ARISTOTELIAN INDUCTION

Jaakko HINTIKKA

1. Different types of primitive assumptions in Aristotle

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

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

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

The results of the earlier examination of the nature of I-IV will be presupposed here. They can be applied so as to throw some light on the following question : How, according to Aristotle, do we come to know the first principles of a science ? We have found that there are several essentially different kinds of "first principles", i.e., ultimate assumptions, in an Aristotelian science. Accordingly, there presumably will have to be several different ways of coming to know them, that is,

(1) *Nous* vol. 6 (1972), pp. 55-69. For some further developments of the same ideas, see also Jaakko Hintikka, "Aristotelian Axiomatics versus Geometrical Axiomatics" (forthcoming).

different kinds of induction, for it is precisely induction that according to Aristotle "deals with the first and immediate (*amesos*) premise" (*Pr. An.* II, 23, 68b30-31).

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

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

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

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

Aristotle's explanations to be able to distinguish the two processes from each other.

2. Aristotle's different accounts of induction

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

The main discussions of induction in Aristotle are the following:

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

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

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

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

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

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

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

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

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

3. Aristotle's "official account" of induction

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

(2) W. D. Ross, *Aristotle's Prior and Posterior Analytics : A Revised Text with Introduction and Commentary*, Clarendon Press, Oxford, 1949, corrected edition 1965, pp. 49-50. Ross' interpretation is shared by most contemporary philosophers, e.g. by G. H. von Wright in *The Logical Problem of Induction*, second edition, 1957.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(5) $((x)(\mathrm{B}x \supset \mathrm{A}x)\&(x)(\mathrm{C}x \supset \mathrm{B}x)) \supset (x)(\mathrm{C}x \supset \mathrm{A}x)$.

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

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

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

(6) $(x)(\mathrm{C}x \supset \mathrm{A}x)$

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

(7) $(x)(\mathrm{A}x \supset \mathrm{B}x)$.

4. THE BACKGROUND OF THE "OFFICIAL ACCOUNT"

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

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

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

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

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

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

5. Search of definitions as induction

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

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

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

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

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

(3) At *Post. An.* I, 13, 78a34-35, induction nevertheless is contrasted with perception.

Several observations can be made on the basis of this vivid example. First, it is (assuming that the *definiendum* is not ambiguous), parallel with the earlier examples, and in fact serves to explain their peculiarities. Again, the obvious truths of the case are $(x)(Cx \supset Ax)$ and $(x)(Cx \supset Bx)$, the former because C just covers those "instances of *megalopsychia* we know of" from which our inquiry starts, and the latter, because B is what the different puzzle cases that have been examined have been found to have in common. The success or failure of our search for a single definition is contingent on whether we can find a formula that covers all the cases of *megalopsychia*, i.e., whether we can find a B which characterizes all the cases of C and thereby enables us to convert the latter premise so as to obtain $(x)(Bx \supset Cx)$. Then we will have as a regular syllogistic conclusion $(x)(Bx \supset Ax)$ which vindicates B as the definition (explanation) of A. As in the example of the eclipse Aristotle discusses in *Post. An.* II, 8, 93a29-b14 (cf. section 6 below), and indeed even more plainly, this is precisely parallel with the type of induction Aristotle envisages in *Pr. An.* II, 23. It is especially instructive to see how the emphasis Aristotle places in his official account on "enumerating *all* the cases" neatly matches the requirement in the *megalopsychia* example that the definition has to capture what is common to all the different types of instances of *megalopsychia*. As he puts it there, "every definition is always universal" (97b26). This helps us to understand the import of the earlier (68b28-29) statement that induction proceeds by taking into account all particular cases.

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

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

and

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

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

(9)' $(x)(C'x \supset B'x)$, indeed $(x)(C'x \Leftrightarrow B'x)$

and

(9)'' $(x)(C''x \supset B''x)$, indeed $(x)(C''x \Leftrightarrow B''x)$

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

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

From these we can then get the required definitory premise

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

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

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

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

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

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

> "Similarly, too, with logical arguments, whether syllogistic or inductive, ... the latter proving the universal through what is obvious of the particular". (*Post. An.* I, 71a8-9).

> "We must, however, understand C as the sum of all particular instances; for it is by taking all of these into account that induction proceeds". (*Pr. An.* II, 23, 68b27-29).

