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Aristotelian Syllogisms: Valid Arguments or True Universalized Conditionals?

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The Issue

For centuries it was thought that Aristotle's 'syllogistic' was a codification of valid arguments. Early in the 1950s, however, Lukasiewicz [8] offered the view that it was certain true universalized conditional sentences that were being codified. (The traditional notion of a valid argument has been explicated (Mates, [8]) essentially as follows. An *argument* is a couple (P, c) where P is a set of (closed) sentences and c is a sentence: (P, c) is *valid* if c is a logical consequence of P. This explication obviously covers the technical use of the terms 'valid' and 'argument' in logic (cf. Corcoran, [2]). If p and q are open sentences and Q is a string of universal quantifiers one for each variable free in $(p \supset q)$ then $Q(p \supset q)$ is a universalized conditional.) Lukasiewicz rested his case on the proposition that all syllogisms formulated in the relevant corpus involve an equivalent of the 'if . . . then' connective ([8], p. 2). Austin, in his review of the Lukasiewicz work [1], was able to weaken the Lukasiewicz case by citing a few references to syllogisms as arguments while agreeing that Lukasiewicz was largely correct in his observation that syllogisms were formulated as conditionals. Several scholars (cf. [1] [11]) have further weakened the Lukasiewicz case by pointing out that in many circumstances it would be natural to assert the validity of an argument by saying that *if* the premises were true *then* the conclusion would necessarily also be true. Prior regards Lukasiewicz's evidence as 'flimsy' (cf. [11], p. 25) whereas Patzig ([9], pp. 1–4) finds it convincing. In any event, however, neither case seems sufficiently convincing to make it possible to regard the issue as settled.

Additional information bearing on the issue can be obtained by considering how the syllogisms are established in the corpus. In normal contexts, arguments are established (as valid) by deducing the conclusion from the assumption of the premises using presupposed rules of inference, whereas sentences are established (as true) by deducing them from other sentences previously accepted as true. Thus one is lead to reconsider the locations in the corpus where syllogisms are established to see which mode of validation seems to be used.

However, the situation is complicated by the form of the sentences in question. For example, to establish the truth of:

(*a*) For all N, M, X, *if* M belongs to all N and M does not belong to some X *then* N does not belong to some X.

one would naturally simply *suppose* that

(*b*) M belongs to all N and M does not belong to some X.

and deduce

(*c*) N does not belong to some X.

from the supposition together with the other sentences already accepted as true omitting conditionalization and subsequent universal generalization. Indeed, it is accepted practice even to drop universal quantifiers preceding a true universalized conditional ([8], p. 11). The result of all of these abbreviational conventions may appear to be a deduction of the consequent (regarded as a conclusion) from the antecedent (regarded as two premises). That is, a direct *proof* of (*a*) would look very much like a direct *deduction* for the following argument. (In the universalized conditional, (*a*), the letters N, M and X are object-language variables ranging over the class of 'universals' (man, animal, plant, etc.) whereas in the argument, (*d*), the letters must be regarded as 'occasional names' standing in place of arbitrary 'universal names' ('man', 'animal', 'plant', etc.).)

(*d*) M belongs to all N

M does not belong to some X

N does not belong to some X

Thus, an examination of direct cases may not be conclusive. Fortunately the situation is different for the indirect cases and Lukasiewicz scholarship is of some use here even though its present use points to a conclusion in contradiction to its author's views.

The following is an extensive quote from Lukasiewicz ([8], p. 54):

> The proof of Baroco runs thus: 'If M belongs to all N, but not to some X, it is necessary that N should not belong to some X; for if N belongs to all X, and M is predicated also of all N, M must belong to all X; but it was assumed that M does not belong to some X.' This proof is very concise and needs an explanation. Usually it is explained in the following way:
>
> We have to prove the syllogism:
>
> (1) If M belong to all N and M does not belong to some X, then N does not belong to some X.
>
> It is admitted that the premisses 'M belongs to all N' and 'M does not belong to some X' are true; then the conclusion 'N does not belong to some X' must also be true. For if it were false, its contradictory, 'N belongs to all X', would be true. This last proposition is the starting-point of our reduction. As it is admitted that the premiss 'M belongs to all N' is true, we get from this premiss and the proposition 'N belongs to all X' the conclusion 'M belongs to all X' by the mood Barbara. But this conclusion is false, for it is admitted that its contradictory 'M does not belong to some X' is true. Therefore the starting-point of our reduction, 'N belongs to all X', which leads to a false conclusion, must be false, and its contradictory, 'N does not belong to some X' must be true.
>
> This argument is only apparently convincing; in fact it does not prove the above syllogism.

