unqualified. But if he has not grasped the more general fact, and knows only that the property belongs to all isosceles triangles, then, even if he has a perfectly sound proof of the more particular proposition, he does not count for Aristotle as possessing unqualified *ἐπιστήμη*. He knows the fact but not the reason why it is a fact (cf. B 16 98 b 19-24). Clearly, Aristotle does not mean that his state is one of mere belief rather than knowledge⁵. It is *ἐπιστήμη*, but

4. A 5, 74 a 28, recalls A 2's reference to a 'sophistical mode' of *ἐπιστήμη*. The term 'sophistical' here adds nothing (except abuse) to 'accidental', since the accidental is the sphere in which the sophist plies his trade (*Metaph.* E 2, 1026 b 15-16); 'sophistical mode' does not tie Aristotle to any one case of accidental *ἐπιστήμη*.

5. Contra Robert Bolton, review of Barnes, Schofield and Sorabji, *op. cit.*, «Philosophical Review» 86, 1977, pp. 564-5. Neither of

not of the favoured kind (compare the lengthy discussion of the isosceles example in A 24). To which we may be inclined to object, echoing a well-known Platonic theme, that either one knows a thing or one does not. How can there be room for the notion of a favoured mode of knowing a proposition, to be termed (in Mure's phrase) 'scientific knowing', alongside ordinary knowing on the one hand and believing on the other?

This objection can be pressed by anyone who holds a version of the now traditional analysis of knowledge as justified true belief. The point is that justification need not be in terms of first principles. Justification is expressed in argument to show that a proposition is true. The argument need not be deductive, and even if it is, it need not meet Aristotle's requirement of explaining from first principles why the proposition is true. That, of course, is part of what Aristotle is saying in A 2 when he distinguishes between syllogism and demonstration, and in A 5 when he distinguishes between qualified and unqualified *ἐπιστήμη*, and again in A 13 when he distinguishes between having a deduction which establishes a fact and having a deduction which also explains the fact, calling both of these (in a broad sense) *ἐπιστήμη*. In other words, Aristotle both knows and emphasizes that his requirement that demonstration proceed from first principles is not a requirement of justification but of scientific explanation⁶. But in A 2 he also says that syllogism which is not demonstration does not yield *ἐπιστήμη*. It follows that Aristotle's *ἐπιστήμη*

the passages to which Bolton refers (A 2, 71 b 10-25; B 8, 93 a 21-6) contrasts non-accidental *ἐπιστήμη* with mere belief. 93 a 25-6 passes from *κατὰ συββητην ἀδραειν* to *οὐδὲ γὰρ... ἐπιστήμη*, but for that very reason *ἐπιστήμη* must mean *ἐπιστήμη ἀνάλογον*. Note that in the examples of A 13 the non-explanatory deduction is through the more familiar term, where this means the term that is more familiar to us. I take this as evidence (if evidence be needed) that in Aristotle's view the non-explanatory deductions would be satisfactory enough in a justificatory role. For confirmation, cf. B 16, 98 b 19-21.

is not knowledge as knowledge is standardly conceived in philosophy.

Is it, then, understanding? Explanation and understanding go together in a way that explanation and knowledge do not.⁷ Look at Jonathan Barnes' translation of the passage from A 2:⁸

We think we understand a thing *simpliciter* (and not in the sophistic fashion incidentally) whenever we think we are aware both that the explanation because of which the object is its explanation, and that it is not possible for this to be otherwise. It is clear, then, that to understand is something of this sort; for both those who do not understand and those who do understand — the former think they are themselves in such a state, and those who do understand actually are. Hence that of which there is understanding *simpliciter* cannot be otherwise.

Now whether there is also another type of understanding we shall say later; but we say now that we do know through demonstration. By demonstration I mean a scientific deduction; and by scientific I mean one in virtue of which, by having it, we understand something.

If, then, understanding is as we posited, it is necessary for demonstrative understanding in particular⁹ to depend on things which are true and primitive and immediate and more familiar than and prior to and explanatory of the conclusion (for in this way the principles will also be appropriate to what is being proved). For there will be deduction even without these, but there will not be demonstration: for it will not produce understanding.

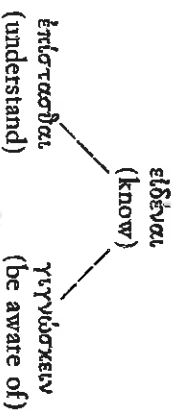
It was worth motivating the reader to embrace this trans-

7. This remark was intended to be non-controversial, and I have found that, by and large, English speaking philosophers accept the point at once. Interestingly, however, the conference made clear that it does not sound right, let alone obviously right, to some scholars working in other languages and/or different philosophical traditions. I will address this problem of communication later (p. 107 and n. 22 below), after first developing my theme in my own terms.

8. *Aristotle's Posterior Analytics*, Oxford 1975; henceforth *BARNES* (2).

9. 'In particular' gets the emphasis wrong: see n. 2 above.

lation because Barnes himself seems reluctant to make philosophical use of the contrast between knowledge and understanding. Not only does he offer the traditional phrase 'scientific knowledge' as an alternative equivalent to 'understanding' (pp. 89, 90),¹⁰ but he encourages us (p. 90) to read 'understanding' as no more than a way of tagging the occurrence in Aristotle's Greek of the verb *ἐπινοεῖν* in contradistinction to *εἰδέναι*, which Barnes translates 'to know', and *γινώσκειν*, for which he uses 'to become aware of'. To distinguish the three verbs thus tagged Barnes relies on the lexical schema which Lyons found to hold for Plato,¹¹ namely,



This schema gives contrasting senses for *ἐπινοεῖν* and *γινώσκειν*, which has the welcome result that circularity is avoided when Aristotle at the beginning of A 2 uses *γινώσκειν* to elucidate *ἐπινοεῖν*.¹² At the same time *εἰδέναι*, the widest verb of the family, is taken to be, according to context, convertible and synonymous with *ἐπινοεῖν* or convertible and synonymous with *γινώσκειν*; there is no contrast of senses along the vertical dimension of the schema. This fits the Greek,¹³ but unfortunately, when translated into Barnes' English, it has the result that we are deprived of any contrast of sense between

10. Cf. also 'scientific' for *ἐπιστημονικός* in his translation of 71b18.

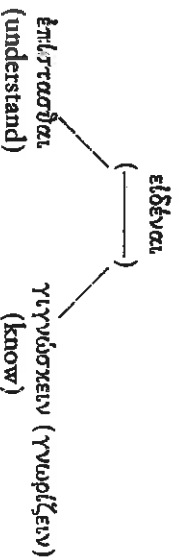
11. John Lyons, *Structural Semantics - an analysis of part of the vocabulary of Plato*, Oxford 1963, p. 177.

12. Cf. Barnes (2), p. 97.

13. E.g. within A 2 itself *εἰδέναι* stands in for *ἐπινοεῖν* at 71b17 (cf. A 3, 72b30), for *γινώσκειν* at 71b31.

'know' and 'understand'; the translator has to ask us to pay no attention to the colloquial nuances of our verbs (p. 90). But we need that contrast. It has philosophical work to do in making sense of Aristotle's enterprise.

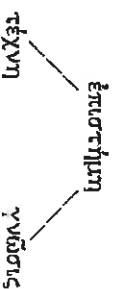
We may indeed be tempted to associate the contrast directly with the horizontal dimension of the schema, setting our verb 'understand' to represent *ἐπινοεῖν*, our verb 'know' to represent *γινώσκω* (and also *γινώσκω*). Not only have we no third verb which functions like *εἰδέναι*, but it would in any case be misleading to think of *εἰδέναι* as the expression of a third, generic concept to which the other two verbs are subordinated as species to a common genus; rather, *εἰδέναι* is to be regarded, according to context, as a synonymous replacement for *ἐπινοεῖν* or for *γινώσκω*.¹⁴ In a sense, therefore, the Greek trio provides only two concepts to match up with our verbs, so that, while exact translation is no doubt impossible, the schema to use is the following:



This proposal should not be taken to cover more than the use of the verb *ἐπινοεῖν* which Aristotle studies in the *Posterior Analytics*. By comparison with Plato, Aristotle has specialized the verb considerably, even more so the cognate noun *ἐπινοήματα*. (i) The most characteristic Platonic constructions for *ἐπινοεῖν* do not appear at all, viz. *ἐπινοεῖν* plus infinitive, *ἐπινοεῖν* plus the accusative

14. Even this is a simplification (cf. Lyons, *op. cit.*, p. 177, p. 183), but it holds, I think, for the Aristotelian constructions we need to consider.

of a noun denoting a *τέχνη* or its domain.¹⁵ Aristotle is also more hospitable to the construction *ἐπινοεῖν* *ἐπι* (e.g. A 1, 71 a 27-9; A 2, 71 b 26; A 6, 75 a 14; A 13, 78 a 22; A 33, 89 a 21; B 1, 89 a 23-4) than one would expect from Platonic precedent.¹⁶ (ii) Where Plato's usage of the epistemic nouns is given by the schema



with *ἐπινοεῖν* in the superordinate position corresponding to *εἰδέναι* among the verbs,¹⁷ in the *Posterior Analytics* *ἐπινοεῖν* is coordinate with *ἐπινοεῖν* and denotes either the cognitive state of the *ἐπινοεῖν* (e.g. A 2, 71 b 13-16; A 4, 73 a 21; A 6, 74 b 5-6) or the body of knowledge (science) he has mastered (e.g. A 10, A 27).¹⁸ Nevertheless, Aristotle in A 2 does take himself to be starting his analysis from a base in ordinary thought, and this may serve as a first test of our proposal to take seriously the idea of rendering *ἐπινοεῖν*/*ἐπινοεῖν* in terms of understanding.¹⁹

15 Cf. Lyons, *op. cit.*, p. 183, p. 188. It is worth noting that although the infinitive construction is the nearest match to the English 'knowing how to...', both these constructions could often be translated by 'understand'.

