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Catana, Leo

Published in:
Intellectual History Review

Publication date:
2011

Document version
Peer reviewed version

Citation for published version (APA):
Catana, L. (2011). Leo Catana, 'Tannery and Duhem on the concept of a system in the history of philosophy and history of science'. *Intellectual History Review*, 21(4), 493-509.

Tannery and Duhem on the concept of a system in the history of philosophy and history of science (preprint)

By Leo Catana

Published in *Intellectual History Review*, vol. 21.4 (2011), pp. 493-509.

INTRODUCTION

The history of science was given a methodological foundation in the second half of the nineteenth century. The newly founded discipline soon gained institutional recognition. In 1892, the first chair of history of science was established at the Collège de France. Soon after, in 1909, a chair on the history of science was erected at the Sorbonne.¹ In the first half of the twentieth century, history of science was given a solid institutional foundation, endowing the discipline with most of the sociological features characterizing a scientific discipline — international networks, conferences, periodicals, and educational programmes.

The immediate challenge for this new historical discipline was to define the material to be dealt with and the analytic tools by which an account of this material should be structured. In the following, I refer to these analytic tools as ‘historiographical tools’, or ‘historiographical concepts’, since they are employed specifically on historical material when narrating for the history of science.

¹ B. Brenner, *Les origines françaises de la philosophie des sciences* (Paris: Presses Universitaires de France, 2003), 5, 101. I should like to thank the following scholars, with whom I have discussed various aspects of this article: Hanne Andersen, Roger Ariew, Anastasios Brenner, Carl Henrik Koch and Robert Westman.

When pioneering French historians of science like Paul Tannery (1843-1904) and Pierre Duhem (1861-1916) composed their works on the history of science, they did not, I shall argue, invent all their historiographical tools from scratch; they took over such tools from nineteenth-century German and French histories of philosophy. These histories of philosophy had dealt with an area, which the history of science was now to cover, the history of natural philosophy, including astronomy. In addition, these earlier histories of philosophy had also dealt with other branches of philosophy such as the history of metaphysics and the history of moral and political philosophy. In these nineteenth-century histories of philosophy, one specific historiographical concept had been adopted almost universally, namely the concept system of philosophy. As I shall argue below, this historiographical use of ‘system’ stood out from the traditional use of the term to denote a physical or an astronomical order. Tannery and Duhem were familiar with both senses of the term, but transferred the historiographical sense to the history of science. Ever since, the concept system of philosophy has been widely circulated by many historians of science. Hence, an analysis of Tannery and Duhem’s inclusion of this concept provides insight into a formative moment in the history of science.

This historiographical background has not yet been recognized, either by the early historians of science themselves, or in the existing modern literature on the emergence of the history of science. Admittedly, Thomas Kuhn (1922-1996) called attention to the history of philosophy as an important background to the history of science, pointing out Ernst Cassirer (1874-1945) as a key figure in this process of transmission.² Alexandre Koyré (1892-1964) had also singled out Cassirer

² T. Kuhn, ‘The History of Science’ [1968], in *id.*, *The Essential Tension. Selected Studies in Scientific Tradition and Change* (Chicago and London: The University of Chicago Press, 1977), 107-108; *id.*, ‘The Relations between History and History of Science’ [1971], in *id.*, *The Essential Tension*, 149.

in this context.³ Unfortunately, neither Kuhn nor Koyré provided any examination of how history of philosophy contributed to the methodology of history of science. Cassirer was indeed a historian of philosophy as well as a historian of science, and he undoubtedly contributed to the spread of history of philosophy's historiographical tools, but he cannot have been a source to the earliest historians of science, e.g. Tannery, since his works were published too late. Hence I think we need to go further back in order to find historiographical sources used by Tannery and Duhem. If we pass on to more recent and general treatments of the history of science and its historical emergence, we find no references to nineteenth-century history of philosophy, but are left with the impression that the discipline began without methodological forerunners in that direction worth mentioning.⁴ If we turn to the literature focusing narrowly on Tannery's and Duhem's studies on the history of science, we do find valuable historical contextualization of their respective works, especially that of Duhem, but these studies too have ignored nineteenth-century history of philosophy as a source.⁵ In the following I intend to remedy this omission.

³ E.g. A. Koyré, 'A l'aube de la science classique' [1935-1937], in *id.*, *Études galiléennes* (Paris: Hermann, 1966), 11.

⁴ E.g. H. Kragh, *An Introduction to the Historiography of Science* (Cambridge, etc.: Cambridge University Press, 1987), 1-19; K. Park and L. Daston, 'Introduction', in *The Cambridge history of science*, general eds D. C. Lindberg and R. L. Numbers (Cambridge and New York: Cambridge University Press, 2003-), vol. 3 (*Early modern science*), 1-17; M. J. Nye, 'Introduction', in *The Cambridge history of science*, general eds D. C. Lindberg and R. L. Numbers, (Cambridge and New York: Cambridge University Press, 2003-), vol. 5 (*The modern physical and mathematical sciences*), 1-17; S. Shapin, *The scientific life: A moral history of a late modern vocation* (Chicago and London: University of Chicago Press, 2008), 29-30.

⁵ A. Brenner, 'Réconcilier les sciences et les lettres: Le rôle de l'histoire des sciences selon Paul Tannery, Gaston Milhaud et Abel Rey': *Rev. hist. sci.*, 58:2 (2005), 433-454. *Ibid.*, 440-442,

Since Tannery and Duhem did not relate uniformly to the historiographical concept system of philosophy, available in nineteenth-century general histories of philosophy, I analyze their respective uses of this concept in turn and bring out important connections between them.

PAUL TANNERY

Paul Tannery (1843-1904) was trained as a mathematician at one of the excellent French polytechnics and worked as an engineer in the tobacco industry at various places in France for most of his life. He was a patriot, and in 1870 he participated in the Franco-German War, defending Paris; he was wounded, and Paris had to surrender in 1871. The same year, the third French Republic was put in place. This tangible political involvement may well have affected his stance

Brenner relates Tanner's stance towards history of philosophy. The following studies ignore nineteenth-century history of philosophy as a background to Duhem's history of science: A. Lowinger, *The Methodology of Pierre Duhem* (New York: Columbia University Press, 1941); H. W. Paul, 'Pierre Duhem: Science and the Historian's Craft', *Journal of the history of ideas*, 33 (1972), 497-512; S. L. Jaki, *Uneasy Genius: The Life and Work of Pierre Duhem* (The Hague/Boston: Martinus Nijhoff, 1984); R. Ariew and P. Barker (eds), *Pierre Duhem: Historian and Philosopher of Science* (Dordrecht: Kluwer, 1990), 127-191. Brenner has examined the historical context of Duhem's methodology for the history of science, though without examining the role of history of philosophy and its methodology: A. Brenner, *Duhem. Science, réalité et apparence. Le relation entre philosophie et histoire dans l'oeuvre de Pierre Duhem* (Paris: Vrin, 1990), 131-201; *id.*, 'Introduction', in P. Duhem, *L'aube du savoir. Épitome du système du monde*, ed. A. Brenner (Paris: Hermann, 1997), xiii-lix; *id.*, *Les origines*, 181-188; *id.*, 'Genèse, évolution et continuité du développement scientifique selon Pierre Duhem', *Revue des questions scientifiques*, 175:1 (2004), 35-58.

towards nineteenth-century German intellectual life, including its history of philosophy. Another factor that needs to be mentioned in connection with Tannery's broader outlook, is the French positivist and sociologist Auguste Comte (1798-1857), whose *Cours de philosophie positive* (1830-1842) made its mark on Tannery's work throughout his life, especially Comte's proposal of history of science as a new, autonomous discipline. Tannery took a great interest in history and classical languages, and he praised contemporary French historians of philosophy striving to integrate Comte's ideas into the methodology of history of philosophy.⁶ He used his spare time to cultivate this interest of his, resulting into three important publications: *Pour l'histoire de la science hellène de Thalès à Empédocle* (1887); *La Géométrie grecque* (1887); and *Recherches sur l'histoire de l'astronomie ancienne* (1893).⁷ These works reflected to some extent Comte's vision of a history of science. Retrospectively, they have been assigned a crucial role in the formation of history of science in France, since they were embraced by later historians of science such as Gaston Milhaud,

