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**Introductory reading
guide for the famous
Duhemian articles
of the *Revue des
questions scientifiques*
(1892-1896)**

**Circumstances surrounding
their drafting and investigation
of their reception**

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Introductory reading guide for the famous Duhemian articles of the *Revue des questions scientifiques* (1892-1896)

Circumstances surrounding their drafting and investigation of their reception

1. Introduction¹

On the threshold of the French republication, and a new Italian version, of the seven Duhemian articles that first appeared in *Revue des questions scientifiques*² between 1892 and 1896, various questions of varying impact arise. We would like to address a few of these here. What relevance could such an editorial undertaking possess in light of the fact that, eight years after having released the last of these articles, Pierre Duhem (1861-1916) launched the publication of his masterpiece, entitled *La théorie physique : son objet, sa structure*, which should have instantly cast them into the realm of his dated, or even outdated, works? Does the present project imply that reading his masterpiece, which also includes many of these articles³, does not suffice? In what way does it distinguish itself from the former anastatic reprint of six of these texts by Stanley L. Jaki (1924-2009) in 1987⁴, by incorporating the lengthy, technical and seemingly insignificant⁵ article, which this renowned Duhemian biographer thought it fit to omit, name-

1. This text was inspired by the fourth chapter of our book (J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 121-198), which has since been extensively summarised, highly polished, and entirely updated. We warmly thank Fábio Rodrigo Leite for his kind and attentive proof-reading.

2. Hereinafter, the *Revue*.

3. Duhem himself informs us (P. DUHEM, *La théorie physique* [1906], p. 85, note 1) that chap. 4 of the first part of *La théorie physique* expounds upon the ideas covered in 1893 in *L'école anglaise et les théories physiques*. Similarly, in indicating that the ideas expressed in chapters 4 and 5 of the second part of this book (*Ibid.*, p. 233, note 1) should take priority, he also points out that these two chapters — to which 3 sections of chap. 6 are to be added — were taken from the article *Quelques réflexions au sujet de la physique expérimentale* published in 1894.

4. P. DUHEM, *Prémices philosophiques*.

5. At least according to what contemporary peers and commentators apparently thought of it. Indeed, of the seven articles included herein, it is the only one not to have been published immediately, just as it is the only one to have been obliged to wait until the year 2000 to finally enjoy, thanks to Paul Needham, its first translation (cf. P. DUHEM, *Atomic Notation and Atomistic Hypotheses*), and now, owing to the present compilation, its first republication.

ly *Notation atomique et hypothèses atomistiques*¹? Turning to the articles themselves, should the striking confluence of time and space which characterises them — having all been published in under 5 years within the same journal — be interpreted as the result of a well-thought-out, predefined plan or, on the contrary, as extremely nimble footwork in response to a revolving dance of circumstances? Lastly, since the vast majority of these articles have already been studied in a fair amount of detail², perhaps it is now time to move away from detailing their specific contents and rather focus on identifying any recurrent themes, and even the reason behind their particular sequencing, such as to guide the reader along as many Ariadne's threads as possible? In our opinion, these are a few of the questions that need to be addressed in order to lay the foundations for a deeper understanding of the texts republished herein, as well as of those (i.e., most of them) being translated into Italian for the first time³.

1.1. Why read Duhem?

There remain numerous reasons for reading Duhem. One of the main ones from a historical point of view is the impetus that Duhemian thought could give to many of the epistemological currents in the 20th century, and which would turn his masterpiece into a significant milestone marking the latter. For our part, we would like to highlight another more philosophical aspect: the highly sophisticated⁴ nature of his epistemological thinking. Enriched by his own hands-on experience as a mathematical physicist (and thus without external interference), by his regard for the basic aspirations of humankind and particularly physicists, by his active consideration for history, by his interest in the relationships and interactions between different types of knowledge, by making room for the intuitive mind alongside the mathematical mind, his methodological thinking constantly strove to find a middle ground between the dangers of dogmatism and scepticism. Taking both logical and extralogical reasons into account, and being flexible enough to accommodate the diversity of real-world scientific practices, it is particularly well-suited to describing a scientific methodology and a physical world of which the complexities are widely recognised⁵.

1. Hereinafter, *Notation atomique*.

2. In order to guide the reader desiring more information about one or more of this set of articles, we have annexed [§ 15.1] the main recent monographs from those reputable commentators who have specifically addressed them.

3. Only three of these articles, namely *Quelques réflexions au sujet des théories physiques, Physique et métaphysique* and *Quelques réflexions au sujet de la physique expérimentale*, were already available in Italian thanks to the tireless toils of Mirella Fortino (for the first and third one, cf. P. DUHEM, *Verificazione e olismo*, pp. 55-86 et pp. 89-132; for the second one, cf. ID, *L'autonomia della scienza in un fisico credente*, pp. 44-93).

4. We purposefully use this adjective for its perfectly selected and well theorised usage by St. Bordoni (e.g., St. BORDONI, *Taming Complexity*, p. 22).

5. This is a well-documented Duhemian trait in the works of St. Bordoni, who likens his growing awareness of the complexity of the physical world to that of Aristotle and to Pascal's scientific en-

Albeit sophisticated, Duhemian epistemology remains biased: it is more easily applied to science that is already well-established than to fledgling science, which is still being formed; it favours direction from those loving order, unity and coherence, over inventiveness; the abstract over the imaginative; the deductive over the intuitive; and mathematical physics over experimental physics. Thus, if one is to read Duhem, since his writings provide access to one of the most sophisticated epistemologies ever to be developed by a mind such as his, one must not lose sight of the fact that there are indeed two main types of mind and that they each contribute, in their own way, to the progress of science. Thus, although most certainly necessary as it is a prime example of one of these types of mind, reading Duhem exclusively will not suffice.

1.2. Why read these Duhemian texts?

In 1985, Roberto Maiocchi was still trying to convince the scholars to read more than just *Théorie physique* and to also take his other works into consideration, otherwise, as he rightly pointed out, it would be difficult to understand the content of this publication in and of itself¹. Aware of the fact that Duhemian thought was essentially shaped by his work in theoretical physics before the start of the 20th century², Duhem's specialists have since become convinced of the need to pay particular attention to his first-period works and, more specifically, to his first nine didactic and illustrative writings³, among which the seven published in the *Revue*⁴ feature prominently. Today, we need to ensure that these writings are accessible to as large an audience as possible. Such is the aim of this volume. More precisely, however, having established that it is still worth reading

deavours, adding that the recognition of the first had surpassed that of the latter (St. BORDONI, *Taming Complexity*, p. 24; ID., *When Historiography Met Epistemology*, p. 241 et 259). At first glance, this dual association seems rather propitious.

1. R. MAIOCCHI, *Chimica e filosofia [...]*, pp. 2-3 et p. 15

2. Cf. St. BORDONI, *Taming Complexity*, p. 17 and, especially, ID., *When Historiography Met Epistemology*, a publication in which this learned commentator established that Duhem's work, generally recognised as one of the starting blocks of French epistemology, is also and above all the endpoint of an earlier tradition that began in the 1860s.

3. The terminology which we previously used here to make this distinction (J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 57-60), namely "philosophical" versus "illustrative" writings, could be confusing: leading one to believe that since they are not classified as philosophical writings, they could not contain such content. Due to the constant overlapping of scientific, historical and philosophical ideas, we thought it preferable, while keeping the same layout, to distinguish between "didactic" writings, aimed chiefly at presenting Duhemian thought, and "illustrative" writings aimed primarily at explaining and justifying it. As far as the articles gathered here are concerned, we consider them all to be didactic, apart from three of them — *Notation atomique*, *Une nouvelle théorie du monde inorganique* and *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours* — which we classify as illustrative.

4. To the seven articles assembled here, it is thus necessary to add two illustrative writings, namely *Les théories de l'optique* (1894) and *Les théories de la chaleur* (1895), which both appeared in the *Revue des deux mondes*.

Duhem more than a century after his death, why should one focus specifically on the texts collated herein?

By enabling us to become acquainted with Duhem's then already firm, yet incomplete thinking, reading these initial writings makes for a whole new perspective on his thought when compared to that which we have become accustomed to from *La théorie physique*. Whereas, from the outset, the latter offers us a phenomenalist attitude¹, which is inherently mitigated by the doctrine of natural classification and a ruthless critique of both the inductive method and the crucial experiment, the former, due to their delayed publication, allow us to discover a strict phenomenalist and carefree inductivist, who would have disquieted a good many of his readers by the radical way in which he intended to redefine the relationship between physics and metaphysics. Reading these writings, which were an immediate success at least equal to that of *La théorie physique*, means, firstly, sparing oneself the terrible sin of anachronism by rediscovering the gradual unfurling of Duhemian thought as his peers experienced it, in order, secondly, to better understand why this thinking had to be refined, in the space of a few months, having initially elicited a rather heated response. In short, thanks to the comparison it offers and the evolution it demonstrates², this reading brings to the fore the degree of sophistication — one which has been neglected in many a simplistic and erroneous interpretation of Duhemian thought developed particularly during the second half of the 20th century³ — attained by *La théorie physique* and, consequently, an accrued appreciation of the balanced stance that its author then attempted to assume.

In order to achieve this objective, over and above reading Duhem's initial didactic and illustrative articles, one must examine the circumstances in which they were written and the reactions that their publication elicited. For this reason, the present study will pay close attention to reconstructing the immediate circumstances surrounding these articles, which are often based on unpublished information⁴, since their general con-

1. Perilously simplistic, labels — and we cannot stress this enough — should quite simply be prohibited, especially when it comes to highly sophisticated thinking such as Duhem's. However, they are indeed convenient. In adopting the — currently uncommon — label of “phenomenalist”, we wished to favour the one that seemed most likely to describe the main aspects of his thinking, and least likely to suggest any comparison, necessarily partially unjustified, to other thinkers. In short, we will qualify as phenomenalist the conception of those who, such as Duhem, deny physical theories any objective scope by ascribing them the sole function of coordinating experimental laws. Conversely, we will qualify as realist the conception of those who, ascribing an ontological scope to physical theories, perceive them to be an explanation for these same laws.

2. The collection of texts published as is, so either modified or neglected by Duhem himself, proves significant from this point of view — which is why a critical edition of *La théorie physique* demonstrating the different layers of the text would be highly appreciated.

3. By this we mean the so-called “Duhemian simplicity” and the advent of the Duhem-Quine thesis.

4. We have made use of many publications from that era which do not feature in our 1996 bibliography (J.-Fr. STOFFEL, *Pierre Duhem et ses doctorands*), as well as Duhem's unpublished correspondence.

text¹ can now be gleaned due to various excellent monographs². Indeed, Duhem himself thought it pertinent to inform his readers, as concerns two of the articles selected here, of the particular circumstances surrounding their publication: the first, and least objectionable, cautioned against the “venom of scepticism” which would form the basis for his concept³ for *Une nouvelle théorie du monde inorganique*⁴, and the second was due to the fundamental criticism⁵ of Eugène Vicaire (1839-1921), which could hardly go unanswered since it was published within the very *Revue*⁶ itself, for *Physique et métaphysique*. This attention to the surrounding circumstances will prove all the wiser since — as we hope to demonstrate — they influenced Duhemian thought to a far greater extent than our physicist let on in these two lone references, and also to a far greater extent than is recognised by many of his commentators⁷.

2. Initial context

Let us briefly go over Duhem’s situation when, at the very beginning of 1892 under the title *Quelques réflexions au sujet des théories physiques*⁸, his “opening lessons”⁹ were published in the *Cours de physique mathématique et de cristallographie* assigned to him in July 1890. From a personal point of view, our young teacher, who had just turned 30 at the time this text was published, had lost his father two and a half years earlier, (7 April 1889), had married Adèle Chayet over a year earlier (28 October 1890),

Unless otherwise stated, this correspondence is kept in the Duhem Collection in the archives of the Académie des sciences of the Institut de France (Paris).

1. This is characterised by: firstly, the success of thermodynamics; secondly, the presence of a Thomistic Apologetic eager to demonstrate the perfect agreement between modern science and religious dogma; and, thirdly, the introduction of the English model theory into France.

2. As regards the historico-philosophical context, we refer to: St. BORDONI, *When Historiography Met Epistemology*; A. BRENNER, *Les origines françaises de la philosophie des sciences*; M. FORTINO, *Essere, apparire e interpretare*; and R. MAIOCCHI, *Chimica e filosofia, scienza, epistemologia, storia e religione nell’opera di Pierre Duhem*. For the wholly scientific context, we refer to St. BORDONI, *Taming Complexity* and C. VERDET, *La physique du potentiel*.

3. P. DUHEM, *Une nouvelle théorie du monde inorganique*, p. 123, note 1. For the Duhemian writings collated here, we also indicate the pagination which, within the present collection, is that of the texts referred to.

4. Hereinafter, *Une nouvelle théorie*.

5. Amongst the modern commentators, this criticism is chiefly addressed by: R. MAIOCCHI, *Chimica e filosofia [...]*, pp. 326-328; St. L. JAKI, *Uneasy Genius*, pp. 116-117 and pp. 324-328; R. N. D. MARTIN, *Pierre Duhem*, chap. 2; J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 157-165; and St. BORDONI, *When Historiography Met Epistemology*, pp. 235-237.

6. E. VICAIRE, *De la valeur objective des hypothèses physiques*.

7. Very recently, F. R. Leite pointed out the “urgent” need to address the impact of scientific discoveries and philosophical discussions on the composition of Duhem’s intermediate works (F. R. LEITE in P. DUHEM, *Ensaio de filosofia da ciência*, p. 38).

8. Hereinafter, *Les théories physiques*.

9. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 139, note 1.

and had just witnessed the joyful birth of H el ene, his firstborn (29 September 1891). From a professional point of view, he had been appointed to his first teaching post as a lecturer at the Lille Science Faculty (end October 1887), had obtained his PhD in Mathematical Sciences just over three years earlier thanks to his second thesis presentation (30 October 1888), and had just been accepted, on the 4 January 1892, into the Soci et e scientifique de Bruxelles [  15.2]¹ of which the *Revue* is a member. From a scientific point of view, the previous year had been a busy one: not only had he published, with Hermann, two volumes of his *Hydrodynamique,  lasticit e, acoustique*, in this case the contents of the aforementioned *Cours* as stated during the previous academic year, but he had also published, with Gauthier-Villars this time, the first volume of his *Le ons sur l' lectricit e et le magn etisme*, which earned him the congratulations of Heinrich Hertz (1857-1894)², and in which he proposes “to make the thermodynamic instrument function before the very eyes of the reader”³. Lastly, from a philosophical point of view, he sought to substitute another concept of science for the mechanism, which he broke away from during his studies at l' cole normale, and would soon begin to question, under a continuous onslaught of objections from the “elite audience” before whom he was required to teach, this inductive method that he still endorsed at the time⁴.

3. “Some reflections on the subject of physical theories”

It is in this context that Duhem, taking a step back from his habitual work of applying thermodynamics to the various fields of physics, published his first article expressly devoted to questioning “scientific philosophy”. Entitled *Quelques r flexions au sujet des th ories physiques*, he adopted the most instrumentalist and conventionalist stance that he would ever endorse. Let us take a look at its contents⁵.

1. In order to avoid overloading our narrative, which is already rather difficult to follow due to the many participants, we decided against annexing a list of the authors, institutions and journals who played a crucial role in the reception of Duhemian thought, namely: the Soci et e scientifique de Bruxelles [  15.2]; *La science catholique* [  15.3]; Count Edmond Domet de Vorges [  15.4]; the Soci et e de saint Thomas d'Aquin [  15.5]; and lastly, the *Annales de philosophie chr tienne* [  15.6].

2. Letter from H. Hertz to P. Duhem dated 18/04/1892 and cited in St. L. JAKI, *Uneasy Genius*, p. 100.

3. P. DUHEM, *Le ons sur l' lectricit e et le magn etisme*, volume 1, p. vi.

4. Cf. ID., *Physique de croyant*, p. 49.

5. In providing these various summaries, we endeavoured to keep as close to the original text as possible, since our goal is indeed to provide an introductory guide to reading it. For the same reason, we avoided using, where possible, any contemporary epistemological and philosophy of science terms that Duhem himself would not have used.

3.1. A conception of physical theory

Three stages characterise scientific knowledge: firstly, the knowledge of facts, constituting empiricism; secondly, establishing experimental laws, by induction from these facts, thereby forming experimental science; and, lastly, theoretical science. Leaving aside any questions relating to the first stage — namely, the knowledge of facts, which he would never specifically deal with — as well as those related to the second one — in this case, the use of induction, which he left to the philosophers (showing that he was yet to become a critic of the inductive method, and that he was not yet able to foresee how any issues might arise with respect to experimental control) —, Duhem devoted his entire article to the third stage. To this end, he used the most finished theory as an example, namely mathematical physics. By expounding upon the different stages constituting physical theory, he attempted to demonstrate precisely why this theory only served to relieve the memory of the physicist somewhat in terms of being able to retain, with greater ease, the multitude of experimental laws.

In the first of these stages, the physicist assigned any quantity to the various physical notions on which these laws are based, as long as the properties of this quantity adequately represented the properties of the corresponding notion. Purely conventional and thus arbitrary, the match formed, by which a quantity becomes the symbol of a notion, does not express any direct relationship in essence. Consequently, the resulting theory cannot be qualified as either true or false depending on whether it provides a more or less accurate picture of reality, since, right from this initial stage, the physicist refused to concern himself with such an objective.

Then comes the choice of hypotheses, a particularly important step for the success of a future theory. The ideal method would consist in taking only the symbolic translation, in mathematical language, of the experimental laws that the theory intends to summarise as the hypotheses, so that it contains absolutely nothing that is hypothetical. Unfortunately, no theory has ever succeeded in achieving this ideal. Since hypotheses are, therefore, the result of a more or less pronounced elaboration, the most diverse cases are possible: from that of the physicist who has tried to stick as closely as possible to the simple symbolic translation of experimental laws, to that of the scientist who is so far removed from the experiment that the hypothesis has almost lost all physical meaning. It is this latitude left to physicists in the choice of their hypotheses that makes it possible to account for not only the higher quality of one theory over another — a quality which is discerned according to the number of experimental laws it is able to synthesise, the domain it succeeds in covering, and the degree of precision it is able to achieve — but also its greater longevity — the closer the hypotheses have remained to the simple translation of experimental laws, the more likely the theory will persist for as long as the laws it synthesises remain in place.

3.2. A deceptively seductive, radically opposed conception

Among this range of possibilities, theories exist that are diametrically opposed to the conception of the physical theories supported herein. Responsible for discrediting and constantly upsetting theoretical physics, are the mechanical theories. By imposing upon themselves, in their choice of quantities and hypotheses, further constraints linked to the system to which they adhere, the mechanists end up, on the one hand, complicating their theory (as they have a smaller range of possibilities), hence the discredit, and, on the other hand, deviating ever further from the simple translation of the experimental laws (because they obey their system more than their experiment), hence the incessant upheavals.

Therefore, even though mechanical theories are unnecessarily restrictive and fundamentally ephemeral, it must be acknowledged that they have often proved seductive and fecund.

Seductive, as they push the physicist to find an explanation for the laws, instead of simply coordinating them: the inherent tendency of all humans to want to understand the nature of things and the reason behind the laws, the desire to increase the prominence of the discipline to which they are devoted, and even social pressures that push towards the metaphysicist rather than the prudent physicist. One needs to learn to resist this natural tendency and social pressure, however. Just as it is only natural that one's role is most ill-defined in the beginning stages of a discipline, so one's purpose will surely grow along with the discipline as it matures and becomes better understood. Indeed, when it comes to theoretical physics, this trend is apparent: mechanical theories are progressively abandoned as physicists realise that they were merely deceptively seductive.

Fecund, as it is in the beginning stages of a discipline that its harvest is most bountiful. Therefore, there may simply have been a convergence between the initial incomprehension surrounding the true objective of the discipline and the wealth of its beginnings. The fecundity observed is thus in no way linked to the mechanical nature of these early theories.

3.3. A reservation, a discrepancy and an assurance all at once

After having pointed out that “we are not alone in expressing the ideas that we just presented”¹, in reference to the preface of the *Théorie mathématique de la lumière* (1889) by Henri Poincaré (1854-1912) — since he had previously quoted the *Ad lectorem*, which he believed was by Nicolaus Copernicus (1473-1543), from the *De revolutionibus orbium cœlestium* (1543) —, Duhem immediately distanced himself from the

1. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 165.

illustrious geometrician. In fact, he denounced the current tendency which “consists in regarding as equivalent the different theories that one can extend to the same body of laws, and study all of them without giving preference to any particular one”¹ — which we choose to call *eclecticism*². Keen to counter any issues that might be considered as a direct result of his definition of physical theory, he pointed out that one may think, like Poincaré, that physical theory has no aim other than to coordinate laws without being obliged to maintain, of itself, that all theories are also equivalent. Indeed, mechanical physicists are inclined to adopt only one theory, since they seek explanations for things and laws, while nothing stops phenomenalist physicists from embracing a few of them. This, however, does not mean that the latter are obliged to accept all of them. Once only those theories which are equally acceptable from a logical point of view have been selected, they may understandably favour the one that encompasses the broadest class of phenomena and that monopolises the smallest number of hypotheses of the simplest form, namely those closest to an immediate translation of the experimental laws. Therefore, opting for the Duhemian conception of physical theory does not mean restricting oneself to declaring one theory true over all the others, but neither does it mean that one is condemned to being steeped in scepticism by adopting all of them.

* * *

In this article, Duhem did not accuse, as we just suggested, Poincaré’s eclecticism of having led to scepticism, or at least of being able to do so. Such was, however, his opinion and one that he would probably have liked to express. A few months later, he came close to getting the opportunity to do so in a text explaining his *Thermodynamics*. Somewhat disrespectfully, he compared the illustrious analyst’s excursion into the land of physics to that of a Brahman who had left India on a quick trip over to the Old Continent to then deliver his insights before the bewildered Europeans. This text did, indeed³, give him the opportunity to point out that Poincaré’s exclusively mathematical training had made him “more capable of understanding the meditations of a German metaphysicist than the concerns of a City merchant”, in other words more predisposed to “unreal truths” than to a “world haunted by its concern for objective reality” and “thirsting for practical applications”⁴. He also noted therein, however, that what one would find “most surprising about this text” would be “the *sceptical smile* that we sense [...] on the lips of the Brahman who is said to have written these pages”⁵. Due to its severity with respect

1. *Ibid.*, p. 166.

2. By this term, we refer more specifically to the fact of “symbolising either several distinct groups of experimental laws, or even a single group of laws, by means of several theories, each of which being based on hypotheses that are incompatible with those of other theories” (P. DUHEM, *L’école anglaise et les théories physiques*, p. 366).