16 7 cases in the entire corpus - Lyons, *op. cit.*, p. 205.

17 Lyons, *op. cit.*, p. 177.

18 *τέχνη* occurs only twice in *An. Post.*: once in the broad (Platonic) use in which it can stand with *ἐπινοεῖν* in contrast to *γνώσις* (A 1, 71 a 24; cf. *An. pr.* 46 a 22), once in contrast with *ἐπινοεῖν* (B 19, 100 a 9), but a contrast created by philosophical legislation.

19 The proposal (and some of the results to which it will lead) may claim the support of L. A. Kosman, *Understanding, Explanation, and Insight in the Posterior Analytics*, in E. N. Lee, A. F. D. Mourelatos, R. M. Rorty, eds., *Exegesis and Argument. Studies in Greek Philosophy presented to Gregory Vlastos*, «Phronesis», Suppl. Vol. 1, Assen 1973, pp. 374-392, and of J. M. Moravcsik, *Alia as Generative Factor in Aristotle's Philosophy*, «Dialogue», 14, 1975, pp. 622-38.

Aristotle's claim is that ἐπιτορασθαί is ordinarily so conceived that

X ἐπιτορασει Y if and only if (a) X γινώσκει what the explanation of Y is and (b) X γινώσκει that Y cannot be otherwise than it is.

There can be little doubt, surely, that this is a much better definition of 'X understands Y' than of 'X knows Y'. Not that one could not read the definiendum as 'X knows Y' – but the effect would be to *select* a use of our verb 'know' in which it means to be well acquainted or thoroughly familiar with something in an intellectually principled way; as when a man is said to have expert knowledge of, say, mononucleosis or the turnip. We have such a sense of 'knowing', but it is much closer to understanding than to the concept which contrasts with mere belief and which philosophers analyze in terms of justification.

Parallel considerations would suggest that it is a similar, implicitly graded sense of the Greek γινώσκειν which Aristotle has in mind in the *Physics* when he echoes the definition we are discussing but with γινώσκειν in place of ἐπιτορασθαί and with γνωρίζεω in the analyzans in place of γινώσκειν:

We think we γινώσκειν a thing when we γνωρίζομεν its primary causes and primary principles, right back to the elements (*Phys.* I 1, 184 a 12-14, elucidating a claim about ἐπιτορασθαί).²⁰

In both passages, the definition of ἐπιτορασθαί in the

20. Cf. *Phys.* II 3, 194 b 17-20; *Metaph.* A 3, 983 a 25-6, where the definiendum is εἰδέναι and *Metaph.* α 2, 994 b 29-30, where the definiendum is εἰδέναι standing in for γινώσκειν and yet γινώσκειν still contrasts with ἐπιτορασθαί (994 b 20-3). εἰδέναι again stands in for γινώσκειν in the repeat definition of ἐπιτορασθαί at *An. post.* B 11, 94 a 20. On the other hand, at *Metaph.* B 2, 996 b 14-16, εἰδέναι stands in for ἐπιτορασθαί in contrast to γνωρίζεω.

Posterior Analytics and the definition of γινώσκειν in the *Physics*, our verb 'know' is needed in the analyzans not in the analyzandum. Aristotle is analyzing a cognitive state which is achieved by knowing explanations, and whether he is currently calling it ἐπιτορασθαί or γινώσκειν is the corresponding term for that state in philosophical English is 'understand'.

Other languages, other philosophical traditions, may speak differently.²¹ They must find their own means of signalling the non-circularity of the definitions just quoted. For the claim that two distinguishable notions are involved is not a claim about a particular language or jargon. It is equally

21. With γινώσκειν at *Phys.* I 1 *loc. cit.* compare e.g. *De caelo* III 3, 302 a 11-12: in everything ἡ γνῶσις is through first principles. Likewise, *De gen. an.* II 6, 742 b 33-4 has undemonstrated γνῶσις of a first principle in place of *An. post.*'s undemonstrated ἐπιτορήν/νοῦς of it (*An. post.* A 2, 71 b 16; A 3, 72 b 18-20; A 9, 76 a 18; B 19, 100 b 12), and *De part. an.* I 1, 641 a 36-b 2, uses ἡ φυσικὴ γνῶσις as a replacement for ἡ φυσικὴ ἐπιτορήν in the sense of natural science. It will become clearer below that to use γνῶσις for the state of understanding is not necessarily to obliterate the contrast between γνῶσις and ἐπιτορήν.

22. Cf. n. 7 above. Most conspicuously, there is an important tradition, associated with the name of Dilthey, which contrasts explanation (Erklären) and understanding (Verstehen) and assigns the former to the natural sciences, the latter to the 'Geisteswissenschaften'. As I am using 'understanding', it has no special connection with intentionality or with particular human/social phenomena: these are not for Aristotle objects of ἐπιτορήν, and it is quite misleading of G. H. von Wright, *Explanation and Understanding*, Ithaca 1971, chap. 1, to count Dilthey part of the Aristotelian tradition in Western thought on the grounds of the Aristotelian preoccupation with teleology. Von Wright simply says (p. 6), «Practically every explanation, be it causal or teleological or of some other kind, can be said to further our understanding of things» – and that broad, non-specialized use of 'understanding' is the use I was starting from when I remarked (above, p. 102) that explanation and understanding go together in a way that explanation and knowledge do not. Aristotle's ἐπιτορήν is not identical with *that* understanding either, but the reasons why it is not go beyond the divergences in the way different languages carve up the lexical field of cognition. I shall be arguing that the interesting restrictions on ἐπιτορήν come from substantive theses on the nature and scope of explanation.

true that English could supply alternative ways of registering Aristotle's contrast between *ἐπιτοραθία* and *γινώσκω* or *γινώσκω* and *γινώσκω*: for instance, suitably introduced and circumscribed, a contrast between a richer and a more ordinary concept of knowledge, for the first of which the label 'scientific knowledge' might do after all. It is not the words that matter, but the thought. Provided that is understood, each of us may best proceed in terms that are *γνώριμα ἡμῖν*. For these linguistic considerations have philosophical consequences which go to the heart of Aristotle's enterprise.

II

To start with an issue of basic importance, consider the claim at the beginning of A 2 (71 b 12, 15-16) that *ἐπιτορία* is of what cannot be otherwise. As a claim about knowledge, this invites (and has received) the criticism that it is simply mistaken, the product of modal confusion. In reflecting on the principle that what I know must be true, Aristotle has construed *necessitas consequentiae* ('It is necessary that, if I know that *p*, then *p*') as *necessitas consequentis* ('If I know that *p*, then it is necessary that *p*')²³.

23. This notorious fallacy is what BARNES (2), p. 97 (cf. p. 112 *ad* 73 a 21), is referring to when he says that the mistake involved in restricting *ἐπιτορία* to what cannot be otherwise is made every 5 years in «Mind». In truth, the mistake perpetrated every 5 years in that journal and elsewhere is the mistake of attributing the fallacy to other philosophers (usually unspecified figures from the past) as the root explanation of their epistemological position. I doubt the explanation is ever that simple, nor would the fallacy suffice to explain the inference Aristotle actually endorses, which is «If I have *ἐπιτορία* of the fact that *p*, then I know that it is necessary that *p*' (I agree with BARNES (2), p. 97, that *μή ἐνδέχεται* is governed by *γινώσκω*). To be sure, Barnes suggests that Aristotle may be innocent of mistake if his account of *ἐπιτοραθία* is intended as a stipulative definition. But this expedient requires an implausibly narrow reference for the 'we' whose thinking the account expounds. It is par-

But if Aristotle is making a claim about understanding, his point will be that understanding depends on explanation and what gets explained in the sciences (*ἐπιτορία* in the objective sense) which produce that understanding (*ἐπιτορία* in the subjective sense) is *general* regularities and connections: lawlike regularities in the modern jargon, necessary connections in Aristotle's (cf. *Eth. Nic.* vi 6, 1140 b 31-2). Scientific explanation answers to such questions as 'Why is the sun eclipsed?' (B 1), 'Why is it that a pair of lines cutting a third line at right angles to it do not meet?' (A 5, 74 a 13-14), 'Why do vines shed their leaves?' (B 16). Aristotle does think one can apply the explanation of a recurring type of phenomenon to a particular instance of it, e.g. today's eclipse, but what this yields is accidental or qualified *ἐπιτορία*, not *ἐπιτορία ἀπλῶς* (A 8). He thus sides with those modern philosophers of science who hold that scientific explanation is in the first instance explanation of generalities (laws) rather than the explanation of particular events.²⁴ He wants to know why the sun is eclipsed at all, i.e. why there are solar eclipses, rather than why it is eclipsed today. When, therefore, he says that *ἐπιτορία* is of what cannot be otherwise, his claim should be read, not as the product of modal confusion, nor as the

technical implausible for the version in *Phys.* ii 3, 194 b 17-20 where Aristotle proceeds at once to collect up a number of patterns of explanation from both ordinary and scientific speech (cf. esp. 194 b 34-5). Notice also *Eth. Nic.* vi 3, 1139 b 20-1: we all suppose that what we *ἐπιτοραθούμεν* cannot be otherwise (cf. *Am. post.* A 33, 89 a 6-10).

