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## Special Issue

### History and Philosophy of Science in the Belle Époque (1871-1914)

#### Introduction:

#### The *Rayonnement* of Science and the History and Philosophy of Science in the Belle Époque

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Before the First World War (1914-1918), several of the richest European countries, with stable parliamentary regimes, lived through decades in which peace was accompanied by a set of transformations generally perceived as clear progress – this period has been called the Belle Époque, and reflects France's cultural *rayonnement*. The belief in living in a unique period of progress was based on a set of socio-economic, technical-scientific and cultural developments. These developments took place in a context of competition between nations and in a mental framework where the dominant nationalisms allowed some more cosmopolitan attitudes to emerge here and there, which can be seen in the succession of universal exhibitions and international congresses of scholars. In fact, there was an impressive advance in the sciences (with reconfigurations and the emergence of new areas) and in the industries that benefited from these advances – namely the electrical, chemical, metallurgical, pharmaceutical and transport industries – and growth in purchasing power, large urban centers, schooling<sup>3</sup>, the spread of the printing press, the production of books, and the replacement of the aristocracy by a bourgeoisie that demanded meritocratic privileges, but which nevertheless valued habits of distinction, including the worldly and cultural life of the *Salons* and access to conspicuous consumption (to use Veblen's expression).

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<sup>3</sup> In France, for example, the urbanization rate rose from 35% in 1881 to 45% in 1911. There was an increase in the school population at all three levels of education: the country had around 40 million inhabitants in 1888 and almost 42 million in 1914; at the turn of the century, it had less than 5% of illiterate people, with around 163,000 pupils/year at secondary level; in the faculties, in 1888 there were 2,358 humanities students and 1,355 science students, at the beginning of 1914 there would be 60,000 and 70,000 respectively in each row (Leroy and Bertrand-Sabiani 1998, 7, 10-11).

The abolition of censorship, with the laws of July 29, 1881, made the proliferation of books, newspapers and journals possible, including several high scientific vulgarizations (*Les Mondes* de l'abbé Moigno is one of the first examples)<sup>4</sup>. The participation of intellectuals (including writers and scientists) in the daily press is remarkable: many participate in the life of the *res publica* and defend values of cooperation and a veritative ideal (the love of truth is a virtue praised by scientists) – that became clear when renowned scientists intervened in the Dreyfus affair. At the same time, scientists put themselves at the service of the republic and wrote to the general public to form an enlightened public opinion.

The “capillarity” achieved by science proved to be quite wide-ranging: among the population, science spread with the curricular reforms of secondary education, which favored natural science subjects (Belhoste 1990), with the nascent science fiction literature, technology fairs, etc.; among the academic public, it intensified above all with the multiplication of universities, polytechnics and research institutes (Cahan 1985), and with the ramification and specialization of knowledge. The growth of the higher education and research system was accompanied by the establishment of specialized scientific associations (Cahan 2003). Among the most successful were the *Deutsche Physikalische Gesellschaft* (1845), the *Deutsche Chemische Gesellschaft* (1867), the *Société Mathématique de France* (1872), the *Société Française de Physique* (1873), the *Deutsche Mathematiker-Vereinigung* (1890) and the *Société Française de Philosophie* (1901).

In the process of the emergence and consolidation of new areas of research, chairs in the history and philosophy of science were created at important institutions. Thus, in 1892, French president Sadi Carnot signed a decree creating the chair of “General history of sciences” at the Collège de France, which was entrusted to Auguste Comte’s beloved disciple, Pierre Laffitte. This success exemplifies the close link between the positivist movement and republicanism (a link that characterizes the French Third Republic, established in 1870, as well as the Brazilian Republic of 1889 and the Portuguese Republic of 1910). With Laffitte’s death in 1903, Grégoire Wyruboff, physicist and co-founder with Émile Littré of the journal *La Philosophie Positiviste* (1867), took over the chair, maintaining the positivist lineage until his death in 1913 (Petit 1995). At the same time, in 1895, the chair of “History and theory of the inductive sciences” was created in Vienna, with Ernst Mach as its first occupant (Blackmore 1972, 154). The professional reorientation that Mach underwent, giving up a post in the natural sciences in favor of one in philosophy, was an exception in academic circles (Stadler 2019, 3). The physicist held the position until 1901, when he retired due to the after-effects of a stroke. The following year, Boltzmann took up the chair of “Theoretical physics” at the same university and, in 1903, already absorbed by philosophical themes, he signed a contract to teach there “Philosophy of nature and methodology of the natural sciences” (Blackmore 1995, 104).

