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Louis Couturat as a Historian of Logic

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Abstract:

Louis Couturat (1868-1914) is well known as the editor of Leibniz's *Opuscules et Fragments Inédits* and for his study *La Logique de Leibniz*, which is often wrongly associated with his interpretation of Leibniz's metaphysics. The confusion is twofold since both his book and his interpretation of Leibniz's metaphysics are equally often identified with Russell's famous interpretation, despite their remarkable differences. The purpose of this essay is to show that such confusions have obscured Couturat's role as a historian of logic and, in particular, in relating the emerging systems of logic in the 19th century with the Leibnizian project of a *characteristica universalis* and a *calculus ratiocinator*. Couturat must therefore be seen as the oldest pioneer of van Heijenoort interpretation, according to which the new logic arises under two traditions, one with the idea of logic as a language and the other with the idea of logic as a pure logical calculus.

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Introduction

The purpose of this paper is to review Louis Couturat's contribution to contemporary logic and as an exegete of Leibniz's philosophy. It is argued that although his contribution to the new logic in terms of content was undoubtedly modest, from a sociological and historical point of view his role as a disseminator and commentator of the new logical systems allowed us to visualize the emergence of a new community of logicians. In addition, he developed the first history of logic in which the link between Leibniz and the developments of the new logic was systematically established. That is to say, thanks to Couturat, the twentieth century was able to get to know Leibniz as a first-rate logician, and, to a large extent, he was the first to extensively document Leibniz's role as responsible for encouraging the development of contemporary logic in thinkers such as Peano, Schröder, and Grassmann; and, in a certain way, to anticipate some of his most notable results (such as the double interpretation of

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logical calculus). However, this statement should not be taken as a historical assertion about the influence of Leibniz on Boole, Peano, Schröder and Frege in the development of logical calculus as we know it today, since none of them had access – except perhaps a little bit Peano – to the various attempts to construct a logical system that met the requirements that Leibniz himself had set for himself as *calculus ratiocinator* and as *characteristica universalis*.[2]

As Charles Gillispie (2004, 653) has noted, at the beginning of the 19th century the disciplines that were fully professionalized in post-revolutionary France were still the old arts of theology, law, and medicine. Even mathematical physics only became professionally established in France in the last decades of the 19th century. The new logic would go through an even slower process due to the aspects mentioned below, which I will examine here about Louis Couturat, who made a special effort to disseminate in France the work on the new logic of mathematicians and philosophers and was responsible for bringing them together at the first International Congress of Philosophy held in Paris in 1900.

There are several reasons why both aspects, that of popularizer-promoter and historian of logic, have been recurrently overlooked. Among them we can mention the following: 1) the incipient state of the new discipline outside the traditional field of philosophy; 2) the strong Cartesian and Kantian tradition in France, but also present in other places, which opposes intuition to logical deduction, largely because of the limitations of traditional logic and Kant's sense of "analytic"; 3) the recent "internalist" history of logic, little or not at all interested in the ideas and metaphysical and theological problems interwoven in Leibniz's logical projects, as well as alien to the processes of institutionalization and configurations of communities and, consequently, 4) the little interest in investigating the processes of assimilation and reception of new branches of knowledge; and, finally, 5) the tendency to view *La Logique de Leibniz* more as an interpretation of Leibniz's philosophy than as what it really is; that is, as a historical reconstruction of the various attempts to construct a logic as *characteristica universalis* and as *calculus ratiocinator*.

The Rearrangement of Knowledge and the Emergence of the New Logic

From a broader perspective, the reconfiguration of knowledge throughout the 19th century entailed a discussion of the criteria for classifying the sciences, which in the case of the new logic raised identity problems regarding its autonomy concerning its ancient philosophical heritage and its new mathematical niche. This identity crisis is reflected in the proliferation of different labels to designate it (*Mathematical logic, pasigraphy, stenography* [Peano & his school], *algorithmic logic* [Couturat], *Begriffsschrift* [Frege], *algebra of logic* [Boole, Schröder, Peirce], *equational logic* [MacColl], or *symbolic logic* [De Morgan, Venn, etc.]) and with the search to reach consensus on the name using an old notion (*Logistiké, logistique* [Itelson,

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[2] Peckhaus has insisted on the lack of influence of Leibniz on Boole and De Morgan, but he is wrong when he generalizes and denies any influence on the origins and development of the new logic. "It must have been clear", writes Peckhaus (1997, 298) in the conclusions of his study, "that Leibniz's logic, especially as a result of Louis Couturat's edition of the unpublished writings, had no influence on the revival and development of the systems of modern logic... The allusion to Leibniz by mathematicians was intended to legitimize their respective projects in the foundation of mathematics". (see note 15 below) In a recent summary of his research, Peckhaus (2012) qualifies his statements, given that without Leibniz it is not possible to understand the discussion between Frege and Schröder. On the other hand, Knecht (1981, 296) argues that, in any case, the mathematical aspect of Leibniz's logic does not authorize supposing that his logic had as its objective the foundation of mathematics, but rather the opposite purpose, which is particularly true for universal numerical *characteristica* as a method of proof of logical calculation.

2

Lalande and Couturat]), which came into use for a while only to disappear completely a few decades later.[3]

It could not be otherwise, since logic had been a branch of philosophy for many centuries. As a substantial part of the Aristotelian *Organum*, it was not considered a particular type of knowledge, but rather an instrument to achieve it. Similarly, for centuries logic has been identified with the Aristotelian syllogism and its medieval variants. The reputation of logic declined when philosophers of the modern era repudiated medieval logic and the famous *disputatio* that served it as an exercise. As long as the medieval university survived during the following centuries, logic remained firm, without major progress or dangers. However, when the Cartesian tradition ended up conquering broad layers of European intellectuality, logic began to be seen as a simple relic of the past, where rather than deducing something new it could only aspire to an "elegant way of saying the same thing".