⁶ See Tannery's favorable review of E. de Roberty's *L'ancienne et la nouvelle philosophie, essai sur les lois générales du développement de la philosophie* (Paris, 1887), which was inspired by Comte's ideas; P. Tannery, 'L'histoire de la philosophie en France pendant l'année 1888': *Archiv für Geschichte der Philosophie*, 3 (1890), 658-660. For history of philosophy in France, see L. Braun, *Histoire de l'histoire de la philosophie* (Paris: Ophrys, 1973), 139-159; G. Piaia, 'Le storie generali della filosofia nell'area francese', in *Storia delle storie generali della filosofia*, editor in chief G. Santinello (Brescia: La Scuola, 1979-81; Rome and Padova: Editrice Antenore, 1988-2004), vol. 4, part 2, 5-200, especially 106-108, 144-145; G. Piaia and U. R. de Azevedo Marques, 'Dopo Cousin, oltre Cousin: Le storie generali della filosofia nell'area francese', in *Storia delle storie*, vol. 5, 445-563, especially 528-543.

⁷ For Tannery's life and works, see Brenner, 'Réconcilier les sciences', 436-443. For Comte's thought, see M. Bourdeau, 'Auguste Comte', *Stanford Encyclopedia of Philosophy*, first published Oct. 1, 2008. Accessed Jan. 12, 2009.

Abel Rey and Pierre Duhem.⁸ In the ‘Introduction’ to *Pour l’histoire de la science hellène de Thalès à Empédocle*, Tannery outlines the methodology governing this new discipline, allowing us to comprehend his stance towards nineteenth-century history of philosophy.⁹

The aim of this work is to outline the development of Greek science from the sixth to the fourth century BC, beginning with Thales of Miletus (fl. ca. 585 BC), ending with Empedocles (ca. 495-ca. 435 BC). Tannery thus focuses on the earliest period of science, preceding Hippocrates (ca. 460-ca. 370 BC), who founded medicine as a science, and Aristotle (384-322 BC), who founded all the physical and natural sciences, according to Tannery.¹⁰ The imperfect state of our knowledge about this early period of science, Tannery explains, is not only due to the uncertain nature of its sources, i.e. scattered fragments, but also to a misleading method hitherto employed on this material by historians of philosophy. Tannery intends to replace this method with a new one that is able to represent this material in a more adequate manner.¹¹ He first makes a juxtaposition between these two methods in the ‘Introduction’, highlighting the precepts that he thinks proper to the history of science, and then puts these precepts into practice in the remaining part of the book.

⁸ For the development of history of science in France, see Brenner, *Les origines*, 181-188; *id.*, ‘Réconcilier les sciences’, 433-454. For Tannery’s influence upon Duhem, see *id.*, ‘Genèse’, 43-48. It is debateable whether Tannery’s intention back in 1887 was to establish an alternative discipline to history of philosophy; by then he cooperated with leading European historians of philosophy in the *Archiv für Geschichte der Philosophie* (1888-), and he defended the intrinsic value of history of philosophy in his article ‘L’histoire de la philosophie en France pendant l’année 1886’, *Archiv für Geschichte der Philosophie*, 1 (1888), 301.

⁹ P. Tannery, *Pour l’histoire de la science hellène: De Thalès à Empédocle* (Paris, 1887), 9-14.

¹⁰ *Ibid.*, 1.19.

¹¹ *Ibid.*, 9.23-33.

The objects examined in the period selected by Tannery are the ‘systems’ (Fr. *systèmes*) of the ‘physiologists’ (Fr. *physiologues*) active before Plato.¹² What is a physiologist? Aristotle had used the term ‘physiologist’ (Gr. *physiologikos*) when referring to thinkers reflecting on natural causes and phenomena, especially Presocratic thinkers. Tannery claims that he follows the method of Aristotle himself, and that Aristotle was the only one able to account for the beginning of philosophy — a favourable interpretation of Aristotle as a historian of philosophy, which has not survived in modern scholarship.¹³ Tannery’s fondness of the phrase ‘physiologist’ may therefore owe something to Aristotle. Later on, Augustine (354-430) had spoken of the ‘physiological interpretation’ (Lat. *interpretatio physiologica*) among pagan thinkers, who lacked access to Revelation in their understanding of nature.¹⁴ In Latin usage, the term ‘physiology’ (Lat. *physiologia*) came to denote theories within natural philosophy, including Ionian natural philosophy, and this usage remained valid up till the eighteenth century.¹⁵ The term ‘physiology’ has also a more restricted meaning, denoting the normal functions of living organisms. This is the most common meaning of the term today, but clearly not the one Tannery had in mind. Hence a physiologist, in Tannery’s use of the term, deals with a more restricted area of reality than a philosopher; the physiologist works out theories within natural philosophy, whereas the philosopher, in addition to this, also works out theories within such areas as logic, moral and

¹² For Presocratic Greek thinkers as physiologists, see *ibid.*, 11.1-4. Tannery uses the expression ‘physiologues’ *ibid.*, 10.4, 11.12, 12.1, 14.23, 16.1, 16.7. Similarly, he connects the expression ‘système’ to these physiologists *ibid.*, 10.4, 11.12, 12.4, 13.5.

¹³ E.g. Aristotle, *Metaphysica* 986^b14, 990^a3; *De anima* 426^a20; *De partibus animalium* 641^a7. Tannery may refer to such Aristotelian usage in *Pour l’histoire*, 10.16-34.

¹⁴ Augustine, *De civitate dei* vi 8.

¹⁵ For the term *pysiologia* as knowledge of nature, see S. Kusukawa, *The transformation of natural philosophy* (Cambridge: Cambridge University Press, 1995), 61, 131-134.

political philosophy, metaphysics and theology. Tannery wants to emphasize this restricted focus of the earliest contributors to the history of science by using the phrase ‘physiologist’.

This phraseology stood out from the conventions of history of philosophy. Jacob Brucker (1696-1770), the German Protestant minister who established the history of philosophy as a philosophical discipline by his *Historia critica philosophiae* (1742-1744), did mention Thales’ so-called ‘physiological system’ (Lat. *systema physiologicum*), i.e. his natural philosophy. He nevertheless characterized Thales as the ‘founder of philosophy’ (Lat. *inventor philosophiae*) and regarded his natural philosophy as a minor compartment of his entire system of philosophy.¹⁶ Later German historians of philosophy, like Eduard Zeller (1814-1908), praised by Tannery, followed Brucker and attached the term ‘philosopher’ to Thales.¹⁷ Several French historians of philosophy

¹⁶ For Brucker on Thales’ ‘physiological system’, see J. Brucker, *Historia critica philosophiae a mundi incunabulis ad nostram usque aetatem deducta*, 5 vols (Leipzig, 1742–1744. Appendix, 1 vol.: Leipzig, 1767), vol. 1, 468.19-20. For Thales as the ‘founder of philosophy’, see *ibid.*, vol. 1, 458.1-7. For Brucker’s account of Thales’ system of philosophy, see L. Catana, *The historiographical concept ‘system of philosophy’: Its origin, nature, influence and legitimacy* (Leiden: Brill, 2008), 64-72.