24. For an admirable statement of this view, which is not as widespread as it should be, see Michael FRIEDMAN, *Explanation and Scientific Understanding*, «Journal of Philosophy», 71, 1974, pp. 3-19. Note that this interpretation makes intelligible, as the diagnosis of modal confusion does not, how Aristotle could anticipate developing the logical resources for admitting 'for the most part' propositions as objects of demonstration and hence of *ἐπιτορία* (A 30, with BARNES (2), *ad loc.*). It is characteristic of general regularities in the sublunary world to hold only for the most part. For discussion, see M. MIGNOURIC's contribution to this symposium.

stipulation of some specialized concept of his own, nor again as an unexamined legacy from Plato, but as a substantive thesis designed to elucidate a current concept of understanding. That understanding is constituted by knowing the explanation of necessary connections in nature.

We too possess a concept of this kind: a quite ordinary concept, though it is the concept of a specialized type of understanding which is sought in the sciences. We may disagree with Aristotle — philosophers still disagree with each other — about the sense and function to be assigned to the idea of necessity in this context.²⁵ We may have qualms about the restrictions which are imposed on the scope of understanding when Aristotle goes beyond ordinary thought to build the idea of an axiomatized science which will ideally satisfy his stated requirements for *ἐπιστήμη*. But it is important to see that the issues at stake here have much more to do with considerations about explanation than with considerations about what we can know or be certain of.

First, it is because *ἐπιλοτασθαι* involves explanation that Aristotle insists on proceeding from principles which are true, primitive, immediate, more familiar than and prior to and explanatory of the conclusion (A 2, 71 b 29-31). Second, he argues in A 6 that necessity in the premises, transmitting to the conclusion, is a requirement of explanatoriness. Aristotle does not express himself very clearly on why this is so,²⁶ but he is clear that he is not saying, for he does not believe, that a necessary conclusion can only be derived from premises which are necessary (75 a 1-4). His most substantial claim (74 b 26 ff) is that to explain the holding of a conclusion which is necessary one must demonstrate it through a necessary middle term. If the middle term is not necessary, the premise-set could in principle be false

while the conclusion, being necessary, would still be true, and a conclusion which holds whether or not the premises hold does not hold *because* those premises hold; it is not explained by them, nor are they prior to the conclusion in the sense Aristotle intends them to be.

It appears that in a properly ordered science necessity would be transmitted to the theorems from above. To understand a theorem you must understand (*ἐπιλοτασθαι*) not only that it is necessary, but also why it is necessary (A 6, 75 a 12-17)²⁷. It is necessary because it is demonstrable from prior principles which are themselves necessary. These principles in turn are to be not merely necessary but necessary because they are *per se* predications expressing a definitional connection (A 6, 74 b 5-12 with A 4). What is required is a predication *A*∧*B* where either *A* belongs in the definition of *B* or *B* belongs in the definition of *A*. Once again there is unclarity in Aristotle's detailed discussion, not least as regards which features of the principles he thinks are transmitted also to the theorems,²⁸ but it seems fair to say that he is trying to give substance to the idea that the fundamental predications of a science ought to be self-explanatory. They should be not merely immediate, in the sense of not admitting explanation through a middle term (A 2, 71 b 21, 26-7), but should actually explain themselves (cf. A 4, 73 b 16-18, with A 24, 85 b 24-5)²⁹. Their

25. See the contributions to this symposium by A. C. LLOYD and Richard SOKARAJI.
26. For the difficulties, see BARNES (2), notes on the chapter and on A 4, 73 a 21.

27. This refinement is not mentioned elsewhere, but I do not see why it should not be included. *διότι* <ἐνδέχεται ἐκείνο εἶναι> is a more natural way of construing the Greek than either <τό> *διότι* or *διότι* <ἐκείνο ἔστιν> — it is the construal of W. D. ROSS, *Aristotle's Prior and Posterior Analytics*, Oxford 1949, p. 529, as against Mure and Barnes — even though, as Barnes points out to me, *διότι* <ἐκείνο ἔστιν> would yield a neat reprise of A 2's twin conditions on *ἐπιστήμη*.
28. See the several difficulties canvassed in BARNES (2), notes on A 4; also ROSS, *op. cit.*, pp. 521-2.
29. This may suggest that in A 4 the fourth case of *καθ' αὐτό* = *δι' αὐτό* *ὑπόθετον* (73 b 10-11) is not so irrelevant to the general discussion as it has seemed, e.g. to BARNES (2), p. 114. A 10, 76 b 23-4 is also relevant, but with BARNES (2) *ad loc.*

necessity will be directly intelligible from or in the fundamental definitions of the science (cf. A 3, 72 b 24-5; *Top.* viii 3, 158 b 2-4). And it should be remembered here that what Aristotle looks for in a scientific definition is not an analytic truism but substantive knowledge of the essence of something.³⁰

These chapters (A 2-6) are typical of the process whereby Aristotle builds on the ordinary conception of *ἐπιτοκτατα*, to articulate the idea of an axiomatized science. At each step the main motivating consideration has to do with explanation, hence understanding. The man who achieves unqualified *ἐπιτοκτατα* in accordance with Aristotle's prescriptions is a man for whom every 'Why?' question in a given domain has its correct and appropriate answer. (It transpires from A 19-20 that Aristotle is prepared to argue that the number of such questions is certain to be finite.)³¹ Explanation, and so understanding, is then complete (cf. A 24, 85 b 27-86 a 3). The man of understanding has a grasp of the answers which is both systematic and synoptic, in that everything in the domain of his science is explained in the light of first principles which explain themselves. If this sounds like the grand vision of Plato's *Republic* transferred to the individual sciences, well and good: A 33 contrasts *ἐπιτοκτατα* and *ᾄδεα* (meaning '[mere] opinion'; not 'belief' or 'judgement' in general, for which the chapter uses other terms³²), and discusses problems arising out of the contrast, in a manner unmistakably reminiscent of *Republic* V. Aristotle too has his vision of a complete understanding, and it is this that finally supports his claim that one can have *ἐπιτοκτατα* only of things universal, necessary and everlasting,

30. See Richard Sorabji, *Aristotle and Oxford Philosophy*, « American Philosophical Quarterly », 6, 1969, 127-135.

31. This is of course compatible with the (admittedly curious) suggestion at *Soph.* *el.* 9, 170 a 22 that the number of *ἐπιτοκτατα* may be infinite.

32. Accordingly, the contrast and the association of *ᾄδεα* with what can be otherwise (cf. *Eth. Nic.* vi 5, 1140 b 27) has little to do with the problem of distinguishing knowledge from true belief.

not of things particular, perishable or accidental (A 6, 75 a 18-37; A 8, A 30, A 31, *Metaph.* E 2).

Aristotle is not saying, for example, that we cannot know what accidental states of affairs obtain in the world. His contention is that the accidental falls outside the reach of systematic explanation and understanding. 'Of things which are or come about accidentally the cause also is [the cause] accidentally' (*Metaph.* E 2, 1027 a 6-7), where 'accidentally' is defined as 'neither always/necessarily nor for the most part' (1026 b 31-3; cf. A 30). There is no general or generalizable explanation of a pale man's being musical or of a builder effecting a cure; at best, the individual cases may be traced each to their own cause³³. But since the causes of the accidental are in this sense indeterminate or irregular (*Phys.* II 5, 196 b 23 ff; *Metaph.* A 30, 1025 a 24-5; K 8, 1065 a 32-5), knowing them is not *ἐπιτοκτατα*. It is not understanding a recurring type of phenomenon from first principles. It is not even the accidental or qualified *ἐπιτοκτατα* which we have when we apply the explanation of a recurring type of phenomenon to a particular instance of it, e.g. a particular eclipse (A 8)³⁴.

33. I say 'at best' because in some cases Aristotle may wish to say that there is no cause/explanation. Richard Sorabji, *Necessity, Cause and Blame* (London 1980), chap. 1, has a highly suggestive interpretation of *Metaph.* E 3 on just these lines. Another relevant item is *Poetics* chap. 7: a well-constructed tragic plot presents a unified sequence of events, following each other in virtue of necessity or for the most part connections (that the connections are generalizable is the famous message of chap. 9), which connections *break* at the beginning and end of the sequence.

34. Here I must dissent from a well-known thesis of Jaako Hintikka, *Time and Necessity: Studies in Aristotle's Theory of Modality*, Oxford 1973, chap. iv. Hintikka, proceeding from the (false) premise that *εἰδέναι* means 'to have seen', argues on this basis that for Aristotle the question what there can be *ἐπιτοκτατα* of amounts to the question, What is such that past observation guarantees its being so (still) in the present? Answer: only that which is changeless, hence necessary. This connects Aristotle's necessary requirement with the need to be assured of the *truth* (rather than the explanation) of what one *ἐπιτοκτατα*. Aristotle's own justification of the necessity requirement in *An. post.* is in

Again, the reason why according to Aristotle there is no $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ through perception of particular things or events is that one does not in perception discover why something is as it is. Explanation imports generality, which is beyond the scope of perception (A 18, 81 b 6-7; A 31; *Metaph.* A 1, 981 b 10-13). But this is not to say that perception does not yield knowledge: $\alpha\lambda\theta\eta\sigma\iota\varsigma$ is not $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ but it is (one type of) $\gamma\nu\alpha\sigma\iota\varsigma$ (B 19, 99 b 38-9; *Metaph.* A 1, 980 a 21-7; 981 b 11-13; *De Gen. an.* I 23, 731 a 30-4; *De Mem.* 1, 449 b 13-14; cf. *Top.* I 12, 105 a 17-18; v 3, 131 b 23-8; VIII 1, 156 a 7-8; *An. post.* A 2, 72 a 2-3; *Phys.* I 5, 188 b 32; 189 a 5-9).

