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Rethinking Logic: Logic in Relation to Mathematics, Evolution, and Method

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Rethinking Logic is not an easy book. And not because it is difficult to understand this very clearly written book. What may be difficult for many readers is accepting to be kept by the well crafted arguments and the richly documented theses of the Author, and feeling compelled by his plain prose to face the main difficulties which afflict the mainstream view of logic and epistemology. Many readers probably share such view and could feel uncomfortable in seeing it put under such an excoriating scrutiny. This is the sense in which this book may be defined as provocative.But *Rethinking Logic* is worth overcoming such initial possible diffidence, because of the original and stimulating insights on many of the hottest topics in logic, philosophy of mathematics, philosophy of science, and philosophy of knowledge it offers.

Cellucci starts from what he considers nothing more than a constatation: the irrelevance of the mathematical logic in the current scientific and philosophical context, given its failure in attaining the goals it was developed to attain. He thus proposes a global rearrangement of our conception of logic in order to give it a new and central role in that human enterprise which is knowledge.

The core thesis of Cellucci's work is in fact that the main purpose of logic should be that of giving us means for acquiring new knowledge, and not that of giving a secure foundation for mathematics, as it has traditionally been intended. For illustrating and justifying his proposal, Cellucci guides us in a long journey divided in four parts.

After the Introduction (Ch. 1), which offers an overture of all the themes developed in the book and of its main goals, in the first part, *Ancient Perspectives* (Ch. 2-7), Cellucci considers some perspectives on logic in antiquity, especially in Plato and Aristotle. Cellucci describes the origin and the features of the analytic method (more on this below), which he thinks is the method of logic and science, focusing on the formulation of it given by Plato, and the Aristotle's

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heuristic view of logic, which he thinks is the only adequate view of logic.

In the second part, *Modern Perspectives* (Ch. 8-13), Cellucci considers some perspectives on logic in the modern age, from the originators of modern science to mathematical logic. Cellucci describes the view on the method of science developed by Galileo, Newton, Bacon, Descartes, Leibniz and Kant, analyzing in particular their positions about the logic of discovery. Cellucci then explores how the birth of the contemporary view of logic has led to the progressive divorce of logic from method, and to the abandon of the conception of logic as a logic of discovery. Cellucci focuses especially on Frege's and Gentzen's work, and then critically examines the impact of Gödel's incompleteness theorems (and other limitative results) on the tenets of mathematical logic.

In the third part, *An Alternative Perspective* (Ch. 14-19), Cellucci tries to elaborate a perspective on logic "hopefully not subject to the limitations of mathematical logic" (21). This is in some sense the crucial part of the book, where Cellucci's philosophy of knowledge is more clearly delineated. In this part in fact he roots logic in the biological make-up of us humans, and thus puts it in relation to the biological evolution, language, cultural evolution, and emotions.

In the fourth part, *Rules of Discovery* (Ch. 20-21), Cellucci considers and discusses some rules of discovery, namely, non-deductive rules for finding hypotheses to solve problems (more precisely: induction and analogy of various kind, generalization, specialization, metaphor, metonymy, definition, and diagrams). This set of tools which consent us to acquire new knowledge is not a closed set, because, as Cellucci states quoting Bacon, "the art of discovery may grow with discoveries" (331). Nor such rules are sufficient to acquire new knowledge, because hypotheses, after being produced, have to be tested (more on this below). But nevertheless analyzing how problems have been solved using such rules shows how the process leading to the solution of a problem can be considered a rational process and not an obscure region of our cognitive activity.

To maintain the rationality of our discovery process is indeed one of the main goals of *Rethinking Logic*, because relying on whatever form of *intuition* to account for the process of discovery or to secure the truth of our axioms, amounts to prevent the possibility of a truly naturalistic – and thus scientific – account of knowledge and discovery. In Cellucci's view in fact every appeal to intuition is nothing but a remnant of a religious stance, which seeks for absolute truth and certain knowledge.

Given that not all the aspects of such a stimulating book may be treated here, in what follows we will try to describe just some crucial aspects of Cellucci's philosophy of knowledge (Naturalism, plausibility, and method) in order to locate it in the current philosophical landscape. Globally considered,

Cellucci's view may be defined as a kind of Anti-Realist Naturalism, in a sense which will be qualified below.

The two (related) key moves in Cellucci's elaboration of his view are: 1) giving up the concept of truth and replacing it with the concept of plausibility in order to account for the scientific knowledge; 2) giving up the axiomatic and deductivist view of method and replacing it with the view that the method of science and mathematics is the analytic method.

With regard to Naturalism, Cellucci sees it as the basic philosophical framework of his research and defines it simply as the view that "the world does not include supernatural entities or events, and no aspect of the world, including ourselves, is to be explained in terms of supernatural entities or events" (325).

Naturalism is thus contrasted with Supernaturalism, "the view that some aspects of the world can be explained only in terms of some supernatural entities or events" (328), an anti-naturalist view which cannot but be related to some kind of religion and which Cellucci rejects. Even if religion and philosophy in fact may both be seen as a way of exorcising the human fear of the unknown, they are nevertheless different enterprises and must be distinguished, insofar as, while "religion professes to embody eternal and absolutely certain truth and is based on faith, philosophy and science aim at provisional and fallible knowledge of the world and are based on evidence" (*Ibidem*). Thus, as the "medievals warned: *Non est philosophi recurrere ad Deum*" (240).

Given this naturalist framework, Cellucci formulates his view of what knowledge is focusing on its biological role.