¹⁷ E.g. E. Zeller, *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung*, 6th ed., 3 parts in 6 volumes [Leipzig, 1919], cited from the reprint (Darmstadt: Wissenschaftliche Buchgesellschaft, 1963), vol. 1, 258-270, refers to Thales as one of the seven wise men (‘sieben Weisen’) (264) and as a philosopher (‘Philosoph’) (262, 266, 268, 269, 270 n. 1). Zeller only refers to Thales as a physiologist (‘Physiolog’) when speaking of Aristotle’s account of Presocratic philosophers, among whom we find Thales (263). Tannery, *Pour l’histoire*, 76, had stated his admiration for Zeller. For the history of the concept of physiology, see K. E. Rothschuh, ‘Physiologie’, in *Historisches Wörterbuch der Philosophie*, general ed. J. Ritter, vol. 1- (Darmstadt: Wissenschaftliche Buchgesellschaft, 1971–), vol. 7, cols 964-967.

like De Gerando (1822-23)¹⁸ and Renouvier (1885-86)¹⁹ had taken over Brucker's characterisation of Thales as a philosopher. French historians of philosophy influenced by positivism, on the other hand, like Soury (1881),²⁰ had been reluctant to use the phrase 'philosopher' about Thales, preferring to speak of his physics and his connection with other Ancient physiologists, thus inclining towards the terminology of Aristotle. Tannery was clearly susceptible to the subversive classification found among such contemporary historians of philosophy open to positivism, and he wanted to reverse the traditional Bruckerian classification, imported to France by historians like De Gerando and others, by calling Thales a 'physiologist'. This subversive terminology is concordant

¹⁸ P. Bayle, 'Thales', in *id.*, *Dictionnaire historique et critique*, 3 vols (Rotterdam, 1702), vol. 3, 2855-2858, had called Thales one of the seven 'wise men' ('sages') and a 'philosopher' ('philosophe') (e.g. 2855), but not a 'physiologist' ('physiologue'). M. De Gerando, *Histoire comparée des systèmes de philosophie, considérés relativement aux principes des connaissances humaines* [first ed. 1804], 2nd ed., 4 vols (Paris, 1822-1823), does not use the term 'physiologist' about Thales, but the term 'philosopher'; see vol. 1, 64, 71, 98, 184, 317, 334-335, 339-352, 377-378, 382-388. *Ibid.*, vol. 1, 384, 386, De Gerando refers approvingly to Brucker's interpretation of Thales' water theory. *Ibid.*, vol. 1, 146, 148-150, 159, De Gerando praises Brucker's *Historia critica philosophiae* as the first and the most important work in the history of philosophy.

¹⁹ C. Renouvier, *Esquisse d'une classification systématique des doctrines philosophiques*, 2 vols (Paris, 1885-1886), vol. 1, 5, 29-30, does not call Thales a physiologist, but regards him as one of the Ionian philosophers.

²⁰ J. Soury, *Bréviaire de l'histoire du matérialisme* (Paris, 1881), calls Thales a 'philosopher' ('philosophe') on rare occasions, e.g. 124. Typically, he speaks of Thales' 'physics' ('physique'), claiming that Thales was an important founder of Western hylozoism and materialism; see *ibid.*, 55, 59, 70, 124-128, 174, 231.

with Tannery's reservation about the method hitherto employed by historians of philosophy on the Presocratics, and with his phylogenetic explanation of the development of history of science, to which I turn in a moment. It should be observed, however, that even though Tannery opposes this nominal feature in the history of philosophy, he follows this tradition in at least two respects.

First, Tannery regards Thales as the first contributor to the history of science. Brucker had rejected the previously widespread belief that philosophy originated in the Middle East among Chaldeans, Egyptians and Hebrews, in order to place Thales among the first genuine philosophers, on the grounds that he was among the first to build a philosophical system.²¹ Tannery is in line with this inherited historiography of the Enlightenment, placing Ionian natural philosophy first in the history of science.

Second, Tannery sees the task of a historian of science, accounting for the seventh to the fourth century BC, as that of reconstructing the 'systems' of the so-called physiologists. Where did the concept of system come from? And what did it mean? Before the seventeenth century, the term (Gr. *systema*, Lat. *systema*) had not been used in the context of methodology, but in various other contexts: To denote the organization of a government (e.g. Plato, *Leges* 686B; Aristotle, *Ethica Nicomachea* 1168^b32); the organization of an institution (e.g. Polybius 21.13.11); harmonies in music (e.g. Plato, *Philebus* 17D); the composition of a literary work (e.g. Aristotle, *Poetica* 1456^a11); a biological organism (including man), consisting of several parts (e.g. Aristotle, *De generatione animalium* 740^a20, 758^b3); and, finally, in astronomical contexts, denoting the universe and its parts (e.g. Fulgentius, *Mythologiae* 3.9). In addition to these classical meanings of the concept of system, the concept took up a methodological meaning within the sciences of the

²¹ Brucker, *Historia critica philosophiae*, vol. 1, 463.1–3. Cicero, *De natura deorum* I x 25, had considered Thales the first philosopher to reflect on the origin of the world, but without claiming that Thales developed a system of philosophy.

seventeenth century, as described by Otto Ritschl back in 1906.²² More than hundred seventeenth-century works were titled ‘system’, such as Pierre-Silvan Regis, *Système general selon les principes de Descartes* (1691).²³ Tannery, and later on Duhem, were familiar with these non-historiographical uses of the term system, and it will be crucial to distinguish, if possible, these uses from the historiographical use, to which I now turn.

The historiographical concept system of philosophy was invented in the first half of the eighteenth century, as argued elsewhere. It was used retrospectively on all past philosophers for the first time in Brucker’s *Historia critica philosophiae* from the 1740s. He assumed that all past philosophers since the Ionian natural philosophers had striven to philosophize in a manner concordant with this concept. According to him, they had striven to build philosophies which were autonomous in regard to non-philosophical disciplines; which were based on a restricted number of general theories or hypotheses, so-called principles, from which the more special doctrines in the various compartments of philosophy were deduced; and which were internally coherent and unified as a complex of principles and deductions made from them. This historiographical meaning of ‘system’ was an important and distinct addition to the meanings assigned to the concept before the eighteenth century.

According to Brucker, the historian of philosophy was distinguished from earlier doxographers, polyhistorians and antiquarians by the ambition to analyze and expose the systems of past philosophers. Even though Brucker’s Latin opus disappeared from the horizon of nineteenth-century history of philosophy — increasingly written in the vernacular, especially German — this historiographical concept remained central to the ensuing tradition of history of philosophy, the

²² O. Ritschl, *System und systematische Methode in der Geschichte des wissenschaftlichen Sprachgebrauchs und der philosophischen Methodologie* (Bonn: A. Marcus und E. Webers Verlag, 1906), cols 26-40.

²³ For a list of titles, see *ibid.*, Anhang, i-vii.

latest example being Friedrich Copleston's general history of philosophy, published 1946-1976 and reprinted numerous times subsequently.²⁴ By and large, Tannery's immediate context — i.e. French historians of the nineteenth century, including those with positivistic inclinations — conformed with this tradition.²⁵

The main problems with this novel historiographical concept are, in the case of Brucker and some of his followers, the following two. First, it often mistakes two distinct meanings of 'principle' (Lat. *principium*, Gr. *archê*), namely a logical meaning (a hypothesis from which a deduction is made), and an ontological meaning (the beginning of the universe). For instance, Thales' dictum that water is the beginning (Gr. *archê*) should not be taken in the logical meaning, but in the ontological meaning. However, Brucker confounded these two meanings when he identified the so-called principle in Thales' philosophy. Second, Brucker and his followers have ignored the fact that the methodological ideal of doing philosophy by means of system building emerged relatively late, in the seventeenth century, for which reason it is anachronistic to employ it on pre-seventeenth-century philosophy. Tannery also conformed to this second feature of eighteenth- and nineteenth-century history of philosophy by singling out the identification of these early thinkers' systems as the main task of the historian of science, although he understood the genesis and nature of those systems differently, as I explain below.

Let me return to Tannery's phylogenetic account of the history of science. To the early thinkers, the 'core of the systems' was not a 'metaphysical idea', but a 'general conception', generated through a totality of particular experiences. In the course of history, mankind developed

²⁴ For Brucker's introduction of the historiographical concept system of philosophy, see L. Catana, *The historiographical concept 'system of philosophy'*, 11-34. For F. Copleston's adherence to this concept, see his 'Introduction', in *id.*, *A History of Philosophy* (New York, etc.: Doubleday, 1985), vol. 1, 2-9.