However, Leibniz cherished throughout his life the idea of a new theory of syllogism that would overcome the limitations of traditional logic using a dual system that would be at the same time a calculus and a philosophical language, with applications in principle for the entire intellectual domain, since its principles are presupposed in all domains of knowledge. As Kurt Gödel stated, "It was almost two centuries after his death before his idea of a logical calculus really sufficient for the kind of reasoning occurring in the exact sciences was put into effect (in some form at least, if not the one Leibniz had in mind) by Frege and Peano" (Gödel 1971 [1944], 125).

Although Frege and Peano began to publish their logical investigations in 1879 and 1888 respectively, it was not until 1899 that the work of Peano and his school began to be disseminated in France to a philosophical audience through the pages of the *Revue de Métaphysique et de Moral* thanks to Giovanni Vailati (1899) and Couturat (1899).[4] Speculation on the relationship of logic with the other sciences was not foreign to the French intellectual environment. One year earlier, Edmund Goblot had published his French doctoral thesis (defended in 1896), *Essai sur la classification des sciences*, in which he assigned to logic the task of establishing the criteria for the classification of sciences. However, he maintained that the syllogism did not adequately represent mathematical deduction, since syllogistic deduction is understood as the deduction from the general to the particular, in relations of inclusion and exclusion, whereas mathematical deduction consists of a succession of generalizations whose validity is not reduced to form, nor does it consist of the passage from genus to species, since it is about "the apperception of the necessary relations between concepts without resorting to experience".[5]

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[3] Ironically, Couturat made limited use of the term, particularly in his polemic with Poincaré (Couturat 2006), and borrowed it from A. A. Cournot (see below note 21). Rudolf Carnap published his first textbook as *Abriss der Logistik* in 1929, but his second book, *Introduction to symbolic logic and its applications* (1957), he stated that the use of the label was limited to the European continent.

[4] From now on *RMM* for *Revue de Métaphysique et de Moral*. But in his review, Couturat was still incapable of appreciating fully the advantages of Peano's logic over previous algebras of logic (i.e., the development of propositional calculus to the theory of class or the introduction of a special sign to express membership). Later, in a letter to Giovanni Pappini, Vailati regretted that Giovanni Amendola's article published in the *RMM* in 1908 on Italian philosophy made no mention of Peano's logical investigations, which "represent without doubt the most important contribution to the theory of knowledge of the last fifty years". (In De Zan 2010, 450). But as Ferrari (1982, 123) points out in his note to Peano's only postal letter to Bernardino Varisco, Peano's European fame contrasted with the prevailing silence in his own country. Varisco, like Vailati, published reviews of *La logique de Leibniz* in the *Bollettino di Bibliografia e Storia delle Scienze Mathematiche* in 1901 and in the *Rivista Filosofica* in 1902, respectively.

[5] The full passage reads: "Le syllogisme ne suffit donc pas à rendre compte de la démonstration mathématique; elle ne conclut pas par la seule puissance de la forme; le contenu n'y est pas indifférent

3

In his unpublished *Traité de Logique algorithmique* Couturat pointed out that Aristotle was the first to deny that mathematics uses syllogism as a form of reasoning. Then he wondered if the new logic could do this. At the same time, he acknowledges that mathematics uses forms of reasoning that algorithmic logic studies, he denies that these forms of reasoning constitute "the nerve of mathematical deduction" (Couturat 2010, 245). This, of course, means that Couturat had not yet embraced the logicist approach with which he would later be identified in association with Russell. It was surely his change of viewpoint that made him put this textbook aside.[6]

Vailati had published in the *RMM* the same year his essay "La méthode déductive comme instrument de recherche" in which he argued, not from the use of Peano's new logic, but from his work as a historian of mechanics, on the convenience of the deductive organization of the sciences and on the greatest benefit that can be obtained from its use in research.[7] Although Goblot accepted the *logical dualism* that divides the sciences into pure and experimental, he also started from a perspective on the history of the sciences to maintain – in line with *Mill* – that all knowledge was originally the product of induction, including geometry and arithmetic. However, as knowledge increased until it became science itself, it acquired a deductive form. Based on this view, the division between deductive sciences and inductive sciences had to be relative to the state of knowledge at a given time: "Toute science est donc déductive quand elle est constituée".[8]

The immediate consequence is a classification according to their degree of logical constitution, such that there are three types of knowledge: 1) pure theoretical sciences, 2) applied theoretical sciences, finally, 3) practical sciences or arts (techniques), understood as a set of diverse knowledge without a logical order. Although Goblot seems to share the idea of science that floated in the French-speaking intellectual environment at the end of the century and that has subsequently been called the *conventionalist* conception of science, he only suggests how one science is logically constituted without clarifying how one goes from the general logic of the sciences to particular logic beyond appealing to understanding or intuition that systematically appeals to the axiomatic structure, without resolving how one goes from the system of a theory to the system of the science to which that theory belongs and from that science to the set of sciences. His contemporary readers could in vain turn to the *Vocabulaire Philosophique* (1901) or wait for the publication of the *Traité de Logique* (1918) and *Le système des sciences* (1922) to solve these problems. Perhaps the only novelty to be

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à la validité et même à la possibilité des raisonnements; tout ne s'y réduit pas à des considérations d'inclusion et d'exclusion. Mais il reste vrai que les mathématiques, si elles ne sont pas entièrement syllogistiques, son déductives. Nous ne définirons la déduction, ni par le passage du genre à l'espèce, ni par le caractère purement formel des inférences; la déduction, c'est l'aperception de relations nécessaires entre des concepts sans avoir recours à l'expérience" (Goblot 1898, 69).