Now remember that these restrictions on what there can be $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ of are not just restrictions on the types of

the main very different, as we have seen, and in A 8 the restriction of $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ to unchanging things is a consequence of the necessity requirement, not the other way round. At best, the point Hintikka stresses, that for Aristotle non-necessary propositions can change their truth-value, has a minor role in justifying necessity at A 6, 74 b 32-9.

Some passages written after Aristotle had done his systematic analysis of $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ in the *Posterior Analytics* seem to look more kindly on the argument that $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ must be of what is necessary and unchanging for the reason that we cannot be assured of the continuing truth of contingent propositions: *Eth. Nic.* VI 3, 1139 b 21-3 (brief and summary); *Metaph.* Z 15, 1039 b 27-1040 a 7 (cited by Hintikka, pp. 75-6). But from two passages which Hintikka does not notice (*Metaph.* Z 10, 1036 a 3-8; *Top.* v 3, 131 b 19-33), it appears that the argument is chiefly about *singular* propositions. If you have a proposition predicating a necessary property of a contingently existing subject, e.g. « This bronze circle is F » or, for that matter, « This mathematical circle is F », or a proposition predicating a contingent property of a necessarily existing subject, e.g. « The sun is the brightest body moving above the earth », then you cannot be certain of their continuing truth once the subject has passed out of your ken (be this by way of $\alpha\lambda\theta\eta\sigma\iota\varsigma$ or of $\nu\theta\lambda\eta\sigma\iota\varsigma$). But for all that there remain necessary properties of the sun and general theorems on circles, and these you can continue to know (cf. *Metaph.* Z 10, 1036 a 6-8). So the argument is in any case not sufficient to divide off circles and the sun, which are proper objects of $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$, from pale men, who are not. For this there is no better justification than the justification in terms of explanation which is given in *An. post.* itself.

proposition which can find a place within an axiomatized body of knowledge ($\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ in the objective sense) or on the types of thing which can be made the object of systematic science. They are also restrictions on the possible objects of $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ / $\epsilon\pi\lambda\omicron\sigma\tau\alpha\sigma\theta\epsilon\iota\alpha$ as a cognitive state of a person. If that state is taken to be knowledge in the sense connected with justified true belief, Aristotle comes out with a remarkably sceptical view about our knowledge of mundane matters of fact involving perceptible physical objects and their contingent (accidental) properties. Roughly, we have no knowledge of such things, or none in the stricter sense of the word. If, on the other hand, we are serious about taking $\epsilon\pi\alpha\sigma\tau\eta\rho\eta$ / $\epsilon\pi\lambda\omicron\sigma\tau\alpha\sigma\theta\epsilon\iota\alpha$ as understanding, the restrictions are intelligible (which is not to say they are uncontroversial) and Aristotle can be seen to be arguing for them in an intelligible and appropriate manner from considerations about explanation.

III

It is equally important to notice what considerations Aristotle does *not* appeal to in these contexts. Evidence, certainty, justification — these central concepts of the theory of knowledge have little or no place in his present concerns.³⁵ This is reason, of course, for disavowing the once prevalent idea that the *Posterior Analytics* advocates demonstration as the method of scientific discovery. But it is also reason for entering a caveat, or at least a corrective,

35. Consequently I think it misleading of BARNS (2) to use 'certain' to translate $\delta\epsilon\chi\phi\beta\epsilon\iota\alpha$, e.g. in A 27, even with the elucidation offered in his notes *ad loc.* The clarity which Aristotle associates with $\delta\epsilon\chi\phi\beta\epsilon\iota\alpha$ at *Top.* II 4, 111 a 9 should be the clarity of precision and simplicity (*Metaph.* A 2, 982 a 25-8; M 3, 1078 a 9-13), not epistemological certainty. It is especially misleading to introduce suggestions of epistemological certainty into B 19 at 99 b 27, 100 b 8; as we shall see, that is not the emphasis needed to make sense of Aristotle's doctrine of $\nu\theta\lambda\eta\sigma\iota\varsigma$.

to the view, which promises to become a new orthodoxy, that the *Posterior Analytics* advocates demonstration as the method of teaching or imparting knowledge.

This view has been ably argued by Jonathan Barnes, and I will proceed from his formulation of it:

... the theory of demonstrative science was never meant to guide or formalize research: it is concerned exclusively with the teaching of facts already won; it does not describe how scientists do, or ought to, *acquire* knowledge: it offers a formal model of how teachers should *present and impart* knowledge.³⁶

Let us agree that Aristotle, very sensibly, does not present demonstration from first principles as the way to find new facts or to excogitate and confirm new explanations. That disposes of the old view that demonstration is the method of research. But now suppose I am a teacher who must impart to my pupil facts and explanations which are *new to him*. Does Aristotle think that demonstration from first principles is the way to get him to know what he did not know before? That would be poor pedagogy, and a surprising lapse from the enlightened educational traditions of the Academy. It would be contrary also to Aristotle's repeated indications that, so far at least as first principles are concerned, the pupil must be led to them, by nonformal methods, from what is more familiar to him (e.g. *Top.* I 2, 101 a 36 - b 4; VI 4, 141 b 17-19; *Phys.* I 1; *Eth. Nic.* I 7, 1098 a 33 - b 4; VII 3, 1139 b 28-31; VII 8, 1151 a 16-18). But it would be only slightly better pedagogical practice, at least in the nonmathematical sciences, if I tried to take my pupil straight to the first principles and, once there, launched into a remorseless chain of syllogistic deduction.

36. Jonathan BARNES, *Aristotle's Theory of Demonstration*, « *Philosophy* », 14, 1969, henceforth cited as BARNES (1) from the revised version in *Articles on Aristotle*, *op. cit.*, where the passage quoted appears on p. 77. The points I want to concentrate on can be signalled by redistributing the italics: «... how teachers should present and impart knowledge ».

That would mean expecting the novice to come to know, for the first time, the theorems of the science on the evidence solely of their having been demonstrated from first principles; I would not concern myself with the evidential support that particular theorems might find closer to the pupil's own experience. But in Aristotle's own treatises he is constantly, one might almost say obsessively, reaching for evidential support from any reputable (ἑυδοκῶν) source he can cite. It is one great drawback of Barnes' interpretation that the treatises, since they are plainly not 'pieces of formal instruction' on the demonstrative model, have to be discounted as not having 'pedagogic form':

A series of demonstrations is appropriate to the setting out of knowledge securely achieved; it is inappropriate to the sharing of tentative philosophical or scientific explorations.³⁷

Barnes has to describe the treatises as tentative throughout because he has committed Aristotle to the unenlightened pedagogical view that once he was sure of his results he ought to teach them in demonstrative form.

It seems to me that this is one more place where a distinction between knowledge and understanding can be helpful. Teaching in the sense of imparting knowledge to people who did not have it before must normally include the citing of evidence and justification. The path by which the pupil is led to knowledge which is new to him cannot be wholly unconnected with the path by which the teacher won that knowledge in the first place. (I am referring here to the evidential base for a scientific discovery, not to the methods used in the search). From this point of view Aristotle's treatises can perfectly well be regarded as instruments of teaching, which indeed they often claim to be. But teaching may also be designed to impart understanding of knowledge which the pupils already have, or a deeper understanding

37. BARNES (1), p. 84.

of a science which they already have some acquaintance with but in an unsystematic way. I do not think that the concerns of the *Posterior Analytics* are exclusively pedagogical: understanding is first worth having for oneself, because of what it is in itself, namely, an excellence of the intellectual part of the soul (*Metaph.* A 1-2; *Eth. Nic.* VI 1, 1139 a 27-9; VI 2, 1139 b 12-13; VI 12, 1144 a 1-3), and that is why, derivatively, it is worth communicating to another. But to the extent that Aristotle is moved by an educational interest, ³⁸ one should think of this not in terms of a teacher imparting new knowledge to virgin minds but in terms of an advanced university course in mathematics or biology. The scientist aims to display and share his principled understanding of the field – an enterprise which presupposes a good deal of pre-existing knowledge on the part of his audience. And this in turn allows the informal efforts of the treatises to be directed at the securing and communicating of knowledge newly won by Aristotle himself.

We must not be misled here by the parallelism between demonstration and induction (*ἐπαγωγή*) expressed in such statements as: 'We learn either by induction or by demonstration' (A 18, 81 a 40; cf. A 1, 71 a 5-9; *Eth. Nic.* VI 3, 1139 b 26-8). Barnes argues: demonstration and induction are paired here with regard to their function; the function of induction is given as making things known (A 3, 72 b 29-30; A 18, 81 b 2-4) or revealing things to someone (B 5, 91 b 32-5), i.e. instruction; therefore, the function of demonstration also is to instruct ³⁹. The Greek for what induction does in these passages is γινώσκουσι ποιεῖν, γινώσκουσι ποιεῖν. Certainly demonstration could do this too (some of the deductions taught in the advanced university course will bring new information). Aristotle describes a case of coming to know something by deductive inference

in A 1, 71 a 17 ff, using γινώσκω, γινώσκειν. Knowing already that every triangle has angles equal to two right angles, I see that this figure in the semicircle is a triangle and immediately infer that it has angles equal to two right angles. The case illustrated involves perception of a particular and simultaneous inference to new information, but the thesis behind it, that deduction can bring new knowledge need not be so restricted (compare B 8, 93 a 17-19: sometimes the fact becomes clear/known at the same time as its explanation), and elsewhere we meet the somewhat incautious statement that all conviction is the result either of syllogism or of induction; ⁴⁰ Aristotle presumably means that where conviction has reasons, these reasons must be either deductive or inductive. So there undoubtedly is the parallel between demonstration and induction as regards their imparting knowledge. Nonetheless, there remains an asymmetry between the two which is more important for the aims of the *Posterior Analytics* than the parallelism: demonstration can and induction cannot ἐπισημαίνειν ποιεῖν. And ἐπισημαίνειν, not simply γινώσκω, is what the *Posterior Analytics* wants demonstration for (A 2, 71 b 25).