²⁵ The following French histories of philosophy employ the concept: De Gerando, *Histoire*, vol. 1, xiii-xviii, *et passim*; Renouvier, *Esquisse*, vol. 1, 1 *et passim*; Soury, *Bréviaire*, iii *et passim*.

the intellectual skill to make abstractions on the basis of such particular experiences. It would therefore be anachronistic, Tannery argues, to attribute the same ability for abstract and metaphysical reasoning to those early thinkers as we attribute to ourselves today, and which is conspicuous among modern historians of philosophy.²⁶

Be this as it may, it provides the background for Tannery's definition of history of science as 'complementary' to history of philosophy, complementary in a methodological sense: The historian of philosophy first identifies a 'metaphysical idea' (Fr. *idée métaphysique*) in a past thinker's writings and then interprets the thinker's various physical theories as derivations or logical deductions from this metaphysical idea.²⁷ Tannery does not explain what he means by 'metaphysical idea', but opposes it to 'particular experiences' (Fr. *connaissances particulières*), suggesting that a 'metaphysical idea' is an idea arrived at independently of sense perception, i.e. an *a priori* idea. The historian of science, on the other hand, first identifies physical theories, then inter-connects these theories, and, finally, contextualises them historically.²⁸ Hence the two methods are 'entirely opposed', Tannery concludes.²⁹ His phylogenetic account of the history of science thus induces him to call for a Copernican revolution in the method of history of philosophy.

In Tannery's more rhetorical declarations, he not only regards these methods as 'opposed' — he regards the method of history of philosophy as fundamentally misleading and therefore discards it completely: 'I do not want at all to adopt this way of understanding the history of philosophy.'³⁰ In such statements Tannery contends that history of science is the only methodologically sound historical discipline that can account for the history of past philosophies,

²⁶ Tannery, *Pour l'histoire*, 11.20-28. See also *ibid.*, 10.16-34.

²⁷ Tannery, *ibid.*, 10.5-15. Tannery also refers to such 'metaphysical ideas' *ibid.*, 11.13.

²⁸ *Ibid.*, 11.12-28.

²⁹ *Ibid.*, 10.35-40.

³⁰ *Ibid.*, 10.16-17.

since history of philosophy betrays its scientific object; history of science is the only genuine history of philosophy. It is unclear which method Tannery thought proper to areas outside natural philosophy and metaphysics, e.g. ethics, political philosophy and theology, that were also cultivated by some natural philosophers, e.g. Aristotle.

What was the target of Tannery's attack? According to Tannery, historians of philosophy are looking at past thinking as through a telescope, a method, which makes a past thinker's physical theories appear as if they were derivations from a metaphysical idea, although this was not the case. The practice resulting from this procedure is that physical theories are treated as deductions or derivations from such a metaphysical idea.³¹ Tannery's diagnosis fits eighteenth- and nineteenth-century history of philosophy in general. If we take Brucker, for instance, he had first identified Thales' 'principle', that is, a general theory or an axiom, in this case Thales' water theory, from which he deduced Thales' various philosophical theories. These deductions were then assigned to their proper compartment of Thales' system. Thales' natural philosophy and his mathematics, for instance, were interpreted as such derivations from Thales' principle. Brucker applied this procedure uniformly to all past thinkers, even Plato, whose writings do not yield easily to such a hermeneutics. Although this methodology in the history of philosophy was modified and occasionally opposed in the course of the nineteenth century, it remained intact and dominant — the French historian of philosophy, De Gerando, Tannery's compatriot, being an example.³² It would make sense, then, to interpret Tannery's reference to a 'metaphysical idea' as such a 'principle'.

³¹ Tannery, *Pour l'histoire*, 10.5-15.

³² For Brucker's influence in general, see Catana, *The historiographical concept 'system of philosophy'*, 193-282. De Gerando's interpretation of Thales is one case in point. In his *Histoire*, vol. 1, 350-352, De Gerando thus claims, like Brucker had done, that Thales' natural philosophy should be understood on the basis of his metaphysics.

Nineteenth-century history of philosophy, heavily institutionalized, was thus the target of Tannery's attack.³³

Historians of philosophy from the nineteenth century had also been critical of Brucker's method. The German Georg Wilhelm Friedrich Hegel (1770-1831) had complained that Brucker's axiomatic-deductive method was formalistic and ahistorical;³⁴ his compatriot, Zeller, had argued that historians of philosophy should not deal with their material 'from above', that is, deductively, according to pre-established concepts about the grand schemes of historical development, as Hegel's notion of system of development encouraged one to do, but 'from below', that is, inductively, on the basis of historical evidence.³⁵ Zeller did not reject the historiographical concept system of philosophy entirely, but he watered it down to a regulative concept, which had to accommodate historical and textual observations. Hence, Tannery's criticism was not unique —

³³ For the institutional position of history of philosophy in the nineteenth century, see U. J. Schneider, 'Teaching the History of Philosophy in 19th-Century Germany', in *Teaching New Histories of Philosophy*, ed. J. B. Schneewind (Princeton, New Jersey: University Center for Human Values, Princeton University, 2004), 275-295. For the role of Cousin's history of philosophy in France, see D. S. Goldstein, 'Official Philosophies in Modern France: The Example of Victor Cousin', *Journal of social history*, 1:3 (1968), 259-279; Piaia, 'Le storie generali della filosofia nell'area francese', 89-200, especially 146-200. For Cousin's use of the historiographical concept system of philosophy, see Catana, *The historiographical concept 'system of philosophy'*, 227-229.

³⁴ G. W. F. Hegel, *Vorlesungen über die Geschichte der Philosophie*, ed. C. L. Michelet, 3 vols, 2nd ed. (Berlin, 1840-44), vol. 1, 57.6-17.

³⁵ E. Zeller, 'Die Geschichte der Philosophie, ihre Ziele und Wege', *Archiv für Geschichte der Philosophie*, 1 (1888), 1-10; *id.*, *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung*, 2nd ed., 5 vols (Tübingen and Leipzig, 1856-1868), vol. 1, 14.

German authors had levelled similar kinds of criticism. Unlike them, however, Tannery's criticism led him to a radical reform of the discipline history of philosophy.

What was, then, Tannery's alternative to the history of philosophy? As said above, historians of science reconstruct the respective systems of past thinkers on the basis of their individual, physical theories. Even though Tannery refers several times to such systems, he never explains in the 'Introduction' what 'system' means, probably because it was such a widespread term that it appeared as self-explanatory. He does indicate, however, that this concept renders the doctrines of the past thinker 'unitary' and reveals their 'natural bond'; doctrines which may even be perceived as discordant and contradictory by historians of philosophy. The historian of science arrive at such hermeneutic results because he side-steps the procedure of the historian of philosophy, whose point of departure is a metaphysical idea, or a principle, identified in past thinkers' writings; discordances and contradictions among past thinkers' doctrines derive from the domain of metaphysics, erroneously construed by historians of philosophy. Hence Tannery thinks that history of science results into internally coherent interpretations of the various past systems, where an internally coherent complex of physical theories, not a metaphysical idea, constitutes the 'core' in these systems.³⁶ Such a methodology would be in better agreement with the phylogenetic development of mankind, Tannery thinks.

Tannery carried on a widespread misunderstanding among nineteenth-century historians of philosophy by accepting that past thinkers had produced systems, which were autonomous and internally unitary and coherent. In fact, many past thinkers made theoretical connections between natural philosophy and disciplines outside natural philosophy. Brucker had made this mistake 'from above', so to speak, by placing a principle or a metaphysical idea at the top of such a philosophical system; Tannery had the courage to refuse this method in history of philosophy, but repeated the mistake 'from below', by placing a coherent unity of physical theories at the centre of a

³⁶ Tannery, *Pour l'histoire*, 11.12-12.2.

philosophical system. Brucker and Tannery both dismissed the possibility of non-unitary complexes of theories that drew on heterogeneous disciplines.