3. Cf. R. MAIOCCHI, *Chimica e filosofia [...]*, p. 311.

4. P. DUHEM, *Compte rendu d’Henri Poincaré : « Cours de physique mathématique : thermodynamique » (1892)*, p. 605.

5. *Ibid.* For emphasis.

to analysts, the initial version of the Duhemian text presented to Paul Mansion (1844-1919) for publication, would startle the latter to such an extent that he felt particularly uncomfortable — a fact worth noting — due to a quotation from Pascal to be found *in fine* (which was omitted in the final version)¹. Through the private comments this elicited from the Secretary-General of the Société scientifique de Bruxelles, this embarrassment at least allows us get an idea of the real meaning hidden behind the, seemingly harmless, and fleeting expression “sceptical smile” in the published text that we just mentioned. After having agreed that it might be a good idea for analysts to better study physics and to increasingly frequent physicists before “applying [their] deductive machines to the facts”, Mansion suggested that Duhem ought to follow up his text with a “*pro analysi*” plea attached to his submission, all the while hoping that his correspondent would not also consign him to the category of “*geometry sceptic*”². Admitting that he had “read [Poincaré’s] famous prefaces without finding him sceptical”, Mansion went on to mention that which would — without being restricted to analysts — later become the crux of one of the main objections formulated by Vicaire, namely eclecticism as the ultimate natural consequence of his phenomenalism: “I believe that all non-physical analysts are inclined to take full advantage, such as Mr Poincaré, of your ever-so-accurate idea that theories are symbolic representations of real phenomena and are, consequently, inclined to place them on an equal footing. [...] Mr Poincaré has transferred this indifference regarding the choice of representational theories, from analysis, over to physics; hence his apparent scepticism”³. He finally acknowledges that the clarification that Duhem included in his account could prove useful to certain readers of the illustrious analyst: “If, however, you judge that this scepticism, even if only apparent, might provoke a real scepticism in those readers seduced by such a towering figure of analytical authority as Mr Poincaré [...]; then it would seem fair [...] to indicate his shortcomings or inaccuracies. Your article [...] will benefit those who have been unsettled by Mr Poincaré’s books, and who [...] would be inclined to regard his scepticism as factual⁴. Duhem having already revised his text, the “*pro analysi*” plea would not be published. Although not reflected in the final version, other than fleetingly in the famous quotation we mentioned, that which motivated the harsh judgement of our physicist is thus *also* the scepticism, real or apparent, that is likely to have resulted from our illustrious analyst’s eclecticism. Thus, precisely when Duhem published the most instrumentalist, most conventionalist or — to use our terminology — most phenomenalist articles of his entire career, namely the *Les théories physiques*, as well as the *Commentaires aux principes de la thermodynamique*, he strove to combat eclecticism not only because he was a creature of logic, but also because he refused to nourish any form of scepticism whatsoever. Our young lecturer was right: despite this preoccupation of his, he would also be accused, as we

1. Cf. the passage of the letter from P. Mansion to P. Duhem dated 11/02/1892 quoted in J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, p. 344, note 54.

2. Letter from P. Mansion to P. Duhem dated 11/02/1892.

3. Letter from P. Mansion to P. Duhem dated 17/02/1892.

4. *Ibid.*

will explain forthwith, of the very grievance he levied upon Poincaré, in other words feeding into this dangerous philosophical doctrine.

* * *

At the end of his article, Duhem concluded that, as physical theories are not geared towards discovering new laws or producing practical inventions, they have the modest yet useful task of coordinating and synthesising experimental laws. Since they achieve this goal by making conventional and symbolic connections, they will be judged as good or bad depending on the number of laws they manage to synthesise; they cannot, however, be described as true or false.

* * *

Since no particular reaction to this first article had had time to be published, and since no other special circumstances had arisen, Duhem was entirely at liberty to offer up anything he fancied in answer to Mansion's urgent request of 11 February 1892, for another article to be published in the following issue of the *Revue*. Very symptomatically, he offered to provide him with an article on atomic theory. Certainly understandable considering that he was in the process of writing his *Introduction à la mécanique chimique*¹, this choice attested to his desire to prioritise complementing² his first philosophical publication with an article aimed more specifically at his scientific peers. This prioritisation would prove to be a strategical error, although the issues would not arise from this!

4. "Atomic notation and atomistic hypotheses"

On our particular journey, *Notation atomique* is the first illustrative work we come across. Its aim is less about presenting Duhemian thought, however, and more about demonstrating how it is likely to materialise. If our author resorted to chemical theory, and not to one of the mathematical physics theories in which his reasoning was already particularly well-developed, it is because the latter are so very abstract and complex that they risked being beyond the grasp of the majority of the *Revue* readers. Nonetheless, this constraint, having obliged him to turn to a more accessible theory, turned out to be an advantage: it allowed him to convey the broad lines of his ideas, since these can even be applied to a theory quite dissimilar in nature such as, in this case, chemical theory. From our side, we would like to add that this example was particularly well chosen: if

1. The preface of this work is indeed dated 8 September 1892.

2. As we will come to see, while he was composing the article intended for his scientific peers, namely *Notation atomique*, Duhem was already planning to publish another one aimed at philosophers and his co-religionists, namely *Une nouvelle théorie*. It is thus the prioritisation of one of these articles over the other that would prove unfortunate.

chemical theory illustrates the Duhemian concept so well, it is undoubtedly because it was, to a large extent, its inspiration¹.

Interesting inasmuch as it gives us a better understanding of Duhem's point of view at the outset of his career, this atomism having been at the centre of many a scientific controversy in the 19th century², this article is also engaging in that it reveals not only the first stage of his strategy aimed at a broader public than that of his technical writings, but also the only not to have been truly "contaminated" by the reactions and accusations of his co-religionists.

* * *

Through this article, Duhem endeavoured to convey the idea that one can indeed use atomic *notation* without being obliged to support the atomistic *hypotheses* that prevailed at the time of its creation. In doing this, he achieved two objectives. Firstly, he reassured his scientific peers: after having done so a first time, in *Les théories physiques*, by specifying that endorsing his conception would not oblige them to accept any particular theory, he proceeded to do the same again by stipulating that this would not require them to abandon this widespread atomic notation. Secondly, he anticipated a counter-argument: since atomic notation is independent of atomistic hypothesis, trying to draw upon the success of the former to protect the interests of the latter is absolutely pointless.

* * *

If, with the exception of the odd reference to it in the *Études* journal³, this second Duhemian publication seems to have gone almost entirely unnoticed, since it did not elicit any reviews, at least inasmuch as any comments that it might have provoked did not get published⁴, this was not the case with his first article which became the object of negative criticism at the same time⁵ as a similar remark surfaced concerning one of his more recent works.

1. R. MAIOCCHI, *Chimica e filosofia* [...], pp. 100-101, 119-120 and 133-134.

2. P. NEEDHAM, in P. DUHEM, *Atomic Notation and Atomistic Hypotheses*, p. 127.

3. Cf. J. DE JOANNIS, *Stéréochimie*, p. 321, note 2.

4. "[...] your article on atomic theories was also the subject of criticism by a friend of mine. I urged to send me his comments in writing as well, inviting him to enter into a friendly debate with you in the *Revue*. At the same time, however, I brought the *Mécanique chimique* to his attention, which, I think, will make him think twice before entering into a polemic of this sort" (letter from P. Mansion to P. Duhem dated 16/10/1892). Indeed, the friend in question seems to have revoked his position

5. We follow the chronological — and not logical — sequence of publications as closely as possible. Bearing printing lead times in mind, there could thus be delays of varying lengths between the completion of an article and its publication.

5. The very first reactions

These very first reactions are all the more noteworthy as it was the first time that Duhemian writings gave rise to published comments from the Catholic world. There were two initial responses: 1°) a review of his *Leçons sur l'électricité et le magnétisme* by Fr Villaume appeared in the bibliographical part of the review *Études*¹; 2°) a critique of his first article, which made a rather significant appearance in *La science catholique* [§ 15.3] penned by Count Edmond Domet de Vorges (1829-1910) [§ 15.4], who, at the time, was the President of the Société de saint Thomas d'Aquin [§ 15.5]. While the first of these would have no impact (and remained perhaps unknown to Duhem), this was certainly not the case with respect to the second.

5.1. Fr Villaume: a first accusation

Duhem having abruptly announced, at the beginning of his *Leçons sur l'électricité et le magnétisme*, that in order to conform “to the true purpose of Physics”, he intended to break the link that had been established between the “assumptions about the nature of electricity” and “the hypotheses representing the properties of electrified bodies”². Fr Villaume, who had been satisfied with his work until then, indicated his disapproval. In so doing, he was the first to point out what was to become the crux of the criticism levelled at Duhem by many of his co-religionists, namely causality. Accusing him of rejecting “true physics” which is “the science of causes” since he considered it “not only pointless, but impossible to study causes and their effects” as shown by his reduction of physical hypotheses to “mere conventions of mathematicians”, he judges the Duhemian conception to be “in accordance with a good number of his contemporaries” whose thought adheres to “the theories of the positivist doctrine that unknowingly dominates them”³. Herein lies the first of the hefty accusations that our physicist had to face: even though he was not positivist himself, for having allowed himself to be contaminated by this doctrine. Through the words of Domet de Vorges, we will shortly discover the other three.

5.2. Domet de Vorges: three additional accusations

As early on as *Les théories physiques*, Duhem mentioned “in passing” that if physical theories were only given a symbolic scope, as he had recommended, “they will become

1. Cf. E. VILLAUME, *Compte rendu de P. Duhem* : « *Leçons sur l'électricité et le magnétisme* », vol. 1 (1891) et vol. 2 (1892).

2. P. DUHEM, *Leçons sur l'électricité et le magnétisme*, vol. 1, p. 1.

3. E. VILLAUME, *Compte rendu de P. Duhem* : « *Leçons sur l'électricité et le magnétisme* », vol. 1 (1891) et vol. 2 (1892), p. 260.

independent of the fashionable metaphysical doctrines, while at the same time renouncing their ill-conceived pretensions of imposing their system upon metaphysics”¹, thus suggesting that everyone, whether scientist or metaphysicist, would stand to gain from this. In *Notation atomique*, he had all but² reiterated the same idea, although it concerned a specific case. In severing the established ties between atomic notation and atomistic hypotheses, he remarked, chemical theory would be free of “the solutions furnished by various philosophical schools with respect to issues raised by the nature of bodies” and would thus avoid “all metaphysical objections”, the brunt of which would be borne by “atomistic theories on the constitution of matter”³. This dual declaration of independence — you saw that coming! — would not go down at all well with metaphysicists.

The first to return fire, and hotly, was Domet de Vorges: “It is hardly for the love of metaphysics that Mr Duhem thus gives it free reign: it is rather out of disdain; he does not want this foreign plant growing on his territory”⁴. After having thus accused our physicist of scorning metaphysics — the second accusation after that of Fr Villaume —, he quickly changed his mind: “We were of the opinion that Mr Duhem wanted nothing to do with metaphysics. Well, this is not the case, we were wrong! He has a metaphysics and this metaphysics, whether he suspects it or not, is Kantian metaphysics”⁵. The third accusation — which was particularly insulting⁶ — having thus been launched at him, was soon to fizzle out.

Regarding what is certainly one of the least justified and yet most often recited criticisms⁷, which Duhem would finally acknowledge⁸ — namely that the scholars would never have developed science had they not been driven by the desire to discover reality —, two remarks are worth noting.

The first one signals, from the outset, a misunderstanding that prevailed at the time and that would last for the entire period under consideration. Seeking the reason behind certain Catholic scholars having adopted this new way of thinking, Domet de Vorges

1. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 164.

2. Chiefly addressing his scientific peers, Duhem omitted to mention the advantage that his conception might hold for metaphysicists.

3. P. DUHEM, *Notation atomique et hypothèses atomistiques*, p. 452.

4. Ed. DOMET DE VORGES, *Réflexions sur les théories physiques*, p. 654.

5. *Ibid.*, p. 655.

6. It barely requires mentioning that, at that time, calling someone Kantian was tantamount, for a Catholic, to being accused of one of the most hideous philosophical heresies.

7. For example, Ed. DOMET DE VORGES, [*Compte rendu de P. Duhem : « Une nouvelle théorie du monde inorganique » et de Ch. de Kirwan : « Newton et l'action à distance » (1893)*], p. 669.

8. Is this not, after all, what Duhem would acknowledge, in 1908, while stating, himself, in no uncertain terms, that it “would be unreasonable to strive for the progress of physical theory if this theory were not a reflection, increasingly clear-cut and precise, of a Metaphysics; the belief in a transcendent order to Physics is the only reason d'être of physical theory” (P. DUHEM, *La valeur de la théorie physique*, p. 18)?

reiterated that a similar conception had been adopted by the first founders of modern science in order to guard against a “somewhat fierce orthodoxy”¹. Although left unspecified, this naturally calls to mind the *Ad lectorem* of the *De revolutionibus*. As convenient as this defensive strategy might have been, he added, it did not adequately account for “the venom of scepticism”², which remained hidden initially. With this fourth accusation, which would turn out to be as short-lived as the one before it, we are made aware of the strong suspicions that were to weigh upon the shoulders of Duhem: positivism, disdain for metaphysics, Kantianism, and lastly, scepticism. We also foresee the great lengths that he will have to go to in order to convince his co-religionists that the point of his conception lies not in protecting *himself* from them — as was the case around the time of Copernicus, Galileo and Descartes — but rather in protecting *them* from their real enemies, which did not include him!

The second one provides us with useful information concerning what is at stake for a metaphysicist such as Domet de Vorges: if physicists refuse to lead metaphysicists to the “primitive facts”, which the latter need to be able to analyse according to their own methods, and if these metaphysicists themselves are not able to gain access to these same facts since they can only attain “definitive results” for “superficial facts”³, will metaphysics have to resign itself to remaining unaware of the true nature of things? By means of a more substantial article, in which Domet de Vorges summarises his thinking [§ 9.1], we will address the concern expressed here in more depth. It already demonstrates that if the Duhemian removal of all ontological scope from science in order to reserve it for metaphysics alone seems to benefit the latter by granting it with unparalleled prerogative, this is not the case: lest it lose its starting point, which it cannot itself constitute, metaphysics needs science to retain a certain cognitive scope.

* * *

By the time that these two reactions had been released in the form of simple reports, the four serious accusations that Duhem would have to dispel had already been delivered. Having (at least) familiarised himself with the text of Domet de Vorges, our physicist would attempt to answer the simplest of them forthwith: that of his so-called disdain for metaphysics.

6. “A new theory of the inorganic world”

While he was in the process of highlighting, in *Notation atomique*, the philosophical and scientific issues that resulted from the acceptance of atomistic hypotheses, Du-

1. Ed. DOMET DE VORGES, *Réflexions sur les théories physiques*, p. 655.

2. *Ibid.*

3. *Ibid.*

hem remarked that such difficulties arose particularly when physicists succumbed to the temptation of specifying the constitution of atomicity, such as attributing, for example, the form of a polyhedron (as did Fr Armand-Jean Leray, °1828) to the atom. On this occasion, he had already announced that he would soon be entertaining the readers of the *Revue* with an “interesting little book”¹ in which the mechanical physicist had explained his doctrine. Six months later, in January 1893 — during which time he had lost his wife, who died on 28 July 1892 while giving birth to their premature child — the promised study entitled *Une nouvelle théorie du monde inorganique* was published.

6.1. A puzzling article

This article, which is divided into two distinct parts, was all but ignored by his commentators.

The first part is dedicated to a metaphysical explanation of the inorganic world that was put forward by Fr Leray, whose primary concern was to respect the metaphysical principle by which a substance cannot act where it is not present, and this by managing to account for universal attraction without ever having to invoke the slightest remote action.

The second examines the various answers that had been offered up, over time, concerning precisely this question: “is action at a distance possible?”. This gave Duhem the opportunity to make it known that certain reputable scholars shared his ideas. Firstly Pascal, who described the ambitious Cartesian project of knowing and explaining everything as futile, uncertain and tedious, and then Newton who reiterated, after the unfortunate deviation of Huygens, the wise principle of a necessary distinction between physics and metaphysics².

* * *

This article, which is disconcerting to say the least, raises many questions. Why, in the first part, did Duhem specifically address the theory of Fr Leray, when even though he was quite successful at that time his name had since been forgotten? Furthermore, no matter which physicist’s theory it might be, why did he make a point of extensively examining a contemporary metaphysical theory — this being the only time he would do so — and why would he have done this so overtly when he was perfectly aware that he was taking a “dangerous detour” around his area of expertise? Lastly, what conclusion

1. P. DUHEM, *Notation atomique et hypothèses atomistiques*, p. 446.

2. As Maiocchi pointed out (*Chimica e filosofia [...]*, p. 252), Duhem thus transformed Newton’s proverbial and provisional prudence, representing the banner for French positivism, into a permanent distinction of principle.

can be drawn from this article, since at the end of the second part, there is no longer any mention of the first part concerning Fr Leray's theory at all? Let us examine these three questions individually.

First of all, it turns out that it was not by chance that he chose Fr Leray. As Duhem had, in 1886, favourably reviewed his *Essai sur la synthèse des forces physiques*¹, this physicist, with the permission of Abbot Adrien Pautonnier (1853-1943), had just sent him his new work which complemented it. He sent this in the hopes that his correspondent would once again be willing to review his work. Additionally, having taken note of the fact that Duhem had stated, in *Les théories physiques*², that a mechanical theory must necessarily include consequences contradicted by experimental laws, he was also challenging him inasmuch as one of the consequences of his hypotheses and definitions was, indeed, in conflict with these laws³. Having acquiesced to this double request, Duhem had already responded to the challenge by criticising Fr Leray's theory in *Notation atomique*; he then responded to his request for an appraisal by reviewing his book *Une nouvelle théorie*. This aside, we still need to explain why our physicist chose — instead of merely dedicating a short review to this work, as he had done for the previous one — to satisfy this request with such a lengthy article.

While it is not always possible to determine which reactions and publications Duhem was aware of and which might thus have influenced him, in the present case there can be no doubt: in a footnote to his article, he specifically referred to the aforementioned heated response [§ 5.2] of Domet de Vorges, without however mentioning either its author (probably deliberately⁴) or its exact place of publication (perhaps unintentionally⁵). Notwithstanding, in this first publication, the president of the Société de saint Thomas d'Aquin had accused him of scorning metaphysics and of refusing to lend his support to philosophy. Yet in the first part of his article, Duhem attested to his good will: far from scorning contemporary metaphysics, he was quick to address it; and far from refusing to lend his support to philosophers, he went out of his way to summarise the more technical works for their ease of comprehension. Better still, he took advantage of this article to deliver several messages to his co-religionists: having a clear awareness, like Fr Leray, of the limitations in terms of the scope of application of science, philosophy and theology, means avoiding errors that could be considered, at worst, as heretic; possessing a thorough knowledge, like Fr Leray once again, of experimental laws before attempting

1. We have since identified this analysis, which he simply initialled: P. DUHEM, *Compte rendu d'Ad.-J. Leray* : « *Essai sur la synthèse des forces physiques [...]* » (1885).

2. Cf. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 149 et p. 157.

3. Letter from Ad. Leray to P. Duhem dated 18/02/1892.

4. Duhem had a copy of this article among his correspondence.

5. The “Bulletin philosophique” that Duhem mentioned is the title of the column in which his response appeared, and not that of the journal in which it was published. This is what made it somewhat difficult to identify his response, which was resolved in 2008 (cf. J.-Fr. STOFFEL, *Pierre Duhem avait-il « quelque théologien derrière lui » [...] ?*, p. 89).

to explain them, is a healthy attitude that is rarely implemented in the Catholic world¹; lastly, preventing science from being its own metaphysics, would mean preserving the very existence of metaphysics. These reasons should suffice in order to justify Duhem's only detour into contemporary metaphysical terrain.

Finally, since each of these two articles is rather self-contained, why is there no final conclusion uniting them? Indeed, this absence constitutes the article's conclusion: by refusing, after his historical overview addressing remote action, to express his opinion on the metaphysical theory of Fr Leray, Duhem demonstrated, by his silence, the independence of physics and metaphysics which led the former to renounce the "ill-founded claim"² of imposing its system and preferences on the latter. Yes indeed, studying Fr Leray's metaphysical theory was merely a pretext, as it was not up to the physicist to pass judgement on its value and, in any case, irrespective of this value, this metaphysical theory was of no consequence for physics.

* * *

Thanks to the response of Domet de Vorges, Duhem realised that by primarily addressing his scientific peers when demonstrating the advantages of his concept, he had underestimated the issues that might arise with respect to his co-religionists, to whom he had not sufficiently explained the benefits for them specifically. Without waiting for his doctrinal clarification regarding these questions — which would be *Physique et métaphysique* —, he offered them *Une nouvelle théorie*. Thus we can conclude, in light of: his response to the request of the Fathers Leray et Pautonnier; the proof of his interest in metaphysics and of his regard for philosophers; his emphasis on the advantages of his doctrine for the Catholic world; his exhortation addressed to the clergy encouraging them to further their knowledge of the sciences; his appreciation of the healthy attitude adopted by Fr Leray; and, lastly, his highlighting several very prominent scientists having adopted the same ideas as he had, that this little-studied article was certainly deserving of our time.

6.2. A well-received clarification

By way of proof that Duhem had achieved his main objective, Domet de Vorges, although still harbouring certain reservations, did admit that our physicist had, thanks to his great article, managed to "victoriously" disabuse him of his error: he had not fallen prey to the contempt for metaphysics that seemed rife among scholars³. As for Vicaire,

1. At this point, it should be noted that this idea is to be reiterated, in a much more controversial manner, during the Congrès de Bruxelles [§ 12.1].

2. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 164.

3. Ed. DOMET DE VORGES, [*Compte rendu de P. Duhem : « Une nouvelle théorie du monde inorganique » et de Ch. de Kirwan : « Newton et l'action à distance » (1893)*], p. 669. Cf. also Ed. DOMET DE

who had just read *Une nouvelle théorie*, he hastily added, to the critique he had already written, a footnote in which he stated that Duhem was in fact not opposed to metaphysics and did not feel the slightest disdain for it, since he did not hesitate to devote his “physicist’s leisure time”¹ to it. The first accusation was thus quelled.

6.3. Kirwan: a reserved yet accommodating newcomer

Responsible for presenting the work of the Société scientifique de Bruxelles to the Société bibliographique de Paris, Charles de Kirwan (1829-1917), who had established a career in forest administration and had published many of his articles under the pseudonym Jean d’Estienne, began reviewing several Duhemian publications even though he did not yet entirely agree with all of them “on all points”². Even if he was not in the best position to appreciate the ongoing debate, from a physical point of view³, he would contribute to broadening his audience by drawing attention to him in the *Revue du monde catholique*. For the time being, he was especially critical of Fr Leray’s system, particularly so in fact, since he had just devoted a study to *Newton et l’action à distance*⁴. Duhem would incidentally mention this in *Physique et métaphysique*⁵, due to their shared understanding of the author of *Principia*’s viewpoint.

7. Eugène Vicaire’s critique

On 16 October 1892, Mansion informed Duhem that he had been promised “a refutation or partial refutation”⁶ of his article on *Les théories physiques* since its publication. Having received it finally in March 1893, this lengthy and impressive critique was published in the April issue under the title *De la valeur objective des hypothèses physiques : à propos d’un article de M. P. Duhem*. Its republication in the April and May issues of the *Annales de philosophie chrétienne*⁷ testified not only to the importance attributed to it by the Société de saint Thomas d’Aquin — of which the author was a member and to which this journal was affiliated [§ 15.6] —, but also to the impact it was to have on the Catholic world. This impact would be considerably heightened by the fact that it came from a scholar with an impeccable scientific reputation, namely Vicaire.

VORGES, *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 147.