[6] There were at least two kinds of logicism: those who, like Frege, sought to derive the number theory from logic and those who attempted to derive classical mathematics (arithmetic and geometry) from logic. In a letter to Frege, Couturat wrote: "I drafted this article [about Kant's philosophy of mathematics] before I had read your book [*The foundations of arithmetic*], and arrived at the same conclusion as you: that arithmetical judgments are analytic while geometrical judgments are synthetic" (Frege 1980, 13-14). Although Peano and his followers used logic to express and make more evident the relationship between mathematical formulas, they never adopted the logicist cause and in my view, Couturat had the same point of view at least before his commitments with Russell.

[7] Later, in an article published in *La Revue de Mois*, Vailati related his own ideas on the deduction to the results of Peano and his school in the construction of scientific theories using analysis and symbolic representation, which were known in France thanks to "l'exposition très claire et soigneuse qu'en a donnée M. L. Couturat" (Vailati 1907, 170-171).

[8] "La science est une dans sa forme; que les diverses méthodes, spécialement la méthode démonstrative et la méthode expérimentale, ne conviennent pas à deux sortes de sciences différentes, mais à des moments différents des progrès de toutes les sciences" (Goblot 1898, 10).

found in this last work is the revelation it makes regarding the support he received from Poincaré about the inadequacy of the syllogism to account for mathematical reasoning. Undoubtedly, it was a late revelation given the famous and widespread polemic against the logicists, in particular with Couturat and Russell.[9] To what extent Poncaré's criticism encouraged animosity and inattention in turn-of-the-century France can be seen in Goblot's *Traité de Logique*, which ignores the developments in *logistique* disseminated by Couturat and other logicians, convinced that formal logic could not account for mathematical deduction, a position that would give rise to a late polemic with Louis Rougier (1889-1982), a former disciple of Goblot himself, then of Gaston Milhaud and later an ally and disseminator of the Vienna Circle and early advocate of neoliberal economics.[10]

Leibniz, Kant and the Sciences

From the proposals of Comte, Ampère, and Cournot to Goblot and Durant de Gros, the question of the classification of sciences had been of theoretical and practical interest throughout the 19th century in France and had found space for discussion from the educational and political perspective, but also from the scientific philosophy of the end of the century and the new logic. From the point of view of the sociology of knowledge, both Comte and Durkheim saw the social dangers of the increase of intellectual subdivision of labor. The latter saw the growing specialization of science as an anomic social phenomenon. Unlike Comte, he is more pessimistic about the intervention of government and philosophy to achieve unity against the dispersion of the sciences.[11]

In this respect, Couturat's commentary on the report by Émile Picard, his former mathematics teacher, on the state of the sciences at the Universal Exposition of 1900 is an obvious counterexample of Durkheim's fears. But Couturat's commentary on Picard is also relevant to relation in his intellectual evolution since he had been trained in Kantianism. In that frame, he developed his French thesis on the mathematical infinite. But by the turn of the century, Couturat had already moved on to the study of Peano's logic, the algebra of logic through the monumental work of Ernest Schröder, and had been able to appreciate their role in the foundations of mathematics. Hence his first remark was about the philosophical implications of the logical foundation of the continuum thanks to Cantor and Dedekind, and by the way, by the collateral results on continuous functions and curves by Darboux and Peano. Those achievements, it follows that "the idea that prevails pure mathematics is the divorce of intuition and logic, and therefore, the exclusion of everything given to the imagination".

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[9] The battle of Poincaré against Couturat and Russell started with the foundations of geometry, a few years before Couturat and Russell were involved with the new logic, and then both embraced the logicism thesis.

[10] In the "Avertissement de l'auteur", Goblot (1918) distinguished the algebra of logic from logistics and excused himself from dealing with both, pointing out that he was not an adversary of either. However, about the algebra of logic, he maintained that its creators had not sought to go beyond offering a new notation for the elementary concepts and principles of the discipline, while about logistics, he warned that its purpose was to set forth the general theory of reasoning and not just mathematical demonstration. On the Goblot-Rougier controversy, see Boudeau (2014). On Rougier, see *Philosophia Scientiae* (AA.VV. 2006), and the companion booklet of the next year (AA.VV. 2007).

[11] "According to Comte, to assure the unity of science, it would be enough to have methods reduced to unity; but it is just the methods which are most difficult to unify, for, as they are immanent in the very sciences, as it is impossible to disengage them completely from the body of established truths in order to codify them separately, we can know them only if we have ourselves practiced them. But it is now impossible for the same man to practice a large number of sciences. These grand generalizations can rest only on a very summary view of things..." (Durkheim 1933 [1893], 363).

