The Royal Academy of Sciences of Paris and the birth of historical epistemology

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Introduction : organizing institutions, sharing knowledge.

The history of the creation and reformation of the Royal Academy of Sciences of Paris is part of a complex set of political, scientific, economic and cultural issues that have been the subject of important studies. In 1666, Colbert, minister of Louis XIV, proposed the creation of a general Academy, which later became the Academy of Sciences, in the tradition opened by various scholarly circles of the first half of the seventeenth century[1]. But the changes introduced by the ministry of Louvois, which considerably weakened the institution, lead his successor, Pontchartrain, to take over the Academy, which he entrusted to his nephew, abbot Jean-Paul Bignon, already a member of the French Academy since 1693[2]. Pontchartrain also appointed new members, as the pace of recruitments had been considerably slowed down by Louvois. Among the new recruits were the botanist Joseph Pitton de Tournefort, the chemist Guillaume Homberg and the astronomer Giacomo Maraldi, scholars recognized and supported by members of the Academy, but also relatives of Pontchartrain and Bignon. The Marquis de l'Hôpital entered the institution in 1693, and Bernard Le Bovier de Fontenelle in 1697.

The institution was finally deeply reformed in 1699 and acquired the status of Royal Academy. The new regulations defined the different categories that would organize the work of the members of the Academy, now divided into four large groups : the honorary members, the boarders, the associates and the student academicians. The rules also set out the official functions of the director and especially the perpetual secretary, who was responsible for keeping the records of the institution and for giving the public an annual report on the activities of the society, which would be published at the same time as a selection of memoirs of academicians, in other words, the publications that we know today under the title of

[1] For example the Academy of Montmor, as shown by Simone Mazauric, who also mentions the cabinet of the brothers Dupuy, the conferences of the 'Bureau des addresses' organized by Théophraste Renaudot, the academies of Mersenne and of Bourdelot, Jacques Rohault's lectures, and more. *Cf. Fontenelle et l'invention de l'histoire des sciences à l'aube des Lumières*, Paris, Fayard, 2007, p. 23-26. See also S. Mazauric « Aux origines du mouvement académique en France : proto-histoire des académies et genèse de la sociabilité savante (1617-1666) », in *Académies et sociétés savantes en Europe (1650-1800)*, Daniel Odon-Hurel et Gérard Laudin eds, Paris, Champion, 2001, p. 35-47.

[2] René Taton, *Les Origines de l'Académie des Sciences*, Paris, Palais de la Découverte, 1966 ; Roger Hahn, *L'Anatomie d'une institution scientifique. L'Académie des sciences de Paris, 1666-1803*, Paris, éd. des Archives contemporaines, 1993. Éric Brian and Christiane Demeulenaere-Doutère, eds., *Histoire et mémoire de l'Académie des sciences. Guide de recherche*, Londres — Paris — New York, Lavoisier, coll. Tec & Doc, 1996, 449 p.

Histoire et Mémoires de l'Académie Royale des Sciences[3], whose first volume appeared in 1702 and would continue to be published almost continuously throughout the eighteenth century.

The birth of the Academy of Sciences is therefore a strong political gesture (the assertion of royal power engaged in the production of new knowledge), but also a fundamentally modern act : following the Baconian ideal, which would dominate research for a large part of the eighteenth century, it aimed to promote the progress of scientific knowledge, decided to produce its own journal that not only confirmed the break with the culture of academic secrecy initiated by the *Journal des Sçavans*[4], but which in addition escaped the control of royal censorship, since it was the Academy which decided what would be published[5]. Finally, the Academy adopted French as the only language of publication, breaking definitively with the erudite and elitist tradition of Latin publication.

The choice of the perpetual secretary was not trivial either. As David J. Sturdy remarks, it is difficult to know whether Fontenelle was chosen as the figure who best corresponded to Bignon's ideal secretary for the Academy, with a view to reformation of the institution, or whether the functions envisaged by the rules had been modeled on the personality of Fontenelle[6]. Actually, Fontenelle had many talents. He was most notably a man of science, who mastered modern mathematics, publishing in 1727 of the *Éléments de la géométrie de l'infini*[7], a work which, as Michel Blay has shown, imposed the notion of the infinite as an epistemological presupposition indispensable to the new scientific thought[8]. He also knew how to be the wise interpreter of the different forms of knowledge in construction, and capable of transmitting this knowledge according to the aesthetic and intellectual codes of the most demanding readers, as he had proved in his *Entretiens sur la pluralité des mondes*,

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[3] The exact title is *Histoire de l'Académie royale des sciences, année […] avec les Mémoires de Mathématique et de Physique pour la même année, tirés des registres de cette Académie.* The *Histoire* and the *Mémoirs* constituted separate sections of the publication, each with its own pagination. Hence they are usually referred to distinctly, a practice we will follow here. Hereafter, therefore, *HARS* refers to the *Histoire de l'Académie des sciences*; and *MARS* refers to the *Mémoires de l'Académie des sciences.*

[4] Founded by Denis de Sallo, under the protection of Colbert, the periodical was intended to make known the latest discoveries in science and the arts. Completely in French, it also responds to the desire to break with the tradition of secrecy that weighed on the work of scientists of the time. The first issue was published in January 1665 and would be very quickly followed by the publication of the first issue of *Philosophical transactions of the Royal Society* (March 1665).