> "[We] show inductively by enumeration of manifest particular instances that every case is like this because none is otherwise ..." (*Post. An.* II, 7, 92a37-38).

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

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

6. The "official account" parallels Aristotle's examples of definitory syllogisms

Once we have seen how one particular search for a definition in Aristotle matches his official account of induction, we can also see that the syllogism (5) is largely parallel with the syllogisms which Aristotle uses to illustrate definitions (primary premises) of type III in his general discussion of definitions in *Post. An.* II, especially *Post. An.* II, 8. In one of them we are dealing with an explanation why the moon is eclipsed. "Let A be eclipse, C the moon [sc. occurring in certain circumstances], B the earth acting as a screen". The explanatory syllogism is again of the form (5). The further point Aristotle makes here is that giving this kind of explanation of eclipse through a syllogism at the same time serves to exhibit the definition (the essence) of eclipse. "The question 'What is eclipse?' and its answer 'The obstruction of the moon's light by the interposition of the earth' are identical with the question 'What is the reason of eclipse ?' or 'Why does the moon suffer eclipse ?' and the reply 'Because of the failure of light through the obstruction of the earth' " (*Post. An.* II, 2, 90a15-18).

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

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

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

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

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

According to Aristotle's official account of induction in *Pr. An.* II, 23, this should be shown by showing that the other premise is convertible, i.e., that (7) holds. Of course, this will obviously be the crucial point in any account of the situation. Ascertaining it means ascertaining that obstruction by the earth is present in all the cases of eclipse (as a causative factor). This of course cannot be ascertained without somehow taking all the cases of eclipse into account – a requirement which is the precise analogue to what Aristotle says in the official account about induction proceeding "through an enumeration of all the cases". It does not suffice to consider for the purposes only some types of kinds of eclipse. We must make sure that B is among the features common to all kinds of eclipse (of the moon). This amounts to somehow seeing that (4) is true on the interpretation which gives rise to the present example. It is *mutatis mutandis* completely analogous with Aristotle's official account. The differences between the two cases are obvious, and do not disrupt the analogy. First, different aspects of the situation are emphasized by Aristotle on the different occasions: reduction to syllogistic form is stressed in *Pr. An.* II, 23, the relation to definition and essence in *Post. An.* II. There is also a difference in that premises of type II do not seem to fit into what Aristotle says in *Pr. An.* II, 23. Furthermore, it seems that the induction that goes together with Aristotle's example in *Post. An.* II, aims at the minor premise and not at the major, unlike the example chosen by Aristotle in *Pr. An.* II, 23.

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

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

7. The "official account" does not cover generic premises

One thing we can now understand is why Aristotle's official account of induction is restricted to those inductions that give rise to primary premises of type III. In both the kinds of arguments covered by the official account, we start from a class of cases to be explained which are summed up in the minor term C. The extension of C is typically the same as that of the major term A in one of the two kinds of uses (cf. the example discussed in section 3), and always the same in the other (cf. section 6). In the course of induction we must therefore consider a term, viz. the middle term B, which *a priori* could have an extension larger than C. Now it is the peculiarity of premises of type II that they deal with the widest term in a science, a term which in effect serves to define the genus which constitutes the field of the science in question. Hence such a premise can scarcely be reached by means of terms which might, for all that we initially know, be larger in scope than the genus. Hence premises of type II cannot be established by the specific procedure described in the official account.

This line of thought is highly suggestive. If it is representative of what Aristotle thought, we can now understand very well why Aristotle's discussion in *Post. An*. II, 19, does not refer to syllogisms at all. It covers the finding of premises of both types II and III, and only the latter process can be explained by reference to syllogisms.

This interpretation agrees in any case with what we find in *Post. An*. II, 19. For, Aristotle discussed there both the definitions that can serve as premises III and the definitions that can serve as premises II. The concluding account of how the first premises of a science are found is obviously intended to cover both, since neither is excluded. In fact, there are a couple of specific indications that premises of type II are in any case included. The attribute Aristotle uses in *Post. An*. II, 19, of first premises is *amesos*, not *atomos* (4). Perhaps more significantly, they are not only called indiscriminately *arkhai*, but also are once called *ta prota* (100b3) – an expression which elsewhere (76a33) is restricted to assumptions II.