However, when Couturat considers the philosophical consequences of non-Euclidean geometries, he still regards as mistaken those who maintain that the existence of such geometries refutes Kant, when in fact it refutes Leibniz, since "among all the logically possible forms of space, only one is given and imposed on us as a form of intuition, because of our sensible nature and not by our reason" (Couturat 1902c, 517). Two years later, in his essay on "Kant's Mathematical Philosophy", he inclines to an intermediate position between Kant and Leibniz regarding the nature of space, where, he claims, "intuitive elements organized by intellectual principles" probably intervene (Couturat 1904, 377). Although the general conclusion was even more scandalous, stated on the centenary of Kant's death: "The progress of logic and mathematics in the nineteenth century has challenged Kantian theory and proved Leibniz right" (Couturat 1904, 379).[12]

Moving from mathematics to physics, Couturat highlights another question of great philosophical interest raised by Picard: are all natural phenomena susceptible to mechanical explanation? This is a question that at the beginning of the 19th century could be considered a rhetorical question, but from the second half of the century onwards its positive answer would be severely contested. But in Picard's opinion, the question was somewhat indeterminate, since he assumes that it is largely a verbal matter, because everything depends on what is understood by a mechanical explanation, given that eminent physicists such as Boltzmann, Helmholtz, Hertz, and Poincaré, under the approach that Picard calls *deductive*, offer different theoretical answers that fall under that qualification.[13] This diversity of ways of understanding what counts as a mechanical explanation inevitably leads to the most fundamental question of the scientific philosophy of the time: what is a physical explanation?

To a large extent, the new approach to the question was a consequence of the reordering of knowledge of the physical world due to the broadening of the domain to include phenomena such as heat and electromagnetism, their consequent disciplinary subdivision and the accompanying current of thought, which – in general terms – displaced the concept of *force* by the notion of *energy*, as a fundamental category. However, from the perspective that Couturat draws from Picard's caution, rather than an opposition between mechanism and energetics, he foresees an evolution:

> For a long time, it has been held that [explanation] consisted in penetrating the essence of phenomena and the real constitution of nature; however, at present it is understood as nothing more than a symbolic representation, a notation, or a

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[12] The extent to which the dispute over logistics was understood as a quarrel between Leibniz and Kant can be seen in the following comment by Léon Brunschvicg on Couturat's conclusion: "Without having to deal with the question of the relationship between logic and mathematics itself, it is enough to observe that if starting from this general problem, we return to the precise question posed in the 18th century concerning the state in which Leibniz had left logic, the situation turns in Kant's favor […]. Nowhere did Kant give a greater display of genius by going straight to the capital defect of Leibnizian logic, as the Logistics of our contemporaries was to reveal, by insisting in that Essay of 1763 on the impossibility, by deduction from purely positive concepts, of operating the passage to the most elementary part of the exact sciences" (Brunschvicg 1951 [1924], 217).

[13] "Aussi d'illustres physiciens ont-ils voulu rompre avec les anciennes habitudes. Abandonnant complètement le point de vue historique du développement de la science, ils se placent à un point de vue analogue à celui du géomètre qui construit une géométrie en partant d'un certain nombre d'axiomes; leur méthode est ainsi toute *déductive*. Une telle manière de procéder a ses avantages et ses inconvénients. Les avantages sont que l'exposition est d'une clarté parfaite et que le système est bien enchaîné; on construit ainsi de toutes pièces et *a priori* un ensemble de représentations, et l'on en tire toutes les conséquences possibles. C'est seulement quand l'exposition du système est complète que l'on compare les résultats avec l'expérience. Cette façon de procéder est évidemment très philosophique" (Picard 1901, 19).

"description" of phenomena. We avoid unverifiable hypotheses concerning the invisible and content ourselves with laws, which are nothing more than generalizations of observed facts. Such are the laws of Energetics, which embrace physics and chemistry. Thermodynamics is free from the kind of mechanistic hypotheses, which have dominated this science since its origin and its principles greatly exceed the domain of classical mechanics. But if the mechanism in the strict and ancient sense seems doomed to failure, how can we know whether energetics will condense into a broader and more complex mechanism? Indeed, its principles seem to be generalizations of the principles of mechanics. (Couturat 1902c, 518-519)

Apart from the strong but ephemeral existence of Energetics, Pierre Duhem's position is well known. He reserves the concept of *explanation* with the old, metaphysical meaning, due to his interest in establishing the autonomy of physical theory with metaphysics. However, a little later Émile Meyerson noted that the etymology of the word also admits the positivist interpretation, which he identifies with Comte, Kirchhoff, and Mach, but not Duhem, nevertheless, he recognizes Mach as a kindred spirit regarding the notion of physical theory.[14]

Finally, Couturat's comment indicates the need to create a universal language given the tendency of modern science to internationalize. This is a topic related to his studies on Leibniz's logic since the project for the creation of logic like *Characteristica* had the purpose of being an adequate symbolism for the exact expression of thought, whose first application was to serve as a vehicular language to facilitate communication and understanding among nations. In the third chapter of *La Logique de Leibniz* he described the projects of the time aimed at the elaboration of a universal language that Leibniz knew and whose "main defect consisted in its complete lack of logical and philosophical foundation" (Couturat 1901, 54). Couturat was so strongly convinced of the validity of this project that he did not hesitate to promote among the scientific and intellectual community the formation of an international delegation for the adoption of a vehicular language, a project that would end up separating him from the academy and, according to Russell's judgment, from the truly creative work in logic and philosophy of mathematics.