I conclude that the pedagogical interests of the *Posterior Analytics* are concentrated on teaching as the imparting of understanding, rather than as the imparting of knowledge. 'Those who teach are those who state the explanations about each thing' (*Metaph.* A 2, 982 a 29-30). This is a remark about ordinary language, given (in characteristic fashion) as evidential support for a doctrine to the effect that one science or branch of knowledge (*ἐπιστήμη*) is more διδασκαλική than another if it is more concerned with explanations. It is more instructive if it is more explanatorily illuminating. (Examples to illustrate the doctrine can be culled from the account of higher and lower

38. For evidence on this, see BARNES (1), pp. 77-80.

39. BARNES (1), pp. 81-2.

40. *An. pr.* II 23, 68 b 13-14: ἕκαστα γὰρ πιστεύουσιν ἢ διὰ συλλογισμῶν ἢ ἐξ ἐπαγωγῶν ἦς.

sciences in *An. post.* A 13). Teaching, διδασκαλία, in the sense Aristotle is chiefly interested in, is explanatory illumination, the conveying of understanding.

IV

At this point the question may be raised whether my account of Aristotle's pedagogical philosophy really improves the claims of demonstration to be an enlightened instrument of teaching. The answer, it seems to me, depends on whether we agree with Aristotle on the answers to certain prior philosophical questions about understanding.

The key to understanding is demonstration, and in the *Posterior Analytics* as we have it the demonstration Aristotle has in mind is, above all, demonstration by (apodeictic) syllogisms in *Barbara* (A 14). Against this we can set a broad notion of demonstration matching the broad notion of syllogism⁴¹ laid down at *An. pr.* 1 1, 24 b 18-20. As Aristotle puts it in the *Topics* (I 1, 100 a 25-30): syllogism is an argument in which, certain things being laid down, something else follows of necessity from the things laid down, because of the things laid down, while demonstration is a syllogism (as so defined) which proceeds from things primary and true or from things known on the basis of things primary and true. So which demonstration, broad or narrow, do we have to confront on the issue of teaching? Both. It is a substantive thesis of Aristotle's logic (*An. pr.* I 23) that all syllogism in the broad sense, and hence all demonstration in the associated broad sense, can be reduced to syllogistic form in the narrow sense defined by the figures. And that noble mistake becomes in turn a thesis of Aristotle's philosophy of science. A 14 states roundly that the first figure is the most productive of understanding

(ἐπινοητικόν), that it is the paradigm vehicle of explanation, and that it is already exemplified in the mathematical sciences. Even if, as Jonathan Barnes so persuasively argues in his contribution to this symposium, this is to be viewed as a syllogistic reconstruction of a theoretically, and perhaps also chronologically, prior theory of demonstration (broad sense), it is clear that Aristotle did not think syllogistic incompatible with the claims he wanted to make on behalf of demonstration. The remarks in A 14 rather suggest that he thought his claims were strengthened by the supposed availability of a formally rigorous reduction for all explanatory demonstration.

Suppose, then, we accept that there is a kind of understanding that is to be gained, and is only to be gained, from relating and organizing knowledge which has so far been acquired in an informal or unsystematic way. It by no means follows that understanding is to be sought from putting the knowledge into Aristotle's demonstrative mould, with or without the syllogistic reduction. It is possible to use language quite close to Aristotle's in the service of a conception of understanding far removed from his; as in the following specimen of Eighteenth Century philosophical English, which is in fact — and this fact will concern us later — an attempt to sum up the lessons to be learned from Plato's proof in Part I of the *Theaetetus* that perception is not ἐπινοήματα.

We know a thing when we understand it: and we understand it when we can interpret or tell what it signifies. Strictly, the sense knows nothing. We perceive indeed sounds by hearing, and characters by sight; but we are not therefore said to understand them. After the same manner, the phenomena of nature are alike visible to all; but all have not alike learned the connexion of natural things, or understand what they signify, or know how to vouchsafe by them. There is no question, saith Socrates in *Theaeteto*, concerning that which is agreeable to each person, but concerning what will in time come to be agreeable, of which all men are not equally judges. He who foreknoweth what

41. 'Deduction' in the terminology used by Barnes in his translation and in his contribution to the present volume.

will be it: each kind is the wisest. According to Socrates, you and the cook may judge of a dish on the table equally well, but while the dish is in the making, the cook can better foretell what will ensue from this or that manner of composing it. Nor is this manner of reasoning confined only to morals or politics, but extends also to natural science.

Thus Bishop Berkeley, expressing his vision of science as 'a grammar for the understanding of nature', where 'grammar' and 'understanding' mean no more than a systematic grasp of general rules over observables enabling us to 'vaticinate' or predict the course of nature, which for Berkeley is God's language to us⁴². Berkeley agrees that understanding requires a systematic connecting and organizing of phenomena independently known, but his conception of science as a set of predictive devices connecting observables is as far removed from Aristotle's as any could be.

Now one reason for the distance between Berkeleyan and Aristotelian understanding is, of course, that Berkeley has no room for a conception of explanation which goes further than the subsumption of phenomena under predictive generalizations⁴³. Whereas Aristotle, notoriously, demands

42. George BERKELEY, *Siris*, § 253 with § 252. For his interpretation of the *Theaetetus* see also § 304-5 and my further remarks below. Note that « Strictly, the sense knows nothing » uses 'knows' in the meaning just defined for it, viz. 'understands', not in the meaning in which Berkeley held that the *esse* of sensible things is their being « perceived or known » (*Principles of Human Knowledge*, § 6). Note also that what Berkeley is defining here is what I earlier (above, p. 108) called a richer sense of the English verb 'to know'.

43. Cf. BERKELEY, *De Motu*, § 37: « A thing can be said to be explained mechanically then indeed when it is reduced to those most simple and universal principles, and shown by accurate reasoning to be in agreement and connection with them. For once the laws of nature have been found out, then it is the philosopher's task to show that each phenomenon is in constant conformity with those laws, that is, necessarily follows from those principles. In that consist the explanation and solution of phenomena and the assigning their cause, i.e. the reason why they take place ». § 39: « And just as geometers for the sake of their

much more. But we must be careful here. Some enthusiastic recent writing has commended Aristotle for seeing the deficiencies in the covering law (deductive-nomological) model of scientific explanation⁴⁴. The prize exhibit is the example in A 13: 'The planets do not twinkle; all objects that do not twinkle are near the earth; therefore, the planets are near the earth'. About this example (and likewise about the similar examples in B 16) Aristotle states, perhaps rightly, that it is not explanatory. The fact that the planets do not twinkle does not explain why they are near the earth, but rather their being near the earth explains why they do not twinkle. Hempel says of a similar case (the pendulum, whose period can be inferred from its length and vice versa) that 'the common sense conception of explanation appears to provide no clear grounds on which to decide whether a given argument that deductively subsumes an occurrence under laws is to qualify as an explanation⁴⁵'. Thus, in so far as Hempel — like Aristotle — is not seeking a descriptive analysis of the ordinary notion of explanation but (in the technical jargon) an *explication* of it, leading to a more precise and fruitful characterization of explanatory procedures in natural science⁴⁶, it is not

art make use of many devices which they themselves cannot describe nor find in the nature of things, even so the mechanician makes use of certain abstract and general terms, imagining in bodies force, action, attraction, solicitation, etc. which are of first utility for theories and formulations, as also for computations about motion, even if in the truth of things, and in bodies actually existing, they would be looked for in vain, just like the geometers' fictions made by mathematical abstraction ». (Tr. Luce).

44. B. A. BRODY, *Towards an Aristotelian Theory of Scientific Explanation*, « Philosophy of Science », 39, 1972, pp. 20-51; SOKRATY, *Necessity, Cause and Blame*, *op. cit.*, chap. 3; BARNES (2), p. 150, is more cautious, as is Günther PYZG in his contribution to the present symposium.

45. Carl G. HEMPEL, *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*, New York & London 1965, p. 353.

46. HEMPEL, *ibid.*, pp. 488-9.

clear that it is a deeply serious matter for him if his criteria count the planets example as explanatory.⁴⁷ Further, Hempel's Aristotelian critics should tell us whether they favour a position as strong as Aristotle's, which is that *no* pair of converting terms is such that explanation can run both ways (B 16-17, esp. 98 b 16-24). For example, Aristotle would not accept that one could explain why a certain substance is gold by reference to its atomic number and also explain why it has a certain atomic number by reference to its being gold. But now, I suggest, it is Aristotle who is at variance our ordinary notion of explanation.⁴⁸ Even if in some important sense one of the converting terms in the gold example is prior to the other (and Aristotle might take a different view from us about which is which), this is only relevant against Hempel if the priority in question can be elucidated independently of ideas about explanation. Here Aristotle can rest on a metaphysical system which posits real priority and posteriority in nature (see below), but it would be a bold follower who sought to revive that option today. And it is in any case important — far more important — to add that it is only Berkeley's instrumentalism, not Hempel's

47. They do not, of course, count it explanatory unless « All objects that do not twinkle are near the earth » is taken to be true, testable, and above all lawlike (that is, entailing counterfactuals of the form « If x did not twinkle, x would be near the earth »). For some cautionary remarks about apparent counter-examples which trade on doubts about the lawlikeness condition, see HEMPEL, *ibid.*, pp. 374-5.