If we leave aside Tannery's methodological recommendations in the 'Introduction' and pass on to the remaining part of the book, we find various practices. In his account of Thales, it is very hard to recognize a practice, which matches the precepts from the 'Introduction'. For instance, Tannery does not identify Thales' physical theory (the water theory being the most prominent) and he does not reconstruct Thales' 'general conception' on the basis of his physical theories, if one can speak of such at all. What he does is to discuss the significance of non-Greek sources to Thales' thinking. Otherwise, he refers his readers to Zeller's authoritative account of Thales' thought, contained in Zeller's *Die Philosophie der Griechen in ihrer geschichtlichen Entwicklung*, translated into French with the title *Philosophie des Grecs*, adding the following remark: 'Why should I wish to remake that which is well said and sufficiently disseminated?'³⁷ This admission leaves the reader wondering what has become of the revolutionary antagonism against history of philosophy from the 'Introduction'. In his account of Anaximander of Miletus (ca. 610-after 546 BC), on the other hand, we find Tannery reconstructing a system of physical theories, much in line with his 'Introduction'.³⁸

I now pass on to Duhem, who explicitly endorsed Tannery's method in the history of science.

³⁷ *Ibid.*, 76 n. 1: "Si je suis en désaccord sur quelque point avec l'illustre historien [Eduard Zeller], j'aurai soin de l'indiquer. Mais pourquoi voudrais-je refaire ce qui est bien fait et suffisamment répandu?"

³⁸ *Ibid.*, 87-93.

PIERRE DUHEM

Pierre Duhem (1861-1916) studied mathematics and physics at the Ecole Normale Supérieure in Paris between 1882-1887 and took his doctorate in physics from Sorbonne in 1888. Later in life he worked as a theoretical physicist.³⁹ His many publications reflected this educational and professional pattern. He published numerous studies on thermodynamics, physics, elasticity and energetics from 1884, then only twenty-three years old, until his death in 1916, then aged fifty-five. Even though his appreciation of history was manifest from the outset in his career, his more substantial, published studies on the history of science came relatively late, around 1903 and onwards, *Les origines de la statique* (1903-1906) being among the earliest. By then Duhem had already established himself as a theoretical physicist and was in his early forties, increasingly turning to the history of physical theories in order to provide genetic accounts of the theoretical developments pointing towards physical theories of his day.⁴⁰ Although his interest in modern physical theories remained vibrant until his death, his list of publications suggests that the last thirteen years or so were increasingly dominated by his interest in the history of science. Over the last eight years of his life, he wrote the massive ten-volume work, *Le système du monde*, the first five volumes being published between 1913 and 1919, volume six to ten in the 1950s.⁴¹

Duhem took great care to explain the methodology governing theories of science, primarily in *La théorie physique: Son objet, sa structure* (1906). This methodology has been analyzed and

³⁹ For Duhem's life and education, see R. Ariew, 'Pierre Duhem', *Stanford Encyclopedia of Philosophy*, first published July 13, 2007. For Duhem's education at the Ecole Normale Supérieure, see Jaki, *Uneasy Genius*, 37-69.

⁴⁰ For a list of Duhem's works, see Jaki, *Uneasy Genius*, 437-455. Duhem's *Les origines de la statique* (1903-1906) is among his earliest works on the history of science.

⁴¹ Ariew, 'Pierre Duhem'.

discussed in authoritative studies, e.g. Lowinger's *Methodology of Pierre Duhem* (1941). Duhem did not, however, explain in great detail the methodology adopted by him in the history of science.⁴² These two uses of the concept of methodology should not be conflated, since the former, concerning theory of science, is typically an intervention into a contemporary scientific community discussing such methodologies; the latter, concerning the history of science, guides the interpretation and explanation of what has counted as science in the past. To conflate the two uses would be to deny the historical evolution of science. In the following I focus on Duhem's methodology controlling his studies in the history of science.

Modern commentators have pointed out two important sources to the method in Duhem's history of science, namely the French historian Numa Denis Fustel de Coulanges (1830-1889) and the above-mentioned Paul Tannery. Fustel de Coulanges set out as a historian of Ancient Greek and Roman political and social institutions, later turning to the history of political institutions in Ancient France.⁴³ He had a brilliant career. In 1870, he was appointed to a lectureship at the Ecole Normale Supérieure. In 1875, he went to the Sorbonne, where he took up a chair of Medieval history three years after. From 1880 to 1883 served at the Ecole Normale Supérieure as its director, after which he went back to the Sorbonne.⁴⁴ When Duhem entered the Ecole Normale Supérieure in 1882, Fustel de Coulanges was thus a famed historian, director of this prestigious institution, and clearly one who could influence the young Duhem's sensitivity towards the past.

⁴² Exceptions are P. Duhem, 'Paul Tannery', *Revue de philosophie*, 6 (1905), 216-230, and id., *La science allemande* (Paris: A Hermann & fils, 1915).

⁴³ For Fustel de Coulanges as a historian, see J. Herrick, *The Historical Thought of Fustel de Coulanges* (Washington, D.C.: The Catholic University of America Press, 1954).

⁴⁴ *Ibid.*, 7.

For this reason it seems obvious to trace Duhem's historiographical ideas guiding his work in the history of science back to Fustel de Coulanges, as has been done by Stanley Jaki.⁴⁵ As pointed out by Jaki, this interpretation finds support in Duhem's own statements in *La science allemande* (1915), where he explicitly affirms Fustel de Coulanges' criticism of 'German' historical method, which is excessively based on 'deduction' from *a priori* ideas. Instead, Duhem praises, together with Fustel de Coulanges and ultimately Pascal, the 'French' method, which is not deductive, but based on the 'esprit de finesse' and 'bon sens', that is, intuitive judgement. The French method is a genuine historical method that respects the contingency implied by historical agents endowed with free will.⁴⁶ Moreover, Duhem openly acknowledges other virtues inherent Fustel de Coulanges' historiographical practice, namely the skill to present solid, textual evidence and to interpret with a high degree of precision.⁴⁷ This attitude to the study of history clearly echoes the historical and philological impartiality and thoroughness characteristic to Fustel de Coulanges' historical scholarship, where archival research and textual verification are crucial elements.⁴⁸ There is no need to doubt that Duhem adopted an attitude to the study of the past which owed much to Fustel de Coulanges. Duhem too stressed careful textual analysis, the need to bring forth textual evidence in his explanations; he rejected, like Fustel de Coulanges, preconceived schemes of historical development that tended to block historical research. On this background Jaki has asserted that to Duhem, '[r]igor in matters historical means above all a reliance on original

⁴⁵ This interpretation we find in Jaki, *Uneasy Genius*, 40, 392 n. 65.

⁴⁶ Duhem, *La science allemande*, 58-61, 64. Duhem praises Fustel *ibid.*, 54-55, 60-61, 62, 64-65, 66-67, 71-72. For Duhem's use of Pascal, see R. N. D. Martin, *Pierre Duhem. Philosophy and History in the Work of a Believing Physicist* (La Salle, Illinois: Open Court, 1991), 59-126.

⁴⁷ Duhem, *La science allemande*, 54-55, 57, 62.