However, the history of the new logic is broader and more complicated, especially if one takes into account the algebraic approach to logic that begins with George Boole (1815-1864) and Augustus De Morgan (1806-1871), then moves on to Stanley Jevons (1835-1882), John Venn, Alexander Macfarlane (1851-1913), Ernest Schröder (1841-1902), Charles S. Peirce (1839-1914), Hugh MacColl (1937-1909) and Platon S. Poretskii (1846-1907) to end with Th. Skolem (1887-1963) and A. Tarski (1901-1983). This approach is not alien or independent of the tradition that Gödel outlines about Leibniz, Frege, and Peano, but rather, so to speak, it is just another side that leads to the systems of logic developed by mathematicians inspired by or in tune with the Leibnizian idea of a *calculus ratiocinator*. This way of doing logic is opposed to, but also paired with, on the one hand, the logic cultivated by metaphysicians (of Hegelian orientation) and the logic as a theory of knowledge of the neo-Kantians. On the other hand, mathematicians with different epistemological orientations on the foundations of their science were opposed to or indifferent to the new field of research, which, on the other hand, explains the neglect of that other branch of the Leibnizian lineage identified with the

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[14] It is striking, moreover, that Meyerson devotes to Duhem comments and criticisms on other topics (such as Duhem's opposition to the theory of relativity), but not to the *phénoméniste* conception of science (Meyerson 1991 [1921], 10). In a forthcoming article I will describe in general terms the passage from the "hermeneutic" concept of *explanation* (as an interpretation of the book of nature) to the secularized concept of contemporary science.

Grassmann brothers.[15] These problematic relationships with established communities of philosophers and mathematicians raised doubts about the place of the new science in the tree of knowledge that emerged in the slow but progressive conceptual rearrangement throughout the 19th century and the first decades of the 20th century.

Couturat as a Historian of Logic

Scientific philosophy in 19th century France always had a historicist approach, since its epistemological problems and discussions concerned the evolution of science. The historicist perspective was a legacy of the previous century, in particular of the enlightened project associated with the Encyclopedia, and of the philosophical history of figures such as Anne-Robert-Jacques Turgot (1727-1781) and Condorcet. And if one agrees with Crombie (1996), one can see Voltaire as the first to integrate the philosophy of nature into the general history of civilization and to offer the first interpretation of what would later be called, anachronistically, "the scientific revolution" of the 17th century.

Not all French thinkers of the 19th century and the first decades of the 20th century understood it this way. Some, like A. A. Cournot,[16] thought that their historicist perspective was due to another disposition, largely motivated by the advances achieved during the century. The same ones that had led many physicists to disbelieve in the omnipresent power of mechanism, but also those that had provided chemistry with a notation deceptively similar to the equations of algebra, without forgetting the turbulent political changes that shook the new institutions of higher education from top to bottom and would make the process of professionalization of its scientists waver. On the contrary, others saw in the historicism of Comte and other positivists nothing more than a barely disguised and anachronistic copy of the optimism of Turgot and Condorcet.[17]

In any case, it is the history of the sciences of the 19th century that is responsible for establishing the chronological boundaries of the sciences, their revolution, and their heroic figures, which the 20th century will turn into "official" history, only to later challenge it, blur its boundaries and show the "dark" sides of the protagonists of the so-called "scientific revolution". But from its origins, this history has found its opponents, its revisionists, and its marginals. The latter is the case of Couturat, who obtained his doctorate in philosophy with a Latin thesis on the role of myths in Plato's philosophy (*De platonicis mythis*) besides the

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[15] A. E. Heath (1917b) was perhaps the first to notice the irony in Hermann Grassmann's comment about the little response Leibniz received for his project of a characteristic geometry and the fate of his own theory of extension (*Ausdehnungslehre*). A similar fate befell his brother Robert's theory of symbolism (*Begriffslehre*), but as Couturat note: "Erudition often does violence to inventive power and the proof is that the modern discoverers of symbolic logic, Boole and his successors, have all ignored (and rightly) the example and precedent of Leibniz; it has even been remarked [by John Venn] that they have almost all been ignorant of one another, and if this ignorance has been a source of error, it has been above all a condition of originality. Similarly, Staudt and Grassmann did not know, when they founded their projective geometry and geometrical analysis, that they were rediscovery and realizing ideas of Leibniz" (Couturat 1901, 440). I quote Heath's translation with a final addition (cf. Heath 1917a).

[16] "The history of science as it was conceived and written in the last century is no longer possible – Cournot notes –. It has become an analysis, a story, a gazette, a magazine; anything but history. And this important, definitive change coincides very well with the advent of the current century, of which it is one of its most notable characteristics" (Cournot 1872, II, V, 124).

[17] In *Les Âges de l'Intelligence*, Léon Brunschvicg commented on its first pages: "La doctrine du progrès, telle que les Encyclopédistes et Condorcet l'avaient rendue populaire, ne sera plus chez Comte qu'une façade derrière laquelle se dissimule l'adhésion au mouvement romantique qui, en France comme en Angleterre et en Allemagne, tendait à ramener vers le Moyen Age la pensée du XIXᵉ siècle" (Brunschvicg 1953 [1934], 9).

French thesis on mathematical infinite. From the first thesis emerged a project unfinished, but of which he presented an advance in the History section of the First International Congress of Philosophy: "Sur l'evolution historique du système de Platon".[18]

As was his project over the history of new logic, this project was displaced by the double impulse due to the book about Leibniz's logic and the study of Leibniz's posthumous writings. The remaining state of his project on the history of new logic was edited in 2021. In any case, if these unfinished projects are not enough to consider him a true historian, it should be remembered that he also wrote, with Léopold Leau, the *Histoire de la Langue Universelle* (1903) a nearly six hundred page complement to his two books on Leibniz.

