ARISTOTLE'S SYLLOGISM: LOGIC TAKES FORM

For Greek Science -- From Thales to Euclid
Professor Crane

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Look at the comments on this paper.

This is a brief look at Aristotle's logic and its impact on modern logic and thought. While philosophers since Aristotle have criticized Aristotle's logic for being too trivial and of little philosophical importance, we ought to recognize the great debt philosophical, scientific and mathematical thought owe Aristotle. Aristotle's logic is important in that it introduces a formal system of thought. This formalization makes possible a new realm of thought, an ability to answer questions of logical consequence and proof. The beauty of Aristotle's logic is his introduction of the syllogism.

THE SYLLOGISM:

A syllogism is modernly defined as "a particular kind of argument containing three categorical propositions, two of them premises, one a conclusion". Logical form allows one to substitute subjects and predicates for letters (variables). Aristotle was the first to create a logical system which allowed predicates and subjects to be represented by letters. We can see an example of this in Aristotle's famous "Barbara" syllogism:

If A is predicated of all B

and B is predicated of all C,

then A is predicated of all C.

By predicated, Aristotle means A belongs to B, or all B's are A's. For instance, we can substitute subjects and predicates into this syllogism to get:

If all humans (B's) are mortal (A),

and all Greeks (C's) are humans (B's),
WHY FORMAL LOGIC IS IMPORTANT:

Aristotle's syllogism is referred to as formal logic. In order to better understand the impact of Aristotle's logic, let us consider what formal logic means today. Lukaswicz states that "Modern formal logic strives to attain the greatest possible exactness. This aim can be reached only by means of a precise language built up of stable, visually perceptive signs. Such a language is indispensable for any science...Every scientific truth, in order to be perceived and verified, must be put into an external form intelligible to everybody."[2]

In Aristotle's Prior Analytics A23 and A25, "he argues that every deductive argument can be expressed as a series of syllogistic inferences. That the argument is unconvincing masks the fact that simply by raising the problem, Aristotle earns the right to be considered not only the father of logic, but also the (grand)father of metalogic."[3] By introducing the idea that arguments can be translated into syllogisms, Aristotle brought scientific thought into a new dimension -- it became possible to predict consequences by applying logic.

We have been talking about Aristotle's logic in reference to the syllogism. Aristotle defines a syllogism as a "logos in which, certain things being posited, something other than what is posited follows of necessity from their being so" (An. Pr. 24b18ff). This is the same idea that we saw in the modern definition which more clearly states that there must be two premises and one necessary conclusion. Although Aristotle did not state this pattern explicitly in his definition, his syllogisms fit this definition perfectly, as we saw in the Barbara syllogism.

PERFECT AND IMPERFECT SYLLOGISMS:

Aristotle says there are two types of syllogisms, perfect and imperfect. Lear explains that a syllogism is perfect "if it needs nothing other than what is stated to make evident what necessarily follows" [4](An. Pr. 24b22-5). Conversely, a syllogism is imperfect when what necessarily follows is not immediately evident (see section on making an imperfect syllogism perfect a bit further down). Aristotle lists several examples of perfect syllogisms in An. Pr. 25b32ff. For example:

HOW TO READ SYLLOGISMS:

In order to understand these syllogisms, we must understand the variables and how to read the syllogism. "A" denotes "All," so "Abc" is read either as "All b's are c" or as "c belongs to all b". "E" denotes no, so that "Ebc" is read either as "No b's are c" or as "c belongs to no b". "I" denotes some, so "Ibc" is read as either "Some b's are c's" or as "c belongs to some b". "O" denotes not all, so "Obc" is read as either "Not all b's are c" or as "c does not belong to some b". In modern logic, "A" is called the universal affirmative, "E" is called the universal negative, "I" is called the particular affirmative and "O" is called the particular negative. The syllogisms are
read from left to right, from top to bottom. Thus, the first one reads "if all b is a and all c is b, then all c is a", which is the same as we saw above in Aristotle's Barbara syllogism.

**HOW TO MAKE AN IMPERFECT SYLLOGISM PERFECT:**

Aristotle distinguishes imperfect syllogisms as those which can become perfect syllogisms by following his rules of conversion:

*From Eba infer Eab*

*From Aba infer Iab*

*From Iba infer Iab*

Aristotle explains these rules in *An. Pr. 25a5-13 and An.Pr. 25a14-26*. In these passages, Aristotle illustrates by using the terms "pleasure" and "good" that imperfect syllogisms can be converted into perfect syllogisms by using these rules of conversion. Aristotle gives this example as an instance of valid inference, however, he does not offer a proof of the rules of conversion.

Aristotle's rules of conversion are analogous to modern logic's rule of and-introduction: "From P and Q, infer P-and-Q." Like Aristotle, modern philosophers offer no proof to this rule of conversion -- one is expected to see that the inference is obviously valid. An example of perfection (converting an imperfect syllogism into a perfect syllogism) is Aristotle's *Cesare* syllogism: "Enm, Aom so Eon" (*An. Pr. 27a3ff*). By converting Enm to Emn, we perfect the syllogism to obtain: "Emn, Aom, so Eon". This is better understood if we substitute subjects and predicates, for example: the perfect syllogism now reads: No people are purple (Emn), and All children are people (Aom), so No children are purple (Eon).

Aristotle's introduction of the syllogism should not be underappreciated. By introducing the syllogism, Aristotle opened the door to a precise system of determining logical consequence. Formal systems of thought and logical consequence have made immeasurable progress in science, math and philosophy possible.