The intertwining of the sciences, philosophy and history that took place at the time – thanks to the great polymath scientists, whose breadth of interests is partly due to their membership of informal circles of sociability such as the *Salons* – is clearly evident in the International Philosophy Congresses. The first Congrès International de Philosophie, which was organized on the initiative of the *Revue de Métaphysique et de Morale*, took place in 1900 in Paris and had a special section dedicated to “logique, philosophie scientifique et histoire des sciences”, which was attended by leading names in mathematics, logic and the natural

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<sup>4</sup> During this period, Paris had up to 50 daily newspapers. The daily circulation of *Le Petit Parisien*, around 1910, reached 1.400,000 copies. As for books, while in 1840 4,630 titles were published, in 1909 there were 11,340 titles. At the height of book production and sales, Zola’s novel *Le Débauché* (1892) sold 213,000 copies by 1905 (Leroy and Bertrand-Sabiani 1998, 11, 17, 19). Jules Verne’s science fiction novels, published by Flammarion, were also very successful, as were several books promoting science, such as Henri Poincaré’s *La Science et l’Hypothèse* (1902).

sciences. In his opening speech, Boutroux (1900, xvi-xvii) spoke about the practical importance of the rapprochement between the “philosophical sciences” and the sciences tout court (Soulié 2009, 113-151).

Boutroux thus recognized the importance of the figure of the *savant-philosophe*, in whose lineage we can include A.-M. Ampère, H. von Helmholtz and J. C. Maxwell, a lineage that flourished at the turn of the century with the prestige of the works of E. Mach, W. Ostwald, M. Berthelot, H. Poincaré, P. Duhem and L. Boltzmann. These scholars took an interest in the history of their disciplines, using them to justify scientific research programs in which they were personally engaged, epistemological or historical theses that were dear to them, sometimes in a context of scientific controversy<sup>5</sup>. Today’s reader will be able to identify elements of a historical epistemology here. Several topics appear in depth in the works of these *savant-philosophes*: the questioning of empiricism, with the emphasis on the creative power of the spirit, particularly with regard to the analysis of space-time framework, experimental knowledge and the function of measurement and mathematics; the types of hypotheses, the structure of theories and inter-theoretical relationships; the analogical character of models and theories, and the recognition of the role of error and scientific fallibilism; the advantages of pluralism; the topic of the unity of science and its multiplicity exemplified by the various classifications of the sciences, a topic that sheds light on the dispute over autonomy between distinct areas of knowledge.

The articles presented here highlight that at least two types of cognitive autonomy were at stake: one, relating to social values, as was the case with physiology, which sought an experimental method free from moral interference that could slow down its progress; the other, between different areas of knowledge, as was claimed for the new logic concerning philosophy and mathematics, and by Duhem, when he claimed the autonomy of physics against the interference of cosmological systems, or even when he defended religion from the scientific advances then in vogue. Let’s move on to a brief description of each of the texts that make up this issue of *Transversal*.

The interpretation proposed by Víctor Márquez in “Louis Couturat as a historian of logic” highlights Couturat’s roles (i) as a popularizer and promoter of the new logic among mathematicians and philosophers of the 19th century, and (ii) as the author of a particularly original history of that logic, since he was the first to give Leibniz an important role in its advent. Márquez dissociates Russell’s metaphysical interpretation of Leibniz from that offered in *La Logique de Leibniz*, which, in his view, is more concerned with reconstructing the history of attempts to establish a logic understood as a General Science – that is, as a *characteristica universalis* and, equally, a *calculus ratiocinator*. Although Couturat’s description was later re-evaluated, ponders the commentator, it would have anticipated van Heijenoort’s interpretation, according to which there were two traditions in the awakening of the new logic: one, which saw it as a universal language, with possible applications to all domains of human knowledge; and another, which considered it to be a pure abstract calculation, with no intended applications. Thus, for Couturat, logic could synthetically encompass both of these conceptions and, given the growing need to facilitate international scientific communication, help to create a universal language – something pressing from the Frenchman’s point of view.

In the article “Philipp Frank and the relationship between physics and philosophy in the Belle Époque”, Rafael Velloso and Antonio Videira describe some of the first philosophical texts published by Frank. Based mainly on bibliographical reviews produced by the future

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<sup>5</sup> For example: Duhem disagreed with the style of Maxwell’s *Treatise on Electricity and Magnetism* (Duhem 1954 [1906]: 85-86); Boltzmann disagreed with Mach’s emphasis on the idea of economy of thought (Broda 1981: 4); Poincaré had to defend his view of science against the accusation made by Le Roy of the artificial character of science (Poincaré 1908 [1905]: 213-247).

philosopher of science, they show his interest in topics that were much discussed at the beginning of the 20th century – such as the debate between vitalism and mechanism, the relationship between representation through the use of theories and the univocal determination of reality or knowledge of nature, causality and determinism. Frank adopts a pluralist position similar to that of Boltzmann (his professor), Mach and Poincaré, suggesting that the context of his formative years in Vienna favored dialogue between philosophy and the sciences, particularly physics. It is also clear from these reviews how important the French context was for the Viennese and how the ethical reflections of a Poincaré could perplex an Austrian reader. The authors pay attention to the historical context, relating national history to institutions and the thematic predispositions (in Holton's sense) of scientists.