I have already suggested that Leibniz's rehabilitation as a logician appeared in France amid a Kantian environment that was adverse to Leibniz, but there were exceptions. In this case, Couturat had two indisputable authorities who supported him. The best known was the voice of A. A. Cournot, from whom Couturat had taken ideas that would be common heritage of the scientific philosophy of the time, but who in this particular case lacked approval since he placed Leibniz above Kant as regards natural philosophy. The other, Louis Liard, was responsible for making the algebra of British logic known to the French public and marking the route that would lead Couturat to the current of the new logic.[19]

Although Couturat is mainly recognized as the editor of a significant collection of unpublished minor works and fragments by Leibniz, as well as for his *controversial* interpretation of Leibniz's philosophy, the truth is that there is a double confusion surrounding the latter contribution that is worth trying to eradicate. First, it is necessary to point out that Couturat's interpretation of Leibniz's philosophy has been subject to various evaluations since its appearance and is currently considered outdated. However, this fortune is debatable, not to say openly mistaken, since its fate has been linked to the interpretation made almost at the same time by Bertrand Russell, with which it shares an astonishing affinity, at least on the surface. Hence, the interpretation of the former is regularly assimilated to that of the latter, in such a way that it is taken for granted that what is valid for the interpretation of one is also valid for the other. At best, from a certain perspective of recognition, some scholars speak of "the Russell-Couturat interpretation" of Leibniz, making explicit the uniqueness of both interpretations. As a result, this interpretation has been identified on several occasions with *La Logique de Leibniz*.

However, a simple comparison shows notable divergences between Russell's interpretation and Couturat's study of Leibniz's logic. The most obvious is that Russell's work deals with Leibniz's metaphysics and Couturat's book is a history of Leibniz's logical systems associated with the projects of a General Science, an Encyclopedia, and a *Characteristica Universalis* – and most importantly – reconstructed in the light of the advances of the new logic. Moreover, Russell (1903) himself admitted the differences in his review of *La Logique de Leibniz* as well as in the second edition of *A Critical Exposition of the Philosophy of Leibniz*. Walter O'Brien (1972) examined and discussed all these differences in detail, making use of the recently discovered correspondence between the two thinkers.

Complete recognition of the contribution of this Leibnizian conception of logic to the philosophy on which the various systems of the new logic are built merits not only a proper assessment of the importance of his two most important works on Leibniz (*La Logique de*

9

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[18] According to the testimony of his friend Louis Benerts, Couturat left behind a large collection of papers relating to this historical investigation into Plato's intellectual evolution.

[19] Liard, a disciple of Jules Lechalier, had been Couturat's teacher, as well as Duhem, Durkheim, and many others, at the École Normale and, later, as director of the Ministry of Higher Education, he provided the means for Couturat's stay in Hannover. His book *Les Logiciens Anglais Contemporains* (1878) collected and revised his articles on Boole and Jevons previously published in the *Revue Philosophique* (Liard 1907 [1878]). His course of logic was reissued four times before the end of the century.

Leibniz and the edition of the *Opuscules et Fragments Inédits*) and the two articles on Leibniz's metaphysics but also all the articles on logicians above-mentioned, whose systems and contributions he interprets as successful partial realizations of the Leibnizian dream of the projected universal characteristic.[20]

Few, moreover, have noticed that Couturat's interpretation of Leibniz's influence was partly motivated by Cournot's logistics.[21] Thus, he could not have thought it was a mere coincidence when he found references to Leibniz's *characteristica* in Peano and Schröder. Therefore, when Giovanni Vacca, one of the members of Peano's circle, pointed him in the direction of the unpublished manuscripts, Couturat had already produced a part of his extensive work on Leibniz's logic. Although Peano and Vacca identified the project of the *Formulario Mathematico* with Leibniz's logic as a partial realization of the Encyclopedia, the concerns with the historical character had a complementary purpose and a limited scope. These historical notes were only relevant to the history of mathematics as a repertoire of formulas and rules of deduction and not as a history of logic or as the source from which the project of the Formulary arose. Furthermore, Vacca's idea of the elaboration of the history of mathematics was in direct opposition to what Couturat was doing with the reconstruction of Leibniz's logic, as is evident in a letter from 1901:

> I want to give you a brief account of the historical notes in the *Formulario*. When I began to enter the notes, I did so almost at random. As I progressed in the work, I saw that there was a new historical method here. What is the history of one science? One might think, it's an impartial exposition of the ideas of those who have preceded us. However, we cannot expose them all; if we want to expose them all impartially, we must reproduce them almost in their entirety. This work prepares history but it is not yet history. The only perspective that allows us to choose from the works of the ancients is to adopt our point of view. To make the history of the truths of a science is to seek and expose in the past all the attempts that have successively produced the truths that we know. A page of history of this type is the history in the *Formulario*. Therefore, the history of a science is the ordered exposition of the truths of this science followed by a name or a date. (cited in Roero 2010, 104)[22]

Given the length of his book, Couturat did not share Vacca's opinion. Indeed, much of the content of the nine chapters, five appendices, and twenty notes that make up the book

[20] In the closing lines of his critical review of Whitehead's Universal Algebra, Couturat (1900, 362) notes: "Since Whitehead has developed and unified in a comprehensive synthesis the logical calculus of the one [Boole] and the geometrical calculus of the other [Grassmann], it may be said that he has completely realized the philosopher's great dream and that his universal algebra is nothing else than the universal characteristic of Leibniz". However, many years later, Whitehead (1941, 10) declared that his knowledge of Leibniz's research was entirely due to Couturat, and consequently, Leibniz's influence on Universal Algebra could only have been gained through Grassmann (Peckhaus 1997, 299).

[21] In the introduction to *De l'Infini* Couturat (1896, xxi) writes: "The universal mathematics dreamed of and founded by Descartes and Leibniz finds in physics an unlimited field of application, since it sets out there to determine the laws of natural phenomena […]. In effect, Analysis constructs *a priori* all the conceivable relations between magnitudes and deductively studies their properties and their transformations. It is a repertoire of abstract forms, a catalog of mathematical laws related to those simple and general types using which physics must necessarily find those that link such and such concrete magnitudes to facts. It is not, therefore, a science distinct, juxtaposed, or opposed to, the physical sciences: it is the universal language of the sciences, it is a true logic, the logic of quantity. That is Cournot's *logistics*". The last line corresponds to the footnote (cf. Sanzo 1991, 17).