⁴⁸ For Fustel's method, see Herrick, *The Historical Thought*, 19-94

sources’,⁴⁹ and he has characterized *Le système* as ‘a storehouse of data to satisfy the precepts of logical positivism according to which everything meaningful must be “on the surface”’.⁵⁰

Even though Fustel de Coulanges doubtless had a considerable impact on Duhem’s historical work, it should be observed that he was a historian, not a historian of philosophy, nor a historian of science, as indicated by his list of publications.⁵¹ If we take a closer look at Duhem’s eulogy of Fustel de Coulanges’ method in *La science allemande*, it becomes clear that Duhem only spoke of him as a historian, not as a historian of philosophy or a historian of science.⁵² To Duhem, he was a historian, a very good and inspiring historian. In the nineteenth century, however, history and history of philosophy were two distinct disciplines endowed with some common but also some individual historiographical concepts. One case in point is the concept system of philosophy, which was a key concept in nineteenth-century historiography of history of philosophy, but which played a marginal role in nineteenth-century history. It is indeed likely, as Jaki has argued, that Fustel de Coulanges convinced Duhem about the value of some basic precepts and practices when interpreting primary sources, but it is unlikely that Fustel de Coulanges conveyed to him the historiographical concept system of philosophy, since it was irrelevant to the issues on which he worked, Ancient social and political institutions. Instead, history of philosophy from the nineteenth century was the source to this concept in Duhem’s writings on the history of science. In principle, Fustel de Coulanges could have pointed out this tradition to the young Duhem in an informal manner, stressing the peculiar methodological precepts pertaining to the history of philosophy, but we should keep in mind that Fustel de Coulanges scorned (Hegelian) philosophy of history, and that Duhem’s many explicit references to nineteenth-century historians of philosophy in his *Système*

⁴⁹ Jaki, *Uneasy Genius*, 378.

⁵⁰ *Ibid.*, 404.

⁵¹ For Fustel de Coulanges’ list of publications, see Herrick, *The Historical Thought*, 123-129.

⁵² E.g. Duhem, *La science allemande*, 62.

suggest something else, namely that Duhem, at some point in his career, consulted this tradition directly.⁵³ Before tracing his sources in nineteenth-century history of philosophy, I shall deal briefly with the other source commonly assigned to Duhem's methodology for the history of science, namely Paul Tannery.

In recent years, Anastasios Brenner has made important contributions to our understanding of Duhem's historical and methodological background, pointing out, among other things, the role which Tannery's methodological differentiation between history of philosophy and history of science had to Duhem as a historian of science.⁵⁴ I am indebted to these studies. Duhem affirmed Tannery's vehement rejection of history of philosophy and its methodology, Brenner reports, in keeping with the explicit statements of these two authors. In his obituary on Tannery, published in 1905, Duhem thus admitted that Tannery's research into early Greek science in *Pour l'histoire de la science hellène* from 1887 could be perfected, but he insisted that Tannery was right in assuming that Presocractic thinkers based their thought on astronomical ideas, not on metaphysical ideas, and that 'one should keep to the same method as the one which he [Tannery] has discovered and followed'.⁵⁵ It seems, then, from this and other passages in Duhem's 1905 obituary, as if Duhem

⁵³ For Fustel de Coulanges' sceptical view of philosophy of history, see Herrick, *The Historical Thought*, 29-30. Hegelian history of philosophy was notoriously interwoven with philosophy of history.

⁵⁴ I am indebted to Brenner, 'Réconcilier les sciences', 433-454; *id.*, 'Genèse', 35-58. On Duhem's background, especially Tannery, see also Brenner, *Les origines*, 181-188.

⁵⁵ For Duhem's acknowledgement of Tannery, see Brenner, 'Genèse', 44-45. *Ibid.*, 45 n. 12, Brenner cites Duhem, 'Paul Tannery', 220: "Il nous semble qu'un point demeurera inébranlable et une vérité définitivement conquise: c'est que les pensées des premiers philosophes grecs doivent être rattachées bien plus à leurs doctrines cosmologiques qu'à leurs aperçus métaphysiques. L'oeuvre de Paul Tannery sera assurément modifiée et perfectionnée; c'est le

joined Tannery and regarded history of philosophy as a monumental disciplinary phenomenon from the nineteenth century, now superseded by history of science; history of science developed its own, distinct methodology, independently of, and even in opposition to, nineteenth-century history of philosophy.⁵⁶

A closer examination of Tannery's work of 1887 reveals stronger ties between the methodologies governing history of philosophy and history of science than Tannery acknowledged, as I have argued above. Given this circumstance, and the fact that Duhem consulted nineteenth-century histories of philosophy, as we shall see, I doubt that Tannery was a privileged, methodological source to Duhem; they had a common source in nineteenth-century history of philosophy, even though their programmatic statements deny such a link at first glance. Duhem's use of one central historiographical concept from nineteenth-century history of philosophy, system of philosophy, has not yet been examined. Lowinger's monograph, for instance, has not analyzed this historiographical concept in Duhem's oeuvre, nor has it examined whether the history of

sort qui attend toute oeuvre humaine, et surtout celle des novateurs; mais pour faire autrement et mieux, on devra procéder par la méthode même qu'il a tracée et suivie." Duhem thus agrees with Tannery, *Pour l'histoire*, 9-12, especially 11.12-19. F. Picavet, 'Paul Tannery, historien de la philosophie', *Archiv für Geschichte der Philosophie*, 11 (1905), 297-299, takes Tannery's stated opposition between the methodologies of history of philosophy and history of science at face value, like Duhem.

⁵⁶ To note in passing, Duhem's expressed admiration for Tannery in this obituary of 1905 is not reflected Duhem's list of sources dating from 1908, where he points out T. H. Martin, G. Schiaparelli and P. Mansion as his forerunners in history of astronomy; see P. Duhem, *ΣΩΖΕΙΝ ΤΑ ΦΑΙΝΟΜΕΝΑ. Essai sur la notion de théorie physique de Platon à Galilée* (Paris: Hermann et Fils, 1908), 2.

philosophy, and indeed its methodological assumptions, entered Duhem's methodology. The same can be said about a number of later studies on Duhem's methodology.⁵⁷

We need to be cautious when discussing Duhem's historiographical practice in *Le système*. Although he does refer to nineteenth-century historians of philosophy like the Frenchman Victor Cousin (1792-1867) and Eduard Zeller, and although he explicitly uses the phrase 'system of philosophy', used by these two historians of philosophy among many others, he does not use the concept system of philosophy universally and mechanically in *Le système*.⁵⁸ Some past thinkers are not subjected to this concept, others are. One notorious example of the first group is Duhem's exposition of Plato's cosmology, which almost completely omits reference to Plato's so-called theory of ideas, which had been used as a metaphysical foundation in nineteenth-century accounts of Plato's natural philosophy. When Duhem, in his interpretation of Plato's cosmology, refers to Zeller's authoritative account of Plato's philosophy, it is not in order to cite Zeller's description of Plato's theory of ideas. In this case one can clearly see Duhem sidestepping the nineteenth-century tradition among historians of philosophy for using a 'metaphysical idea' as a starting point. This had been the case in the interpretation of Brucker, and in those of Hegel, Wilhelm Gottlieb Tennemann (1761-1819), Zeller and other Plato scholars from the nineteenth century.⁵⁹ In

⁵⁷ None of the studies on Duhem listed in n. 5 above examines the historiographical concept system of philosophy, or the history of philosophy, in connection with Duhem's methodology for the history of science.

⁵⁸ For Duhem's exposition of Plato's cosmology, see P. Duhem, *Le système du monde*, 10 vols (Paris: Hermann, 1913-1959), vol. 1, 28-101. Duhem refers to Cousin in *ibid.*, vol. 1, 89 n. 1; vol. 3, 68 nn. 2 and 3, 92, 94, 95, 261, 265; vol. 5, 256. He refers to Zeller in his treatment of Plato's cosmology in *ibid.*, vol. 1, 70 n. 2, 77 n. 1, 78 n. 1, 79 n. 1.

⁵⁹ For Brucker's interpretation of Plato, see Catana, *The historiographical concept 'system of philosophy'*, 73-94; for nineteenth-century historians' interpretation of Plato, see *ibid.*, 195-265.

accordance with Tannery's recommendations, Duhem sets off from Plato's physical and astronomical theories, not from his alleged metaphysical idea. We find an example of the second group, past thinkers whose texts are subjected to the concept system of philosophy, in Duhem's exposition of Nicholas of Cusa (1401-1461).