48. Why should our intuitions be different (if I am right that they are different) in the gold and in the planets/pendulum examples? Günther Patzke's contribution to this symposium makes some interesting suggestions about temporal genesis which would fit the planets and the pendulum but not the gold example. This inclines me to think his suggestions are on the right lines. See also Adolf GRUBBAUER, *Temporally Asymmetric Principles, Parity between Explanation and Prediction, and Mechanism versus Teleology*, in B. BAUDRIN ed., *Philosophy of Science: The Delaware Symposium*, Vol. 1, 1961-1962, New York & London 1963, pp. 57-96, at pp. 90-1.

covering law theory, which must admit that the planets example is as *good* an explanation, as *good* a case of understanding, as any we can have.

On Hempel's view, explanation becomes more powerful as it is incorporated into wider, more embracing systems of theory.⁴⁹ This gives him middle ground between Berkeley and Aristotle for his account of the kind of understanding that we get from systematically organized explanation; he has quite a lot to say about what it takes for one explanation to give us deeper insight and understanding than another.⁵⁰ This middle ground is important. It allows us to think that the conditions for understanding are interdependent, if not with the conditions for explanation, then at least with the conditions for good (illuminating) explanation.⁵¹ A rejection of the Berkeleyan picture of scientific understanding is by no means sufficient to push us all the way to Aristotle's account of understanding in terms of demonstration from first principles in a fully axiomatized system. What it would take to get us that far is nothing less, but also nothing more, than a whole-hearted Aristotelian conception of the possibilities for complete explanation. And the existence of middle ground makes a difference also to the issue of teaching. To the extent that we doubt that understanding, or the most important type of understanding, is the fruit only of axiomatization, to that extent we shall doubt that demonstration is the mode in which to impart understanding. But equally, to the extent that we believe that full understanding requires axiomatization,

49. BROU, *op. cit.*, pp. 20-1, discounts this non-Berkeleyan element in Hempel before proceeding to his critique; but the discounting rests on little but the rhetorical question « Why should laws that explain more explain better? », a question which Hempel had certainly tried to answer (see next note).

50. HEMPEL, *op. cit.*, p. 278 ff, pp. 345-7, p. 444; cf. also his *Philosophy of Natural Science*, Englewood Cliffs 1966, pp. 75-7, where he states clearly that explanatory import is only a minimal necessary condition for illumination and scientific interest.

51. Compare FRIEDMAN, *op. cit.*, p. 14 ff.

to that extent we shall propose demonstration, even (we) we to accept the reduction (thesis) syllogistic demonstration, as the means to convey understanding. If we agree with Aristotle about the benefits of axiomatization, our pedagogy will follow suit.

I conclude that a teacher can sensibly aspire to conduct Aristotelian demonstrations if it is right to claim that, where we can achieve the full axiomatization of a science, that axiomatization will provide us with a completed structure of explanation which should be the ideal fulfillment of a common conception of understanding. Whether or not a modern proponent of axiomatization could believe this, it is well nigh compelling if (as Aristotle does) you believe, what is now usually held to be false, that for any science there is just one adequate set of axioms and if, further, you believe (as Aristotle does) that these axioms are true, primitive, immediate, more familiar than and prior to and explanatory of a complete and finite set of theorems. If such axiom sets are possible, they are surely necessary for a wholly adequate understanding. The inference whereby Aristotle at A 2, 71 b 19-20, argues that, if τὸ ἐκταραθῆαι has the character it is commonly conceived to have, then it is necessary that (ἀνάγκη) apodeictic ἐπιστήμη be grounded upon an axiom set of the specified kind, would be outrageous if it was an inference about knowledge in the sense we are used to in philosophy, but it has every justification as an inference about understanding, given Aristotle's belief that there is real priority and posteriority in nature. For Aristotle, an axiomatic system is not just a preferred ordering of humanly constructed knowledge, but a mapping of the structure of the real.

v

From this metaphysically vertiginous thought let us pull back to the cognitive state of the ἐπιστήμειος. I have

emphasized Aristotle's lack of concern with evidence, certainty and justification, concepts which for us are central to the theory of knowledge, and I have used this point to help shift our focus to the notion of understanding. But it is time to backtrack with some qualifications and concessions.

It may be objected to the account I have been giving that in A 2 itself, at 72 a 25 ff, Aristotle states it as a requirement of ἐπιστήμη that I both know (εἰδέναι, προγγνώσκων, γνωρίζων) and am convinced of (πιστεύων) the first principles more than the theorems, and the reason he gives for making this requirement is that it is because (we know and are convinced) of the first principles that we know and are convinced of what is demonstrated from them (72 a 30-2). May this not show that he does, after all, think of the first principles as grounds or evidence for knowledge of what comes later, serving as such in virtue of the fact that deductive argument transmits certainty as well as necessity to its conclusions?

There is a sense, I think, in which this objection is correct, but it is not a sense that would normally interest philosophers who analyze knowledge as justified true belief. None of these could say, what Aristotle blandly says in A 25 without hesitation or clarification, that the explanation of something (τὸ δι' οὗ) is more convincing (πιστότερον) than its explanandum (86 b 5, 27, 30). Aristotle takes this to be obvious. He cannot mean that an explanation is easier to believe than the fact it explains, or that the evidence for it is more accessible to us. On the contrary, being more universal it is more remote from our experience, as Aristotle himself indicates in the previous chapter (A 24) and elsewhere (A 2, 72 a 4-5). His point is that the explanation, being prior to what it explains, is more knowable or familiar in the order of nature (γνωστότερον τῆ φύσεως), and if it is more knowable, then (he assumes or infers) it is more believable and convincing (πιστόν) as well (cf. A 25, 86 a 38-9; b 27, 29-30). This connection between the knowable

(familiar) and the convincing is significant. It shows that the distinction which has governed the treatise since A 2 (71 b 33 - 72 a 5), the celebrated and all-pervasive Aristotelian distinction between what is more knowable or familiar in the order of nature and what is more knowable or familiar to us, is intended quite literally. It points not only to a natural order of explanation – an order of explanation which is not relative to the knowledge and needs of particular persons⁵² – but also, in view of the remarks about conviction, to a corresponding difference of cognitive state between the man who has the conviction which comes from a grasp of first principles and the man whose conviction rests on experience (cf. *Top.* VI 4). Both types of conviction must rank as knowledge (*γνώσις*), but this is not inconsistent with the interpretation I have been giving. Aristotle says in the very context we are considering that demonstration produces *γνώσις* (A 25, 86 a 36; cf. B 16, 98 b 19-24), and he says it in the course of an argument which implies that demonstration always produces *γνώσις*; for his point is that the more knowable (familiar) and the fewer the premises, the better the demonstration and the quicker and more effectively *γνώσις* comes. Even so we may still and should still allow *γνώσασθαι* to contrast with *ἐπιτορασθαι* in the usual way. But this time it is knowledge as a grasp of what is knowable by nature. This is knowledge which comes with understanding, not knowledge as contrasted with mere true belief, which is the concept now analyzed in terms of true belief plus justification or evidence. It is *γνώσασθαι* as that notion is defined in the *Physics* account I quoted earlier.⁵³

52. On this point compare *Μοναρχικ.*, *op. cit.*, p. 625.

53. The *γνώσις*-*πράξις* parallel also helps with the old problem of whether to translate *γνώσις* 'known' or 'knowable'. For a good statement of the issue, see Wolfgang WIRZMAN, *Die aristotelische Physik*, Göttingen 1962, p. 71, n. 2, who prefers 'known' and argues impressively (p. 71 ff) for the thesis that the *γνώσις* *τῆς φύσεως* are actually known by us all along, but implicitly. We have an implicit grasp of the principles in the light of which

To vindicate this distinction between knowledge with and knowledge without full understanding, we ought to see whether, in Aristotle's view, it would in principle be possible for a man to know all or a large part of the propositions of a science in the sense of having grasped them with the knowledge we have of things familiar to us, and yet not to have achieved full understanding. A passage in the *Nicomachean Ethics* (VI 3, 1139 b 33-5) tells us that it is indeed possible. It is possible if you still find the conclusions more knowable (familiar) and more convincing than the first principles. Then you have *ἐπιτορήν* only in an accidental or qualified way.

Another passage from the same work (VII 3, 1147 a 21-2) suggests that something like this might be the condition of apprentice learners, of *πρώτων μαθόντες*. These must be our university students, not schoolkids, for they can connect

the things known to us are also known (by us, implicitly) in the order of nature. Rather than raise questions about whether this would work plausibly for the biological sciences, say, I simply suggest (a) that the *γνώσις* is no more that which is actually known than the *πράξις* is that which is actually believed, (b) that, by the same token, it would be as wrong to say that the *γνώσις* is merely what *can* be known as to say that the *πράξις* is merely that which *can* be believed. 'Can be' is too weak (for the reasons Wieland gives), 'is actually' too strong (as implying that every *δέξις* is known, at least implicitly), but *tertium datur*. A convincing story is not one that actually convinces, but rather one that will *tend* to convince *unless* some further factor (e.g. contrary evidence) interferes to prevent it. Likewise, the *γνώσις* may be taken as that which is of a nature to be known (*ἄν. πρ.* II 16, 64 b 34-5: *πρόφασε γνώσεσθαι*): it has, as it were, a tendency to be known and it will actually be known if you attend to it or think about it in the appropriate way. What the appropriate way is will be different for *γνώσις* *τῆς φύσεως* and *γνώσις* *ἡμῶν* (cf. *Top.* VI 4, 142 a 2 ff), but in either case the condition is non-trivial and finds support at *Eth. Nic.* I 4, 1095 b 7-9, where Aristotle says of the well-brought up beginner that he has *or can easily get hold of* *ἀρετῆς* (= *τὸ εἶναι* = *τὸ γνῶσις* *ἡμῶν*). The essential point (*Top.*, *loc. cit.*; cf. *Metaph.* A 2, 983 a 11-21) is that *τὸ ἀπὸ ἀρχῆς γνῶσις* is not *γνώσις* to all men, but to those whose thought is properly disposed (*τοὺς εὖ διασκευμένους τῆν διάνοιαν*) as a result of training (*ἀκροβαστείας δὲ γεννηθέντος*).