[22] In 1899 Vacca had traveled to Hannover to consult Leibniz's manuscripts and had published a list of the contents of the manuscripts in *Bollettino di Bibliografia e Storia delle Scienze Mathematiche*, edited by Gino Loria.

10

hardly fits into what is understood today as the history of formal logic.[23] Rather than attempting a selection from Vacca's point of view, Couturat sought to be as impartial as possible in presenting and interpreting that material which, as he mentions in the preface, had been neglected by both historians of philosophy and historians of mathematics. In any case, the error of both was not, in his opinion, in selecting only those ideas that precede the truths of a discipline (which to a certain extent would make sense for a history of mathematics as Vacca thought, if the history of mathematics were truly a cumulative discipline), but rather in a carelessness and lack of criteria to appreciate the value of those manuscripts and the intimate relationships they have with each other. However, some consider Couturat's exhaustive exposition of the ideas relative to the universal language and general science in Leibniz excessive. For example, Giuculescu comments:

> When dealing with Leibniz's ideas on the conception of a General Science, where methodology should be applied to all possible forms of thought, Couturat gives it a greater place in the economy of the book than the other chapters (100 pages), considering it as the core of the entire Leibnizian system. It seems that Leibniz's enthusiasm for the project of a *Scientia generalis* has contaminated Couturat's intellect, to which he raises no objection or reservation, even though it is a project bordering on utopia. The reason for this attitude lies in Couturat's profoundly idealistic character, which pushed him to work until the time of his death from an accident in 1914 on the project of institutionalizing a universal language – another Leibnizian "dream". (Giuculescu 1974, 81)

In fact, Chapter VI on "General Science" takes up more than a hundred pages, a little more than twice as long as the previous chapter on the "Encyclopedia" and the shorter subsequent chapter on "Universal Mathematics". The work and its subject matter have indeed worked against its translation into other languages.[24] It is enough to keep in mind that the utopian character of the Leibnizian project was one of the reasons for the scant attention that his work attracted during the first half of the 19th century in Germany (Peckhaus 1997, §3.6) and France (Brunschvicg 1953 [1934], iii).

Of course, for Peano, Grassmann, Schröder, and Frege the utopian side of Leibniz's *characteristica* was not at all an impediment to them. Frege, as Gödel many years after, excuses Leibniz with these words:

> His idea of a universal characteristic, a *calculus philosophicus* or *ratiocinator*, was too ambitious for the effort to realize it to go beyond the mere preparatory steps. The

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[23] The narrow criterion is used in the histories of logic that have appeared in cascade since the relocation of the discipline. In Bochenski's monumental history (1961, §36D), despite considering Leibniz "the father of mathematical logic", he is barely mentioned. According to Knecht (1981, 7), the historiography of Leibniz's logic suffers from a double error, of method and perspective; he reproaches Couturat, among other things, for ignoring the work of Cantor (and Frege), which he already knew by the time *La Logique* was composed but which he does not cite in the body of the work, and he regrets that many of the later studies take as a starting point a work that lagged in the development of the discipline. But this criticism is out of place at least about Frege, whom he had invited to the first International Congress of Philosophy, but whom he only read carefully years later thanks to Russell's insistence (cf. Frege 1980, 13; Schmid 2001, v. 2, 350-352). Only a few acknowledge a debt to Couturat and value his work as a historian of logic. Scholz (1961), for example, praises *La Logique de Leibniz*, and Kneale and Kneale (1961) used mainly the same Couturat in their chapter on Leibniz.

[24] Donald Rutherford has made an incredible effort to move towards the English version and has made available on his website seven of the nine chapters and six of the twenty notes that he has translated so far.

enthusiasm that overcomes its [would-be] creator when he considers what an immense increase in the mental power of mankind would result from a method of notation which fits things themselves lets him underestimate the difficulty which such an undertaking confronts. But even if this high aim cannot be attained in one try, we still need not give up hope for a slow, stepwise approximation. If a problem in its complete generality appears unsolvable, we have to limit it provisionally; then, perhaps, it will be mastered with a gradual advance. (Frege 1972 [1879], 105)

As regards the algebra of logic, it is based on his knowledge of these systems that (Couturat 1901, 385-386) can authoritatively assert that Leibniz possesses a complete knowledge of the fundamental logical operations, and has adequately conceived the double interpretation of the calculus as a calculus of concepts and as a calculus of propositions, so that it can be said that "he possesses practically all the principles of the logic of Boole and Schröder and that in several respects he is even further ahead than Boole himself". However, he then asks, "How has it been possible that he has not succeeded in constructing definitively the algebra of logic (Logique algorithmique) as Boole did a century and a half later?"