1. E. VICAIRE, *De la valeur objective des hypothèses physiques*, p. 482, note 1.
2. Letter from Ch. de Kirwan to P. Duhem dated 14/08/1893.
3. Kirwan’s interest in the question of the relationship between science and faith caused him lean more towards cosmology and transformism.
4. Cf. Ch. DE KIRWAN, *Newton et l’action à distance*.
5. Cf. P. DUHEM, *Physique et métaphysique*, p. 79.
6. Letter from P. Mansion to P. Duhem dated 16/10/1892.
7. Hereinafter, the *Annales*.

7.1. Vicaire: a pertinent critique with ongoing repercussions

If this engineer went after Duhem's reduction of physical theory to a mere "mnemonic process"¹, it is because he interpreted it as "destructive of all science" and he considered it all the more important to refute it because it had infiltrated "a journal with affinities and an agenda that should have made it more resistant to such an invasion of scepticism"². From the outset, this last comment conveyed the message that this his critique was to go way beyond the scope of a simple philosophical debate concerning the nature and purview of physical theories. Nonetheless, considering the audience that he was addressing and the fact that he had made this accusation himself, Vicaire did not feel the need to say anything further. We can, however, gauge what he feared: by undermining the power of human intellect and thus introducing scepticism into science, Duhem (albeit unwittingly) promoted its introduction into religious matters; in denying the objective scope of physical theories, he endangered Thomistic proof of the existence of God; by making physics independent of metaphysics, he overturned the traditional concept of their relationship; by favouring a descending axiology (theories to summarise laws; laws to group facts), he did not encourage the converse, in other words, deriving the natural extension of physical theories from metaphysical systems. Bearing in mind these hidden undertones which would need to be subjected to verification, let us go over the illustrious engineer's thinking before examining the most salient points of his critique.

* * *

According to Vicaire, the experimental laws possess, in increasing order of importance, three advantages: their practical and heuristic utility, the intrinsic beauty in the order they give to nature, and lastly the generation of theories. As for theories, although devoid of the latter ability, they share the first two functions: first the ability to increase their scope of application and to favour the discovery of new ideas, and then their capacity to reveal the splendour of the world. This fecundity and beauty of theories requires that they be, at least partially, in accordance with nature, and this ascent from facts to laws and from laws to theories also constitutes, in the same way, a deepening that leads phenomena to their interactions and these interactions to their causes. Indeed, the knowledge of the true nature of things may well be questioned by "sceptics, who reject any kind of certainty", and by "idealists, who do not believe in the reality of matter"³. Ignoring the latter (since Duhem obviously did not belong to this group), Vicaire conceded to the former that "we will never know all phenomena nor everything about a

1. E. VICAIRE, *De la valeur objective des hypothèses physiques*, p. 452.

2. *Ibid.*, p. 453.

3. *Ibid.*, p. 465.

single one”, pointing out, however, that even if science would never be infinite, it could nevertheless “grow indefinitely in study and in depth”¹.

* * *

Leaving aside the other objections expressed by the illustrious engineer — namely, by reducing physical theory to a mere utilitarian exercise, the Duhemian concept ignored the true purpose of science (in other words seeking causes), destroyed scientific curiosity and was detrimental to academic motivation — we will focus on the two that seem most important to us.

The first consisted in demonstrating an incoherence at the heart of Duhemian thinking. If its goal was to merely relieve the memory of a physicist, as was stated by Duhem, then the simplest solution would have been to use a series of mnemonic techniques which would have no constraints other than their effectiveness, instead of imposing, as he did, a coherent mathematical theory. Allow us to better explain this objection. Since realists aim for relevancy with respect to their theories and to reality, they cannot accept any contradictions in any of their theories, nor any incompatibility between different theories. Far from having to impose any constraints on themselves since their goal was so radically different, supporters of the Duhemian concept were to accept everything, since “success justifies everything”² when it comes to relieving one’s memory³. However, since he could not bring himself to accept such a consequence, the author of *Les théories physiques* decided to seek out any criteria which would justify choosing between logically equivalent theories, thus opposing Poincaré. He was, therefore, inconsistent unto himself.

The second objection criticised the Duhemian conception for having left the scientist without any guidelines when it came to defining notions and choosing hypotheses. Far from being thus left to his own devices, the realist scholar is fortunate enough to be guided by “principles, although metaphysical ones, indeed, but no less useful”⁴.

7.2. Lechalas: joins the game providing comfort and correcting Vicaire

In turn, having momentarily entered the discussion, Georges Lechalas (1851-1919) first addressed Vicaire and then Duhem, before leaving the debate for the better part of a

1. *Ibid.*, p. 471, note 1.

2. *Ibid.*, p. 475.

3. Even though Duhem did not contest the first part of this premise, it is worth noting that he would hasten to forget, at least temporarily, the second part, in this case that of the mnemonic function which had hitherto been the goal of his physical theories.

4. E. VICAIRE, *De la valeur objective des hypothèses physiques*, p. 478.

decade. For the time being, let us examine his *Quelques réflexions soumises à M. Vicaire* published in the *Annales*.

After having given his “full support”¹ — which would astonish Maurice Blondel (1861-1949)² — to Vicaire’s study as a whole, Lechalas set out to clear up any confusion, or even error. Believing that they were claiming to exclude the idea of cause, Vicaire equated Duhem’s supporters with those who, in demonstrating mechanics, rejected the word “force”. Lechalas decided to prove him wrong: one could, without contradiction, divest oneself of this notion without excluding the idea of cause, because what is thus pushed aside is not cause itself, but only a certain anthropomorphic conception of it. Being particularly interested in matters of absolute space and movement, he then opposed Mansion’s attempt to label Copernicus as a forerunner of Duhem.

7.3. Couette: an unfairly forgotten conciliator

Unlike the philosopher Domet de Vorges, the amateur in natural sciences Kirwan, the engineers Vicaire and Lechalas and all the other contestants involved in this game, Maurice Couette (1858-1943) is the only one who was, like Duhem, a physicist³: specialised in fluid mechanics, he was at the time a professor of physics at the Facultés catholiques d’Angers. His point of view is thus of particular interest. Let us summarise that which characterises his various contributions to this debate, since he does not seem to have missed a single publication⁴.

Firstly, he was motivated to seek a reconciliation between the “old” and the “new” philosophy of science, convinced that “their opposition is more apparent than it is real⁵. In order to achieve this objective, he came at the problem from various angles. He pointed out that since the old one had “Bâcon [sic] and Descartes as its predecessors” while the new one “cannot deny a close kinship with the doctrines of Kant, Auguste Comte and Stuart Mill”, this was not, however, “a sufficient reason” to condemn the latter⁶. He conceded that even if at first one experiences “a strange anguish” at seeing the collapse of “what we believed to be scientific certainty”, because as it crumbles “all certainty

1. G. LECHALAS, *Quelques réflexions soumises à M. Vicaire*, p. 278.

2. “I was surprised and troubled by the articles of Mr Vicaire, in the *Annales de Philosophie Chrétienne*, who discredits the cause he claims to support. And what astonished me even more is that Mr Lechalas, who is not the first person to do so, ‘gives his entire support to the whole’ study by Mr Vicaire” (letter from Mr Blondel to P. Duhem dated 17/08/1893).

3. Cf. J.-M. PIAU & M. PIAU, *Le prix Maurice Couette du GFR*.

4. It should be noted that Couette would also review *Quelques remarques au sujet de l’électrodynamique des corps diélectriques proposée par J. Clerk Maxwell* presented by Duhem at the third International Scientific Congress of Catholics held in Brussels in 1894: cf. M. COUETTE, [*Quelques remarques au sujet de l’électrodynamique des corps diélectriques proposée par J. Clerk Maxwell*].

5. M. COUETTE, [*Discussion sur la valeur objective des hypothèses physiques (1)*], p. 186.

6. ID., *Esquisse historique du mouvement des idées [...]*, p. 1108.

seems ready to collapse with it” — the floundering of wholly scientific certainty is thus the same as that of *all* certainty —, one must then, he continued, hold one’s “nerve and vigilance” in order to put everything back in its place and one’s “mind at rest”¹! Lastly, he suggested a definition of physical theory that might prove acceptable to both Duhem and Vicaire: “A physical theory is an intellectual image intended 1° to remind us, in a condensed form, of the relationships between phenomena, 2° to represent, as much as possible, the very nature of things”².

Secondly, he demonstrated a competence in scientific methodology which surpassed that of most of the other debaters. While Domet de Vorges thought he could establish, through the verification of their consequences, if not the certainty of the hypotheses, at least their “very high probability”³, this physicist from Angers strongly reiterated, although using other words, the epistemological consequences of the function of implication: whereas true premises can only yield true consequences, verified predictions are not certain to indicate the truth of their premises. Better still, as he would modestly point out⁴, he stayed one step ahead of Duhem in stating the holistic theory, and above all, in proclaiming the impossibility of the crucial experiment⁵.

Thirdly, far from having been content with sticking to more or less critical reviews of the articles published, he took full advantage of the works of Poincaré⁶ and of Duhem, who provided him with the “ray of light”⁷ he needed in order to develop his very own line of thought. Therefore, far from sharing “the harsh feelings”⁸ of Domet de Vorges towards Duhem, whose ideas he judged to be “generally quite accurate, as long as they are not given more latitude than the author himself”⁹ — a healthy scepticism that many reputable authors of the 20th century would lose sight of! —, he refused to believe however, like the latter did, that everything in science is symbolic¹⁰: the idea of mass, for ex-

1. *Ibid.* As this comment follows the one expressed, in the same journal and on the same subject, by Domet de Vorges, he must clearly have appreciated it!

2. M. COUETTE, [*Discussion sur la valeur objective des hypothèses physiques (1)*], p. 185.

3. É. PEILLAUBE, [*Communication de M. de Vorges sur « La valeur des théories physiques »*], p. 402. Other passages testify to the fact that Domet de Vorges did not conceive of any process other than verificationism: Ed. DOMET DE VORGES, [*Compte rendu de P. Duhem : « Physique et métaphysique » (1893)*], p. 1035.

4. M. COUETTE, *Les expériences et les lois de la physique d’après M. Duhem*, p. 87.

5. Cf. ID., [*Discussion sur la valeur objective des hypothèses physiques (2)*], p. 360 et p. 364.

6. In particular, the following provocative statement comes to mind — one that Vicaire would attempt to put into perspective (E. VICAIRE, *De la valeur objective des hypothèses physiques*, pp. 468-472) — which appeared in the introduction of one of his more recent works in 1890: “If a phenomenon thus has a complete mechanical explanation, it will have infinite others which will also take all of the characteristics revealed by the experiment into account” (H. POINCARÉ, *Électricité et optique*, vol. 1, p. XIV).

7. M. COUETTE, *Les expériences et les lois de la physique d’après M. Duhem*, p. 86.

8. ID., *Esquisse historique du mouvement des idées [...]*, p. 1105.

9. ID., [*Discussion sur la valeur objective des hypothèses physiques (1)*], p. 185.

10. ID., [*Discussion sur la valeur objective des hypothèses physiques (2)*], p. 360.

ample, is not, even though it is an abstract idea¹. There are others, such as symbolic laws which are not either, so he was of the opinion that Duhem “would do well to set aside or explain this word *symbol* which was causing problems”². Refusing to adhere to a binary representation, which stipulates that physical theories either possess or do not possess an objective value, he developed a typology³ comprised of five main types of physical theories, thereby allowing him to vary the degree of difficulty of these “intellectual images” that were the theories according to their type⁴. This led him to come up with two main scenarios. When it comes to assertions about objects that are directly accessible to experimentation, an objective certainty — if not perfect, then at least “very close and by no means symbolic”⁵ — can be achieved, contrary to what Duhem believed. When this essential condition is not fulfilled, however, attempting to draw conclusions from the certain metaphysical principles that should lead to physical propositions enjoying an objective certainty, is futile — this time agreeing with Duhem et Domet de Vorges; on the other hand, it is possible to arrive at such propositions by resorting to a demonstration by the absurd, provided, of course, that this occurs between a proposition and its contradiction, which condemns this process to being able to implement only fairly general and simple propositions. In short, “the only affirmative *physical* propositions for which the objective truth can be established with complete certainty are: 1° either propositions concerning objects that are directly accessible to experimentation; 2° or very simple and general propositions about certain substances, or certain properties that are not directly experimentally accessible, but that do not imply any precise quantitative affirmation”⁶.

Fourthly, he recognised, without seeing the slightest problem in it, that “if a single image is not enough to represent all [the properties of an electrical current, for example], [he] is not afraid of using several of them in succession, even if they are mutually incompatible”⁷. Couette, who essentially embraced the “new” philosophy of science, thus unsurprisingly adopted the premise shared by Vicaire and Duhem, whereby a phenomenalist is also, naturally, an eclectic.

Finally, it should be noted that his contribution went largely unnoticed. With the exception of Domet de Vorges, his colleague at *La science catholique*, who hastened to state that his refutation of the symbolic character of the notion of mass served to “completely overturn” the Duhemian theory⁸, no one seemed to have taken his thoughts into

1. ID., *Les expériences et les lois de la physique d'après M. Duhem*, p. 88.

2. *Ibid.*, p. 89.

3. ID., [*Discussion sur la valeur objective des hypothèses physiques (1)*], pp. 185-186.

4. ID., [*Discussion sur la valeur objective des hypothèses physiques (2)*].

5. *Ibid.*, p. 361.

6. *Ibid.*, p. 365.

7. ID., *Esquisse historique du mouvement des idées [...]*, p. 1107.

8. Ed. DOMET DE VORGES, [*Commentaire au compte rendu consacré par M. Couette à P. Duhem...*], p. 404.

consideration: neither the debaters of his time, nor any modern commentators¹. As for Duhem, himself, although he is said² to have been sent, in 1903 and 1906, respectively, his *Recherches sur l'hydrodynamique* and his *Recherches sur l'élasticité*, and that he graciously received, at around the same time, the letters of a former student of his, namely Fr René Hedde, he only mentions, in the fourth part of his *Recherches sur l'hydrodynamique*³, his scientific works without ever having referred to the aforementioned thoughts.

7.4. Lacome: an incisive defence of Duhem

Nowadays, the name of the exegete and Dominican, Bernard Lacome (1856-1947), hardly evokes any memories. Some may recall that in 1891 he published, in the *Revue de Lille* under the direction of the Facultés catholiques, a lengthy article⁴ arguing that it would be inappropriate to seek any foresight of current scientific knowledge in the text of Genesis. They may also recall that, in line with this work, to which Fr Marie-Joseph Lagrange (1855-1938) attached a certain importance⁵, he published a monograph in 1904 entitled *Questions de principes concernant l'exégèse catholique contemporaine*⁶. As regards the Duhemian commentators, only H. W. Paul⁷ et St. L. Jaki⁸ gave adequate attention to his one and only publication about our physicist⁹. Yet, it is said that while he was in Lille, Duhem spoke with him “from the beginning of [their] relationship” about his “idea of boundaries delimiting the various scientific fields” and that on this occasion, any exegesis having been forgotten, he had congratulated him and called him a “peripateticist without being aware of it”¹⁰. This fact confirms our theory that Duhemian phenomenalism had also been thought out, either from the beginning or at least incredibly quickly, within a theological framework. It once¹¹ led us to suggest that Lacome might have been the “theologian” or “prompter” that Domet de Vorges suspected the existence of, as we shall soon see [§ 9.1]. In support of this possibility, it is worth noting that Duhem, who would remain great friends with him his entire life¹², held him in very high

1. We have not found a single commentator who even mentions him at all.

2. Cf. the letter from M. Couette to P. Duhem dated 23/04/1903 and 22/10/1906.

3. P. DUHEM, *Recherches sur l'hydrodynamique*, Part IV, pp. 252-253.

4. Cf. B. LACOME, *Quelques considérations exégétiques sur le premier chapitre de la Genèse*.

5. Cf. B. MONTAGNES, *Marie-Joseph Lagrange*, p. 123, note 3.

6. Cf. B. LACOME, *Questions de principes concernant l'exégèse catholique contemporaine*.

7. Cf. H. W. PAUL, *The Edge of Contingency*, pp. 169-170.

8. Cf. St. L. JAKI, *Uneasy Genius*, pp. 117-118.

9. Fr Hilbert's unpublished doctoral dissertation is obviously and exception inasmuch as the contribution, which favours Duhem, of the neo-Thomist Lacome constitutes a strong argument in favour of his thesis. It is for the precisely opposite reason that R. N. D. Martin makes no mention of it.

10. Letter from B. Lacome to P. Duhem dated 03/12/1893.

11. Cf. J.-Fr. STOFFEL, *Pierre Duhem avait-il « quelque théologien derrière lui » [...]?*, pp. 94-95.

12. Being extremely difficult to read, the correspondence consisting of 24 letters that he addressed to Duhem, attests to this fact.

regard: he found his “little passage on exegesis” to be “really marvellous” and believed that its author could “do much towards the synthesis” of, on the one hand, the “old theology” and, on the other hand, the “intellectual labours of the last centuries” and “modern aspirations”, because he possessed “both the profound intelligence of the old school and a clear perspective on modern trends¹. We will shortly go through this lone article that Lacomme devoted to Duhem, which will serve to confirm this opinion. We would first like to address its tone.

Even though Vicaire had his son look over his text to “see if, here and there, he had not been too harsh on Poincaré [and Duhem]”, and even though his son had “found the article to be beyond reproach from that point of view”², it did contain one or two allusions that could be considered unpleasant. This no doubt explains why Lacomme’s retort, published in the first volume of the all-new *Revue thomiste*, was equally incisive, as Kirwan and Lacomme himself would come to regret³.

* * *

While he did pay homage to the science of Vicaire, Lacomme also accused him of lacking knowledge in both Catholic philosophy and even, quite simply, philosophy in general, because, he said “he seems to [have touched] upon [it], like many others, [in other words] without having completed any specialised studies in it since he left school”⁴. In contrast, he presents Duhem, “as sincere a Catholic” as his opponent, as being “more scholastic, less Cartesian and academic”⁵. These few lines already hint at: the intra-Catholic debate which, until then, had mainly opposed the Lillois physicist and the neo-Thomists of Société de saint Thomas d’Aquin, became a debate between neo-Thomists to uncover which of them were more faithful to the “Catholic philosophy”, “more scholastic”, and “less Cartesian”, which is to say: “the most orthodox”.

They were not only the most orthodox, but also the most discerning. Having noticed, on the one hand, that Vicaire had been unnerved by Duhemian “radicalism” after which nothing seemed to be left standing, and, on the other hand, that he had not hesitated to put them all in the same basket — Duhem, the believer; Poincaré, the sceptic; and Gustav Kirchhoff, the agnostic (1824-1887) — Lacomme emphasised the extent to which the Duhemian perspective embodied, on the contrary, the “middle ground” between the “two extremes” represented by Vicaire and Poincaré. The former, personifying “the

1. Letter from P. Duhem to A. Gardeil dated 15/09/[19..].

2. Letter from P. Mansion to P. Duhem dated 20/03/1893.

3. Believing the comment to be directed at Domet de Vorges when it was aimed at Vicaire, Kirwan would deplore this lack of “urbanity” (cf. Ch. DE KIRWAN, *Questions scientifiques* [1894/2], p. 355, note 1). Lacomme would acknowledge that he should not have “offended a man who had done [him] no harm” (letter from B. Lacomme to P. Duhem dated 12/11/1894).

4. B. LACOMME, *Théories physiques (1)*, p. 677.

5. *Ibid.*

bigoted credulity of the fanatic”, defended everything, “even when it is no longer defensible”; the latter, touting “the carefree radicalism of the sceptic”¹, abandoned everything, “even that which should be maintained². Between the two, Duhem, turned out to have more confidence in science than Vicaire, since he had no qualms in subjecting it to a harsh “examination of conscience”, and was more certain than Poincaré of the “unwavering stability of the foundations of philosophy”, as he did not fear “the bankruptcy of all metaphysics”³.

When Lacombe contemplated doctrines, he naturally began writing about people. Faced with the historical observation that all these physical theories kept rising only to fall back down again even harder, he tended to agree with Duhem’s idea of being cautious, before taking advantage of the opportunity to shoot another arrow at Vicaire. In his critique, the latter had described Duhem, with a certain paternalism — being about twenty years his senior —, as a “*young and learned author*” with a “*precocious talent*”⁴. It is here that we pick up Lacombe’s finely crafted criticism, based on Duhem’s argument accounting for the wealth of beginnings [§ 3.2 et § 8.3], and deploy it in the direction of Vicaire. Full of illusions and blind self-confidence in its youth, science, having matured somewhat, is now more prudent. Some (in this case Vicaire) have mistaken this caution for scepticism. Thus, despite their (physical) age, they have remained (intellectually) young, in other words in the same state of mind as science was at the beginning of modern times. However, while we were willing to forgive a certain pride and credulity in those precocious children back then (meaning those alive at the time of science’s modern beginnings), this is no longer the case today. Those who remained (intellectually) young would do well, therefore, to let go of those untoward childlike traits and to evolve enough to be able to keep up with those who, while physically young, are more intellectually mature. In this sense it is thus Vicaire, and not Duhem, who can be described as young; as for his accusation of scepticism, it was simply the result of his inability to grow up!

Following on from this salient point, Lacombe formulated other arguments in favour of the Duhemian conception. For example: theories do not have to be true in order to fulfil their function; also, when they are rejected, it is not because of their falsity, but because of their inability, now established, to fulfil this function; moreover, in practice, physicists do not treat theories as explanations, since they do not hesitate to use them,

1. According to Lacombe et Duhem, it is thus Poincaré who represents the figure of a “smiling” and “carefree” sceptic.

2. B. LACOME, *Théories physiques (1)*, p. 683.

3. *Ibid.*

4. E. VICAIRE, *De la valeur objective des hypothèses physiques*, p. 451.

successively or even simultaneously, in a contradictory manner¹. Within this more or less structured argument, two points in particular are worth examining in more depth.

Firstly, Lacombe underlined the extent to which physics uses terms (“temperature”, “force”, “matter”, “movement”) which we can say — along with Pascal — are self-evident “although hard to define”², and even far from being in agreement from one physicist to another. He also considered it “astounding that we have been able to practise science for centuries in this way, with such incertitude reigning over ordinary vocabulary” and just as “astounding that this grave and fundamental flaw of modern science is hardly recognised today”³. This reference to Pascal and to this failure, which was not at all debilitating, pointed out by a theologian who Duhem had discussions with about delimiting the different sciences, naturally brings to mind the entire apologetic scope that Duhem would draw specifically from this observation in his letter to his friend Joseph Récamier (1861-1935)⁴.

Secondly, and in order to illustrate this lack of clarity and precision in the definitions of numerous physics terms, Lacombe studied the notion of temperature at length — it constituted the entire second instalment of his article — by referring to Aristotelian typology. Between temperature, which is a quantity, and heat, which is a quality, there cannot be, as Duhem maintains, any natural relationship that can furnish us with a complete knowledge of the latter, nor even a partial knowledge, because there is nothing, absolutely nothing, in heat which pertains to quantity. Furthermore, “those who believe in the essential articles of scholastic philosophy” should be obliged to ratify this conclusion, along with those who do not believe them, but are Catholic, because “scholastic philosophy is officially recognised by the Church as being philosophy which is somewhat orthodox”⁵. By this demonstration, “before scholastic philosophy and reason”⁶, the Duhemian defence of Lacombe was indeed, as we pointed out, that of a scholastic countering the criticism of other scholastics, assisted by the doctrine to which the latter should have adhered, at least if they had been, like Duhem, more scholastic than they actually were!