Duhem obviously uses the term 'system' in the astronomical sense throughout *Le système*, also in his exposition of Cusanus' astronomical theories.⁶⁰ He also uses the term in a historiographical sense in his treatment of Cusanus in this work.⁶¹ In other works, Duhem uses the term in a methodological sense, keyed to the structure of physical theories, primarily contemporary or near-contemporary physical theories.⁶² Although there are occasionally overlaps between the

⁶⁰ Duhem uses explicitly the term 'système' in an astronomical sense in the following places in his exposition of Cusanus in *Le système*, vol. 10, 247-347; see *ibid.*, 316.16 ('système'), 316.18 ('système'), 319.5 ('système'), 320.4 ('système héliocentrique'), 320.8-9 ('système héliocentrique ... système géocentrique'), 323.38 ('systèmes').

⁶¹ Duhem uses the same term ('système', 'système philosophique' or 'système métaphysique') explicitly in a historiographical sense in his exposition of Cusanus' thought; see Duhem, *Le système*, vol. 10, 249.5-6 ('système philosophique'), 251.30 ('système philosophique'), 251.34 ('système'), 259.21-22 ('système philosophique'), 261.23 ('système'), 262.1 ('système métaphysique'), 296.15 ('système'), 304.23 ('système métaphysique'), 342.26 ('système'), 343.15 ('système'), 343.16 ('système'), 344.36 ('système'). Moreover, he seems to use the term in the historiographical sense on 313.9 ('système').

⁶² For his definition of a physical theory, see Duhem, in P. Duhem, *La théorie physique. Son objet et sa structure*, 1st ed. (Paris: Chevalier et Riviere, 1906), ii 1, 26, repeated *verbatim* in the second edition from 1914. For his methodology governing physical theories, see Lowinger, *The Methodology*, 17-59. Even though Lowinger briefly reports Duhem's use of this concept in his account of the history of Greek physics (e.g. 53-55), he does not examine the legitimacy of this

historiographical and the methodological sense of the term, I shall not deal any further with this methodological sense here.

Duhem's historiographical use of the term is problematic, since he thereby assumes that Cusanus had intended to work out his ideas in the form of a system, even though system building had not yet emerged as a methodological ideal. He thus explains doctrines stated within natural philosophy as derivations from a metaphysical idea. Tannery had warned against the last-mentioned procedure in regard to Presocratic thinkers, who had not yet developed the kind of deductive rationality characteristic to later philosophers. One could add to Tannery's warning that this dividing line should be pushed from the fourth century BC till the seventeenth century AD — not on the phylogenetic grounds indicated by Tannery, but on methodological grounds; the methodological ideal presupposed by the historiographical concept system of philosophy, was only developed in seventeenth-century science and onwards.

Let us see how this historiographical use of the system concept is put into practice in Duhem's interpretation of Cusanus' texts. Duhem's exposition of Cusanus is instructive, partly because it highlights the influence of Brucker's historiographical model upon nineteenth-century historians of philosophy, partly because it demonstrates that even though Brucker's original works were distant and insignificant to Duhem, Brucker's model of explanation was transmitted to Duhem by means of nineteenth-century historians of philosophy, who also provided Duhem with interpretative elements in the case of Cusanus. Duhem bases his interpretation on the 1565 edition of Cusanus' collected works, and he centers his interpretation of Cusanus' thought on his assumed system of philosophy, even though the term, and the concept it denotes, is absent in Duhem's

concept when used for this purpose, nor does he explore into the sources to the concept when used in such a historiographical context.

citations from Cusanus.⁶³ Having accounted for Cusanus' life and work, he points out *De docta ignorantia* (1440) as the key work in which we find the outlines of Cusanus' system: 'it comprises', Duhem explains, 'the outline and plan to the philosophical system to which his other writings add various developments.'⁶⁴ The task of a nineteenth-century historian of philosophy, susceptible to Brucker's precepts, is to excavate the principles in a past thinker's system, even though the texts 'conceal' such principles. Duhem follows this procedure in the case of Cusanus, though he sometimes uses the term 'principle' synonymously with 'axiom' and 'basic postulate'.⁶⁵

⁶³ Duhem, *Le système*, vol. 10, 251 n. 1, informs us that he used Cusanus, *Opera* (Basel: H. Petri, 1565). In none of the citations from this work does Duhem cite the words 'system', or 'system of philosophy'; see Duhem, *Le système*, vol. 10, 247-347. In addition to this work, Duhem, *Le système*, vol. 10, 313.33-315.15, uses a manuscript of Cusanus, transcribed and published in F. J. Clemens, *Giordano Bruno und Nicolaus von Cusa* (Bonn, 1847), 97-99.

⁶⁴ Duhem, *Le système*, Vol. 10, 249.5-7: 'elle [*De docta ignorantia*] contient l'esquisse et le plan du système philosophique auquel ses autres écrits apportent des développements variés.' This is repeated *ibid.*, vol. 10, 251.33-252.1.

⁶⁵ Duhem refers to 'principle' or 'priciples' ('principe', 'principes') *ibid.*, vol. 10, 252.6, 256.21, 261.32, 267.12, 279.28, 295.19. He refers to 'axiom' or 'axioms' *ibid.*, vol. 10, 260.3, 260.13, 261.29, 262.12, 303.34, 345.26, 347.8. He refers to 'basic postulate' *ibid.*, vol. 10, 259.18. Let me give an example of Duhem using the terms 'principle', 'axiom' and 'basic postulate' synonymously: Having mentioned the 'basic postulate' ('postulat fondamental') (259.18), he passes on to 'the principles of a philosophical system' ('les principes d'un système philosophique') (259.21-22); over the next two pages, however, he speaks of these principles as 'axioms' ('axiomes') (260.3, 260.13, 261.29).

Brucker stipulated that those past thinkers deserving to be included in the history of philosophy were those who had construed systems of philosophy, based on principles.⁶⁶ In his brief treatment of Cusanus, however, Brucker did not identify any principle.⁶⁷ In general, Cusanus was not a well-studied figure until the second half of the nineteenth century — even Hegel passed over him in silence, as observed by Heimsoeth.⁶⁸ It was not until Franz Clemens published his monograph in 1847 that Cusanus was assimilated into the history of philosophy. Clemens conformed, as most other nineteenth-century historians of philosophy, to Brucker's criterion of inclusion in the history of philosophy.⁶⁹ He thus claimed the existence of a system of philosophy unifying the doctrines in all Cusanus' writings, though without asserting any specific principle in Cusanus' system of philosophy.⁷⁰ In 1866, Eduard Erdmann, a German historian of philosophy, identified the doctrine of coincidence of opposites (Lat. *coincidentia oppositorum*) as the key

⁶⁶ See Catana, *The historiographical concept 'system of philosophy'*, 13-17.

⁶⁷ Brucker, *Historia critica philosophiae*, vol. 4, 29.34-30.33.

⁶⁸ H. Heimsoeth, 'Giordano Bruno und die deutsche Philosophie', *Blätter für die deutsche Philosophie*, 15 (1941), 431.

⁶⁹ For the influence of Brucker in the nineteenth and twentieth centuries, see Catana, *The historiographical concept 'system of philosophy'*, 193-282.

⁷⁰ Clemens, *Giordano Bruno und Nicolaus von Cusa*, ii-iii, announces his intention to expose the philosophical systems of Bruno and Cusanus. *Ibid.*, 37, he asserts the existence of a unified system underneath all Cusanus' texts and explains that he has selected extracts from Cusanus' texts in order to illustrate this system. In his actual exposition (37-132), however, he does not explain the nature of this alleged system. Clemens, *ibid.*, 40-41, points out Christology as central to both Bruno's and Cusanus' philosophies. In his exposition of Cusanus' thought, *ibid.*, 37-132, he does not claim that the *coincidentia oppositorum* is the privileged principle in Cusanus' system, as later Cusanus scholars did.

principle in Cusanus' system of philosophy.⁷¹ Erdmann's identifications fitted into nineteenth-century ideas about the nature of past philosophies as a successive series of systems of philosophy. Richard Falckenberg and other Cusanus scholars soon carried on his identification of the mentioned principle in Cusanus' system of philosophy.⁷²

According to Duhem, the principle in Cusanus' system is the doctrine of coincidence of opposites — precisely the principle identified by Erdmann and later on by Falckenberg. This principle is, according to Duhem, the 'axiom', the 'fundamental postulate', from which all Cusanus' ideas derive.⁷³ In the course of his exposition, Duhem refers to publications on Cusanus by Clemens (1847) and Falckenberg (1880).⁷⁴ Clearly, Duhem's practice contains distinct traces of nineteenth-century German historiography of history of philosophy.

