# PUBLICATIONS OF JOHN CORCORAN ON ARISTOTLE

Indeed, one of the great strides forward in the modern study of Aristotle's syllogistic was the realization that it is a system of natural deduction.

-Kevin Flannery, SJ [2001, 219].

Corcoran [...] has convincingly shown that the best formalization of Aristotle's reductio ad impossibile is by means of a natural deduction system. —Mario Mignucci [1991, 12].

The most radical opponent of Lukasiewicz is J. Corcoran. —Tadeusz Kwiatkowski [1980, 188].

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I. Articles

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<sup>&</sup>lt;sup>a</sup> Smiley 1973, p.154: (Added in proof) Since this article was written I have learnt of concurrent work by Prof. J. Corcoran (to appear in *Journal of Symbolic Logic, Archiv für Geschichte der Philosophie*, and *Mind*). Corcoran's approach to the syllogistic is very similar to that advocated here, but his treatment is independent and distinctive and provides further strong support for the new approach.

<sup>&</sup>lt;sup>b</sup> Kwiatkowski 1980: "The most radical opponent of Lukasiewicz is J. Corcoran."

<sup>&</sup>lt;sup>c</sup> Novak's "Conclusion" makes several points that are now widely accepted.

<sup>&</sup>lt;sup>d</sup> Smith 1989, p. xvii: One principal virtue of Corcoran's approach, which is especially important in the context of a translation of the *Prior Analytics*, is that it permits a formal model which stays very close to Aristotle's actual text, since it allows us to read formally precise natural deductions straight out of it.

<sup>&</sup>lt;sup>e</sup> Mignucci, 1991, 11: Nowadays two interpretations seem to have a following among scholars. One is the Łukasiewicz interpretation [...]. The other [...] I believe is the true one [...].

<sup>&</sup>lt;sup>f</sup> Mignucci, 1991, 12: J. Corcoran, 'Aristotle's natural deduction system' [...] 1974, has convincingly shown that the best formalization of Aristotle's *reductio ad impossibile* is by means of a natural deduction system.

<sup>&</sup>lt;sup>g</sup> Scanlan 1991: In the early 1970s, working independently, J. Corcoran and T. Smiley each gave treatments of Aristotle's logic as a natural deduction system that did not involve propositional logic [Corcoran, Arch. Gesch. Philos. **55** (1973), no. 2, 191–219; MR0444423 (56 #2776); Smiley, J. Philos. Logic **2** (1973), no. 1, 136–154]. Aristotle's syllogisms were viewed as direct and indirect deductions in a language in which all sentences belong to one of the four categorical types. Aristotle's claimed "reduction" of all syllogisms to the two universal syllogistic forms of the first figure, traditionally called Barbara and Celerant, was seen as the proof-theoretic assertion that every deduction can be transformed into one using only these two rules. This approach accounts much more closely for the fine details of terminology and reasoning in specific passages of the *Prior analytics* than previous interpretations of Aristotle's logic.

<sup>&</sup>lt;sup>h</sup> Degnan 1994, p.82: Timothy Smiley and [sc. John] Corcoran, working independently, showed that Aristotle's theory of deduction contains a self-sufficient natural deduction system that presupposes no other logic.

<sup>&</sup>lt;sup>1</sup> Reyes et al. 1994, p. 61: The work of Łukasiewicz on syllogistic has been criticized by Corcoran [5]. In particular, Corcoran disputes the view of Łukasiewicz that the Aristotelian syllogistic constitutes an axiomatic theory. The

main thrust of Corcoran's work is to show that it is rather "[...] an underlying logic which includes a natural deductive system and that it is not an axiomatic theory as had previously been thought".

<sup>k</sup> Martin 1997, p.1: My goal in this paper is to reconsider John Corcoran's now classical work on the syllogistic. Corcoran's purpose was to argue against two key theses of the interpretation of Lukasiewicz (1957) and others: that syllogisms should be construed as conditionals [...] and that Aristotle's reduction [sic][...] should be viewed as an axiomatic theory.

<sup>1</sup> Degnan 2000, p.215: In the mid-seventies John Corcoran and Timothy Smiley published ground-breaking articles on Aristotle's assertoric syllogism which rescued Aristotle's reputation as a logician from W. V. O. Quine's and Bertrand Russell's criticisms.

<sup>m</sup> Flannery 2001, p.219: Indeed, one of the great strides forward in the modern study of Aristotle's syllogistic was the realization that it is a system of natural deduction.

<sup>n</sup> Flannery 2001, p.202: The approach I take here is somewhat different from John Corcoran's, although it owes much to it. According to Corcoran, "an imperfect syllogism is 'potentially perfect and is made perfect by adding more propositions which express a chain of reasoning from premises to the conclusion" [Corcoran 1973, p. 195; see also p. 205; see also Smiley 1973, p.137]. I agree that, according to Aristotle, a syllogism is perfected by performing additional operations; but the perfected syllogism does not seem to be this augmented chain of reasoning. As the above texts [sc. 28a3-7, 29a31-36] show, the perfected syllogism, for Aristotle, becomes a perfect (i. e., first figure) syllogism in the process of being perfected.

<sup>o</sup> Woods 2001, Ch I: Aristotle's own [sc. completeness proof] attempt, which doesn't quite succeed, is to be found at *Prior Analytics* I 23. However, Corcoran has shown how to repair Aristotle's proof. See John Corcoran, "Completeness of an Ancient Logic", *Journal of Symbolic Logic* 37 (1972), 696-702.