At the end of his response, Lacombe launched an appeal which was, to say the least, in line with Duhem’s own wishes, namely that of a reconstruction of the Catholic philosophy alongside modern sciences, and for which the former felt, as we have mentioned, that his friend was particularly well prepared. By specifically pointing out that “there

1. If the observation of eclecticism implied the negation of all realistic perspective on the part of those who implemented it, Duhem’s challenge would be to argue that the inverse is not true: forsaking realism does not necessarily imply accepting eclecticism.

2. B. LACOME, *Théories physiques (1)*, p. 688.

3. *Ibid.*

4. Cf. J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 79-81.

5. B. LACOME, *Théories physiques (1)*, p. 692.

6. B. LACOME, *Théories physiques (2)*, p. 104.

is, in the religious orders, [...] sufficient talent” and thus certainly “a few vocations for this glorious work”¹, Lacome also pleaded *pro domo*, since he dreamed of a “house of studies” and aspired to the creation, for him, of a “Chair of Philosophy of Science”².

7.5. Mansion: a fair judgement, even if the wrong way around!

Vicaire’s criticism revealed, over and above its differences, some striking similarities between his viewpoint and Duhem’s — the same commitment to ordering and unifying knowledge, the same desire to eliminate contradictions — Mansion, upon receiving it, had told our physicist that in “pushing the author’s ideas to the limit, we can demonstrate how they will lead to the same conclusions as yours”³. For our part, we think that the converse could just as well be argued: it is in pushing certain of Duhem’s ideas to the limit that we can, even more certainly, end up finding some of Vicaire’s primary convictions. Whether in the present context or in that of *La théorie physique*, it is indeed Duhem who would, initially by developing his doctrine of natural classification and then by reinforcing his cognitive statements, move closer to Vicaire... and not the other way around!

For the time being, after having responded to the second accusation by asserting that he did not scorn metaphysics, our author published *Physique et métaphysique* in order to explain to his brethren in faith that his separation from both of these was not due to either positivism or scepticism, contrary to what one might think in the face of the accusations brought against him by Villaume et Domet de Vorges.

8. “Physics and metaphysics”

After having ascertained from Mansion⁴ that Vicaire had not yet confirmed the project he had laid out⁵ with respect to defining the limits between physics and metaphysics, and that he could thus immediately reply to his contradictory scientist, Duhem set out to define these limits himself. While taking care, to Mansion’s great satisfaction⁶, to make this response as impersonal as possible due to the particular circumstances to which the latter had drawn his attention⁷, he did so in the following edition of *Revue*, by publishing *Physique et métaphysique* in the July 1893 issue. This article was to have all the more

1. *Ibid.*, p. 105.

2. Letter from B. Lacome to P. Duhem dated 24/04/1894.

3. Letter from P. Mansion to P. Duhem dated 20/03/1893.

4. Letter from P. Mansion to P. Duhem dated 19/05/1893.

5. Cf. E. VICAIRES, *De la valeur objective des hypothèses physiques*, p. 282, note 1.

6. Card from P. Mansion to P. Duhem dated 06/08/1893.

7. Vicaire had had his text reread by his seminarian son who had passed away in the meantime (letter from P. Mansion to P. Duhem dated 20/03/1893).

impact as it would be republished in the *Annales*, just as was previously the case with Vicaire's critique.

8.1. An independence for physics, but not for metaphysics

After having recalled his theory and Vicaire's, which opposed his — without any further mention of summarising the laws or relieving the memory, which he had attributed to physical theories in the three previous articles¹ —, Duhem defined the terms “physics” and “metaphysics” while endeavouring to clarify to what extent his own distinction overlapped with that of the Stagirite. He then specified that this distinction resulted from the nature of human intelligence which, unlike angelic intelligence, is obliged to acquire knowledge of phenomena (physics) before that of their causes (metaphysics). Although the latter precedes the former in the order of excellence, it thus follows it in terms of logical order: before being able to do metaphysics, one must first *seriously* study physics. This is indeed one of Duhem's leitmotifs, which he had already mentioned in his article on Fr Leray.

After having thus recognised, along with Duhem, that physics is the basis for metaphysics, could one not also maintain, this time along with Vicaire, that when a certain metaphysical knowledge has been acquired in this way, the latter is also at the source of the first inasmuch as it would be possible to deduce, from this previously acquired metaphysical knowledge, the resulting phenomena and the laws governing them? In particular, could one not find, in this metaphysical knowledge, the solution to the problem of the excessive latitude granted to the physicist, when selecting hypotheses, by the Duhemian doctrine? For Duhem, this would mean keeping science under the tutelage of metaphysics, which is exactly the opposite of what he was attempting to accomplish. He would also argue that, while theoretically possible, “the method of taking metaphysics as the starting point for the discovery of physical truths” is, in practice, “very difficult and fraught with danger”². Firstly, since it is true that a knowledge of causes implies a knowledge of effects, one must first gain access to this knowledge of causes. However, an exhaustive knowledge of these is impossible since it issues from effects, and the same effect can be produced by several different causes. Secondly, since metaphysics is composed of truths and systems, and neither of them enjoy sufficient simultaneous certainty and precision, then: where truths possess certainty, they are too imprecise to uncover any new physical laws; and where systems are sufficiently precise to do so, they are too uncertain to provide the indications that physics should not have to verify for itself. In

1. This mnemonic goal, which had led Vicaire to associate the coordination of laws, not with Duhem but with Poincaré, was to resurface in *La théorie physique*: drawing upon the existence, as demonstrated in the *L'école anglaise*, of different kinds of minds, Duhem would explain that certain minds, such as his, are more sensitive than others to this economic aspect of physical theory.

2. P. DUHEM, *Physique et métaphysique*, p. 59.

reading these lines, Vicaire, who had merely mentioned the “precious indications” that a metaphysical system could eventually present to the physicist, without actually believing that it would be possible to derive new laws from it, must have realised that Duhem was not very far removed from the doctrine that he himself supported.

Incapable of leading to the acquisition of any new physical truths, can metaphysics at least explain and justify the notions and principles of the experimental method, since it falls to philosophers — according to Duhem, in *Les théories physiques* — to analyse the induction process? Yes, replied our physicist, but as interesting as it may be, such a task would not provide anything further in terms of the certainty and evidence that the scientist requires in order to implement these notions and principles within experimental physics. Autonomous, physics is therefore independent of any preliminary metaphysical basis.

* * *

If metaphysics is thus of no consequence for physics — either it is incapable of assisting physics (in terms of physical laws), or it is capable (in terms of notions and principles), but then physics would not need it — the converse, as we know, is not true: it is from the physical study of phenomena that we can hope to gain access to the metaphysical knowledge of causes. Along this axis that leads from physics to metaphysics, does the “proximity” of physical theories and metaphysical systems not already allow us to recognise a certain metaphysical scope in the former? Faithful to his definition of physical theory and his preferred top-down axiology, Duhem dismisses this perspective. Physical theory serves to classify the physical laws which constitute a starting point for the metaphysical investigation. By classifying these laws, the former thus offers, both the physicist and the metaphysicist, a science that is “more perfect in form, more orderly, simpler and, consequently, more beautiful”¹. However, in becoming theoretical, this science has not changed in nature: it is still physical and not metaphysical. Indeed, the act of classification itself does not have any metaphysical significance (Duhem had not yet developed his doctrine of natural classification): convenient or not, good or bad, it can neither be true nor false.

* * *

As regards the independence of physics and metaphysics, it is important to consider to what extent the Duhemian asymmetry, so calmly asserted here, overturns their traditional relationship. Whereas for Thomism, physical theory, since its goal is to (at least partially) uncover the truth, is contingent upon metaphysics, Duhem, having deontologised it, could reverse this relationship of dependence: it is thus now metaphysics, and

1. *Ibid.*, p. 65. It is worth noting the Duhemian integration of this intrinsic beauty, which Vicaire had used as one of the three theoretical benefits.

only metaphysics, which is trapped in a relationship of dependence, as it is contingent on that which has an objective scope in physics, namely facts and experimental laws, but not physical theories.

8.2. Advantages for physics, but what about metaphysics?

What are the advantages, therefore, of this Duhemian separation of physical theory from metaphysics?

As far as physics is concerned, they are patently obvious: it would no longer be at the mercy of the ongoing quarrels between philosophical schools, which, by sparing it these incessant upheavals, would foster a continuous progression; it would no longer be dependent upon the individual philosophical opinions of its researchers, which would allow all scholars to work together, whatever their personal convictions; and lastly, since no proposition of physical theory could ever be considered to contradict a metaphysical reality, it would no longer be in danger of being subjected, in an “absurd” way¹, to seeking the confirmation or refutation of what it affirms among metaphysical truths.

Where does this leave metaphysics? As this article primarily provides a response to the neo-Thomist Vicaire, and is set in a context marked by the opposition of many of his co-religionists, one might have expected Duhem to also explain the advantages, for metaphysics, that resulted from his doctrine. This was not the case, however. Yet there was a consequence that would have been of particular interest to our physicist’s audience, and that led directly on from the previous statement: that it would be just as “absurd” to seek, among scientific truths, the confirmation or refutation of a metaphysical theory. He, however, either did not think of it... or simply did not express it. It was not until *Physique de croyant* and, better yet, his famous letter to Father Jean Bulliot (1851-1915) in 1911², that he explained all the consequences of his proposed separation. Did he wish to keep secret, as long as possible, this apologetic consequence of his doctrine, which implies that it is impossible to condemn a metaphysical theory in the name of science? Was he obliged to progressively provide more information to his co-religionists, who he had realised were unable to understand this and were thus not benefitting from it?³ Or did he want to keep it quiet, seeing that his main interlocutors, far from fully appreciating this consequence which issued from a negative apologetic strategy, would above all resent the fact that it also signified the end of all positive apologetics? Had he guessed,

1. *Ibid.*, p. 65.

2. J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 302-307.

3. In support of this possibility, recalling [§ 5.2] that Domet de Vorges had not reacted to Duhem’s statement, which he had quoted, that thanks to his conception, physical theories “will renounce the ill-founded claim of imposing their system on metaphysics”, even though this might have helped him to understand that this conception had the advantage of protecting metaphysics, once and for all, from scientific attack.

in other words, that far from appreciating the consequence of this doctrine, which made it possible to declare null and void any *objection* against Christian metaphysics that was to be carried out in the name of science, his opponents would condemn his doctrine as it prohibited, in the same way, any *demonstration* of this same metaphysics that was to be established in the name of science?

In any case, Duhem would not address the consequences of his doctrine for metaphysics, and merely continued to respond to those criticisms that directly concerned him. Far from his separation of physics and metaphysics having played into the hands of scepticism and positivism, this was the best way to avoid them: if one confuses these fields, one not only favours scepticism, but one also validates positivism, because stating that scientific methodology is applicable even to metaphysics is to admit that there is no method other than that of science. In doing this, Duhem threw the neo-Thomists very own accusation back at them: it was their attitude that inevitably led to positivism, and his that protected those who adopted it.

8.3. The unexpected discovery of a true phenomenalist tradition

At the end of this article, which, without furnishing any new developments, nevertheless succeeds, to some extent, in improving on the structure of numerous earlier ideas and which shows, for the first time, a number of slight variations, we finally come to an entirely innovative section. In order to fully appreciate the discovery to be unveiled therein, which inaugurated what would turn out to be one of Duhem's main historical research programmes, let us briefly retrace the path that led him to this innovation¹.

In *Les théories physiques*, our physicist, eager to instil greater confidence in his concept, had resorted to an argument from authority by invoking the names of Copernicus and Poincaré, when he was already up against a true mechanistic tradition which obliged him to furnish, as best he could, an explanation allowing him to account for its existence, its successes and, conversely, the scarcity affecting the phenomenalist representatives. Even if, a year later, he were to have added Pascal and Newton to Copernicus and Poincaré, his situation would not have miraculously improved. Contrarily, Vicaire² and Lechalas³ had revoked the patronage of Copernicus, pointing out that the text produced was probably by Andreas Osiander (1498-1552) and that it was in any case not in keeping, despite Mansion's opinion, with the views on the Polish astronomer. Fortunately, upon reception of the reprint of *Les théories physiques*, the Secretary-General of the Société scientifique de Bruxelles sent Duhem a crucial piece of information that he was far from suspecting: when faced with the mechanistic tradition, it is possible to oppose

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1. For more information, cf. J.-Fr. STOFFEL, *Pierre Duhem interprète de l'« Affaire Galilée »*.
 2. E. VICAIRE, *De la valeur objective des hypothèses physiques*, pp. 498-499.
 3. G. LECHALAS, *Quelques réflexions soumises à M. Vicaire*, pp. 280-282.

a rival tradition, comprising authors from Antiquity and the Middle Ages, provided that astronomy is taken as a model for physical theory. From the beginning of his article, having prepared the readers of *Physique et métaphysique* for this new link established between modern physics and ancient astronomy, Duhem could now, by “plundering” Mansion’s article (which he remained entirely dependent on), challenge the theory of his opponents whereby all great scholars had always researched the metaphysical explanation of things. In light of this theory, he was then able to advance the tradition of all those who, like Thomas Aquinas and Copernicus — thus appropriating Mansion’s theory again —, had thought that astronomy should instead be content to “save phenomena”. Instead of appearing to be the, somewhat direct and conscious, consequence of recent philosophies with a nefarious reputation in the Catholic world (namely Kant and Comte, as their adversaries never failed to point out), his conception was thus part of a very long and very glorious tradition. With each side now possessing its own tradition, the fight would become a fairer one, provided that Duhem strongly reinforced these shaky historical foundations. This would not be accomplished in his masterpiece — it only contains the argument concerning the historical fecundity of the realist attitude by distinguishing, within a theory, the part that is explanatory from that which is representative¹ —, but instead, summarily, in his *Essai sur la notion de théorie physique* and, in a more contextually developed way, in *Le système du monde*.

9. Still more heated reactions

This “truly memorable discussion”² between Duhem and Vicaire did not fail to produce numerous reactions. If Kirwan publicly judged this new presentation of Duhemian thought to be “more easily acceptable”, “although objectionable”, because there was no longer a “proscription comparable to that of his previous articles”³, and if he privately considered that the ideas of Vicaire, whose work he “very much enjoyed”, did not “deviate very far, in substance, from those” that Duhem had just expressed in *Physique et métaphysique*⁴, others did not share this opinion. The famous representative of Parisian Thomism feared, therefore, that metaphysicists could no longer count on the contribution of physicists. As for Lechalas, he believed that Duhem did not grant the same objective scope to physical theories, depending on whether or not these are directly verifiable experimentally. Let us examine these reactions more closely.

1. Cf. P. DUHEM, *La théorie physique* [1906], pp. 46-58.

2. Ch. DE KIRWAN, *Les questions scientifiques*, p. 154.

3. *Ibid.*, p. 166.

4. Letter from Ch. de Kirwan to P. Duhem dated 14/08/1893.

9.1. Domet de Vorges: the increased visibility of his reviews

Although there had hitherto always been, in *La science catholique*, a timely review of the various Duhemian articles, Domet de Vorges offered up a more substantial contribution this time: in a February 1894¹ issue of the *Annales*, he published his thoughts in the form of an article called *Les hypothèses physiques sont-elles des explications métaphysiques ?* Let us examine the main points raised before summarising, beyond this sole publication, all the ideas put forward with respect to the most important one, namely the need for physicists to lead metaphysics to primitive facts.

* * *

After having recognised the fact that Duhem had established “in good strong words” the distinction between physics and metaphysics — which would attract the criticism of Father Bulliot — to such an extent that one “might wonder if he doesn’t have a theologian backing him”² or a “prompter”³, Domet de Vorges agreed with our physicist “that it is almost impossible to deduce a new physical truth from metaphysical truths, that the primary principles of physics are self-evident independently of any metaphysical study, that metaphysics should not reign over physics, that physical theories are not metaphysical explanations, and lastly that physics teaches us the experimental laws of phenomena, while metaphysics, on the contrary, teaches us the essential nature of things”⁴.

However, from a philosophical point of view, he criticised our physicist for not having realised the polysemy of the word “cause”, which requires distinguishing physical cause from metaphysical cause, and for having forgotten to demonstrate how using the hypothesis, to expose hidden phenomena, is impossible or unjustified.

From a historical point of view, once again, he condemned his use of texts bearing reservations about specific hypotheses as casting doubt on the capacity of hypotheses to, generally, arrive at the truth. Outraged by the Duhem’s reliance on the patronage of Doctor Angélique, he above all opposed his interpretation of the text and advised him, that if he wanted to “at all costs [find] the antecedents to his doctrine”, he should turn to “neo-criticists and positivists” instead of seeking, “like a clever man”, “to turn the neo-scholastic movement to his favour”⁵.

1. It was indeed at this time that the November 1893 issue would finally be published (Ch. DE KIRWAN, *Questions scientifiques* [1894/1], p. 155, note 1), which explains why Domet de Vorges’s text was not available for the meeting of the Société de saint Thomas d’Aquin on 29 November 1893.

2. Ed. DOMET DE VORGES, [*Compte rendu de P. Duhem : « Physique et métaphysique » (1893)*], p. 1034.

3. ID., *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 137.

4. ID., [*Compte rendu de P. Duhem : « Physique et métaphysique » (1893)*], pp. 1034-1035.

5. ID., *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 137 et p. 151.

Finally, he reported that many young physicists seemed ready to adopt this new conception of science, one the one hand, through the influence of Kantianism, which had either made them terrified of metaphysics or had led them to accept, despite themselves, the prejudices which were incompatible with their faith, and, on the other hand, through the extreme predominance of mathematics, which accustomed them to favouring formulae and methods over the truth.

* * *

The primary motivation that led Domet de Vorges to oppose Duhemian thought, however, concerns this starting point, which only an objective physics can and must necessarily bring to metaphysics. As regards this thought, let us summarise this neo-Thomist's thinking from his very first contribution to the debate [§ 5.2]. Recognising that “Duhem wished to *cast off*” — it is worth noting his choice of words! — “all that is an explanation of reality onto metaphysics”, the famous Thomist “cannot accept this *gift*”¹ — which it certainly is in view of the history of astronomy! [§ 14.1.2] —, because this “imposes a burden onto metaphysics that it cannot bear”². Indeed, as Duhem himself aptly pointed out, metaphysical knowledge is far too incomplete to be able to discover, beyond appearances, those facts which are inaccessible to direct experience. Consequently, metaphysicists need physics in order to maintain an objective scope so that it can tell them, not what the most elementary phenomena are — as this would mean stepping out of physics and into metaphysics —, but what the most elementary phenomena are that, for now, it has been able to attain. Only physics is in fact able to bring about, and above all to verify, this decomposition of phenomena into increasingly elementary phenomena, which are thus inaccessible to basic observation³. In doing so, a mutual exchange between the two disciplines would be established: “physics demonstrates that certain phenomena, once believed to be primitive, must be reduced to still simpler phenomena. Metaphysics demonstrates that the most elementary phenomena glimpsed by physicists are, often, still far removed from the essence of things”⁴. If physics were to refuse this responsibility, this would leave a “vast space” between the two, that would remain unexplored. However, even this “*no man's land*” would not be able to guarantee peace between the two disciplines, because inevitably “each science, in pursuing its

1. É. PEILLAUBE, [Communication de M. de Vorges sur « La valeur des théories physiques »], p. 402. Emphasis added.

2. Ed. DOMET DE VORGES, [Compte rendu de P. Duhem : « Une nouvelle théorie du monde inorganique » et de Ch. de Kirwan : « Newton et l'action à distance » (1893)], p. 669.

3. Let us note, that the objective assigned to physical theories is less ambitious here than the one previously set by Domet de Vorges, as well as the one that Duhem liked to entertain in order to better demonstrate its impossibility: it is no longer a question of attaining primitive facts, but of trying to bring an order of facts to another one that is simpler, without assuming that the latter will indeed be the last one. G. Lechalas (*M. Duhem et la théorie physique*, p. 133, note 1) would remember this nuance.

4. Ed. DOMET DE VORGES, *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 143.

goal, will invade this supposedly neutral domain and will make certain claims that the other will not be able to accept”¹.

In short, Duhem was accused of overly belittling physics and overly praising metaphysics, by not evenly sharing, between the two, the *burden* of explaining reality, which should not be the goal of any specific science, but *all* science, physics and metaphysics included.

* * *

While his article was still in press, Domet de Vorges had already shared his thoughts during a meeting of the Société de saint Thomas d’Aquin held on 29 November 1893. Vicaire, at this session, had agreed with the speaker, and a discussion had begun on the relationship between physics and metaphysics that was to last several sessions. In the course of this discussion, they witnessed Fr Bulliot criticise Domet de Vorges for having “too easily accepted” the Duhemian delimitation², which suggested “that physics only studies phenomena and that metaphysics alone is concerned with seeking the real nature of things”, since this positivist conception, neglecting the study of causes, would be tantamount to “leaving a vast field lying fallow, one that no human hand would ever stir up again”³. As we can see, when Duhem, eager to shelter physics from unwarranted interference by metaphysicists, wiggled his way out of this easily by entirely deontologising his science, the latter, aware of their dependence on physics, were concerned about preserving a certain objective value in it and were thus obliged to face the difficult question of the position and nature of the limits that should be established between the two disciplines. Moreover, the members of Société de saint Thomas d’Aquin were clearly unable to reach an agreement: while Fr Bulliot only saw a difference of “degree in jurisdiction”⁴, Marist Donatien Derennes (1837-1895) and Joseph Gardair (1846-1911) opted for a sharper separation, such as Duhem’s, except that, for them, this distinction would result from the very nature of things, and not from intellect, as the author of *Physique et métaphysique* had suggested.

9.2. Lechalas: a question left unanswered

After having previously indicated his agreement with Vicaire, even though he had corrected him on one detail [§ 7.2], Lechalas then decided to support Domet de Vorges⁵, or more precisely, his theory that Duhem’s personal tendencies were definitely inclined

1. *Ibid.*, p. 141.

2. Cf. P. DUHEM, *Physique et métaphysique*, p. 58.

3. É. PEILLAUBE, [Réflexions du R. P. Bulliot à propos de l’article d’Éd. Domet de Vorges...], pp. 593-594.

4. *Ibid.*, p. 594.

5. Cf. G. LECHALAS, *M. Duhem est-il positiviste?*

in favour of positivism. Indeed, believing he had found a contradiction between the optics course of our physicist, which was perfectly in line with his concept of not assuming any kind of vibration or wave, and his acoustics course, in which he sought to *explain* sound by means of an elastic medium acting on our auditory organs, Lechalas offered up an explanation: this difference in attitude was due to the fact that sound vibrations, which could be observed directly, were not hypothetical (hence Duhem's acceptance of the traditional theories in this field), unlike light waves which remain inaccessible (hence his condemnation of any attempt to develop a mechanical theory for them). Insofar as this difference was indeed the reason for the observed change in attitude, he concluded that Duhem did indeed deserve the adjective assigned to him by Domet de Vorges: while accepting the traditional ideas on the cause of sound, like a good positivist he rejected those theories that could not be directly verified, namely those relating to light. To no longer deserve this adjective, concluded Lechalas, Duhem would have had to renounce his acoustics course.

