

Aristotelian Explanation

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Jaakko Hintikka's influential paper, "On the Ingredients of an Aristotelian Science,"¹ suggests an interesting experiment. We should select a bright and promising graduate student in philosophy who has never read any Aristotle. We should then give our student Aristotle's *Prior Analytics* for close study, add a little extra coaching on "the role of existential presuppositions in syllogistic premisses" (55), drop the hint that "syllogisms are the universal tool of any systematic science" (*ibid.*) and then ask our student to predict "the ingredients of an Aristotelian science." If what Hintikka tells us in his paper is right, we could reasonably expect from such a student a moderately accurate sketch of the *Posterior Analytics*.²

Clearly any student who followed those instructions and produced the sketch of the *Posterior Analytics* Hintikka himself offers in his paper would deserve an "A"; for Hintikka's result is indeed what the student in our experiment should have projected. But do the constraints of the experiment fit the real Aristotle? Does the outline of an Aristotelian science that emerges in the *Posterior Analytics* actually conform to the Hintikka projection? I think the answer to both questions is "No."

¹ *Nous* 6 (1972), 55–69. Simple page references refer to this article. Line references are, of course, to Aristotle.

² ". . . Aristotle's syllogistic theory, together with his belief that syllogisms are the universal tool of any systematic science, naturally led him to a specific view of the ingredients of a science. One is almost tempted to say that Aristotle's views on the first principles of a science are predictable on the basis of his syllogistic theory, including his ideas of the role of existential presuppositions in syllogistic premisses" (55).

Hintikka is right to link the notion of demonstration in Aristotle with that of explanation. Here there is an interesting parallel between Aristotle and a modern proponent of the deductive-nomological model of explanation, such as Carl G. Hempel. Just as for the modern deductivist there is a certain symmetry between explanation and prediction, so, for Aristotle, there is a symmetry between explanation (giving the cause) and demonstration. On the modern deductivist's view, to explain an event one must come up with a law, or lawlike generalization, from which, together with appropriate initial conditions, that event could have been predicted.³ What explains a given phenomenon, on this view, is precisely what could have been used to predict that the phenomenon would occur. On Aristotle's view, to explain why every C is an A one must produce appropriate premises from which that conclusion can be demonstrated. "Demonstration" (*ἀπόδειξις*) Aristotle says, "is syllogism that can show the cause" (*δεικτικὸς αἰτίας*) (85b22). So what explains the fact that *p* is, on this view, precisely what can be used to demonstrate the fact that *p*.

What count as appropriate premises for demonstrating that every C is an A, and hence for explaining why this is so? According to Hintikka they are basically the universal, affirmative, categorical propositions that link the species, C, to the genus, A, through the mediation of some intermediate genus, B (57, 59).

There may, of course, be more than one intermediate genus, so long as successive intermediates are nested in order of what they encompass. Thus suppose the following propositions true:

Every C is a B₂.
 Every B₂ is a B₁.
 Every B₁ is an A.

Suppose further that the terms, "C," "B₂," "B₁," "A," constitute what Solmsen has called an "*Eidoskette*";⁴ that is, suppose they are nested in such a way that the comprehension of each (1) includes the comprehension of all its predecessors but (2) is narrower than the comprehension of each of its successors. The series, "isosceles,"

³ Cf. Carl G. Hempel, *Philosophy of Natural Science*, (Englewood Cliffs, NJ 1966), pp. 48-50.

⁴ "The syllogism originated out of "*Eidosketten*," i.e., ideas arranged along a chain in the order of decreasing extension, their normal relation being that of genus, species, inferior species, etc. Chains of this kind had been worked out and theorized upon by Plato and his pupils in the Academy, in connection especially with their favorite method, the *diaeresis*" (Friedrich Solmsen, "The Discovery of the Syllogism," *Philosophical Review* 50 [1941], 410).

“triangle,” “rectilinear,” “(plane) figure,” may serve as an example of such a chain.

Now the question,

Why is every C an A?

can be given this answer:

Because every C is a B_2 and every B_2 is an A.

Or this answer:

Because every C is a B_1 and every B_1 is an A.

I shall call the concept of explanation illustrated by these answers the “mediating concept of explanation.” The intermediate genus locates the species within the genus by mediation.

What can be said for the mediating concept of explanation? Well, we sometimes put it to work. Suppose a library catalogued on the Dewey decimal system has its 100s on the first floor and its 900s on the third. To an expression of puzzlement that Ralph Barton Perry’s *The Thought and Character of William James* is on the third floor, not on the first, the librarian might explain, “A book devoted to the life of a single philosopher will be on the third floor, because it’s biography.” Or again, to a pupil puzzled over how it is that whales are warm-blooded creatures we might point out that whales are, after all, mammals and, of course, mammals are warm-blooded creatures.