The main consequence of such approach is the idea that knowledge is not related to the concept of truth. In fact, if knowledge is related to our biological make-up, and the latter is related to evolution, then in order to account for our knowledge it is better to abandon the concept of truth for at least three reasons: 1) evolution is not an aimed at truth process; 2) if knowledge is something biological entities do, then it cannot be independent from the biological subject. But if instead truth has to be intended, as realists do, as a non-epistemic concept, i.e. if it is not related to the subject who knows, then human knowledge cannot be related to truth; 3) if knowledge is related to truth, and truth may not be attainable, because its elevated standard cannot be met by humans, then knowledge would be unattainable, but given that not only knowledge is attained, but that it is even necessary for survival, knowledge cannot be related to truth (Ch. 14).

It is thus principally for his giving up the concept of truth that Cellucci's view may be qualified as an anti-realist position. In fact, in the context of the debate over realism in philosophy of science, 'realism' is intended as 'Scientific Realism', i.e. the view that may be briefly described as the claim that our

best scientific theories are true (Psillos 1999), and so 'Anti-Realism' has to be intended here in the sense of a view opposing Scientific Realism. Now, the concept of truth appears to be crucial for Scientific Realism, at least for the great majority of its formulations. For example, Giere states that "virtually every characterization of scientific realism I have ever seen has been framed in terms of truth" (2005: 154). Thus, the giving up the concept of truth qualifies Cellucci's view as an anti-realist position. But Cellucci's Anti-Realist Naturalism must not be confused with other views which can be defined, broadly speaking, as anti-realist.

Anti-Realist Naturalism has not to be confused with idealism. In fact, Cellucci's position does not deny the existence nor the independence of the external reality. It is not a form of metaphysical anti-realism, but rather it stands opposed to Scientific Realism on the epistemological level of the problem of realism. Anti-Realist Naturalism has not to be confused with scepticism. In fact, Cellucci's position does not deny the possibility of knowledge. It claims that knowledge is possible and that we do have knowledge, but it denies that knowledge needs to be true, because it denies that the concept of truth is necessary to define knowledge. Moreover, given its view of knowledge, Anti-Realist Naturalism may avoid the traditional sceptical objections, while Scientific Realism does not.

With regard to the concept of plausibility, Cellucci shows how the most widespread adopted definitions of truth, e.g. that of truth as correspondence, are not able to give a criterion of truth, i.e. a mean to decide whether a specific statement is true, and so that they cannot avoid the sceptical argument of the criterion (Ch. 8). Thus, if we maintain the concept of knowledge based on that of truth, knowledge results to be unattainable. So, we will never be able to account for our having knowledge, less than ever to account for our knowledge *naturalistically*.

Being truth such an *unrealistic* aim for our human activity, Cellucci takes instead plausibility as the central concept of his epistemology:

> the goal of science is plausibility. Scientific theories do not deal with the essence of natural substances, but only with some of their phenomenal properties, and deal with them on the basis of plausible hypotheses. Then a scientific theory is not a set of truths but rather a set of plausible hypotheses. Thus the goal of science is plausibility rather than truth. (154)

In order to judge over the plausibility of a hypothesis, the following plausibility test procedure is given:

> (1) Deduce conclusions from the hypothesis.

(2) Compare the conclusions with each other, in order to see that the hypothesis does not lead to contradictions.

(3) Compare the conclusions with other hypotheses already known to be plausible, and with results of observations or experiments, in order to see that the arguments for the hypothesis are stronger than those against it on the basis of experience. (56)

But to fully appreciate this maneuver, it has to be put together with Cellucci's view of the method of science. In fact, with regard to the method, Cellucci takes the analytic method to be the method of natural science, mathematics, and even philosophy. He defines the analytic method as:

> The method according to which, to solve a problem, one looks for some hypothesis that is a sufficient condition for solving it. The hypothesis is obtained from the problem, and possibly other data already available, by some non-deductive rule, and must be plausible, (…). But the hypothesis is in its turn a problem that must be solved, and is solved in the same way. (…). And so on, *ad infinitum*. Thus solving a problem is a potentially infinite process. (55)

Cellucci traces back the origin of the analytic method to Hippocrates of Chios, Hippocrates of Cos and Plato (Ch. 2-4), and maintains that the axiomatic method is inadequate for giving a naturalistic account of mathematics and science. He shows in fact that it is not able to account for the hypotheses production, and so that it is not able to show the real path which has been followed to reach a result.

Being based on the analytic method and on the concept of plausibility, Cellucci's view of knowledge takes knowledge acquisition to be a potentially infinite process, and knowledge to be always hypothetical and provisional. But, unlike other fallibilist approaches, Cellucci's view does not separate the context of discovery from that of justification (Ch. 17). And thus Anti-Realist Naturalism seems to be able to account for the process of knowledge production in a more satisfying naturalistic fashion, because it does not make of such crucial aspect of knowledge a mystery.

To conclude, *Rethinking Logic* is a valuable and remarkable book, especially because it does not resemble to any of the books dealing with logic which normally can be found on the market. In fact, *Rethinking Logic* is not an introduction to logic, nor a sectorial work full with technicalities, nor a historical survey. It is instead a global and wide philosophical reflection on what logic and knowledge are, which argues for a theoretically purposeful view, with which one may obviously disagree, but with which it is certainly interesting confronting.

References

Giere, Ronald N., 2005, "Scientific Realism: Old and New Problems", in *Erkenntnis*, 63, 2: 149-165.

Psillos, Stathis, 1999, *Scientific Realism*, Routledge, New York.