Far from attempting to contest or dispel the observed inconsistency, our physicist merely stated that his contradictory scholar¹ had used, in this comparison, a course in optics that he could not have known anything about, since this course had neither been published nor taught publicly. He went on to say that such a misuse was not only contrary to the rules of scientific discussion, but also showed a serious recklessness, as demonstrated by Lechalas' erroneous assertion that he had refused to use the expression "wavelength".

Apologising for his indelicacy, acknowledging that Duhem had indeed used the relevant term, adding that it was not necessary to refer to this optics course to understand Duhem's thoughts on the matter, specifying that he had had no intention of offending his interlocutor by describing his tendencies as positivist, Lechalas clarified his request: either Duhem would make it known that he did not attach a greater value to vibrations in acoustics than in optics, and the debate would be over; or he would not, and he would then be obliged to answer the accusation brought against him by Domet de Vorges.

Duhem would not react to this. As for Lechalas, he would not intervene in the debate until the publication of *La théorie physique*². Noting that Duhem had always avoided taking a stance on acoustics, he then returned, in detail, to the question which had been put forward a decade earlier, this time offering to do what the author of *La théorie physique* thought he did not have to do: apply Duhemian criticism to the explanatory theory of sound in order to verify its truly non-scientific nature.

1. Cf. P. DUHEM, *Letter from P. Duhem*.

2. Cf. G. LECHALAS, *M. Duhem et la théorie physique*.

10. “The English school and physical theories”

Having quarrelled, firstly, with the head of laboratories who had failed to fulfil his obligations and, secondly, with his Rector who had not believed it necessary to punish this misconduct as much as our physicist would have liked, Duhem, whose demeanour had darkened following the death of his wife, was transferred, against his will, to Rennes on 29 July 1893. It was while at this university, which he likened to an intellectual desert, that *L'école anglaise et les théories physiques* was published.

* * *

If, with *Physique et métaphysique*, Duhem had tried to answer the objections of Villeneuve and Domet de Vorges taken up by Vicaire, he was far from having replied to all those specifically formulated by the latter: he had not yet reacted to the impression of abandonment that his doctrine elicited at that crucial point of choosing a hypothesis; he had not taken into account his wish to keep physicists motivated by providing them with the noble objective of unveiling reality, instead of the purely utilitarian one of establishing mnemonic processes; and, above all, he had not exonerated himself from the accusation of inconsistency that his request for a theory which was both phenomenalist in objective and coherent in form had aroused. Mansion's request, addressed to him on 19 May 1893, that he “say a few words in the Revue”¹ about the *Conférences scientifiques et allocutions* by Sir William Thomson (1824-1907) gave him the opportunity to respond to these last two criticisms². Having appeared in the October issue of the same year under the title *L'école anglaise et les théories physiques : à propos d'un livre récent de W. Thomson*, the resulting article is doubly important: it introduced, for the first time, the doctrine of natural classification, in response to the criticisms of demotivation and incoherence, and it inaugurated a new theme which was to run through all of Duhem's works and become increasingly important, namely that of the national differences in conceiving and practising physics³.

10.1. The choice of consistency supported by reasonable belief

If mechanical models, which embody the victory of the imaginative mind over the abstract mind, were as well received by the representatives of the English mind as they

1. Letter from P. Mansion to P. Duhem dated 19/05/1893.

2. In this article, with respect to his combating logical incoherence, Duhem, exceptionally and specifically refers to Vicaire's critique (P. DUHEM, *L'école anglaise et les théories physiques*, p. 365).

3. Taking advantage of the example provided by the proposed work, Duhem indeed analysed the reasons why a French reader, when confronted with a book by an English School physicist, experienced a “strange feeling” that this book “is not quite science [...] as we like it” even though it had been written by a “first-rate scholar” (P. DUHEM, *L'école anglaise et les théories physiques*, p. 345). The explanation put forward was to draw upon the characteristic traits of their respective forms of minds.

were by the French and German mind — Duhem had not yet made a distinction between the two! —, there was, however, a difference between these two national minds: the latter, being predominantly abstract, wanted this mechanism to be simple, unique and bound by logic, whereas the former, being fundamentally imaginative, would have no issue with stringing a multitude of concrete elements together while basking unashamedly in the very eclecticism that mortified the French.

This difference in attitude was due to the way the two sides viewed the goal of physical theory: being realists, the French were naturally concerned with unity and coherence; being phenomenologists, the English, also quite naturally, were not bothered with such concerns.

Through this idea, Duhem merely confirmed the premises upon which Vicaire's objection was based. Vicaire had specifically asked our physicist to choose a side once and for all: he said he should either be a coherent realist (like the French) or an eclectic phenomenologist (like the English), but that he should refrain from muddying the waters by claiming unity and coherence (like a Frenchman) for a theory that he had conceived in a phenomenologist manner (like an Englishman).

Recognising that realism as a way of developing physical theories had already been supplanted by phenomenology, Duhem wondered whether it would be better to withdraw this requirement of unity and coherence which characterised this outdated scientific conception and to move, along with Poincaré, on to eclecticism. Agreeing with Vicaire about the fact that while a realist had the right to condemn such eclecticism, the phenomenologist could not, Duhem, having evolved since what he had written the reasons for preferring one theory over another in *Les théories physiques*, no longer limited himself to the rules of logic alone. He thenceforth appealed to a universally shared and self-evident conviction: the perfection of science. He said that if one were to legitimately, if not logically, prefer a physical theory that was singular and coherent, it would be because such a theory would be better and more perfect. Having foreseen the fact that this conviction would not be equally well-received by the different kinds of mind, he endeavoured to "found" it by granting, contrary to what he had just affirmed in *Physique et métaphysique*, a certain ontological value to the classifications produced by physical theory, thereby bringing physics and metaphysics closer together.

If, even to a phenomenologist, a coherent physical theory would be more perfect than an incoherent set of incompatible theories, this is because it would be closer to the ideal theory which is characteristically a *natural* classification of physical laws, that is to say a classification which arranges them "in an order which [is] the very expression of the metaphysical relationships between the essences from which these laws emanate"¹. A classification of this sort would most certainly be inaccessible to our intelligence. While

1. P. DUHEM, *L'école anglaise et les théories physiques*, p. 368.

we may not be able to establish a physical theory that truly conforms to this classification, however, we could at least, and with certainty, reject all those theories of which the classification is incompatible with this idea, by applying the only characteristic we know of this classification as a criterion, namely that the relations it establishes are neither indeterminate nor contradictory. By thus driving incoherence out of physical theory in this way, we would have a better chance of perfecting it because it would be more natural.

* * *

With this article Duhem, therefore, radically changed his position. Firstly, concerning the objective of physical theory: it was no longer a question of primarily pursuing a purely mnemonic goal, but of seeking total coherence within physical theories. Unjustifiable from a strictly logical point of view, this enhanced objective was geared towards getting increasingly closer to natural classification. Then, concerning the approach to be adopted when dealing with this realistic tendency inherent to humankind: whereas in his first article it was a case of resisting it, he now saw fit to accept it, at least *indirectly*. Indeed, it would not be by adopting a realist stance that the physicist was going to make a meaningful contribution towards this asymptotic reconciliation of physical theory and ontological order, but by seeking *coherence* within a *phenomenalist* stance, because, quite paradoxically, it is in this manner that the classification could be rendered as natural as possible. A phenomenalist stance, because the best way to ensure the effectiveness of scientific research would be to ensure its autonomy with respect to disruptive extrinsic considerations. Seeking coherence, because if our knowledge of natural classification were only negative, it would nevertheless be sufficient to guarantee that this classification would not be incoherent. As we shall soon see in *L'évolution des théories physiques*, another “factor”, that in itself was entirely independent of the physicist’s influence, would facilitate, and even guarantee, this onward march, as invigorating as it was comforting, towards natural classification. We thus emphasise that: Duhem responded to both of Vicaire’s criticisms, namely the incoherence of his stance and the demotivating character of his conception of physical theory, not by modifying the essential traits of his epistemology — he would continue to favour both phenomenism *and* coherence at the same time — but by adding extralogical considerations to this epistemology that would allow him to replace, *hic et nunc*, the *current coherent phenomenism* with an *aspiring asymptotic realism*.

Bearing in mind our interpretation that it was Duhem who was led to approach Vicaire, and not the other way around [§ 7.5], one should note the significance of this development: a theory was no longer “more or less good” or “more or less bad” according to the greater or lesser number of experimental laws it was capable of coordinating and summarising; it was no longer only replaced by a broader or more precise theory; a classification was no longer “more or less convenient”; thenceforth, a theory was to be considered as more or less perfect — and as such, could replace another which was less

so —; a classification, provided that it was as natural as possible, would be more or less true!

10.2. Inattentive reactions to the publication of natural classification

Of the two novelties introduced by this article, the theme of national differences in the way of conceiving and practising science was the only one to attract any attention, whether in the literature or in private¹. More accessible than the concept of natural classification, it was also more likely to be applicable in fields other than physics. In the journal *Études des Pères de la Compagnie de Jésus*, Fr Joseph de Joannis (1864-1932)² and Fr Lucien Roure (1857-1954)³ referred to it, as did, at around the same time, the Spanish pharmacist and biochemist José Rodríguez Carracido (1856-1928)⁴ while dealing with the subject of nationality in the scientific arena. As for the appearance of the concept of natural classification as a Duhemian regulatory ideal, no one seemed to mention it: not even Kirwan⁵, who was rather accustomed to Duhemian thought. This was to be, even among modern commentators, a frequently recurring omission.

11. “Some reflections on the subject of experimental physics”

Having been published in the July 1894 issue, *Quelques réflexions au sujet de la physique expérimentale*⁶ is probably the best-known article in this collection. It was in this article that Duhem argued that it would be impossible to refute an isolated hypothesis and criticised the crucial experiment, thus adopting a stance which was incompatible with the inductivism expressed in his early writings⁷. This explains why it is the most frequently translated text among the seven articles gathered herein. Its renown naturally comes from its integration into *La théorie physique*. However, as his conclusion was not covered therein, hardly anyone remembers that his teachings were primarily intended for metaphysicists. This fact is worth noting, as it confirms just how prevalent the theme of the relations between physics and metaphysics was during this initial period.

1. Émile Boutroux (1845-1921), for example, confirmed that “the results that [Duhem arrived at] coincide perfectly with those furnished by the comparison of the philosophical work of the three nations” (undated letter from É. Boutroux to P. Duhem).

2. J. DE JOANNIS, *Compte rendu de W. Thomson : « Conférences scientifiques et allocutions »* (1893) et de P. Duhem : « L'école anglaise et les théories physiques » (1893), p. 506, note 1.

3. Cf. L. ROURE, *Herbert Spencer et l'évolutionnisme mécaniste*, pp. 457-458.

4. Cf. J. R. Carracido, *Estudios histórico críticos de la ciencia española*, pp. 8-13.

5. Cf. Ch. DE KIRWAN, *Questions scientifiques* [1894/1].

6. Hereinafter, *La physique expérimentale*.

7. The process that led Duhem to criticise the inductive method and to formulate the holistic theory was studied, in particular, by A. BRENNER, *Duhem*, pp. 29-53.

This article can be considered as constituting — yet again! — a response to Vicaire's criticisms and remarks. Firstly, let us look at his first objection. If, within the Duhemian conception, clear instructions were indeed not given in order to facilitate the choice of hypotheses, this was because the experimental method, provided that it had been correctly understood, was quite simply incapable of providing any: firstly, because experimental physics that is free and independent of any theory is a chimera, and also because experimental control is rejected at the end of the theory's development. Now let us look at his remark about Wiener's experiment. Although Poincaré had rejected its status as a crucial experiment, Vicaire maintained that it had nevertheless allowed us to take one step further towards the solution of the debated question, which, although not decisive, would certainly not be the last one¹. This remark gave Duhem the opportunity to develop his own interpretation of this famous experiment.

Finally, it is worth recalling the context and the originality of the Duhemian critique of experimental physics and, more specifically, of the *experimentum crucis* dealt with in this article.

The unparalleled power of the experiment was, for positivist historiography, the driving force behind scientific progress since it provided a clear-cut and certain distinction between truth and error. This assessment was also shared in Thomist circles, where a solid scientific basis upon which to build metaphysics was a major concern. Duhem, opposed to this simplistic view which placed the experiment in a position of judge and jury whose decisions could never be contested, had already chipped away at the omnipotence of the experiment in his *Introduction à la mécanique chimique*² published the previous year. Therein he had, from a historical point of view, noted the general inability of the experiment *alone* to reject an erroneous theory, if physicists were not in possession of any other more satisfactory theories that could replace it. It would be necessary, not only to reintroduce theoretical physics into the dialogue alongside experimental physics when making decisions following on from an experimental failure, but also to recognise the highly contextual, and thus relative, character of the decisions made³. Continuing in this direction, it is from an epistemological point of view that Duhem, with originality, then proceeded to relativise the power of the experiment.

Specifically concerning his criticism of the *experimentum crucis*, it is worth noting that the renowned experiment of Otto Wiener (1862-1927), carried out in 1890 and widely discussed, was interpreted by some as a typical example of the capacity of these crucial experiments to separate two contradictory hypotheses. According to them, it had had the effect of condemning that of James MacCullagh (1809-1847) and of Franz Ernst

1. Cf. E. VICAIRE, *De la valeur objective des hypothèses physiques*, p. 471.

2. Cf. P. DUHEM, *Introduction à la mécanique chimique*, pp. 176-177. This is taken verbatim in ID., *Les théories de la chaleur (2^e partie)*, pp. 392-393.

3. Cf. R. MAIOCCI, *Chimica e filosofia [...]*, pp. 249-250.

Neumann (1798-1895), and of validating that of Augustin-Jean Fresnel (1788-1827). This was not, however, the opinion of Poincaré who, not wishing to defend a false hypothesis, challenged the crucial nature of the experiment. In another illustrative article, *Les théories de l'optique*, published shortly before this, Duhem had not only aligned himself with Poincaré, but had also taken this one step further than the latter would ever do: the generalisation, with respect to all physics experiments, of this illustrious analyst's judgement on the one and only Wiener experiment¹. Duhem had indeed highlighted the fact that this impossibility of a crucial experiment in physics was not merely "a peculiarity of the experiment carried out by M. O. Wiener", but "a general trait of the experimental method"². It was this principle, already mentioned "incidentally"³ in *Les théories de l'optique*, that was at the crux of this article.

11.1. Famous contents, forgotten conclusion

In the first part, dedicated to examining the constitution of the physics experiment, Duhem firstly endeavoured to show that the methodological principle, according to which the scientist is obliged, during the trial experiment intended to test the hypothesis, to let the facts speak for themselves while leaving aside any theoretical implications, is quite simply impossible to apply in the case of a science as advanced as physics, wherein mathematical and physical theories had become so predominant. Additionally, a physics experiment did not only involve the passive observation of certain phenomena, but also required the interpretation of observed facts via the full range of physical theories accepted as accurate by the observer. Consequently, the scope of a physics experiment was not as obvious as the *reductio ad absurdum* of mathematicians. Indeed, the failure to produce the expected phenomenon signalled the presence of at least one error. However, this error did not necessarily concern the hypothesis that the experimenter was aiming at: one only knew that at least one of the constituent hypotheses of the whole theoretical framework, that the experimenter had constructed in order to carry out the experiment, was defective. Therefore, while the experiment succeeded in pointing out an error, it failed to specify where the error lies. This impossibility of subjecting an isolated hypothesis to experimental control attested to the fact that physics did not resemble a machine in which each piece could be tested in isolation, but rather an organism to be considered as a whole (hence, the so-called holistic theory).

The crucial experiment, which transformed the reduction to an absurdity into a demonstration method, was not possible either, even assuming that all the accompanying experimental framework was correct: one would have had to be sure of having dis-

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1. Cf. A. BRENNER, *Duhem*, pp. 39-43.
 2. P. DUHEM, *Les théories de l'optique*, p. 112.
 3. *Ibid.*, p. 113.

proved *all* of the hypotheses imaginable, except one, which would thus be transformed into an indisputable truth, and this was impossible.

On the strength of these principles, teachers should be sure to make students aware that these experimental checks could not be carried out at the start of the theory, but only once the theory had been entirely completed¹.

* * *

After having thus explained that all physics experiments contained not only an observation phase, but also an interpretation phase, Duhem endeavoured to explain that which constituted this second phase. It “substitutes the concrete data actually collected through observation with abstract and symbolic representations that correspond to them by virtue of the physical theories accepted by the observer”². Several consequences resulted from this substitution. For example: since the result of an experiment was not a fact — not even when translated into a technical language —, but an abstract symbol, this result was only approximated; also, since the results of an experiment were intrinsically linked to the theories accepted by the physicist, if these theories were not your own, either by not belonging to the same school or because you were separated by centuries, it would be impossible for you to make sense of the results unless you managed to establish a correspondence between those theories and yours; and lastly, because the theoretical interpretation is a prerequisite, a physics experiment would be less certain than a fact observed by common-sense procedures³, yet more precise.

* * *

In the second part, dedicated to examining that which constitutes physical law, Duhem naturally rediscovered, between the laws of common sense and the laws of physics, the differences that he had already noted between the non-scientific observation of a fact and the result of a physics experiment. Abstract, like the laws of common sense, and yet contrarily, also symbolic, physical laws were neither true nor false, but approximated; they were also always provisional, because their degree of approximation, judged to be satisfactory at a precise moment in time, would not necessarily be satisfactory at another point in time, so that they would have to be adjusted; they would also be less certain, but more precise than the laws of common sense; and, lastly — contrary to that

1. It should be noted that this criticism of the inductive method further increased the problem of the choice of hypotheses, as pointed out by Vicaire: whereas, thanks to this method, physicists could position themselves according to the experimental results, they were thenceforth obliged to wait until the end of the constitution of the theory to be able to ensure the fecundity of the hypotheses chosen initially.

2. P. DUHEM, *Quelques réflexions au sujet de la physique expérimentale*, p. 182.

3. Regarding this important concept, which is used extensively in this article, cf. F. R. LEITE, *Pierre Duhem considéré comme un philosophe du sens commun*.

which was still asserted in *Physique et métaphysique*¹ —, their meaning varied according to the theory adopted.

* * *

Wishing to retain only one conclusion from the many he could have drawn from his article, Duhem decided to conclude by addressing those metaphysicists who tended to mostly use “the laws of physics for either building or ruining philosophical systems”². He urged them to be extremely cautious: they ought to bear in mind that a law of physics, far from being an absolute truth and eternally true, was necessarily provisional, because it was approximated and symbolic. He also invited them, once again, to be more competent: although it was the laws of physics that interested them, they should acquire a deeper knowledge of these theories, since they would not be able to correctly comprehend the laws without them.

11.2. Several reactions, including a new accusation from Domet de Vorges

In agreement with the Duhemian idea that an experimental contradiction did not prove the falsity of the hypothesis from which the incriminated prediction was logically deduced, but instead pointed out “simply the necessity to modify at least one of the elements” among the many involved in its outcome, Gaston Milhaud (1858-1918) referred to the “ever so comprehensive and interesting article³” of our physicist.

As for Duhem’s co-religionists — and perhaps even Duhem himself —, they obviously lacked the hindsight to perceive the full apologetic scope of the assertions contained in these last two articles, namely that physics did not enjoy, compared to theology, the demonstrative superiority that the positivists had granted it. For the time being, Kirwan, having reviewed this article, again commended Duhem for having abandoned those components of his system that were “exclusive and too absolute”⁴. As for Domet de Vorges, who had adopted Couette’s reservation regarding the symbolic nature of the notion of mass [§ 7.3], one can imagine his exasperation at seeing Duhem now going after experimental physics as well: in maintaining that it was purely empirical, did he not strip it of its certitude (absence of any disruptive theoretical elements), its power (ability to refute an isolated hypothesis), and its reliability (superiority over an ordinary experiment) that was conferred upon it by this particular status? He also threw down a new accusation. Once the Duhemian confusion between an abstract idea and a symbol has been

1. Physical laws “retain exactly the same meaning” (P. DUHEM, *Physique et métaphysique*, p. 65) compared to “depending on whether one adopts one theory or another, the law changes meaning” (ID., *La physique expérimentale*, p. 215).

2. P. DUHEM, *Quelques réflexions au sujet de la physique expérimentale*, p. 228.

3. G. MILHAUD, *La science rationnelle*, p. 296 et note 1.

4. Ch. DE KIRWAN, *Questions scientifiques* [1894/1], p. 355.

removed, he wrote, referring to Duhem's article, only "a few well-known observations" remain. Also, "there is no reason to vitiate all experiments by definitively placing them below the most ordinary experiment. To accept as certain only the observation of the *hic et nunc* discernible fact, is a prime example of the materialist theory: does Mr Duhem not realise this?"¹. At least this new accusation would not meet with much success!

12. The Brussels congress of Catholic scholars

From 3 to 8 September 1894, the third International Congress of Catholic Scholars was held, for the first time outside of France, in Brussels. As the organisation of this Congress had been entrusted to the Société scientifique de Bruxelles, Mansion had obviously invited Duhem to take part in it. Having responded favourably to his correspondent, as it would finally allow him to get to know him personally², Duhem would attend in order to again demonstrate, presumably, his regard for the work of his co-religionists. He would even present a rather technical paper on James Clerk Maxwell (1831-1879)³. What is noteworthy here, however, are the two most pertinent contributions that he was to make, which were to attract much attention to say the least. In the course of this journey of ours, which is strictly reserved for seven of his publications, four reasons led us to take these two into account: they allow us to clarify the content of his previous publications; they reveal the influence of the Stagirite who's thinking, at that time, was particularly influential; they were to have such a great impact — even in the weekly press⁴ — that the Catholic world would no longer be able to ignore his name; and lastly, they help us to understand the bitterness that our physicist would feel towards the greater part of the Catholic world throughout his life. During this congress, Father Ambroise Gardeil (1859-1931), having had the good fortune to sit next to Duhem although he had not yet made his acquaintance, and to publish a faithful account of these contributions thereafter⁵, was to make for an easy understanding of their contents. Let us first take a look at the context.

1. Ed. DOMET DE VORGES, [*Commentaire au compte rendu consacré par M. Couette à P. Duhem...*], p. 404.

2. Letters from P. Mansion to P. Duhem dated 10/09/1893 and 10/12/1893.

3. Cf. P. DUHEM, *Quelques remarques au sujet de l'électrodynamique des corps diélectriques proposée par J. Clerk Maxwell*.

4. The narration of these incidents was widely reported in varying amounts of detail, not only in the vast array of journals available at the time, but also in newspapers such as *L'Univers*, *Le Temps*, and *La Croix*.

5. A. GARDEIL, *La philosophie au Congrès de Bruxelles (1)*.

12.1. Two memorable contributions

It is 4 September and we are in the philosophy section chaired by Désiré Mercier (1851-1926), who is being assisted by Domet de Vorges. After Abbey Albert Farges (1848-1926), a “dogmatic philosopher”¹ convinced that Aquinas’s thinking alone was sufficient to meet all the needs of the century, had irked Duhem with his flood of eloquence, Bulliot, who was a professor in philosophy at l’Institut catholique de Paris, made a better impression on him with the clarity of his presentation and the simplicity of his eloquence. At least such was the opinion of our physicist until such point when the speaker went on to assert that the proof of the existence of God as the prime mover might have been confirmed through recent progress in thermodynamics. No longer able to hold it in since the dear abbey had dared to utter the name of Rudolf Clausius (1822-1888), Duhem got up to speak for the first time, in a somewhat animated fashion, in the midst of this cénacle of metaphysicists who were rather accustomed to debating among themselves.