Hintikka tells us that Aristotle “reduces all syllogisms to those of the first figure” (57) and that the alleged “superiority [of the first figure] is somehow due to the fact that syllogisms in the first figure turn directly on the transitivity of class-inclusion” (*ibid.*). “Accordingly, he says, “Aristotelian explanation will operate by making class-inclusions clear through [the] transitivity of this relation, that is, by inserting intermediate terms between the ones whose connection is to be explained” (*ibid.*). No doubt the story about the first figure and its importance to Aristotle is really somewhat more complicated than this. But we can at least agree on a main point: what Aristotle’s syllogistic prepares us for is the idea of constructing explanations by the insertion of terms intermediate between the comprehensions of the “ones whose connection is to be explained.” That is what our mythical “A” student should anticipate from a careful study of the *Prior Analytics*—namely, an account of science based on the mediating concept of explanation.

What we actually find in the *Posterior Analytics* is something quite different. To be sure, certain passages do suggest that Aristotle has the mediating concept of explanation in mind. Thus, for example, Aristotle says at 84a36–37, in a passage Hintikka cites, “It is by adding a term internally, not externally, that a proposition is dem-

onstrated." Even more striking is the schematic example near the end of B17 (99a30–99b3); it certainly seems to presuppose the mediating concept.

Yet to conclude from passages like these that it is the mediating concept of explanation that Aristotle wants to build science on would be a mistake. In fact Aristotle makes a special point in the *Posterior Analytics* of rejecting the mediating concept. One could say that his reason for rejecting it is that the mediating concept assures us only of a sufficient condition for C's being A's, whereas what Aristotle is really after in science is something much, much stronger.

For convenience's sake let us suppose that all Aristotelian demonstrations can be cast in the form of the Barbara syllogism:

Every B is an A.

Every C is a B.

∴ Every C is an A.

Thus one asks, "Why is every C an A?" and the answer is, "Because every C is a B and every B is an A."

What Aristotle does in the *Posterior Analytics* is to place stringent conditions on what can function as middle and major terms in a scientific demonstration, conditions unanticipated in the *Prior Analytics*, and to some extent out of keeping with that work. For one thing, the attribute expressed by the major term must be essential, or *per se* (καθ' αὐτά—A4), to the subject expressed by the middle. Much more surprising from the perspective of the *Prior Analytics*, and hence much more interesting for present purposes, is the requirement that the major term be (as Mure renders "*katholou*" in the Oxford translation of the *Posterior Analytics*) "commensurately universal" with the middle. This requirement is introduced and explained at A4–5, argued for in A24, and referred to here and there pretty much throughout the *Posterior Analytics*.

What the English expression "commensurately universal" brings out most clearly is the extensional force of the requirement that Aristotle has in mind. That is, what it best suggests is simply that the major and middle terms must be coextensive, that they must be "reciprocals" (τὰ ἀντιστρέφοντα), as Aristotle sometimes puts it (78a27, 84a24).

The additional force of the requirement Aristotle is interested in is perhaps better put by saying that, if it is really because of being B's that C's are A's, then it must be *qua* B that a thing is A (73b27, 74a35, 75b36, etc.); or again, B must be the *first subject* of A (73b39, 74a12, 74a38, etc.). I shall call this requirement the "first-subject

requirement" and the concept of explanation to which it leads the "first-subject concept of explanation." But I should add the warning that typically in the *Posterior Analytics* Aristotle uses "*katholou*" ("commensurately universal") to introduce in its full force what I am calling the "first-subject requirement."

An example may help make the concept clearer. At the end of *Posterior Analytics* A5 Aristotle considers why the brazen isosceles is a figure with interior angles adding up to two right angles, or, as we might say more simply, a 180° figure. Using the mediating concept of explanation we might come up with the answer that the brazen isosceles is, after all, an isosceles, and every isosceles is a 180° figure. But Aristotle rejects that. His complaint is that other things besides the isosceles have angles adding up to 180° . Isosceles is not the first subject of 180° figure; triangle is. Equivalently, it is not *qua* isosceles, but *qua* triangle, that the brazen isosceles is a 180° figure. So to demonstrate that the brazen isosceles is a 180° figure, or to explain why this is so, it is not enough to link brazen isosceles to 180° figure by means of the mediating term, isosceles. Mere mediation does not demonstrate, or explain. One needs to find the first subject of 180° figure, which, according to Aristotle, is triangle. Thus it is by being a triangle, he thinks, that the brazen isosceles is made to be a 180° figure.