This example of Duhem's practice suggests that we should not take Duhem's 1905 affirmation of Tannery's opposition between the methodologies of history of philosophy and

⁷¹ J. E. Erdmann, *Grundriss der Geschichte der Philosophie*, 2 vols (Berlin, 1866), vol. 1, 560-564. *Ibid.*, 553, Erdmann refers to Clemens' study of 1847.

⁷² R. Falckenberg, *Grundzüge der Philosophie der Nicolaus Cusanus mit besonderer Berücksichtigung der Lehre vom Erkennen* (Breslau, 1880), refers to Cusanus' system (e.g. 1, 3, 5, 6, 53, 54, 59, 64, 74, 149, 159) and mentions Cusanus' doctrine of coincidence of opposite (63, 154), assigning to it a certain role in Cusanus' system of philosophy, though without making much of the claim. R. Falckenberg, *Geschichte der neueren Philosophie: von Nikolaus von Kues bis zur Gegenwart* [1st ed. 1886], 7th ed. (Leipzig: Veit & Comp., 1913), 21, 23, contends, much more boldly than he had done in 1880, that the doctrine *coincidentia oppositorum* is the fundamental principle in Cusanus' system of philosophy.

⁷³ Duhem, *Le système*, vol. 10, 259.18-263.25.

⁷⁴ *Ibid.*, vol. 10, 313 n. 2, refers to Clemens, *Giordano Bruno und Nicolaus von Cusa*. *Ibid.*, vol. 10, 253 n. 1, 342 n. 1, Duhem refers to Falckenberg, *Grundzüge*.

history of science at face value. In this case, Duhem not only follows the method of nineteenth-century historians of philosophy — first identifying the ‘metaphysical idea’ or ‘principle’ — he openly cites historians of philosophy from that century and adopts their interpretations. The case also shows that even though Duhem follows Fustel de Coulanges’ *ad fontes* principle by consulting Cusanus’ *Opera* of 1565, he imposes extrinsic, historiographical concepts on his primary material, the concept system of philosophy being one conspicuous example. This procedure is also difficult to reconcile with the methodological statements in *La science allemande*, where Duhem defies the ‘German’ deductive method in historical studies.

How does this practice affect Duhem’s interpretation of Cusanus’ astronomy? The major part of his exposition is concerned with Cusanus’ system of philosophy, that is, its sources, architecture and ramifications within various philosophical areas.⁷⁵ Only the last thirty-seven pages, out of hundred, are concerned with Cusanus’ astronomy and physics, allegedly being part of that system.⁷⁶ Duhem sets out to understand Cusanus’ astronomy on the basis of the principle advanced in *De docta ignorantia*, i.e. that of *coincidentia oppositorum*. This principle is exemplified in Cusanus’ dichotomy between the maximum and the minimum, and precisely this instantiation is the key to understand Cusanus’ astronomical doctrines, Duhem continues, singling out, among other things, its consequences for Cusanus’ idea of a universe without centre; its centre ‘coincides’ with its circumference, as stated in *De docta ignorantia*.⁷⁷ Having said so, Duhem cites other works by Cusanus exemplifying the same astronomical consequence, assuming that Cusanus employed this

⁷⁵ Duhem, *Le système*, vol. 10, 251-305, entitled ‘II. Esquisse du système philosophique de Nicolas de Cues’.

⁷⁶ *Ibid.*, vol. 10, 305-342.

⁷⁷ *Ibid.*, vol. 10, 306.11-307.17. *Ibid.*, vol. 10, 261.22-28, Duhem determines the maximum-minimum as an instantiation of the principle, which is central to Cusanus’ system.

principle cross-wise in his various works.⁷⁸ Duhem does not distinguish between various meanings of the dichotomy maximum-minimum, nor does he pay attention to the argumentative and disciplinary context of the cited works. This practice signals one of the weaknesses of the historiographical concept system of philosophy: Principles, which may never have existed nor assigned such an over-arching, explanatory power in the texts of the past thinker, are hypostasised into all-embracing, causal entities with unlimited explanatory power in the theories of that past thinker.

On the other hand, when Duhem enters Cusanus' technical, astronomical arguments about celestial movements and the plurality of inhabited planets, he does not bring this principle to the fore, nor does he refer to Cusanus' acclaimed system of philosophy. He refers, instead, to Cusanus' astronomical 'system'.⁷⁹ He does not explain the connection between the two uses of 'system', even though they differ semantically. Similarly, his account of Cusanus' concept of impetus, well known to Duhem from his study of John Buridan (ca. 1300- after 1358), is devoid of references to any system of philosophy. In this account, Duhem pays much more attention to the disciplinary and argumentative context of Medieval and Renaissance theories of impetus — a feature which, ironically, turns it into the most original and convincing part of Duhem's exposition of Cusanus.⁸⁰ The problem is that the account is unconnected to the system of philosophy attributed to Cusanus. In this account of impetus, there remains, then, a split between Duhem's acclaimed model of explanation and his practice.

⁷⁸ *Ibid.*, vol. 10, 307.18-313.11. *Ibid.*, vol. 10, 313.4-11, Duhem affirms that this consequence derives from the principle laid down in *De docta ignorantia*, and that it is part of his philosophical system.

⁷⁹ Duhem, *Le système*, vol. 10, 313.12-324.35. For Duhem's use of the term 'system' in the astronomical sense in this passage, see references in n. 60 above.

⁸⁰ *Ibid.*, vol. 10, part vi, 325.1-336.13.

CONCLUSION

Tannery's revolt against history of philosophy and its methodology has been seen as a Copernican revolution in which the explanatory power is transferred from metaphysics, typical of nineteenth-century history of philosophy, to natural philosophy, as in subsequent history of science. However, even Copernicus, despite his novelties, remained within the old finite cosmology; likewise, Tannery retained the idea of a unitary system from nineteenth-century history of philosophy and remained encrusted within that model of explanation.

If I am right that Tannery and Duhem owed more to nineteenth-century history of philosophy than they openly admitted, it leaves one wondering why they, especially Tannery, confronted history of philosophy with such overt hostility in their methodological statements. I can think of three explanations, all hypothetical. First, it is probably wise not to exclude completely the possibility that such hostile declarations were also rhetorical devices being part of institutional power struggles, in which aspiring historians of science, as Tannery, desired to conquer one specific scientific object — roughly speaking, the history of natural philosophy — which had been the property of history of philosophy since the eighteenth century. In that position upcoming historians of science could not afford to admit that a key concept in their methodology of an alternative discipline was in fact borrowed from the discipline whose position they challenged — they had to declare a methodological schism. Another possibility, also to be held open and possibly co-existent with first explanation, is that these early historians of philosophy did not regard this historiographical concept as a construction made up by historians of philosophy, but as an authentic methodological concept, operative in most philosophy going back to Antiquity. It was used by historians of philosophy, truly, but it could equally well be applied by all other historians, including historians of science. Third, patriotic emotions may have fuelled Tannery's and Duhem's animosity towards history of philosophy, which was, after all, primarily a German tradition in the nineteenth

century. Tannery and Duhem had both a somewhat strained relationship to Germany, due to national and personal experiences of the Franco-German war of 1870.⁸¹ They may well have been eager to cast off the yoke of nineteenth-century German scholarship, which also exerted itself strongly in the field of history of philosophy. The establishment of history of science was one way of regaining intellectual independence and national pride.

⁸¹ For Tannery on this point, see Brenner, 'Réconcilier les sciences', 436-437. For Duhem, see Jaki, *Uneasy genius*, 6-9.