We are now on the third day of the congress. Before the same section, this time chaired by Domet de Vorges, Father Bulliot presented a second paper in which he ventured to establish a relationship between the concept of mass, as defined by modern mechanists, and the concept of raw materials, as determined by the Ancients, through metaphysical analysis. According to him, this relationship was able to confirm scholastic doctrines. As this identity conferred a certain metaphysical scope to a notion which, from a Duhemian point of view, was only a symbolic representation, the entire audience awaited the reaction of our physicist with bated breath. Refusing to tackle the fundamental question, in this case the scientific definition of the notion of mass, he instead took the opportunity to reiterate, using other words, what he had already said the two days earlier.

* * *

With this background in mind, let us summarise Duhem’s thinking as expressed through his two contributions, his conversations with Fr Gardeil, and the letter he wrote to his mother telling her about the “great blow”² he had decided to deliver.

For Duhem it was not a question, as some had believed, of contesting either the existence of metaphysics or its right to seek the knowledge of causes and essences through its own methodology. Nor was it a question of burdening metaphysics alone with the responsibility for this detrimental confusion between itself and physics, which he was constantly pointing out, because it was actually Descartes that was at fault: it was his

1. *Ibid.*, p. 574.

2. Letter from P. Duhem to his mother dated 09/09/1894, published in H. PIERRE- DUHEM, *Un savant français*, pp. 157-158.

mind, much more imaginative than it was metaphysical¹, which had unfortunately led to “imagining essences, as one would a triangle or a pyramid”².

It was, however, a case of once again urging Catholic philosophers to focus on mastering the sciences before risking discussing them. He even went as far as asking them to remain silent until this mastery had been achieved, especially in light of the fact that it could not be obtained in the various popular works³, which tended to present hypotheses as unquestionable truths. Additionally, in order to acquire it, one needed to have practised science itself for ten to fifteen years⁴. In the absence of such a mastery, not only would the free thinkers continue to make fun of Catholic philosophers, but the latter, not having fully understood the true scope of the scientific approach⁵, would run the risk of building metaphysics on unstable foundations instead of upon rigorous experimentation. This risk was all the more serious considering the fact that the religious and moral interests, resulting from this ill-founded metaphysics, were at stake.

Other than this requirement of competence, he was inviting them yet again to exercise extreme caution: history has taught us the fundamental instability of physical theories, while scientific logic has taught us — here we are referring to the “holistic theory” that Duhem had just formulated — that “at any moment the most unassuming experiment could overturn them, because they are *all* involved in the most mundane of experiments”⁶. Lastly, he wanted them to understand that “there is no greater amount of physical truth at the end of Thermodynamics than there is in the sensations that serve as its starting point”⁷. As a consequence, they should be persuaded not to use the theories as a starting point for their metaphysical constructions, since they needed to get back to the state of mind of infants seeking the cause of the sensations they had just experienced, but rather to use the experimental phenomena. These are what constitute the joint starting point for science and metaphysics.

1. This observation had already been put forward in *L'École anglaise et les théories physiques* (pp. 351-352). Ollé-Laprune qualified it as “excellent and by no means ordinary” (letter from L. Ollé-Laprune to P. Duhem dated 08/04/1894).

2. Remark reported by A. GARDEIL, *La philosophie au Congrès de Bruxelles (1)*, p. 583.

3. Here Duhem was most likely aiming at philosophers such as Farges.

4. To get an idea of the provocative tone used on this occasion, it is worth noting the following quip that Duhem had fired at his audience: “If you wish to practise the philosophy of science, then be a Helmholtz or a Poincaré!” (as reported by A. GARDEIL, *La philosophie au Congrès de Bruxelles (2)*, p. 754).

5. This time, our physicist was probably referring Fr Bulliot, whose error, according to Gardeil’s keen remark, was not “of being ignorant of physical theories, but of knowing them so well that he lent them a philosophical value” (A. GARDEIL, *La philosophie au Congrès de Bruxelles (1)*, p. 580). The same argument had already been used, in reference to the same congress, in *Le Monde*: the error of neo-scholastic philosophy is not being ignorant of science, but of involving it in their discussions too much (UN [AUTRE] CONGRESSISTE, *Congrès scientifique de Bruxelles*, p. 1).

6. Remark reported by A. GARDEIL, *La philosophie au Congrès de Bruxelles (1)*, p. 584. Emphasis added.

7. *Ibid.*, p. 583.

From an Aristotelian perspective, explicitly recognised as such in a letter to Gardeil¹, Duhem thus puts these “obvious and immediate data of non-scientific observation” at the root of metaphysical systems, as they are accessible to all involved before becoming the starting point of the physicist’s or metaphysicist’s work.

12.2. Mixed reactions

Although Duhem could no longer be suspected of being an enemy of metaphysics, his concern to see it spared from unstable foundations was, as one can imagine, fairly controversial. Abbey Farges, for example, had left the room shouting vehemently: “These are not scholars, they are obstructionists!”². Since we cannot evoke the innumerable reactions to these Duhemian contributions, let us limit ourselves to those coming from the concerned debaters, before mentioning the attack by a congress participant who was to remain anonymous.

Absent from the congress, but having been informed of the proceedings by Father Auguste Poulain, professor at the Facultés catholiques d’Angers, Kirwan, whose attitude towards Duhem had seemed to have evolved over the two preceding years, wrote to him saying that if he had managed to provoke some angry reactions, then that proved he was right³! While reviewing the Congress, still in the *Annales*, Domet de Vorges reported and commented on a number of general objections addressed to Duhem⁴. Firstly, while it might have been necessary for philosophers to acquire a much deeper knowledge of the sciences, a conviction which is incidentally at the origin of the Institut supérieur de philosophie de Louvain, expecting them to do ten to fifteen years in physics was unrealistic. Secondly — and here he reported the observation of Father Bulliot —, since philosophers were only interested in understanding fundamental ideas, it was not necessary for them to comprehend scientific research “in such great detail”. It is only natural, that in connection with a statement of this sort, one should note the very recent conclusion of *La physique expérimentale* [§ 11.1]: therein, Duhem had pointed out that understanding that which philosophers were interested in, namely the laws and their relevant notions, could not be arrived at if one did not comprehend that which should not concern them, in other words, the theories. Lastly, unless one “postpones the *agreement* between the sciences and philosophy indefinitely for centuries to come”⁵, waiting until such time

1. Letter from P. Duhem to A. Gardeil dated 29/11/1894 and cited in J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 339-340.

2. Remark reported by A. GARDEIL, *La philosophie au Congrès de Bruxelles (2)*, p. 755.

3. Letter from Ch. de Kirwan to P. Duhem s. d.

4. Ed. DOMET DE VORGES, *Compte rendu du III^e congrès scientifique international des catholiques [...]*, pp. 179-180.

5. *Ibid.*, p. 180. Emphasis added.

as each science had reached absolute clarity and unquestionable certainty¹ would be impossible. As for Gardeil, considering such a, sometimes heated, exchange of views between physicists and metaphysicists to be rather productive, he published a second article in favour of Duhem, in the *Revue thomiste*. Seeking to reassure those minds in a state of turmoil following Duhem's contributions, he reminded everyone that, being independent of any physical theory, the proof of the existence of the prime mover formulated by the Stagirite remained undisputed².

12.3. The congress participant's attack

A fortnight after the congress had come to an end, *Le monde* — described by Lacome as a “religious and soporific newspaper”³ — had published an article opposing Duhem, under the pseudonym “A congress participant”, which had provoked the equally anonymous counter-response of another “congress participant”. Some time later, the *Annales* published a more extensive article concerning “A congress participant” that was also opposed to Duhem, but one could not be sure whether they referred to the same person⁴.

Duhem's rivals were most concerned with having to postpone their study of the great metaphysical questions until the distant future when science “would have entirely clarified the empirical notions of mass, matter, force and movement”⁵. They felt that such an “outrageous” request was merely a way of reviving, by mitigating it, one of the arguments of the sceptics: since “one will never know everything about nothing [...], one should never [...] seek the relationships that things and concepts share with one another”⁶. The “other congress participant”, who had defended Duhem, retorted that if some scientific questions were indeed too obscure to be taken into account by metaphysicists for the moment, there was no reason to suppose that they always would be. When asked which criteria could be used to distinguish knowledge that could be integrated from that which could not (yet) be, her answer, which was “a lengthy study”⁷, surely did not go far in terms of reassuring her interlocutor.

1. Here again, it is worth noting how the concerns of the neo-Thomists differed from those of Duhem: whereas the former are focused on with truth or falsehood, or at least on the degree of certainty (certainly not absolute, but at least reasonable) that science can offer them, Duhem, aware that the truth of a physical theory is a transitory characteristic, would rather try to focus on gauging their fecundity.

2. A. GARDEIL, *La philosophie au Congrès de Bruxelles (1)*, p. 582.

3. Letter from B. Lacome to P. Duhem dated 29/10/1894.

4. Since the “congress participant” of the *Annales* had used the term “obstructionist” (UN CONGRESSISTE, *Le congrès de Bruxelles et l'argument du premier moteur*, p. 59, note 1), one can assume that this person was none other than Farges himself.

5. UN CONGRESSISTE, *Un écho du Congrès scientifique de Bruxelles*, p. 1.

6. *Ibid.*, pp. 1-2.

7. UN [AUTRE] CONGRESSISTE, *Congrès scientifique de Bruxelles*, p. 1.

Concerning the article published by “a congress participant” in the *Annales*, it offered to compare the “official report of the Brussels congress”¹ to the one that Gardeil had given in the *Revue thomiste*. While this article was not a direct attack on Duhem — except for having noted that it had been “impossible to get the obstructionist gentlemen to formulate a single objection, a single argument for or against”² the memoir of Fr Bulliot — it criticised Gardeil, above all, for having given “some involuntary encouragement” to his theory of “the objective uncertainty of the sciences”³ which, by proclaiming that the sciences were all but useless for philosophers, could be seen as “an incentive to encourage ignorant idleness”⁴!

As we can see once again, that which could be considered as particularly problematic with respect to the Duhemian asymmetry between physics and metaphysics was, contrary to what one might have thought, less the declaration of independence of physics than what was at stake within the relationship of dependence of metaphysics on physics: even if metaphysics were willing to accept that there was indeed a certain dependence, physics did not seem too interested in accepting this relationship and thereby providing metaphysics with that which it sorely needed.

13. “The evolution of physical theories from the 17th century up to the present day”

After he had been transferred to Bordeaux on 13 October 1894, where he would be stationed until the end of his days, even though he had been led to believe that this destination was a mere stopover on his way to Paris⁵, Duhem published, in October 1896, the last article in the present collection, namely *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours*⁶. Having distanced himself from his scientific project, he focussed on attempting to replace, in the course of history, mechanics by thermodynamics as the “queen of sciences”. Two new, rather unexpected, themes appeared in this article: the restoration of certain qualities which he had already established 2 years prior in the third part of his *Commentaire aux principes de la thermodynamique*⁷, and a recourse to the actions of a Divine Providence which, unbeknownst to scientists, steered the history

1. UN CONGRESSISTE, *Le congrès de Bruxelles et l'argument du premier moteur*, p. 70.

2. *Ibid.*, p. 59, note 1.

3. *Ibid.*, p. 68.

4. *Ibid.*, p. 69.

5. St. L. JAKI, *Uneasy Genius*, p. 112.

6. Hereinafter, *L'évolution des théories physiques*.

7. Therein, Duhem redefined, in an Aristotelian way, the word “movement” and constituted a science which embraced “by its common principles, all changes of state of bodies, both changes in place and changes in physical qualities” (P. DUHEM, *Commentaire aux principes de la thermodynamique* (3^e partie), p. 222 and p. 285). Cf. St. BORDONI, *When Historiography Met Epistemology*, pp. 225-226.

of physical theories. The first of these themes would allow Mansion to demonstrate the alignment of the Société scientifique de Bruxelles with the desires expressed earlier by Léon XIII (1810-1903) [§ 15.2]. The second one substituted the history of physical theories for the physical theories themselves as a means of attaining the recognition of the existence of a benevolent and powerful Being. Both of these theories are likely to have been highly appreciated in Catholic circles. Before verifying whether this was indeed the case, let us first peruse the contents of this final article.

13.1. Thermodynamic qualities by virtue of Providence

Aristotle's ever "so simple, so wide, so solid"¹ distinction between quantities, which satisfy arithmetic, and qualities, which enable physics, gave rise, at the end of Scholasticism, to a mediocre conclusion, whereby "minds somewhat concerned with rigour and rather fond of clarity [...] had come to confuse the great work of the Stagirite and the masters of The School, such as Thomas Aquinas, with the ridiculous and futile prattle of their recent heirs"². Additionally, a period of opposition to qualities had begun. To a much greater extent than Francis Bacon (1561-1626), who had had little influence on experimental science, it was Galileo (1564-1642) who introduced the new physics without having managed to entirely rid it of its qualities. This was to be the primary objective and the trademark of Descartes (1596-1650) who, after having made mathematics the science of quantity alone, expelled the qualities of physics by bringing it back to mathematics. Although this reduction in the extent and movement of the material world was, in principle, hailed for the clarity and order it brought to physics, its applications were soon brought into question. Having taken this one step further, Leibniz (1646-1716) challenged this reduction by introducing, into material substance, the notion of force which, since it could not be assimilated into the geometric figure, could only fall into the category of a quality. This did not mean foregoing a mechanical explanation of natural phenomena, but merely accepting the presence, within this mechanics, of an element that could not be entirely reduced to the category of a quantity. This metaphysical conception, which led him to believe that it was "important to restore the reputation of the philosophy of Saint Thomas"³, was ignored by physicists, who only believed in the experimental method. However, Newton (1642-1727) had also introduced the notion of force into his physics, making sure to leave it to the metaphysicists to explain the nature of these forces that were exerted at a distance. Those minds fond of Cartesian clarity would wonder if this was not a return to the hidden qualities, but the fecundity of Newtonian physics ensured its triumph, at least until the beginning of the 19th century. While this physics was still at its peak, certain branches of physics returned to a more Cartesian path, although they did take the fundamental principles of the law of attraction into ac-

1. P. DUHEM, *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours*, p. 468.

2. *Ibid.*, p. 468.

3. Quoted in *Ibid.*, p. 480.

count. This attempt to reject any quality, any remote action, any dynamism in favour of the purest mechanism lay sterile until the “logically cautious mind of Helmholtz” from whom “W. Thomson’s daring imagination gave rise to [...] a new physics”¹. By their form of mind, British physicists were the “natural disciples of this new Cartesianism”², which, like primitive Cartesianism, was seduced by the clarity of its principles while being simultaneously repelled by the complexity of its mechanical models. More successful than the Cartesian mechanism, Newtonian momentum failed, however, to account for the second law of thermodynamics. As Poincaré specifically pointed out, the two doctrines that had clashed for so long were thus both incompatible with this branch of physics. Where one, by rejecting any form of quality, proved sterile, the other, in striving to reduce everything qualitative to force alone, proved too inflexible. One would have to accept that matter could possess various qualities instead of trying to combine them all into one quality. This did not mean attributing a new quality to each new phenomenon; nor did it mean that these qualities could never be reduced into another; nor that one had to renounce mathematics; and it certainly did not mean nurturing the Cartesian claim of being able to explain experimental laws by means of these qualities or even defining what these qualities were. It did, however, mean acknowledging that metaphysics was no longer capable of being “the supreme guardian of the general principles of physics”, since the notions of matter, movement and force were not sufficient to account for physical phenomena. In place of mechanics, one should thus position a more inclusive science which, far from being restricted to local movement alone, would encompass all kinds of movement, as per the Aristotelian meaning of this term. This science would be the thermodynamics that Rankine (1820-1872) called energetics.

At the end of this historical journey, Duhem thought it apt to conclude:

“Impatient to escape from the field wherein the physics of the School was keeping it captive, the human mind engaged thousands of scholars over three centuries in order to carve a passage towards the true science of the material world. This journey has changed course many a time and, to our astonishment, today we find that it is closing in on itself and leading us back to the beginning. And yet, the fruits of their immense labour have not been lost, not a single one; not that this work has always gone according to its author’s plan; the role it plays in science today often deviates from what was intended; it occupies that post which had always been reserved for it ahead of time by the One directing all this turmoil”³.

Instead of a rotational movement, which would indeed bring us back to the starting point — and which would be at odds with his optimistic and providential philosophy of history —, it would have been more accurate to evoke a spiral movement, since this unexpected return to a physics of qualities does not preclude the preservation of the

1. *Ibid.*, p. 491.

2. *Ibid.*, p. 492.

3. *Ibid.*, p. 499.

principal achievement acquired beforehand, namely the desire for mathematical intelligibility. As Duhem said, from his Aristotelian physics, this thermodynamics is thus also the physics of Descartes.

As Bordoni¹ pointed out, it seems that our physicist had allowed himself to get a little carried away in this conclusion: having forgotten the cyclic process of physical theories, which he himself had unearthed, he mistook that which is only ever a provisional stage for the final one. The subconscious adoption, for a fleeting moment, of this dogmatic attitude that he had so often criticised in others and even theorised himself, should have given him the necessary reassurance he needed to continue his work. Even the most sophisticated thinkers are allowed a lapse in judgement!

13.2. Several reactions, including Domet de Vorges's reservations

With this last article, did the strained relationship between Duhem and some of his co-religionists, that had got off to a very bad start four years earlier, relax somewhat as one might have thought? While Kirwan had dedicated a long review to this article² without making the slightest comment, Domet de Vorges had his reservations to say the least. Reluctant to forego mechanics quite so easily, and to prohibit all reduction to movement (in the usual sense of the term) without exception, he above all feared, “under the pretext of re-instating Aristotelian physics”, repudiating “the idea [that the latter] was formed from science”³, by being obliged to accept Duhemian phenomenalism. However — at the risk of stepping out of the chronological parameters that we set for ourselves — at the fourth International Scientific Congress of Catholics held in Fribourg in 1897, the Jesuit, André de La Barre (1855-1933), managed to echo Duhem's ideas with provoking any violent reactions⁴, such as had been the case at the previous congress.

14. Conclusion

Let us conclude in two stages. In keeping with our plan to focus on the immediate circumstances of the relevant Duhemian publications and their reception, we will first assess the greeting they received. Then, in order to better comprehend the main themes we encountered in the course of our journey, we will provide a general overview of their subsequent development.

1. Cf. St. BORDONI, *When Historiography Met Epistemology*, pp. 271-272.
2. Cf. Ch. DE KIRWAN, *Questions scientifiques* [1897].
3. Ed. DOMET DE VORGES, [*Compte rendu de P. Duhem : « L'évolution des théories physiques... »*], pp. 87-88.
4. Cf. A. DE LA BARRE, *Points de départ scientifiques et connexions logiques* [...].

14.1. The reception of Duhemian thought

14.1.1. An intra-Catholic debate

Aside from, on the one hand the *Bulletin des sciences mathématiques* which endeavoured, in its second part, to conduct a “review of academic and periodical publications” dedicated to mathematics — which would lead it to briefly review, although only in 1899, the first six Duhemian articles, as well as that of Vicaire¹ — and aside from, on the other hand, *The Journal of Physical Chemistry* which published, in its very first volume having appeared in 1897, a review of Duhem’s last article written by Joseph E. Trevor², the nine authors³ who directly participated in the debates we mentioned were all Catholic, as were those who participated indirectly⁴, and their texts had all been published in the Catholic press⁵. This fact, which Duhem tried to use to his advantage⁶, seems to show that the preselected choice of place of publication might have anticipatively oriented, and perhaps even restricted, the reception of his seven articles in the Catholic world.

Let us roughly divide his interlocutors into three camps: those who were for Duhem, those who were against, and those who were in between. In the first, we naturally find Lacombe and Gardeil⁷ and, indirectly, Mansion and Blondel, who were at two opposite extremes in relation to Duhem. In the second, we place⁸ Domet de Vorges, Lechalas,

1. Cf. [*Compte rendu de divers articles de P. Duhem et de celui de E. Vicaire*].

2. Cf. J. E. TREVOR, *Compte rendu de P. Duhem* : « *L’évolution des théories physiques du XVII^e siècle jusqu’à nos jours* » (1896).

3. Namely: M. Couette, Ed. Domet de Vorges, Ch. de Kirwan, A. Gardeil, A. de La Barre, B. Lacombe, G. Lechalas, E. Vicaire and E. Villaume.

4. By “indirectly”, we mean those who expressed their approval or disapproval either privately or publicly, but without taking part in the debate via a particular publication, such as M. Blondel, Fr Ad.-J. Leray, P. Mansion and P. J. de Séguier (who we will not include since we did not have the opportunity to present his point of view).

5. In this case the *Annales de philosophie chrétienne*, the *Études religieuses, philosophiques, historiques et littéraires*, the *Revue du monde catholique*, the *Revue des questions scientifiques*, the *Revue thomiste*, and, lastly, *La science catholique*.

6. Duhem would later point out — correctly, even though the argument he drew from it was not — that “the most abundant and vehement attacks against [his] way of thinking came from those who professed the same faith as [he did]” (P. DUHEM, *Physique de croyant*, p. 51).

7. We say this without hesitation: hoping to see Duhem again in 1897 at the fourth International Scientific Congress of Catholics in Fribourg, Gardeil said: “We will support the good fight” (letter from A. Gardeil to P. Duhem dated 01/12/[1896]).

8. Mislead by the initials “H. D. G.” which were used to sign the report, published in the *Revue*, dedicated to the *Introduction à la mécanique chimique*, Kirwan repeatedly mentioned Julien Haton de La Goupillière (1833-1927) among the supporters of the “old school” (cf., for example, Ch. DE KIRWAN, *Questions scientifiques* [1894/1], p. 152). The correspondence actually confirmed that the aforementioned report had been written by Henri De Greeff (° 1860), professor at the Faculté des sciences du Collège Notre-Dame de la Paix in Namur (letter from P. Mansion to P. Duhem dated 16/10/1892).

Villaume and, indirectly, Bulliot, Farges, Leray¹, as well as, without a doubt, Aimé Witz (1848-1926)². Lastly, in the third, we position Kirwan, considering the probable evolution in his opinion, and Couette, by reason of his particularly conciliatory attitude.

In attempting a similar classification of the journals, we would place the *Revue des questions scientifiques* in the first camp and in first position — excluding the article by Vicaire³ —, followed by the *Études des Jésuites* and the *Revue thomiste*, of which many contributors read and mentioned Duhem and even defended him; in the against camp, would be the *Annales*; and lastly, the in-betweeners would be the *Revue du monde catholique*, with Kirwan's fluctuating position, and then *La science catholique*, since despite its editorial policy, which made it lean more towards Domet de Vorges, it also welcomed Couette's point of view.