The answer lies in one of the few occasions on which Couturat, unlike Russell, had a negative opinion of Leibniz as a thinker. Firstly, he considered that among all the attempts made to construct this calculus, Leibniz could not discern which one was the best among them to adapt and develop it systematically. This was an observation to a certain extent obvious given the large number of essays found among the unpublished documents and which led Couturat to point out, as a general conclusion, that Leibniz's logic is insufficient and incomplete (Couturat 1901, 431). But, today we can ask, could Couturat himself say which of these attempts to construct the calculus deserved to be improved? Had he not frequently suppressed some preliminary versions of axioms, theorems, and demonstrations? The new critical edition of these successive drafts suggests not. Just as the question concerning the reasons that prevented Leibniz – what an irony! – from choosing the best among all those possible calculations has been definitively resolved. Was this impossibility really due to Leibniz's excessive respect for tradition and, consequently, to his attachment to the intensional treatment (*compréhension*) to the detriment of the extensional approach? Had Couturat not harbored a prejudice against the intensional treatment? The answer was pronounced in favor of Leibniz quite a while later using a meticulous reconstruction based on the comparison of different versions to arrive at the five types of calculations that Lenzen (2004) has presented as complete systems (of which only one, L1, is susceptible to dual interpretation), seems to show the strength and depth of Couturat's study and his mastery of the algebra of logic. And it could still be argued that Lenzen's assertions are, and have been, questionable under historical criteria (Peckhaus 1997, 292-393).

Furthermore, little attention has been paid to the fact that Couturat undertook the task of reconstructing Leibniz's logic from the numerous clues he had extracted from the new logical systems and Grassmann's calculus of extension, which were seen as partial realizations of Leibniz's dream. He could do that without yet having direct contact with the fragments and pamphlets that he would publish in an independent volume, and only after becoming acquainted with them, he comes to the conclusion to rewriting completely the chapters relating to universal language and logical calculus:

> [...] these documents, however considerable in number, scope, and interest, have in no way forced us to modify our plan, or even to correct our chronological conjectures; for they have merely filled the gaps and confirmed our interpretation. Above all, they have furnished additional proofs for the substantial conclusion of our work, namely, that Leibniz's metaphysics rests solely on the principles of logic and proceeds entirely from them. (Couturat 1901, x)

12

On the other hand, the reader who seeks to expose and demonstrate the interpretation of Leibniz's philosophy with which Couturat is identified with Russell will be disappointed. The reason is simple, Couturat explains his thesis in the essay on Leibniz's metaphysics that appeared with the pamphlet "Prima Veritas". Was Couturat then wrong in claiming that the thesis was among the conclusions of his book on Leibniz's logic? No, since Leibniz's God is, above all, a logician, as suggested by the epigraph he has placed, in abbreviated form, at the front of his work: *Cum Deus calculat... fit mundus* and for which reason he calls Leibniz's philosophy a *panlogism*.

Concluding Remarks

Finally, I must address two further issues in light of the above. The first concerns the logical interpretation of Leibniz's metaphysics, while the second concerns the recent history of logic.

As mentioned at the outset, in recent decades Leibniz scholars have expressed their dissatisfaction with Russell's and Couturat's interpretations in various ways. Most often, the criticisms are directed at Russell's work in particular, assuming that they apply equally to Couturat. As Parkinson (1967, 1-2) observed, it is not clear how it can make sense to claim that the world is in such and such a way from a conceptual discipline such as logic, so it is necessary to examine carefully in what sense it is possible to claim that Leibniz's metaphysics derives entirely – or almost entirely, as Russell qualifies – from his logic and whether this is even possible. So what exactly is meant when it is said that metaphysics is derived from logic? Is it derived from logic as theorems are derived from a few principles? This seems to be assumed by several scholars, according to Mercer when she writes:

> Although commentators have struggled nobly to decipher the exact interrelations among the first truths, no coherent story has been told that included them all. In short, after years of analysis, scholars have found no subset of first truths that strictly implies the others. The matters are worse than that. Not only has the Russell-Couturat approach failed to account for the precise interrelations among the doctrines, it has left many of them unmotivated and unexplained. (Mercer 2004, 6)

If this is so, I fear that a great deal of research in this direction has been in vain. The reason is simple, if one speaks of a strict derivation or implication, one would never get out of logic and would not be able to count on a criterion to distinguish where logic ends and metaphysics begins. Furthermore, it is worth asking then: Was Leibniz wrong to call "prima veritas" to principles that are not such? And if so, what are the first truths about what? If Leibnizian logic is an incomplete system, a dream, why insist on determining what the exact derivation of metaphysics is? In any case, this interpretation is independent of the history of logic that has been bequeathed to us.

Now, the recent history of logic has been dominated, not without detractors, by van Heijenoort's interpretation, according to which there are two main traditions in the revival of logic during the 19th century. Logicians of that time usually argued by comparing their systems with each other and van Heijenoort took the Frege-Schröder dispute as a model of both traditions. Both claimed to fulfill the idea of a *characteristica*, but Frege claimed that while Schröder's algebra of logic was only a calculus, his conceptual notation or ideography was a *characteristica* and a *calculus ratiocinator* at the same time. By employing Leibnizian notions he meant that while Schröder logic was an abstract calculus, with no intended applications, his conceptual notation was intended for immediate application to number theory, but in principle extendible to all domains of knowledge. So we have two conceptions of logic in dispute, one of which van Heijenoort called logic as language and the other called logic as calculus.

13

Without going into details, it must be acknowledged that Couturat anticipated van Heijenoort's interpretation. However, as I have already indicated, Couturat became fully aware of Frege's main tenets after his two books on Leibniz. This is somewhat surprising since as a follower of Schröder, he must have been aware of the dispute with Frege. But perhaps, like many others, having trouble understanding Frege's notation, and given Frege's low recognition at the time, he may have missed the importance of his ideas.

Despite his later adherence to logicism, Couturat remained faithful to the notation of the algebra of logic in Schröder's version ("mes habitudes schröderiennes" as he justified it [In Schmid 2001, v. 2, 352]). This means that he saw logic as a calculus and as an ideography, and not as a pure abstract calculus, in Frege's sense.

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