[5] This is provided for in a letter of privilege from April 6, 1699. See Anne-Sylvie Guénoun, « Les publications de l'Académie des Sciences : le dix-huitième siècle », in Eric Brian and Christiane Demeulenaere-Doutère, ed., *Histoire et Mémoires de l'Académie des sciences, op. cit*., p. 113.

[6] David J. Sturdy, *Science and Social Status. The Members of the Académie des sciences, 1666-1750*, Woodbridge, The Boydell Press, 1995, p. **xxx**

[7] Fontenelle, *Éléments de la géométrie de l'infini*, Paris, Imprimerie Royale, 1727.

[8] Michel Blay, *La Naissance de la mécanique analytique. La Science du mouvement au tournant des XVII^e^ et XVIII^e^ siècles.* Paris, PUF, 1992, and *Les Raisons de l'infini. Du monde clos à l'univers infini*. Paris, Gallimard, 1993. *Cf. Éléments de la géométrie de l'Infini*, Michel Blay and Alain Niderst eds, Paris, Klincksieck, 1995.

whose success had gone well beyond European francophone elites[9]. But Fontenelle was also a true historian, able not only to record the progressive construction of the royal institution, but above all to draw from it the elements of a history of the human spirit (*esprit humain*) in a fundamentally modern dynamic[10], as he had shown in the *Histoire des Oracles*[11] or in the *Digression sur les Anciens et les Modernes*[12].

Article XL of Louis XIV's reforming regulation of 1699 imposed on the perpetual secretary the drafting of a "*histoire raisonnée*" – a rational account – of the annual activities of the Academy, and it was this project which would finally appear as the annual volumes of the *Histoire et Mémoires de l'Académie royale des sciences*. In addition, a letter of privilege granted the institution the right to print "the Daily Observations, and the annual relations of what has been done in the assemblies of the Academy and generally all that it wishes to produce in its name, as well as the other works, Memoirs, Treaties or Books of the individuals who compose it [...]"[13]. The Academy thus had great freedom of action, since it became its own publisher, which enabled it to meet the dual requirement of communication with a specialized public (the *Mémoires*) and with other readers (the *Histoire*), without fear of censorship and without need for external support, as would have been the case for the *Journal des savants*.

This task was all the more complex because the perpetual secretary did not really have a generic model on which to build his history. Some books of a historical nature were published during the first period of the Academy of Sciences, but they were essentially limited to a particular discipline, sometimes intersecting with research carried out within the Academy, but without systematically giving the complete history of the discoveries of the field of knowledge addressed[14]. For instance, Jean-Baptiste Du Hamel had published in 1698 the first volume of the *Regiæ scientiarum Academiæ historia*[15], followed by a second volume in

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[9] Fontenelle, *Entretiens sur la pluralité des* mondes, Paris, Veuve C. Blageart, 1686. The book was first translated into English in 1687 by John Glanville, *A Discovery of New Worlds*, London, Bentley and Magnes, 1687.

[10] On the commitment of Fontenelle as Secretary of the Academy of Sciences in the Quarrel of the Ancients and the Moderns, see Simone Mazauric, *Fontenelle et l'invention de l'histoire des sciences*, *op. cit.*, p. 177-224.

[11] Fontenelle, *Histoire des Oracles*, Paris, G. de Luyne, 1686.

[12] Fontenelle, *Digression sur les Anciens et les Modernes*, Paris, 1687.

[13] Letter of April 6, 1699 quoted by Anne-Sylvie Guénoun, « Les publications de l'Académie des sciences : le XVIII[e] siècle », in Éric Brian et Christiane Demeulenaere-Doutère, dir., *Histoire et mémoire de l'Académie des sciences*, *op. cit.*, p. 113. All translated passages are due to the author.

[14] *E.g. Mémoires pour servir à l'histoire naturelle des animaux* by Claude Perrault, or *Mémoires pour servir à l'histoire des plantes*, by Dodart, published by the royal printing office in 1676. But most often the publications emanating from the first academy correspond to particular observations, or consist of a collection of some memoirs relating to a particular field, such as the *Divers ouvrages de mathématique et de physique. Par Messieurs de l'Académie des sciences* [Roberval, Frénicle, Huygens and Picard], Paris, Imprimerie royale, 1693. See Anne-Sylvie Guénoun, « Les publications de l'Académie des sciences : avant la réforme de 1699 », in Éric Brian et Christiane Demeulenaere-Doutère, eds., *Histoire et mémoire de l'Académie des sciences*, *op. cit.*, p. 107-112.

[15] *Regiae scientiarum Academiae historia, in qua praeter ipsius Academiae originem et progressus, variasque dissertationes & observationes per triginta annos factas, quam plurima experimenta & inventa, cum Physica, tum Mathematica in certum*

1701[16]. The book had the merit of describing the origins of the first Academy and outlining their main activities between 1666 and its reformation. But this was an extremely synthesizing retrospective work that had little impact upon Fontenelle's later approach.