Among these different camps, it is difficult to put one's finger on any common characteristics in any particular camp that could assist in identifying, within this Catholic world, any specific trends or undercurrents which were generally either for or against Duhem's ideas. Let us look at the Thomists, for example. While it is true that the first, and most serious, accusations issued from their side — from the members of the Société de saint Thomas d'Aquin —, the first supporting texts, having come from the Dominicans (Lacome et Gardeil), had also been published in a Thomist affiliated journal — namely, the *Revue thomiste*. However, opposing these two circles, in other words that of the Société and that of the *Revue*, would be too simplistic: even within the Société de saint Thomas d'Aquin, not only had there been debates — as attested to by the following modest admission that “only the end of the session was able to close the discussion”⁴ —, but there were also those that shared a similar opinion to Duhem (Derennes et Gardair).

1. Leray declared that he agreed with Vicaire's criticism and hoped that it would lead our physicist to change his mind (cf. the letter from Ad. Leray to P. Duhem dated 28/07/1893 quoted in J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 327-328).

2. Kirwan placed, without proper justification, Witz in the opposite camp to Duhem (Ch. DE KIRWAN, *Questions scientifiques* [1894/1], p. 152). It is true that this professor at the Faculté catholique des sciences in Lille had published two contributions in the *Revue* before the first article of our physicist appeared, and one which had undertones that were quite different from those Duhem was about to mention (cf. *De la méthode et des théories de la physique moderne*). However, Witz seems to have refrained from taking part in the debate, at least until Duhem's demise, since he published *Le conflit sur la valeur des théories physiques* in 1920.

3. We, therefore, do not agree with the unproven assertion of H. W. Paul (*The Edge of Contingency*, pp. 164-165) according to which there was an “anti-Duhemian position” within the Société scientifique de Bruxelles, of which “a segment” were concerned by Duhem's *Les théories physiques*. Far from having supported Vicaire's point of view, Mansion, who supported the civil and courteous exchange of ideas, welcomed him although he did not fail, during the annual reports he was asked to draw up as Secretary-General of the Society, to publicly praise Duhem's work (cf. J.-Fr. STOFFEL, « *Nulla unquam inter fidem et rationem vera dissensio esse potest* »).

4. É. PEILLAUBE, [*Réflexions du R.P. Bulliot à propos de l'article de Éd. Domet de Vorges...*], p. 595.

While this does not facilitate the task of the commentators¹, it must be said that the issue of clearly labelling Duhem's allies and opponents merely reflects the difficulty Duhem had of pinning one on himself. Unsurprisingly, the complexity of the Duhemian stance is thus mirrored by that of his interlocutors.

Despite the limitations imposed upon the Catholic world, which makes it easier to understand why the debate remained mainly focussed on the objective scope of physical theories and on their relationship with metaphysics, it must be admitted that the controversy was a particularly bitter one, although this did not necessarily displease Duhem as he "enjoyed a good fight"². Let us attempt to identify the reasons behind this.

14.1.2. The *raison d'être* behind this debate

In order to better highlight the potential divide between that which logic predicts and that which history asserts, let us start by outlining the reaction that, logically, could have been that of the Catholic world and, more particularly, of those who, like Domet de Vorges, thought of the relationship between scientific and religious discourse in terms of the history of astronomy³. While the representatives of the Catholic Church, faced with the Galileo affair, had hoped that the Florentine astronomer would prolong the phenomenalist conception — which, for two millennia, had been that of the astronomers — in order to preserve the prerogative of philosophers and theologians to be able to speak the truth, modern-day scientists refused to extend this now unacceptable tutelage. Seemingly going against the grain of this realist claim put forward by his predecessors, Duhem adopted the conception of science that the Catholics had once so ardently desired. It would, therefore, seem that they owed him their gratitude for having restored the exclusive power of metaphysics to be able to speak the truth.

This was not, however, the reaction that was witnessed. The most astute commentators were already aware of this: although it seemed to play into the hands of metaphysicists, his deontologisation of physical theories embarrassed them. Various reasons for this have been put forward: 1°) by renouncing that which constituted the only final destination of science, being the knowledge of causes, his conception risked leading to not only the "death" of science, but also and above all to 2°) the spread of this scepticism

1. For example, when Maiocchi argued that Duhem could not be historically associated with the Thomists since they were his main opponents, Hilbert replied that he had, in fact, been attached by the "bad" Thomists and defended by the "good" ones!

2. As attested to by André Chevrillon in H. PIERRE-DUHEM, *Un savant français*, p. 70.

3. Significant from this point of view, is his explanation of the adoption of phenomenism by certain modern-day scholars in order to protect themselves from the religious orthodoxy of that era [§ 5.2], as well as his example of the reduction, thanks to science, of the complex apparent movements of the planets to much simpler movements (Ed. DOMET DE VORGES, *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 139).

which might continue to extend perilously beyond the scientific arena; 3°) it was likely to deprive its co-religionists of that “aggressive” apologetics which the Thomists felt they needed, leaving them with only a defensive apologetics, which moreover 4°) could lead one to think, contrary to what *Aeterni Patris* had asserted, that the agreement between science and metaphysics could only be negative.

Our study provided more clarity on the matter. First of all, it did so on a chronological level. While the first two motives were explicitly confirmed during the period under consideration and the fourth was implicitly confirmed, the same cannot be said for the third, which, although essential, appeared to be anachronist: it was only after the Duhemian clarifications given later on that it was possible to formulate the judgement whereby “Duhem furnished the apologist with excellent ammunition”, and yet unsatisfactory in terms of relating to a religious philosophy that was “above all defensive”¹. Secondly, it did so with respect to weighing these different reasons. While the question of scepticism was omnipresent and while the concern to maintain a definition of science as knowledge through causes was highly prevalent, only one occurrence explicitly authenticated the will to establish a truly positive and harmonious agreement between physics and metaphysics. Lastly, it did so concerning the reasons actually put forward. There was one, being obviously as strong as the fear of scepticism, which modern commentators had not yet noted: rather than the dissatisfaction in seeing physics proclaim its independence, it was the concern in seeing it refuse its indispensable contribution to metaphysics.

As for the reasons making it possible to account for the opposition of certain Catholics to the early Duhemian writings, many commentators have pointed to their weakness in terms of physics (Jaki²), their inability, particularly in the case of Domet de Vorges³, to perceive the growing importance of mathematics within science, and their poor comprehension of what Thomism really was (Lacome, Mentré⁴, Séguier⁵, Jaki⁶). To avoid any anachronistic judgment, one must naturally add their impossibility to benefit from the important clarifications that Duhem was to give a decade later, notably in *Physique de croyant*, and which commentators should thus be able to disregard here.

1. Fr. MENTRÉ, *Pierre Duhem, le théoricien (1861-1916)*, p. 460.

2. For example, St. L. JAKI, *Uneasy Genius*, p. 336.

3. Condemning “the excessive predominance of mathematics in the teaching of physics” Domet de Vorges nostalgically noted that “the time is long gone when Mr Jamin could write three volumes of high physics without even being able to deduce and integral himself” to the point that he “was obliged to have a friend do the calculations inserted into his work” (Ed. DOMET DE VORGES, *Les hypothèses physiques sont-elles des explications métaphysiques ?*, p. 147).

4. Fr. MENTRÉ, *Pierre Duhem, le théoricien (1861-1916)*, p. 460.

5. Before having engaged in long and profound reflections testifying to his mastery of the subject, the Jesuit Jean de Séguier (° 1862) also pointed out: “It is highly probable that those who oppose you to Aristotle & S. Thomas are not those who know them best” (letter from J. de Séguier to P. Duhem dated 09/04/1895).

6. Cf. St. L. JAKI, *Uneasy Genius*, p. 336.

14.1.3. A sense of bitterness

Even though Gardeil delivered a positive assessment at the end of the short period we just considered — “I think”, he wrote to Duhem, “that the cause you support was won among the scholastics: the era of Farges, Bulliot, and, dare I say¹, Coconnier² is over”³ —, the feeling expressed by our physicist himself, around the same era, was far more bitter. To the philosopher from Aix who, without any illusions about the world, told him about Abbey Denis’s “keen desire” to have “a few pages of [his] prose”⁴ to publish in the *Annales*, he answered:

“The Abbey Denis must be a good man; as for the Société de St Thomas d’Aquin, of which his journal is a member, it undoubtedly also contains good people, but it also contains beings puffed up with vanity — the Count Domet de Vorges, for example — as well as some filthy venomous beasts, like the one hiding in the *Annales de Philosophie Chrétienne*, who also hides himself from the real world, under the name of “congress participant” — I have no desire to exchange words with people of that sort, who believe they have the right to lie just because they wear a cassock.

I will confess to you, moreover, that people of this kind made me disgusted with the Catholic world — and I don’t mean Catholics, which isn’t the same thing — beyond all words; the Faculté catholique de Lille had already given me an idea of the insincerity that reigns in this world; the congrès de Bruxelles further enlightened me — Scribes et hypocritical Pharisees!

It is my firm intention to never commit myself to these people again; to seek the truth; and when you think you have found a piece, scatter the news of it to the four winds; and let the crows squawk! — So, poor Abbey Denis won’t be getting my prose.”⁵

A few months later, Duhem had evidently expressed similar feelings to his friend Lacomme, since he advised our physicist to adopt the attitude that Duhem himself had just declared to Blondel he was thinking of taking on:

“I wholeheartedly approve of your resolve to drop all these vain Thomists from the Catholic congresses. — Never again write any doctrinal misinterpretations. Express the truth. And let it, alone, impose itself.”⁶

1. During the first year of the *Revue thomiste*, Gardeil was in charge of the editorial secretariat under the direction of Coconnier. The caution expressed here is thus that of a former secretary towards his former director.

2. The Dominican, Henri Coconnier (1846-1908), was the director of the *Revue thomiste* (1893-1908) at that time.

3. Letter from A. Gardeil to P. Duhem dated 01/12/[1896].

4. Letter from M. Blondel to P. Duhem dated 11/01/1896.

5. Letter from P. Duhem to M. Blondel dated 12/01/1896 (Louvain-la-Neuve, Université catholique de Louvain, Centre d’archives Maurice Blondel).

6. Letter from B. Lacomme to P. Duhem dated 11/09/1896.

If Duhem felt such a sense of bitterness, it was because he was persuaded that the scientific incompetence of the neo-Thomists had led them not only to spoil the work to be done, but also to complicate the situation for those who were willing to undertake this task. He explicitly stated this in a letter to Abbey Pautonnier in 1896:

“Never speak to me again of Fr Bulliot and company; these imbeciles have spoiled a very beautiful piece of work; one would obviously need to bring back the philosophy of *common sense*, which is the basis of the peripatetic method, in order to counter the senseless doctrines offered to us by these critics and pantheists of all kinds; but, to do so, one would have to imbue oneself with the *mind*, and not the *word* of Aristotle and St Thomas; Better yet! One should not use the *results* of Aristotle, but rather apply the simple and sensible *analytical method* that he used for the ideas of his time, to the ideas we possess today. To do this, above all one would need a thorough knowledge of current ideas, in other words to be *scientists*, having engaged in deep contemplation on the various sciences; secondly, one would have to have a *great sense of intellectual modesty*, knowing that the truth is very difficult to uncover, and that a huge amount of effort would be required to even lift a small corner of the veil. — Instead of this, we have Bulliot et Domet de Vorges who believe they are capable of explaining the essence of movement to us, when they would be <damned> (as Mesureur would say) if faced with undergraduate mechanics problem.

Thus, the work remains entirely incomplete. Unfortunately, far from facilitating it, they’ve made it more difficult by the disfavour they have cast upon it and by the anathema they toss freely in the direction of those who approach it from a different angle to theirs.”¹

After this initial negative experience, Duhem abandoned his personal involvement in the neo-Thomist revival, without however condemning those who chose to take advantage of its writings².

14.2. Subsequent evolution of Duhemian thought

After having become acquainted, thanks to this study, with the rapid and important changes that had already occurred from the articles gathered here for the selected period, let us conclude by broadly contextualising the main themes encountered herein and expounding upon their subsequent evolution.

1. Letter to P. Duhem from A. Pautonnier dated 25/04/1896 (Archives de l’Archidiocèse de Paris, Fonds Pautonnier). I would like to thank Martin Hilbert for having provided me with this document.

2. Significant from this point of view, was his response to Mansion’s request expressed on the occasion of the twenty-fifth anniversary of the Société scientifique de Bruxelles celebrated in 1901: although Duhem refused to accede to his request by going along to announce in person, of his own authority, that today’s science, in reintegrating qualities, conformed with the directive of Léon XIII, he did not seem opposed to the idea of his correspondent making a statement to this effect. For his part, he would limit himself to a purely scientific presentation (cf. J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 332-334).

14.2.1. The goal of physical theory

At the end of this journey, that which the usual readers of *La théorie physique* would undoubtedly find striking is the very modest role that Duhem initially reserved for theory: intended to relieve the physicists memory, it was devoid of any heuristic or predictive scope, and was assessed, not according to its capacity to express the truth, but to the extent of its ability to consolidate the experimental laws according to which it was conceived. Far from glorifying theory, our physicist gave the impression of constantly trying to belittle its claims. It is thus important to qualify this impression: in the context of a triumphant and crisis-free science, as would soon be the case, it was the objective scope of physical theory that Duhem wished to destroy, then to reduce, and not its significance; in the course of his articles, theoretical physics would, however, see its scope of action increase until it seeped into experimental physics, within which positivism had created a territory sheltered from any subjectivism.

Faced with the insurmountable difficulties of the mechanism and the neo-Thomist attempts at reconciliation, which he reckoned would not sufficiently shelter their co-religionists from scientific attacks, Duhem thus adopted, at least provisionally, a strict phenomenalism. Realising that this had been interpreted, particularly by the neo-Thomists, as scepticism, and that he was logically incapable of dissuading physicists from delving into eclecticism, he had no choice other than to soften his initial stance by injecting a dose of realism into it with a call for striving towards the perfection of physics and natural classification. Whether it came to responding to accusations of scepticism, positivism, anti-metaphysical bias, or to preserving a unified and coherent physics, his reply was the same: to provide physical theory with the conditions, both human and divine, necessary for it to move asymptotically closer towards the ontological order. His challenge was therefore to find a middle ground between, on the one hand, a restrictive and dogmatic realism and, on the other hand, an eclectic and discouraging phenomenalism, by going beyond the requirements of logic alone to open a third door behind which lay a precarious and uncertain landscape, especially for those who did not share his philosophy of history.

As confirmed by our journey¹, this evolution from a radically phenomenalist stance to an increasingly historico-asymptotic realism², was profoundly influenced by the ob-

1. H. W. Paul (*The Edge of Contingency*, p. 172) envisaged this and R. N. D. Martin (*Pierre Duhem*, p. 30) suggested it on the basis of Vicaire's criticism alone, not hesitating to note that it "*seems in particular to have drawn blood*" (*Ibid.*, p. 107).

2. In Duhem's case, realism is not only asymptotic but also historical: while our physicist needed to turn to logical analysis in order to found his phenomenalism, he needed, however, to turn to history to found his asymptotic realism, since it is a conviction, which, in escaping all logical reasoning, results from examining history and all that issues from it. We proposed and explained this qualification in J.-Fr. STOFFEL, *Préface*, p. 20 and in J.-Fr. STOFFEL, *Powrót do kontrowersyjnego dzieła Pierre'a Duhema*, pp. 55-56.

jections addressed to him by his co-religionists, and especially by Vicaire, although his name was only mentioned twice¹.

By the time *La théorie physique* appeared, the context had changed somewhat: Duhem would still have to advocate for his separation of physics and metaphysics in order to counter the neo-Thomist attempts at reconciliation, but this time he would above all be required to oppose the relativism and pragmatism that could easily to have turned his phenomenalism to their advantage. Once again, Duhem would only be able to confront these misinterpretations by accentuating his cognitive statements.

14.2.2. Physics and metaphysics

Our journey has shown how omnipresent the theme of the relationship between physics and metaphysics was, both in Duhemian writings and in the commentaries that they have generated, and even in the article which was the furthest from this subject, namely *La physique expérimentale*. In dealing with this relationship, Duhem never ceased to plead in favour of the total autonomy of physics, especially in practice, from all that was metaphysics. Following on from F. R. Leite², it is important to clarify the true scope of this assertion. Even though, after a logical analysis of the scope of physics, Duhem did indeed recommend such an autonomy, this does not mean that, as a historian, he was unaware of the influence, sometimes favourable, that metaphysics had exercised over the development of science in the past, or even that, as a philosopher, it continued to exercise over contemporary physicists, because his thinking — and this is what makes his work particularly interesting — cannot be reduced to a logical analysis of this sort.

First and foremost, as a historian eager to take all the complexity of the true path of science into account, Duhem in no way neglected metaphysical and religious factors, since he even derived apologetic arguments from them. While it is true that this consideration mostly comes through in his later works, such as the *Études sur Léonard de Vinci*, *Le mouvement absolu et le mouvement relatif* and, naturally, *Le système du monde*, it was already present in the articles studied herein, albeit to a lesser degree. There are two reasons that are able to account for this difference in emphasis. Firstly, they were chiefly illustrative articles, not specifically historical ones: his ideas thus did not aim to retrace the real path that science followed, but instead concerned finding historical justification for his preferred philosophical conception. Secondly, Duhem had not yet discovered the

1. In addition to its inevitable mention in the introduction of *Physique et métaphysique*, the name ‘Vicaire’ appeared for a second time in *L’École anglaise et les théories physiques*. Thereafter, it would never be mentioned again, not even in *La théorie physique*.

2. Cf. F. R. LEITE, *Sobre as relações históricas entre a física e a metafísica na obra de Pierre Duhem*. In this article, the author advantageously opposes the interpretations of Joseph Agassi, Imre Lakatos and John Watkins, and corrects those of Pablo Mariconda, Russell Niall Dickson Martin and Donald Miller.

richness of this medieval science that would allow him to fully explore the depth of this “very intricate” and “very powerful” interweaving of physics and metaphysics, which he nonetheless had begun to explore as early as *Les théories physiques*¹.

Then, as a philosopher aware that there is no infallible method of scientific invention and that one cannot ignore everything that escapes pure logic, Duhem accepted, in the same article, that all scientists were naturally and spontaneously inclined to do metaphysics, as demonstrated by their desire to comprehend the nature of material things. Better still, he even used this same desire when he expressed the perfection of physics as a bastion against eclecticism and scepticism.

Should one not, however, acknowledge the existence of a contradiction within his thinking, which, on the one hand and with respect to the past, recognised the unexpected scientific fecundity that the interaction of physics and metaphysics would bring, and yet, on the other hand and with respect to the present, prevented such a fortuitous event from happening again by prohibiting these interactions? Once again, F. R. Leite’s study sheds light on this: the reason why physics should maintain its autonomy specifically relates to those metaphysical systems which are likely to impose their conclusions on science; it does not relate to this metaphysical desire which, on the contrary, supports researchers in their quest for discovering a physical theory that brings them closer to natural classification.

Contrary to what some modern commentators may have believed, the autonomy claimed by Duhem the Logician did not prevent Duhem the Philosopher or Duhem the Historian from accepting both past and present metaphysical influences, especially since Duhem the Philosopher of History was well aware of those hidden paths by which “true science”² would nevertheless manage to shape itself.

14.2.3. The issue of the choice of hypotheses

As early as *Les théories physiques*, our author had already noted the extreme freedom that physicists enjoyed in terms of their choice of hypotheses. Vicaire had also pointed out, the following year, the extent to which the absence of any guide or rule was a hindrance, even before this hindrance was further increased in 1894 by the Duhemian criticism of the inductive method, which removed the possibility of remedying it by resorting to learning from the experimental results. However, although Duhem did then provide some pedagogical guidance with respect to how the teacher, using “common sense data” and “facts gathered by ordinary experimentation”³, could account for the

1. P. DUHEM, *Quelques réflexions au sujet des théories physiques*, p. 164.

2. ID., *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours*, p. 499.

3. ID., *Quelques réflexions au sujet de la physique expérimentale*, p. 197.

emergence of these hypotheses, he left the actual issue unresolved. Initially, in *La théorie physique*, Duhem revisited this question by stating that this issue was in fact not a problem: far from having to actively choose the hypotheses for themselves, physicists should just make their line of thinking available concerning “the idea that germinated in them, without them”¹. He then, at the time of his *Traité d'énergétique*² (1911) and his *Notice*³ (1913), turned entirely and specifically towards the history of science as a “very reliable and precise guide” regarding this issue. Revealing which past hypotheses had proven to be fecund or sterile, would serve as a guide to physicists thus allowing them to place their trust in the hypotheses they had chosen, until such time as they were finally experimentally confirmed. The disadvantage of a purely symbolic conception of physical theory, which prevented any recourse to metaphysical considerations, combined with that of the logical method, which rejected experimental control at the end of the theoretical construction, was thus compensated for, from the very beginning of this construction, by considering those historical factors which made it possible to substitute, at least provisionally, a historical justification for this control. This choice was therefore no longer arbitrary: it was determined by the teachings of the history of science and guided by common sense.

14.2.4. The different types of minds

Two major innovations were to mark the further evolution of the Duhemian theme of the different types of minds. Firstly, the use of Pascalian distinctions between, on the one hand, the intuitive mind and the mathematical mind, and, on the other hand, the strong mind and the broad mind, which, absent from the 1893 article, were to appear specifically in the fourth chapter of the first part of *La théorie physique*. Secondly, the clear-cut distinction between the French and the German mind that Duhem, as Léon Ollé-Laprune (1839-1898)⁴ pointed out to him, did not sufficiently differentiate between in the same 1893 article: he merely established a slight difference in degree between the two. It did, however, contain the basis for the real distinction, which he was to present in *La science allemande*: largely dominated by the inductive method, the German mind lacked the two French qualities of common sense and intuition.

14.2.5. An optimistic and teleological philosophy of history

Confronted with scepticism and the restriction of the very experimental physics that could have generated the historical observation of all these theories which rose only to fall again just as quickly, Duhem favoured, on the one hand, the historical endurance of

1. ID., *La théorie physique*, p. 423.

2. Cf. ID., *Traité d'énergétique ou de thermodynamique générale*, vol. 1, pp. 4-5.

3. Cf. ID., *Notice sur les titres et travaux scientifiques de Pierre Duhem*, p. 116.

4. Letter from L. Ollé-Laprune to P. Duhem dated 08/04/1894.

a part, never none, of these theories¹ and, on the other hand, the progression of physical theory towards natural classification. In order to establish these characteristics, so as to reassure the honest physicists that their work would never be in vain, and to ensure the slow yet steady progress of science like the ebb and flow of the tides², in his 1896 article he added an additional dimension: if it were indeed so, if this apparently chaotic path did actually lead to “true science”, it would be because it was being guided, unbeknownst to scientists, by “the One directing all this turmoil”³. This conviction, closely studied by Leite⁴, would be expressed again, in the form of an action of a “guiding Idea” (in *L'évolution de la mécanique* en 1903⁵ and in *Les origines de la statique* en 1906⁶), of “a Wisdom [...], a Power [...], in a word [...] of a Providence” (still from *Les origines de*

1. Beyond all this superficial turmoil, what remained of the physical theories? The development of mathematical physics and experimental laws had answered this question of Duhem's in 1892. Explaining his thinking in his masterpiece (P. DUHEM, *La théorie physique* [1906], pp. 47-48 and pp. 57-58), he would distinguish two parts within physical theories: one explanatory, which needlessly attempted to explain reality; the other representative, which served to coordinate the laws. The latter, being fecund, would be the one to remain almost in its entirety in the new theory, to the detriment of the former, being harmful and transitory.