together the propositions of a science in an orderly way, but have not yet mastered them (*λογασί δ' οὐκ ἔστιν*).⁵⁴ For that the propositions must become second nature to them, and this takes time. There is good reason to think that these apprentice learners are on the way to making what is knowable in nature be what is knowable to them, that being the formula Aristotle uses to specify the goal of learning (*Metaph.* Z 3, 1029 b 3-12; cf. *Phys.* I 1; *Eth. Nic.* I 4, 1095 a 30 - b 4). If so, then the passage suggests that what is needed to complete the process may not be more evidence — of *πρακτικὸν μαθήματα* can quite well be imagined to have enough evidence already — but intellectual practice and familiarity. There is such a thing as intellectual habituation as well as moral habituation, and in Aristotle's view both take us beyond mere knowing to types of contemplative and practical activity which are possible only when something is so internalized as to have become one's second nature.⁵⁵

This conclusion is in keeping with recent studies of B 19 which have emphasized that Aristotle does not envisage the *voûs* which is our grasp of first principles as a faculty

54. Ross in the Oxford translation renders *συνελεγεῖν* 'string together', and at the time of writing may not have intended the disparagingly, or even usually, disparaging in Aristotle's vocabulary. It is disparaging at *Metaph.* N 3, 1090 b 30; *De divin.* 2, 464 b 4, but not at *Soph.* cf. 16, 175 a 30; *Metaph.* A 5, 986 a 7; α 3, 995 a 10; N 6, 1093 b 27; *De gen. et corr.* I 2, 316 a 8; II 10, 336 b 33; *De gen. an.* I 2, 716 a 4; II 5, 741 b 9; *Probl.* XI 54, 905 a 19. Especially relevant to the present discussion is *Top.* VIII 3, 158 a 36-7.

55. In the context *εὐδαιμονία* stands in for *ἐλευθεροφύλα*, however 'lightly' that verb may be used.

56. The parallel between the intellectual and the moral spheres is hinted in several places by Kosman, *op. cit.*, and by Aristotle at *Metaph.* Z 3, 1029 b 3-12; Cf. *Top.* VI 4, 142 a 9-12; *Eth. Nic.* VII 8, 1151 a 15-19. I try to build up a picture of Aristotelian moral habituation, of this becoming one's second nature (a process which is itself partly cognitive, a genuine learning) in *Aristotle on Learning to be Good*, in Annelie Oksenberg Rorty ed., *Essays on Aristotle's Ethics* (forthcoming).

for intuitive discovery.⁵⁷ Aristotle calls *voûs* both *γνώσις* (99 b 22; cf. b 18) and *ἐπιστήμη* (99 b 24; cf. A 2, 71 b 16; A 3, 72 b 18-21; A 9, 76 a 16-22; A 33, 88 b 36), and does so in a manner which implies that these are different designations of it.⁵⁸ So they are, but I have explained how they coincide when the cognitive goal is achieved. A faculty for intuitive discovery is not needed because discovering or coming to know (*γινώσκω*, 100 b 4) first principles is a matter for induction: on this B 19 is in agreement with pronouncements Aristotle makes elsewhere (*Phys.* I 2, 185 a 12-14; *Eth. Nic.* I 7, 1098 b 3; VI 3, 1139 b 27-31). Aristotle sees no Humean problem about a leap from inductive evidence to *knowledge* (*γνώσις*). He simply thinks, as we saw earlier, that induction *can* give us knowledge, *γνώσις*. Hence, as he sees the problem of our grasp of first principles, the difficulty is not a lack of evidence to transform inductive belief into certain knowledge. That inductive belief is already knowledge (*γνώσις*). What it is not yet is understanding and that kind of *γνώσις* which goes with understanding. To acquire this at the level of first principles what we need is greater familiarity, perhaps some more dialectical practice; in short, intellectual habituation. For remember that the first principles are self-explanatory. Further, just as the first principles explain themselves, so too they are knowable through themselves (*δι' αὐτῶν πέφυκε γινώσκεισθαι*) and convincing in themselves (*Top.* I 1, 100 b 18-21; *An. pr.* II 16, 64 b 32 ff; cf. *Phys.* II 1, 193 a 4-6). They stand in no need of anything else to convince you of their truth or to allow you to grasp their truth: that is, to know them in the way that goes with understanding. Faced with propositions which one has come to know perfectly well on

57. Kosman, *op. cit.*; J. H. Lesher, *The Meaning of NOYΣ in the Posterior Analytics*, «Phronesis», 18, 1973, pp. 44-68; Barnes (2), pp. 248-60; D. W. Hamlyn, *Aristotelian Epagoge*, «Phronesis», 21, 1976, pp. 167-184.

58. Barnes however does not translate the *xal* at 22 and his note on p. 249 paraphrases it 'i.e.'.

inductive grounds and which are convincing and, moreover, knowable in themselves, all one needs to do is: become fully and completely familiar and convinced. That conviction and understanding is νόϋς, the γνωπίζουσα ἐξίς which grasps the things which are most knowable and familiar in themselves (100 b 9-10; cf. A 3, 72 b 24-5).

Thus it turns out that the remarks in A 1 about conviction or certainty deriving from conviction or certainty with respect to first principles do have to do with securing knowledge, but not because absolutely certain first principles are needed to turn mere true belief into knowledge.⁵⁹ What they are needed for is to turn something which is already knowledge into that type of knowledge which is secured by understanding. In one sense or from one point of view γνωσκτικόν is presupposed by ἐπιταραθία, in another sense or from another point of view it comes with ἐπιταραθία, where the two senses or points of view are those defined by the contrast between what is γνώσιμον in the order of nature and what is γνώσιμον to us (cf. *Top.* VI 4). That being so, I may as well admit that in the end it will not do too much damage to go back to the traditional rendering of ἐπιταραθία as 'scientific knowledge'.

But only in the end. If we are not to be badly misled, we need first to think away a welter of assumptions about the aims of the theory of knowledge as a philosophical enterprise. It is remarkable how little interested Aristotle is in the central concepts of that enterprise as it is carried on today. Concepts like evidence and justification, the

59. Here I dissent from T. H. Irwin, *Aristotle's Discovery of Metaphysics*, «Review of *Metaphysics*», 31, 1977, pp. 210-229, who gives a very clear statement of the interpretation of the *An. post.* programme in terms of knowledge and justification which I am opposing. Among other difficulties which Irwin then raises for Aristotle is the need for a 'pseudo-performance', viz νόϋς, to endow the first principles with a non-inferential certainty they cannot get from induction. I submit that these and other difficulties are objections to the interpretation, not to Aristotle's actual doctrine.

Humean problem of induction – all this belongs in Aristotle's terms to the process by which we make something γνώσιμον to us. His treatment of this process in B 19 and its companion, the first chapter of the *Metaphysics*, is by our standards perfunctory in the extreme. It is natural, therefore, but mistaken – a mistake encouraged by the translation of ἐπιταραθία as 'knowledge' – to try to get less perfunctory answers to our epistemological questions out of the body of the *Posterior Analytics*. That is bound to give a distorted picture of what Aristotle is doing. Of course, epistemological matters are raised here and there (e.g. in B 12, which deals with problems about syllogizing across time). But they are not central. Aristotle's thought is concentrated on the τέλος, the achieved state of understanding which is the end and completion of the epistemological process.

VI

This conclusion suggests a brief return to Berkeley. Berkeley translated Theaetetus' first definition of ἐπιταραθία not, as we do, 'Perception is knowledge', but 'Sense is science'.⁶⁰ Thereby he was enabled to construe the argument in the first part of the dialogue as a vindication rather than the penetrating refutation it actually is of the epistemology on which he premised his instrumentalist account of science. This translation is plainly and importantly wrong. ἐπιταραθία at the start of the *Theaetetus* must be translated 'knowledge'. The discussion which ensues, unlike Aristotle's discussion in the *Posterior Analytics*, has plenty to do with certainty and justification. But remember what happens at the end of Part II of the dialogue (200 e - 201 c). The discussion at this point is concerned with Theaetetus' second

60. *Siris*, § 304-5.

definition of knowledge, to the effect that knowledge is simply true belief, which Socrates refutes by the example of a jury reaching the right verdict on a matter which only an eyewitness can know. We all readily agree that the jury has true belief but not knowledge, hence that knowledge is not just true belief. So the question becomes, 'What must be added to true belief to make it knowledge?' – the familiar question from which every text-book in epistemology begins. But if we expect the familiar type of answer in terms of good reasons, justification, the right to be sure, and the like, we are disappointed. Part III of the dialogue suggests adding to true belief the possession of an account (*λόγος*), but this account is throughout considered as something which answers the question 'What is X?' (203 ab, 206 e, 208 cd). What is not considered, to the bewilderment of some commentators,⁶¹ is an account which would answer the epistemological question 'Why, on what grounds, do you believe that p?'. The discussion passes over that epistemological concern to a consideration of what it is to master a whole *τέχνη* or domain of objects, analyzed right back to their elements; *ἐπιστήμη* verges towards understanding as it is related to intelligible systems of elements (206 ab, 207 c-2-3, 207 d-208 b; cf. *Soph.* 253 ab, *Polit.* 277 e ff, *Phil.* 18 bd).⁶² Some recent commentators have