Lukasiewicz goes on to explain the obvious truth (given that the syllogism is a universalized conditional) that an indirect proof of it must take as hypothesis *not* the negation of the conclusion but rather the negation of the whole sentence which, incidentally, is easily 'written':

(*e*) For some N, M, X, M belongs to all N and M does not belong to some X but N belongs to all X

One would then deduce from (*e*) using other sentences accepted as true a sentence which contradicts one of the previously accepted sentences. In Lukasiewicz's words:

> The indirect proof of the mood Baroco should start from the negation of this mood, and not from the negation of its conclusion, and this negation should lead to an unconditionally false statement, and not to a proposition that is admitted to be false only under certain conditions ([8], p. 56).

He proceeds to construct such a proof and then adds 'It can easily be seen that this genuine proof of the mood Baroco by *reductio ad impossibile* is quite different from that given by Aristotle.'

With the latter, I agree. But I suggest that one should conclude not that '. . . Aristotle does not understand the nature of hypothetical arguments' ([8], p. 58), but rather that Lukasiewicz did not understand the nature of Aristotelian syllogisms. (The Lukasiewicz misunderstanding of indirect deduction in *Prior Analytics* was noticed several years ago by Iverson ([7], pp. 35–36) who was then a student of William Parry.)

Importance of the Issue

Universally absent from discussions of this issue is any reference to why it should be important. My own opinion is that *if* the Lukasiewicz view is correct *then* Aristotle cannot be regarded as the founder of the science of logic. Indeed Aristotle would merit this title no more than Euclid, Peano, or Zermelo, regarded as founders, respectively, of axiomatic geometry, axiomatic arithmetic and axiomatic set theory. Each of these three men set down axiomatizations of bodies of information *without* explicitly developing the underlying logic (in the sense of Church [6], p. 317), that is, each of these men put down axioms and regarded the theorems of their systems as those sentences obtainable from the axioms by logical deductions *but* without bothering to say what a logical deduction is. In my view, logic must begin with observations explicitly related to questions concerning the nature of an underlying logic.

Lukasiewicz claims that Aristotle's logic was a theory whose universe of discourse consisted in a class of universals and whose primitive relations were the relations A, E, I and O, respectively; inclusion, disjointness, partial inclusion and partial disjointness ([8], pp. 14–15). He correctly points out the analogy between this theory and the theory of the ordering of numbers—whose universe is a class of numbers and whose primitive relation is the ordinary 'less than' relation ($<$). Lukasiewicz also correctly points out that neither theory concerns the nature of logical reasoning (loc. cit.). According to Lukasiewicz, the existence of the underlying logic of Aristotle's theory was *not* even suspected by Aristotle ([8], pp. 47–49).

(Perhaps because of Lukasiewicz's own important contributions to propositional logic he emphasizes his view that the latter was presupposed in Aristotle's deductions *but* he also points out in several places (e.g. [8], pp. 48, 63–64, 83–84) that he thinks that Aristotle presupposed some of quantifier logic.)

If Lukasiewicz is correct then the Stoics were the genuine founders of logic. It seems clear to me, however, that in the *Prior Analytics* Aristotle was developing the underlying logic for the axiomatically organized sciences that he discusses in the *Posterior Analytics*. (cf. [3], [4] and [5].)[1]

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1 (Added in proof): Since writing this article and others ([3], [4], [5]) it has come to my attention that Timothy Smiley has developed an interpretation of Aristotle's logic which agrees in all substantial points with mine. His work, which goes beyond my own in significant respects, appeared in the *Journal of Philosophical Logic* **2** (1973), 136–154.