In “Henri Poincaré: The love for truth and the relations between ethics and science”, João Príncipe analyzes the reflections on the relations between ethics and science published by Poincaré in the period 1903-1910, showing how they are in line with the debate triggered by Ferdinand Brunetière circa 1895 around the supposed bankruptcy of science, i.e. the inability of science to guide society morally, thus contradicting the naïve positivist credo that had the chemist Berthelot among its heralds. Poincaré (who benefited from the unique atmosphere of informal and polymathic interaction between intellectuals that Xavier Léon's Parisian *salon* provided) came to affirm an ideal of science that shows its moral value, centered on the disinterested cult of truth, independence of spirit, criticism and vigilance towards prejudices, a skepticism that prevents presenting as science what is only half-science. Príncipe also argues that, at the same time, Poincaré, who attributed the driving force behind moral actions to feelings, insisted on the impossibility/disadvantage of reducing morality to science. In the author's view, Poincaré was attentive to the contemporary debates associated with the emergence of the social sciences.

Théophile Carrau discusses, in “Experimental zoology and the concept of milieu: The role of marine laboratories at the turn of the 19th century”, the organizational activity of two laboratories on the French coast by the French zoologist Lacaze-Duthiers. The materiality of this research – the establishment of a technical network and infrastructures – and its “local” character are emphasized – the ideal of pure scientific knowledge, in this case, presupposes interaction with the surrounding environment, i.e., with the characteristics of the laboratory's location, with the local community that participates by helping to finance it, showing how this interaction changes the places themselves, encouraging new habits and practices. After a historical introduction that shows how Lacaze-Duthiers' approach represents an advance towards a truly experimental zoology, as it deals with living beings as living beings that are observed in their own environment, unlike the classificatory tradition that mainly used dead and chemically preserved specimens, the author describes in detail aspects that characterize and distinguish the two laboratories. It also shows how the positivist attitude of the illustrious zoologist goes hand in hand with a republicanism that defends the autonomy of scientific knowledge, its public nature and, therefore, free access to the means of research, which are designed according to functional austerity.

The text written by Giovanna Altieri and Maurício Ramos describes how British physiology developed during the 19th century, highlighting the heated debate about the ethical legitimacy of the experimental method concerning the vivisection of animals. The article explores the dispute between, on the one hand, physiologists, defenders of scientific autonomy, who sought to implement invasive methods on living animals in the name of a supposed future benefit to humanity, and, on the other, social demands, especially from anti-cruelty movements, who saw animals as beings capable of feeling pain. From this opposition, we saw two distinct images of the same place of research emerge: for physiologists, the laboratory was the privileged *locus* of scientific progress, while for opponents of vivisection, “the laboratory was nothing but a glorified torture chamber”. Furthermore, Altieri and Ramos detail how this opposition impacted the British legal system, imposing regulations on scientific practice, especially from the 1870s onwards.



Finally, in “The economy of thought in Mach, Poincaré and Duhem”, Roberto Olguín defends the somewhat risky view that the Machian principle of the economy of thought illuminates several of the fundamental epistemological theses of Poincaré and Duhem. To this thesis, the author associates another, concerning the ontological deflationism of the trio of thinkers, which, in Mach, is presented in his version of the critique of causality; in Poincaré, in the role of generalizations, understood here as conventions; in Duhem, in his critique of induction, which establishes the thesis known today as the underdetermination of theories by data. The importance of the authors studied increases considerably, Olguín argues when we take into account their probable inspiration in the formation of what Rudolf Haller called the first Vienna Circle.

The organizers hope that this issue of *Transversal* can contribute to the deepening of studies on a period of rich reflections on the philosophy and history of science and to the maintenance of a debate that cannot be extinguished. Have a great read!

*Epilogue.* The prestige of scientific knowledge and the products of technology, and their artificiality that distances city dwellers from nature, central aspects of the Belle Époque, were captured with verve and humor by the writer and diplomat Eça de Queiroz in his tale “Civilização” (“Civilization”) (1996 [1892], 50-90) and in the novel *A Cidade e as Serras* (*The City and the Mountains*) (1901); in them, Jacinto, the very wealthy landowner of Portuguese origin, lives in a sumptuous mansion on the Champs-Élysées in Paris. He lives there luxuriously surrounded by new technological devices and also owns a voluminous library containing books on all areas of scientific knowledge and metaphysics – but this possession doesn’t make him happy. Let’s remember the episode of his phonograph, which picked up the voice of Councillor Pinto Porto: “marvelous invention! Who wouldn’t admire the progress of this century?”, an exclamation that the technical failure of the phonograph will echo repeatedly and irritatingly until exhaustion, like a broken record. Jacinto, bored with this “civilization”, will only be able to regain his happiness when he visits Portugal, because the countless pieces of luggage containing these books and devices, which had come by train, will be lost; Jacinto will thus be condemned to the simplicity of a country life...

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