2. Cf. P. DUHEM, *Les théories de l'optique*, p. 125.

3. ID., *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours*, p. 499.

4. Cf. F. R. LEITE, *Um argumento a favor da existência de Deus formulado por Pierre Duhem*. However, this learned commentator links this Duhemian conviction to Thomas Aquinas. More precisely: he links the Duhemian argument represented by the single extract from the *Origines de la statique* to the fifth Thomist way. However, there is an essential difference between these two arguments: whereas Aquinas' argument specifically establishes itself between beings deprived of knowledge (natural things) and an intelligent and knowing being, like an arrow directed towards an end by the archer (THOMAS D'AQUIN, *Somme théologique*, vol. 1, p. 173 [1a, q. 2, a. 3]), that of Duhem's involves, on the one hand, the production of intelligent beings capable of intentional action and, on the other hand, the action of a wise, powerful and kindly being. F. R. Leite, obviously having noted this difference, was obliged to add an additional premise, namely the unconsciousness of those intelligent beings who are, in this case, the builders of physical theories. For our part, as we have already suggested (*Le phénoménalisme problématique de Pierre Duhem*, p. 293), we would rather see the source of inspiration for this conviction, and thus for this argument, as being within the thought of Pascal, who Duhem quotes in another context: “How beautiful it is to see, through the eyes of faith, Darius and Cyrus, Alexander, the Romans, Pompeius and Herod acting, without knowing it, for the glory of the Gospel” (B. PASCAL, *Œuvres complètes*, p. 541 [Lafuma 317]). Indeed, in referring to this perspective, not only is the aforementioned difference no longer relevant — as it is only a matter of political action (in Pascal's case) rather than a scientific production (in Duhem's case) — but it is also no longer necessary to invoke that additional premise, namely the fact that this plan, as Duhem liked to point out, is “unknown to the labourers” (P. DUHEM, *Les origines de la statique*, vol. 2, p. 290), because this “unconsciousness” is already present, through the “without knowing it”, in the Pascalian text. Lastly, the third advantage is that the amiable character of this Being who “makes use of even the most pitiful frailties of the scholars to serve the progress of Science” (P. DUHEM, *Léonard de Vinci, Cardan et Bernard Palissy*, p. 319) is also already present in the Pascalian text, since it is figures like “the Romans, Pompeius and Herod” who contributed to the “glory of the Gospel”. It thus seems to us that the Duhemian conviction on this point is much closer to Pascalian thought than that of Aquinas.

5. Cf. P. DUHEM, *L'évolution de la mécanique*, p. 345.

6. Cf. ID., *Les origines de la statique*, tome 2, p. 290.

*la statique*¹), or even — which remained unnoticed until the study mentioned — “the One who guides human thought [and] makes use of even the most pitiful frailties of the scholars to serve the progress of Science² (in a 1906 article included in the *Études sur Léonard de Vinci*).

14.2.6. The main sources of inspiration for Duhemian thought

Since it would not be possible herein to deal with the still highly controversial question of Duhem’s relationship with the thinking of the Stagirite, Aquinas or Pascal, we would like to encourage the reader to be attentive to the many clues encountered throughout this journey. Many of them bear witness to a deep Aristotelian connection, sometimes even overlooked by Duhem himself, before the Pascalian influence gradually increased (which had the additional benefit of being displeasing to both the Atheists and neo-Thomists³). This is not to say that one replaced the other, nor that we would be obliged to make a definitive choice between an Aristotelian or Pascalian Duhem⁴. Nor is it to maintain that our physicist was always an authentic Aristotelian or a Pascalian. It does not even mean giving up the idea that he might also have shared some points in common with neo-Thomism⁵. Such stances would be incompatible with the complexity of Duhemian thought, which we have always recognised and even affirmed. This merely serves to establish a certain gradation between the different sources of inspiration, one of which, at the end of our scholar’s life, seems to have been indisputably more influential than the others.

14.3. Sophistication can be the source of many difficulties

In the introduction [§ 1.1], we reiterated that, following on from Bordoni, what constitutes the richness of Duhemian thought and should encourage us to read his works time and again is the high degree of sophistication, not only of his epistemology — which was evident even in his rough first-period writings —, but also of his historiography — which we were able to glean from the odd clue we found while researching the period under consideration⁶. Having reached the end of this journey, we would like to

1. Cf. *Ibid.*

2. ID., *Léonard de Vinci, Cardan et Bernard Palissy*, p. 319.

3. The discernment of François Mentré is, from this point of view, exemplary (Fr. MENTRÉ, *Pierre Duhem, le théoricien (1861-1916)*, p. 459).

4. We therefore agree with the salutary clarification by St. Bordoni and F. R. Leite.

5. F. R. LEITE, *Pierre Duhem considéré comme un philosophe du sens commun*, p. 101.

6. Although Duhem had not yet made his main discovery in medieval science, we were already able to discern his awareness of the complexity of history through his use of three different processes: the first one, linear and progressive, only discernable over a long period of time (the asymptotic progression towards “true science”) which occurs, despite the second one, cyclic, easily observable in a shorter time period (the physical theories that rise, fall into dogmatism, and then disappear), but which are reinforced

add that this characteristic, while it continued to represent his wealth, also created his problems: it continued to hamper the reception of his work, albeit during his lifetime or after his death. Sharing chiefly his most naïve epistemological and/or historical conceptions, his peers, even though they shared a common affiliation to the Catholic world, did not always succeed in understanding the meaning and value of his ideas, all the more so because these were subjectively destabilising and objectively incomplete. Not easily accessible, this sophistication probably did not even correspond to what most of his co-religionists were seeking during this period of profound upheaval: the majority of them would most likely have preferred a more naïve stance, one that would not have prevented them from developing a reassuring confluence of science, philosophy and religion; a few others, especially Blondel, having already noted the outdated nature of all that was scientific apologetics, would have preferred Duhem to turn the page much faster and more easily than he did. As for the commentators who reviewed his work after his demise, it is needless to say how foreign Duhem's true thinking¹ remained to them until the 1980s. Fortunately, however, it is never too late to join this genuinely sophisticated school of thought.

15. Annexes

15.1. Bibliographical guidelines

Commentators	Location	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Maiocchi (1985)	Chap. 2	×	×	×	×		×	×
Jaki (1987)	Chap. 9	×		×	×	×	×	×
Brenner (1990)	Chap. 1	×			×		×	
Stoffel (2002)	Chap. 4	×	×	×	×	×		
Bordoni (2017)	Chap. 8-9	×		×	×	×	×	×
Duhem (2019)	Introduction	×			×	×	×	×

Legend: [1] *Quelques réflexions au sujet des théories physiques*; [2] *Notation atomique et hypothèses atomistiques*; [3] *Une nouvelle théorie du monde inorganique*; [4] *Physique et métaphysique*; [5] *L'école anglaise et les théories physiques*; [6] *Quelques réflexions au sujet de la physique expérimentale*; [7] *L'évolution des théories physiques du XVII^e siècle jusqu'à nos jours*.

In order to guide readers who wish to deepen their understanding of this subject, in the below table are listed, in ascending chronological order, the main monographs by prominent commentators having specifically dedicated at least one chapter to at least one of the Duhemian articles collated herein. Introductory texts to collections of Du-

by the third, unexpected and spiral (the return to a non-reductive science, because it also integrates qualities without losing its mathematical formalism).

1. This was inspired by St. BORDONI, *When Historiography Met Epistemology*, p. 250 and p. 289.

hemian articles containing one or more of these articles are not taken into account, with the exception of *Ensaïos de filosofia da ciência*, which contains a remarkable 50-page introduction to Duhemian thought.

15.2. The Société scientifique de Bruxelles

The seven Duhemian articles included in this collection, having all been published in the *Revue des questions scientifiques* which is to become — and will thenceforth always remain!¹ — a privileged location for Duhemian publications, it is worth taking a closer look at the context of his admission into the society of which this revue is a member, namely the Société scientifique de Bruxelles.

He had been: teaching for over three years in the “capital of Flanders”, which is very close to the Belgian capital; sharing the religious orientations of this Société as expressed via its motto²; and in an epistolary relationship, from the end of 1888, with one of its main driving forces, namely the physicist Philippe Gilbert (1832-1892)³. Having had no other scientific journal at his disposal that could, like the *Revue*, take on the type of article he was about to publish⁴, nor offer him, as it did, an independent space free from the likes of the all-powerful Marcelin Berthelot (1827-1907), Duhem inevitably ended up joining this Société. Appreciating, as he would write five years later to Paul

1. Duhem did not show this loyalty, over such a long period of time, to all the journals in which he published. Thus, following the condemnation of the *Annales*, which he suspected must have pleased the heads of the *Revue de philosophie*, he distanced himself somewhat from the latter, even though he had assisted in founding it (J.-Fr. STOFFEL, *Pierre Duhem avait-il « quelque théologien derrière lui » [...]?*, pp. 101-102).

2. Cf. J.-Fr. STOFFEL, « *Nulla unquam inter fidem et rationem vera dissensio esse potest* ».

3. Duhem had sent Gilbert his *Théorie nouvelle de l'aimantation par influence fondée sur la thermodynamique*, which the latter would report on in the *Revue bibliographique belge*. He did so all the more willingly because he was delighted to see the physicist from Lille devote himself to this “mathematical physics, which seemed [to him] to have been somewhat neglected in France in recent years, and for which [he] has always had a penchant”. Regarding this point, Gilbert also hoped that, thanks to Duhem, “France will soon have nothing to envy its neighbours for” (letter from Ph. Gilbert to P. Duhem dated 20/12/1888). In the same journal, the inventor of the barogyroscope also reported on the first volume of his correspondent’s *Leçons sur l'électricité et le magnétisme*, a work that he appreciated all the more seeing, he confessed to the latter, “that Maxwell did not meet [his] expectations” (letter from Ph. Gilbert to P. Duhem dated 16/08/1891).

4. Until this first article, with the exception of his *Notice sur Bronislas-Étienne Wasserzug* published in the *Bulletin de l'Association des anciens élèves de l'École normale*, Duhem had only published in strictly scientific journals, from which the *Revue* clearly distinguished itself in that it was more mainstream, aimed at the high popularisation of science, and was particularly open to issues regarding the history and philosophy of science. There were no other French-language Catholic journals that could rival it. The *Revue thomiste* and the *Revue de métaphysique et de morale* would start appearing in 1893; the *Revue néo-scholastique* in 1894; and la *Revue de philosophie* in 1900. As for the *Annales*, not only was it not a scientific journal, but it is reasonable to suppose that Duhem, from around that time, had already been warned about several of its contributors, as we know to be the case a year later.

Tannery (1843-1904), its “liberalism”, its “broadmindedness”, its “lofty notion of the popularisation of science”, its “gravitas” and its “hospitality”¹, it is even less surprising that Duhem joined it considering that several of his colleagues from “opposite” him, namely the Faculté catholique², were already members. Other than from Witz, a physics professor who, along with Gilbert, served to “sponsor” him for his admission³, the suggestion to join the aforementioned Société might have come from Abbey François Bourgeat (1849-1926). In Eugène Monnet’s hospital family accommodation house, where the teachers from the Facultés de l’Université d’état and the l’Institut catholique used to hold meetings, our physicist took “wicked pleasure” in “scrapping” and “beating”⁴ this geology professor who had himself been admitted into the Société some ten years earlier. According to another theory, and one that had not yet been explored, this suggestion might simply have come from the Secretary-General who presided at the time — the only one Duhem would never know — namely, Mansion⁵.

In any case, when Duhem was accepted into the Société scientifique de Bruxelles on 4 January 1892 — at the same time as his first article appeared — the Société was going through one of the worst crises in its history. Multifactorial, this crisis was caused primarily by the untimely demise on 4 March 1889 of its first Secretary-General, namely Fr Ignace Carbonnelle (1829-1889). Then one year later, unexpectedly, Léon XIII, taking advantage of the necessary restructuring engendered by his death, let it be known that he expected his replacement to declare “full and explicit commitment to the doctrine of St. Thomas as recommended in several pontifical documents and especially in the encyclical *Aeterni Patris*”⁶. To these first two rather traumatic events, a third was soon to be added, just one month after Duhem’s admission, namely the death of Gilbert on 4

1. Letter from P. Duhem to P. Tannery dated 03/07/1897 published in P. TANNERY, *Mémoires scientifiques*, vol. 14, pp. 213-214.

2. Let us note that Duhem, on the contrary, was part of the Université d’État.

3. *Société scientifique de Bruxelles: séances du Conseil: 1890-1891 à 1905-1906*, [p. 23] [session dated 4 January 1892].

4. Letter from Fr. Bourgeat to P. Duhem du 27/11/1899.

5. In Mansion’s first letter to Duhem, which was kept although does not seem to have been the first to have been consulted, the aforementioned Secretary-General, who was acquainted with Witz and whose cousin was Duhem’s Rector, namely Charles Bayet (1849-1918), apologised for having called upon him “to contribute again for a third time” (letter from P. Mansion to P. Duhem dated 11/02/1892). As the two previous “contributions” were specifically mentioned in the letter — namely the new article *Notation atomique* and the review of Poincaré’s *Thermodynamique* —, the first of these contributions might have been *Les théories physiques* which was published — a noteworthy fact — at the same time that Duhem was admitted into the Société. This admission would thus have been the, direct or indirect, consequence of the first contribution requested by Mansion. Whatever the case may be, we have dismissed the implausible idea that it might have been Charles-Eugène Barrois (1851-1939), who was then a lecturer in geology at the Faculté des sciences, as expressed by St. L. Jaki (*Uneasy Genius*, p. 93).

6. *Société scientifique de Bruxelles : séances du Conseil : 1890-1891 à 1905-1906*, [p. 5] [session of 14 April 1890]. Regarding this session and the way in which Duhem’s work would be called upon to testify to the required adherence to Aquinas’s thought, cf. J.-Fr. STOFFEL, *De l’« ultradynamisme métaphysique » du père Ignace Carbonnelle sj au « thomisme élargi » de Pierre Duhem [...]*.

February 1892. By this date, the Société would thus have lost, in under three years, its two main pillars, in addition to have been subjected to a strict pontifical call to order.

In these rather unusual circumstances, Duhem's admission was very highly appreciated from the start, and would even come to be considered as providential¹. Indeed, independently of the many similar views he shared with Mansion², Duhem arrived with a certain number of articles and reviews ready to be published at a point in time when the *Revue* was in sore need of material, in the wake of Gilbert's illness and death³. Moreover, he seemed perfectly suited to replacing him in "the difficult task of reviewing the mathematical physics works"⁴, which he certainly did by responding positively to Mansion's frequent suggestions. Lastly, in a much more fundamental way, his writings were to allow the Société, from the second article, to distance itself from the "metaphysical ultradynamism" of Fr Carbonnelle who had been at the root of the aforementioned call to order, and, from the seventh article, to let it be known that it was displeased with having had to move away from Fr Carbonnelle, and that it had thus moved closer to Aquinas⁵.

15.3. Catholic science

It is perhaps not a coincidence that the very first reaction specifically devoted to one of the Duhemian articles, which appeared in the *Revue*, was published in *La science catholique*. Founded in December 1886 by Abbey Jean-Baptiste Jaugey (1844-1894), this journal proposed "as its primary objective, to defend the faith in the scientific field" and to "spread, among the ranks of the clergy and educated Catholics, the knowledge of the answers provided today by theology and the secular sciences to the many objections which, under the guise of a false science, tended to condemn Christian truths"⁶. This conservative stance, contrary to the one generally adopted by the *Revue*⁷, had already led to quarrels between the two journals, Kirwan having taken the brunt of these. It should be noted, however, that while *La science catholique* naturally welcomed the criticisms of Domet de Vorges, it also allowed Couette to express a divergent view, which was much more favourable towards Duhem.

1. To go into everything that Duhem would thus owe to the Société, and particularly to its Secretary-General, would serve no purpose here.

2. Cf. J.-Fr. STOFFEL, *L'interprétation de l'« affaire Galilée » élaborée par Paul Mansion a-t-elle influencé Pierre Duhem ?*, pp. 154-157.

3. Letter from P. Mansion to P. Duhem dated 11/02/1892.

4. Letter from P. Mansion to P. Duhem dated 29/04/1892.

5. Cf. J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, pp. 331-334 and ID., *De l'« ultradynamisme métaphysique » du père Ignace Carbonnelle sj au « thomisme élargi » de Pierre Duhem [...]*, pp. 597-598.

6. J.-B. JAUGEY, *Notre programme*, p. 1.

7. Cf. J.-Fr. STOFFEL, "Nulla unquam inter fidem et rationem vera dissensio esse potest".

15.4. Count Edmond Domet de Vorges

Having been fascinated by philosophy since his youth, Count Edmond Domet de Vorges resigned himself to a career in diplomacy that was interrupted by the advent of an anticlerical government. Having retired early, in 1883, he was able to devote himself entirely to his passion which had already led him to obtain an honourable mention in 1853 in a competition of the Académie des sciences morales et politiques requiring an *Examen critique de la philosophie de saint Thomas d'Aquin* and to publish, in 1875, a work entitled *La métaphysique en présence des sciences : essai sur la nécessité d'une philosophie fondamentale*. Regarded by Farges as being among “the sincere Thomists, a little tinged with eclecticism, with an admitted weakness for Suarez and Leibnitz”¹, he remains nevertheless one of the most prominent Parisian Thomists. It is for this reason that the Société scientifique de Bruxelles, when it was obliged to proclaim its “full and explicit” adherence to Aquinas’s doctrine, appointed him as president of its board for the year 1890-1891, hoping to provide further proof of its goodwill by this gesture. Prolific if not profound, Domet de Vorges was active in many Catholic causes: for example, the International Scientific Congresses of Catholics, (including the one in Brussels) and the Société scientifique de Bruxelles (of which he had been a member from the outset). Even though he would not be Duhem’s most astute Catholic opponent — this honour would be bestowed upon Vicaire, unless he should have given it to Couette —, he would at least be his most resolute opponent, the first to have reacted to his articles in the *Revue* and the one to have initially labelled him as Kantian, a sceptic and an enemy of metaphysics.

15.5. The Société de saint Thomas d’Aquin

Neither the *Annales* nor the figure of Domet de Vorges can be evoked without mentioning the Société de saint Thomas d’Aquin, of which the former was temporarily a member and the latter the vice president, before having become president. It is all the more important to present this Parisian Société as it included other members involved in the debate under discussion: the engineer, Eugène Vicaire, who published a remarkable critique of Duhemian thought; the Sulpician, Albert Farges, whose “flood of eloquence” Duhem had criticised at the Congrès de Bruxelles; Father Bulliot, who was targeted twice at the same congress before becoming his lifelong correspondent; and Fr Émile Peillaube (1864-1934), whom he later assisted in founding the *Revue de philosophie*.

Picking up on the idea of Père Carlo Maria Jovene (1840-1887), who was a professor of dogmatic theology at the Institut catholique de Paris, the Société de saint Thomas d’Aquin was founded in the autumn of 1884 by Mgr Maurice d’Hulst (1841-1896), its first president, and Domet de Vorges, its first vice president, who was to become

1. A. FARGES, *M. le comte de Vorges*, p. 306.

its president in 1892 (precisely at the beginning of the period under discussion). After having researched and established certain philosophical truths, inspired particularly by Aquinas, its second objective was to “expose and [to] refute modern errors, by basing itself both on Christian philosophy and on the natural experimental sciences”¹. Although there is no official link between the aforementioned Société and the Institut catholique de Paris, “they have many points in common”² acknowledged Mgr d’Hulst, who was president of one and rector of the other, like many of his colleagues who were members of one and professors in the other.

15.6. The “*Annales de philosophie chrétienne*”

It is worth briefly tracing the eventful history³ of the *Annales* in order to establish its positioning during the period under discussion.

Having been founded in 1830 by the layman Augustin Bonnetty (1798-1879) and directed by him, the *Annales* upheld what is known as “Catholic science”. Upon his death in 1879, it was purchased by Xavier Roux (1850-1922) before he handed it over, in April 1884, to Abbey Joseph Guieu (° 1847), who was one of the first members of the Société de saint Thomas d’Aquin. Domet de Vorges presented him as a “partisan of moderate Thomism promoting the serious and observed progress of science”⁴. From this year onwards, the *Annales* would thus become a member of this newly founded Société, for which it would publish the summary of each session and, in the form of articles, a good many of its works. At around the same time, it resolutely abandoned Catholic science, from which it had already begun to distance itself from as early as 1880, in order to promote the “Christian science” upheld Mgr d’Hulst. In 1895, its new director, Abbey Charles Denis (1860-1905), gradually moved away⁵ from Thomism in favour of “the spiritualist school”: having noticed that scientific apologetics was in the process of disappearing, he became increasingly convinced that the neo-scholastic movement was an obstacle to the development of a relevant apologetics. Thus, the collaboration of the Thomists diminished and ceased after the foundation, in 1900, of the *Revue de philosophie*, which in turn became, in 1902, a member of the Société de saint Thomas d’Aquin, although the announced publication of its meeting reports⁶ ceased to be in effect the following year, in accordance with the refusal of its director to “firmly resurrect

1. M. HULST & Ed. DOMET DE VORGES, *Séances de la Société de saint Thomas d’Aquin [...]*, p. 492.

2. *Ibid.*, pp. 492-493.

3. Cf. Fr. BERETTA, *Monseigneur d’Hulst et la science chrétienne*, pp. 98-99; R. N. D. MARTIN, *Pierre Duhem*, pp. 49-58; and H. W. PAUL, *The Edge of Contingency*, p. 13.

4. M. D’HULST & Ed. DOMET DE VORGES, *Séances de la Société de saint Thomas d’Aquin*, p. 494.

5. While Abbey Denis had published the summaries of the meetings of the Société de saint Thomas d’Aquin in full during his first year of office, he then spaced them out with the last having appeared in 1900.

6. Cf. *Revue de philosophie*, 3rd year, 1902-1903, p. 250.

scholastic philosophy”¹. Upon the demise of Abbey Denis, in 1905, the *Annales* was secretly acquired by Blondel, who assigned its direction to his friend Lucien Laberthonnière (1860-1932). Open to the Catholic ideas and intellectuals of the time, it began to be accused of modernism following the publication of *Pascendi* in 1907. In May 1913, a decree from the Holy Office blacklisted all the issues published by Blondel and Laberthonnière, and forbade the latter to publish anything further. The two friends thus decided to close the journal.

It is worth noting that as soon as the *Annales* was in the hands of his friend Blondel, Duhem, who had until then refused to contribute to it, agreed, from the very next issue, to publish an article in it, in this case *Physique de croyant*, and would publish, in 1908, his famous *Σώζειν τὰ φαινόμενα*, before harshly criticising its having been blacklisted: “There is only one way to describe what is happening”, he wrote, “Pius X is a wretch”².

During the period under consideration, this journal, which had successively been — to make a long story short — a follower of Catholic science, Thomism and a supporter of “Christian science”, gradually became opposed to Neo-Scholasticism, before ending up as modernist, and was thus concluding its “Thomist phase”.

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1. Letter for which both the sender and recipient remain unknown, dated 22/01/1902 quoted in J.-Fr. STOFFEL, *Le phénoménalisme problématique de Pierre Duhem*, p. 319, note 1.

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