61. E.g. W. G. RUNCIMAN, *Plato's Later Epistemology*, Cambridge 1962, p. 38.

62. For a detailed discussion of the Jury passage and the transition to Part III, see my *Socrates and the Jury*, «Aristotelian Society Supplementary Volume», 54, 1980. In an interesting and suggestive paper, J. M. E. MORAVCSIK, *Understanding and Knowledge in Plato's Philosophy*, «Neue Hefte für Philosophie», 1978, argues that already in the *Republic* and elsewhere Platonic *ἐπιστήμη* is understood, as contrasted with knowledge. He shows that this hypothesis alleviates a number of the traditional interpretative problems. But I do not think it can be the whole story as far as Plato is concerned. I am arguing precisely that the *Theaetetus* shows it is not, and I would urge the same from the Socratic roots of Platonic *ἐπιστήμη*. Nevertheless, I welcome the discovery (made after the first draft of this paper was com-

seen Part III of the *Theaetetus* as broaching issues that were to concern Aristotle in the *Posterior Analytics*.⁶³ I would like to suggest that Plato was led in this direction by the thought, roughly, that what you need to add to true belief to yield *ἐπιστήμη* is something that will secure understanding. He focuses on the ability to give and receive an account (202 c), and what that secures is not knowledge alone (in the bare modern philosopher's sense) but understanding.⁶⁴ You have *ἐπιστήμη* or *γνώσις* of a thing if and only if you know what it is in the sense of having a *λόγος* which analyzes it right back to its elements (201 c-203 b, 207 ab, and compare the phrase *μέχρι τῶν στοιχείων* in Aristotle's definition of *γνώσις* in *Phys.* I 1). Alternatively, you know a thing if and only if you have systematic and scientific understanding of it in terms of its first principles – lacking Aristotle's clear formulation of the distinction between *γνώσιμα τῆ φύσει* and *γνώσιμα ἡμῶν* (cf. 206 ab). Plato tends, characteristically, to *assimilate* knowledge to understanding; one might describe him as, in effect, explaining *γνώσις* in terms of *ἐπιστήμη*.⁶⁵

played) that someone else has independently been thinking along similar lines.

63. Esp. Glenn R. MORROW, *Plato and the Mathematicians: An Interpretation of Socrates' Dream in the Theaetetus* (201 e-206 c), «Philosophical Review», 79, 1970, pp. 309-333; cf. BARBER (2), p. 106. Morrow goes wrong, however, when he imports his insight into the *transition* of 201 d-202 c, supposing that «Elements (*στοιχεῖα*) can only be named (*νομασθῆναι*)» (201 e) can mean «Basic premises can only be asserted, not demonstrated» (p. 326). *στοιχεῖον* here is that which has no *λόγος*, where *λόγος* means «definitional account», not «proposition» (see 206 d and M. F. BURNEYAT, *The Material and Sources of Plato's Dream*, «Phronesis», 15, 1970, pp. 101-122). We can recognize in the notion of *στοιχεῖον* a concern with axiomatization, but it is worked out in relation to primitive and defined terms, not in relation to axioms and theorems.

64. Hence the phrase *τελευτῶς τοῦ ἐπιστήμην ἔχειν* (202 c); cf. 206 b 9, c 4.

65. Although *ἐπιστήμη* itself occurs only twice (207 e, 208 a), the associated adjectives *ἐπιστήμων*, *δυσπιστήμων*, *τεγνωστός* (on which see LYONS, *op. cit.*, pp. 155-6) are frequent in the relevant sections (202 c, 207 bd, 208 b).

This makes intelligible the claim at 207 e - 208 a, otherwise as outrageous as Aristotle's claim at *An. post.* A 2, 71 b 19-20 (above, p. 126), that a man who spells 'Theaetetus' correctly, and not by accident, ⁶⁶ does not know/understand the first syllable of that name unless he also knows the correct spelling of 'Theodorus'. One must master the whole system if one is to know any of its parts; the parts must be known as parts of the whole (cf. *Phil.* 18 cd). ⁶⁷ In short, knowledge is science.

Now Aristotle, as I have interpreted him, goes a long way towards segregating out and distinguishing the elements of knowledge and of understanding, but he reveals at the end of the work that he sees the task he has completed as one of setting forth what is involved in the claim that all ἐπιστήμη is μετὰ λόγου, accompanied by an account (B 19, 100 b 10; cf. A 6, 74 b 27-8; *Eth. Nic.* VI 6, 1140 b 33). In other words, Aristotle himself viewed the *Posterior Analytics* as working out the solution to some of the ἐπιπέλα with which the *Theaetetus* ends. If, however, we find it difficult to read Aristotle as contributing to a discussion growing out of Theaetetus' first definition, that is doubtless because epistemology for us has come to be dominated by issues of justification, historically linked with the challenge of scepticism. But when Plato and Aristotle say that ἐπιστήμη involves λόγος, neither of them mean λόγος to be an answer to sceptical doubt. Scepticism only came to be the dominant force in epistemology after Aristotle's death, in Hellenistic controversy. A brief illustration of the difference this made will point up the moral I have wished to draw for the interpretation of the *Posterior Analytics*.

66. 207 e 8: σήματα τε δὲν γράφουσιν.

67. The interpretation sketched here is not meant to apply to 208 c ff, which discusses a more everyday, ordinary man's notion of λόγος (cf. 208 c 7) and returns us to themes of Part II of the dialogue. By contrast, λόγος in the discussion of spelling is explicitly linked (206 e 6) to the Dream with which Part III begins.

Consider the difference between the Aristotelian and the Stoic notions of demonstrative proof (ἀπόδειξις). For both schools demonstrative proof is a species of deductively valid argument, differentiated by certain supplementary conditions on top of those required for validity. Most obviously, the argument's premises must be true, but there is more besides, and it is here that the Aristotelian and the Stoic notions diverge in striking fashion. Aristotle's further conditions have to do, as we have seen, with explanatoriness and the deductibility of a conclusion from the highest-level self-explanatory first principles of a science. In the Stoic scheme (here I follow Sext. *Emp.* *PH* II 134-143) the further conditions are strictly epistemological. A demonstrative proof is a valid argument which deduces from premises which are both true and evident a conclusion which in itself is non-evident, where 'evident' and 'non-evident' are strictly epistemic terms paradigmatically illustrated by what is evident or non-evident to sense-perception. The non-evident conclusion is then made known to us by the proof, as in the much-cited example 'If sweat flows through the surface of our bodies, there are insensible pores; sweat does flow through the surface of our bodies; therefore, there are insensible pores'. This approach makes of demonstration an instrument for the increasing of knowledge, for inferring or justifying explanations, rather than for systematizing explanations and understanding knowledge which for the most part has been independently acquired. ⁶⁸ But more than that, the very idea of characterizing demonstrative proof in terms of evidence, the whole project of marrying a rigorously developed system of logic (such as the Stoics' logic was) to an epistemic base in perceptual certainty, shows how decisively philosophical concerns have shifted

68. I have learned much about Stoic ἀπόδειξις from Jacques BRUNSCHWIG, 'Proof Defined', and Jonathan BARNES, 'Proof Destroyed', both in Malcolm SCHOFIELD, M. F. BURNEYAR and Jonathan BARNES edd., *Doxai and Dogmatism: Studies in Hellenistic Epistemology*, Oxford 1980.

in the direction of epistemology as we now know it.

A parallel shift occurs in the notion of what is intrinsically (in itself) convincing (*πυρόδν*). That appellation is transferred by the Stoics from the first principles of Aristotelian science to the ground-level certainties of perceptual experience. They think that nothing is more evident than the intrinsic evidence of what they call the cataleptic impression.⁶⁹ And what is intrinsically evident is also, necessarily, convincing in itself (*πυρόδν* or *πυρόδν*).⁷⁰ But of course at the level of perceptual experience intrinsic convincingness does not help to distinguish the true from the false. The now familiar epistemological predicament is posed, and there is no ignoring it. All through the Hellenistic period, both positive philosophy and the negative attacks of scepticism take their starting point to be the problem of perceptual certainty. Aristotle does not. But not because he is not acquainted with sceptical arguments for conclusions which would undermine his enterprise, nor because he does not think (some of) them worth extended discussion. He is simply very firm that he is not going to let them structure his inquiries or dictate his choice of starting-points (for some characteristic instances of this firmness, see *Top.* I 11, 105 a 3-9; *Phys.* I 2, 184 b 25-20; II 1, 193 a 3-9).⁷¹

And this brings me back to my own starting point. One result of the impact of scepticism was the gradual separation of epistemology from the philosophy of science. Descartes challenged scepticism with a valiant attempt to pull them together again, with a philosophy of science based on epistemology, reversing the Aristotelian (Platonic) enterprise of putting philosophy of science at the centre of

epistemology. But Descartes failed to carry conviction. 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.⁷²

69. A striking testimony to this thought (a passage the appreciation of which I owe to Malcolm Schofield) is *Cic. Acad.* II 17.
70. Thus on the Stoic division of impressions at *Sext. Emp. M VII 242* ff the cataleptic impression is defined as a species of *πυρόδν* impression.
71. Cf. *HAMILTON, op. cit.*, p. 172.

72. In preparing the final version of this paper I have been helped by criticisms received at the conference and by the discussion of earlier drafts at Cambridge, Stanford and UCLA. Individuals to whom thanks is due include John ACKRILL, Rogers ALBARTON, Jacques BRUNSCHWIG, Theodor EBERT, Jonathan LEAR and, especially, Jonathan BARNES and Richard SORABJI. My debt to the writings of Jonathan Barnes is greater than any note of acknowledgement can record.