<sup>p</sup> Woods 2001, Ch II: Here is Corcoran on the point: "My opinion is this: *if* the Łukasiewicz view [that Aristotle's logic is an axiom system] is correct *then* Aristotle cannot be regarded as the founder of logic. Aristotle would merit the title no more than Euclid, Peano, or Zermelo insofar as these men are regarded as founders, respectively, of axiomatic geometry, axiomatic arithmetic, and axiomatic set theory. (Aristotle would merely have been the founder of 'the axiomatic theory of universals')" ("Aristotle's Natural Deduction System", 98). I note, in this connection, that Gentzen's structural rules are not by any means exclusive to the Gentzen calculi. They hold in Frege's system and in virtually every other logic published subsequently. Why do I invoke the name of Gentzen? Why isn't the core theory of validity a Frege-logic or Whitehead & Russell logic? My answer is that Gentzen was the first (along with Jaskowski, independently) to break with the axiomatic tradition in modern logic and to show that natural deduction systems have all the power of axiomatic set-ups. Because I hold, with Corcoran, that Aristotle conceived of logic in natural deduction terms, it is seemly to use the honorific "Gentzen" in reconstructing Aristotle's conception of validity.

<sup>q</sup> Woods 2001, Ch 4: Corcoran makes the interesting proposal, in which I concur, that Aristotle's "distinction between perfect and imperfect syllogisms suggests a clear understanding of the difference between deducibility [...] and implication [...]—a distinction which modern logicians believes to be their own (cf. Alonzo Church, *Introduction to Mathematical Logic*, Princeton: Princeton University Press, 1956, p. 323, fn. 529)". This is an insightful remark.

<sup>r</sup> Guillaume 2004: In fact, many of Corcoran's remarks throughout this very rich paper [...] will be of interest to the reader, including his discussion of recent studies concerning the Aristotelian system and the conclusions that he makes [...]. The author states, "The gulf between modern logic and Boole is much greater than that between modern logic and Aristotle". In fact, starting on the very first page he argues, "where Aristotle had a method of deduction that satisfies the highest modern standards of soundness and completeness, Boole has a semi-formal method of derivation that is neither sound nor complete". He adds in his conclusion that "the method of countermodels for independence proofs (that demonstrate the absence of logical consequence) is prominent in *Prior analytics*, but sadly absent from *Laws of thought*". He also asserts that Aristotle "proves mathematically that two of his four two-premise rules were eliminable. There is nothing in Boole's writings remotely comparable to this." And these are only three of the many examples cited by Corcoran of Aristotle's superiority over Boole.

<sup>s</sup> Tracy 2006, p. 2: Aristotle was not the first to conceive of axiomatic procedures. Euclid's axiomatic geometry is surely descended from axiomatic approaches to geometry contemporary with or earlier than Aristotle (Corcoran,

<sup>&</sup>lt;sup>j</sup> Thom 1996, p.4: In proof theory, I follow the definitive work of Smiley and Corcoran in using a natural deduction analysis of the syllogistic.

"Aristotle, Boole, and Tarski"). But he is the first, as far as we know, to have conceived of studying deduction itself; he is the first to have developed a formal logic.

<sup>t</sup> Tracy 2006: Both Corcoran ("Aristotle's Natural Deduction System") and Smiley ("What is a syllogism?") reconstruct Aristotle's logic as a natural deduction system in this way.

<sup>u</sup> Tracy 2006, p. 174: As Corcoran observes, "[Aristotle's] theory of propositional form is very seriously inadequate. It is remarkable that he did not come to discover this for himself, especially since he mentions specific proofs from arithmetic and geometry. If he had tried to reduce these to his system, he may have seen the problem".

<sup>v</sup> Raymond 2010, p. 194: This section outlines the basis for the interpretation, drawing out how Aristotle develops intuitions concerning polarity (things that never combine) and inseparability (things that never separate). As we will see, these two intuitions are germane to logic, understood as natural deduction (e.g. Smiley 1973, Corcoran 1974, and Smith 1989).

<sup>w</sup> Keyt 2013: Can it be proven that the conclusion of every valid categorical argument is deducible from its premises by means of Aristotle's inference rules without first proving that every such argument is a chain argument? The answer is that it can be. Using the sophisticated methods of modern metatheory, John Corcoran has done it (Corcoran, 1972).

<sup>x</sup> Marion 2013, p. 18: There is certainly no need to see axiomatic systems everywhere when one looks at the history of logic, given that the introduction of that approach only dates from Frege. Moreover, that these are less suited for modelling Aristotle's syllogistic has been independently shown by John Corcoran and Timothy Smiley in the early 1970s, when they interpreted Aristotle's syllogistic not as an axiomatic system requiring an underlying logic, but as an underlying logic itself, which is best modelled (in the ordinary sense of the word 'model') as a Gentzen-style system. They also gave completeness proofs for their respective systems and thus restored Aristotle's stature as a logician.

<sup>y</sup> Łukasiewicz's trenchant and controversial views sparked a controversy over how to interpret the syllogistic. While the principles did win an early adherent in Patzig (1968), subsequent criticisms by Corcoran (1972, 1974) and, independently, Smiley (1974) established clearly that syllogisms are not propositions but inferences, and that Aristotle had no need of a prior logic of propositions. That view is now universal among scholars of Aristotle's logic. In retrospect, it appears that Łukasiewicz was keen to wish onto Aristotle his own (Fregean) view of logic as a system of theorems based on a propositional logic.

<sup>z</sup> Tennant 2014, Abstract: I use the Corcoran–Smiley interpretation of Aristotle's syllogistic as my starting point for an examination of the syllogistic from the vantage point of modern proof theory.