First, in the *megalopsychia* example the induction does not turn on perceptual evidence, but on what one finds difficult not to call *conceptual analysis*. When Aristotle decides that Alcibiades and Achilles are *megalopsychoi* because of their impatience of insult, he is not recording any perceptual observations. Rather, he is pointing out the conceptual fact that this is the basis of our calling them *megalopsychoi* in the first place. He is not inviting his audience to carry out experiments or observations, but to reflect on the way they use their own concepts. This illustrates one of the most important and most characteristic features of Aristotle's philosophical and scientific methodology. He does not distinguish sharply *factual* issues and

(4) Cf. my *Nous* paper (note 1 above), pp. 60-61.

concepts from *conceptual* ones. The very distinction is completely absent from his thinking, not merely absent as a doctrine he would accept, but even absent as a clearly formulated alternative doctrine to be rejected.

This attitude of Aristotle's is so general and so pervasive that a further investigation of its sources and manifestations is in order. By way of an introduction to this enterprise, it is worth spelling out what specific lessons we may learn from our study of Aristotelian induction.

In one respect, we have already anticipated our own insight. By observing that the first premises of a science were for Aristotle definitions, and by taking seriously both their role as premises of syllogistic conclusions and their function as explanations of the meanings of the terms involved, we have in effect acknowledged the inseparability of conceptual and factual assumptions in Aristotle.

Another lesson is about the relation of what Aristotle's practices to what he preaches. Often, scholars and students have found a strange discrepancy, as it seems, between the picture of science drawn in *Post. An*. (and to some extent also in *Pr. An*.), on the one hand and Aristotle's own procedure in his own scientific and philosophical writings on the other.

For instance, G. E. L. Owen has pointed out that there is an apparent discrepancy between the *Analytics* and many other works of Aristotle with respect to the way in which the first premises of a science are obtained. In the *Analytics* they are said to be drawn from experience. "It falls to experience to provide the principles of any subject. In astronomy, for instance, it was astronomical experience that provided the first principles of the science, for it was only when the phenomena were adequately grasped that the roofs of astronomy were discovered. And the same is true of any art or science whatever" (*Pr. An*. I, 30, 46a17-22, Owen's translation). In contrast to this, in many of his other investigations, Aristotle strives to arrive at his basic premises by analyzing, not what experience has taught us, but what we mean by certain words and expressions or even what reasonable men have thought of the matter at hand. This is strikingly illustrated by the observation Owen makes and documents, viz. that well-founded opinions, *endoxa*, were among the *phainomena* a scientific explanation was supposed to account for, according to Aristotle.

What we have found shows that in this respect there is in reality little conflict between the *Analytics* and the rest of the Aristotelian *Corpus*. If we take seriously the identity Aristotle pronounces between definitions of certain kinds and the first premises of a science, and rely on his examples to show us what this amounts to, we can see that even in the *Analytics* there is plenty of scope for inductions which turn on conceptual analyses rather than on gathering empirical observations or on direct sense-perception.

This observation is directly relevant to our investigation into the meaning of *epagoge* in Aristotle. It shows how little disagreement there really was between the different things Aristotle said of induction. (Recall the list (i)-(iv) in section 2 above.) For instance, consider Aristotle's description (ii) of how the primary premises of a science are obtained by organizing the universal concepts which sense-perception has induced (no pun intended) in us. Aristotle compares this reorganization to the restoration of order in a retreating military unit : "If one man halts so does another, and then another until the original position is restored" (100a12-14). I do not see that this kind of process cannot according to Aristotle involve in the more difficult cases conceptual analyses and conceptual reshuffling. It is not enough for the fleeing squadron to stop in whatever disorderly state they have fallen into ; it has to be restructured before each man has found his proper place in the ranks, we might say by way of continuing Aristotle's metaphor. This process is, in other words, not incompatible with the search for a definition by analyzing and comparing conceptually different cases of a given term we are trying to define in the way indicated by the *megalopsychia* example. Nor do I see that all the perceptions Aristotle speaks of in *Post. An.* II, 19, have to be had by the same man. The important things are the forms in the soul, and they can be induced in us by what we hear from others as much as by what we ourselves see directly. Hence, there need not be any real discrepancy between *Post. An.*, II, 19, and Aristotle's remarks in the *Topics* on induction as being a dialectical method, or on the first principles of a science being reached by starting from well-founded opinions, *endoxa*. As Owen already points out, for Aristotle "*endoxa* also rest on experience, even if they misrepresent it" (cf. *Parva Naturalia* 462b14-18).

Florida State University.