It would be understating things to say that Aristotle's theory of the syllogism does not prepare us for this first-subject requirement. Consider just the coextensional import of the requirement alone. In at least one passage in the *Prior Analytics* (46a39 f.) Aristotle insists that, in an affirmative syllogistic demonstration, the major term will always have a comprehension greater than that of the middle. What this passage brings out is the great importance to Aristotle's conception of the syllogism that the idea of an *Eidoskette* has. In fact, of course, there is no good reason to limit the application of syllogistic reasoning to arguments made up of nested terms of ever increasing comprehension. A Barbara syllogism with convertible major and middle terms is best viewed as a special case of Barbara—no more and no less valid than Barbaras made up of terms that yield a bona fide *Eidoskette*. But when the Aristotle of the *Prior Analytics* is willing to do that (for example, in B5 or B22), it is by way of a concession, and certainly not by way of constructing an ideal case.

So we have two quite different notions of explanation—the mediating concept and the first-subject concept. The first arises naturally out of Aristotle's syllogistic; the second makes its appearance, unforeshadowed, in the *Posterior Analytics*.

No doubt Aristotle's interest in the first-subject style of explanation

has something to do with his interest in eliminating competition among putative causes of one and the same thing. To be sure, Aristotle allows that one and the same thing might have several different causes in several different senses of the word "cause" (*aitia*). They will seem to be competitors only to one who has failed to note or take seriously the fact that "cause" is being used in different senses. But if we stick with a single sense of "cause," Aristotle is inclined to expect, or anyway to hope for, a unique cause.

We are thus meant to suppose that no attribute has more than one first subject—that if G and H are distinct, it will not be both *qua* G and *qua* H that A-things are A. By contrast, the mediating concept of explanation guarantees non-uniqueness. If B is merely a species, or subordinate genus, of A, there will be at least one other species (or subordinate genus), B', such that being B' will be an equally good way of being A. Thus if being a mallard is the cause of something's being a duck, so will being a teal be the cause of something's being a duck.

There is a related feature of the mediating concept of explanation that makes it much less attractive than the first-subject concept. To be a mallard is to be a duck of such-and-such a sort. The claim that *x* is a duck because it is a mallard thus looks either trivial or false. It looks trivial if we take "of such-and-such a sort" as so much extra baggage. What we are left with is "*x* is a duck because *x* is a duck." But the claim looks false if we suppose the differentia to be any part of what makes something a *duck*. Being such-and-such a *sort* of duck, one wants to say, is no part whatsoever of what it is that makes something a *duck*.

It is worth emphasizing that simply requiring the major and middle terms to be "reciprocals" would be insufficient to guarantee the kind of explanation Aristotle is after in the *Posterior Analytics*. Since "All and only triangles are 180° figures" is logically equivalent to "All and only 180° figures are triangles," it would seem that being a 180° figure is as much a cause of something's being a triangle as being a triangle is the cause of something's being a 180° figure. But Aristotle expects "is the cause of" to be asymmetrical; if B is the cause of A, it will follow that A is not the cause of B. To use another of Aristotle's examples, since all and only nearby heavenly bodies are non-twinklers, it might seem that being a non-twinkler is as much a cause of being nearby as being nearby is a cause of non-twinkling (78a30 ff.). This seems clearly wrong to Aristotle and paradoxical, at least, to most of the rest of us. It is, of course, a paradox familiar to anyone who has tried to understand the notion of causation in terms of the idea of necessary and sufficient conditions.

Incidentally, it is one of the attractive features of the mediating concept of explanation that it guarantees asymmetry by ruling out commensurate universality. Being a mallard will be the cause of something's being a duck, but obviously being a duck will not, of itself, be the cause of anything's being a mallard. This sort of consideration seems to underlie Aristotle's brief reversion to the mediating concept at 99a30–99b3.

Pretty clearly Aristotle understands the “*qua*” notion and the “first-subject” idea in such a way that they guarantee asymmetry. From “triangle is the first subject of 180° figure” it will follow that 180° figure is not the first subject of triangle. So recourse to the mediating concept of explanation is not required to capture the desired asymmetry. And the first-subject requirement, as we have already noted, offers the additional promise of securing the uniqueness of any adequate explanation.

The form of syllogism that an ideal Aristotelian explanation calls for is thus Barbara-plus. But, contrary to what the *Prior Analytics* would lead us to expect, the form is not Barbara plus the stipulation that the minor, middle and major terms be nested in order of increasing comprehension—far from it. We learn in the *Posterior Analytics* that the form is Barbara plus the stipulation that the middle term name the first subject of the attribute expressed by the major. The ideal in science, according to Aristotle, is to discover, concerning given attributes, *qua* what it is that things have them.⁵

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⁵ An earlier draft of these comments was delivered in the symposium of the American Philosophical Association, Western Division, at which Professor Hintikka presented his paper. Those earlier comments had the benefit of a delightful discussion with the late G. E. L. Owen. Whether that benefit accrues to these comments as well, by a sort of nonlogical transitivity, I cannot judge.