Thus, for Fontenelle, the setting up of this publication, which he produced continually between 1699 and 1740, provided the setting within which Fontenelle was able to invent a modern history of the sciences, by organizing knowledge according to his own epistemology which offered a rational new way of systematizing the emergent disciplines.

I. Organizing new knowledge

Each of the volumes of the *Histoire de l'Académie royale des sciences* is composed of two parts, contained in a single volume, but recognizable by their distinct pagination. The first part is that designated by the title of "History" ; the second is that of the "Memoirs", where the works presented by the members of the institution or sent by the foreign correspondents and approved by the Academy were collected. The publication of the memoirs is placed under the responsibility of the perpetual secretary, whose name is never mentioned, and it constitutes, as Fontenelle himself put it, a sort of appendix of original sources annexed to the historical account[17].

Placed in the first part of the volume, the "History" of the Academy of Sciences thus constitutes a kind of overall presentation of the activities of scientists during a calendar year, offering the reader a general overview of the main discoveries made during this period and proposing a reading of the memoirs themselves. Thus conceived, the book is addressed to two audiences : those "who have only a mediocre tint of Mathematics and Physics"[18], and the "deep philosophers" [savants profonds][19]. The first group would begin with the general historical presentation, and if they so chose, would complete their reading by turning to the corresponding memoir, when there was one[20]; while the second group would pass directly to the more challenging memoirs. The book thus invites readers to go from the simplest to the most complex, and supposes not only some curiosity for the sciences, but also some basic

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ordinem digeruntur. Secundo editio priori longe auctior. Autore Joanne-Baptista Du Hammel, ejusdem Academiae Socio & Exsecretario, Paris, E. Michallet, 1698.

[16] *Regiae scientiarum Academiae historia, in qua praeter ipsius Academiae originem et progressus, variasque dissertationes & observationes per triginta annos factas, quam plurima expérimenta & inventa, cum Physica, tum Mathematica in certum ordinem digeruntur. Secundo editio priori longe auctior. Autore Joanne-Baptista Du Hammel, ejusdem Academiae Socio*, Paris, J.-B. Delepine, 1701. It is actually a second augmented edition, which covers the years 1699 and 1700.

[17] "The place of the Memoirs here is comparable to that of primary source documents which are sometimes annexed to ordinary Histories," *HARS* 1699, « Préface », p. ii.

[18] *Ibid.*

[19] *Ibid.*, p. iii.

[20] Some articles in the *HARS* do not refer to a published memoir.

knowledge in the matter, because, says Fontenelle, "those who have absolutely no scientific knowledge would do better to limit themselves to a more general overview, since whole treatises would be required were we to attempt an explanation that returned to the first elements"[21].

The historical section was, moreover, systematically divided into chapters corresponding to the scientific disciplines recognized by the Academy, grouped into two large sections, Physics and Mathematics. Most of them are fixed chapters corresponding to the disciplinary fields addressed by the academicians : the Physics section included general physics, anatomy (human and animal), chemistry, botany ; while the Mathematics section included algebra, geometry, astronomy, optics, acoustics and mechanics[22]. Roger Hahn sees in this division between mathematics and physics the sources that had formed these disciplines in the seventeenth century, one from the *quadrivium*, the other, a legacy of the Baconian approach to nature based on observation and experience[23]. It may be added that the distribution of these chapters takes the reader from the empirical sciences (Physics) to the abstract sciences (Mathematics) in a movement of increasing intellectual abstraction which establishes a sort of hierarchy between disciplines, starting with the most empirical subjects to finish with those which rest on pure reason. As Fontenelle himself says : "we will begin with physics, because it is easier and less abstract"[24]. This classification corresponds as well to the hierarchy of knowledge on which Fontenelle bases his theory of knowledge.

Actually, the historical part contains much more than just the summary of scholarly memoirs and the record of academic sessions. Fontenelle comments on, discusses, rewrites the theories expounded in the memoirs, introduces reflections on the conditions of the production of knowledge, and brings in themes from his personal work. Fontenelle's discursive strategy for the validation of the sciences of nature appeals to the double epistemological requirement of observation followed by experience. Each of these stages helps to enhance the degree of certainty of scientific knowledge. The meticulous and repeated observation of natural phenomena makes it possible to inscribe the discourse on nature in the register of the probable, and its status is progressively enhanced by accumulated validation. On many occasions Fontenelle insists on the necessity of repeating observations before

[21] *HARS* 1699, « Préface », p. ii.
[22] Depending on the year, chapters on acoustics, optics, and mechanics may be missing from the HARS, just as there may be new chapters, such as catoptric, dioptric, and even geography (about the geographical measurements of the Ancients). The chapters in the "physics" section do not vary much.
[23] Roger Hahn, *L'Anatomie d'une institution scientifique. L'Académie des sciences de Paris, 1666-1803*, Paris, Éd. des Archives contemporaines, 1993, p. 77.
[24] *HARS depuis son établissement jusqu'en 1686*, t. I, p. 17.

drawing any general law. This is the case for instance when he comments on a memoir about the influence of the heart's fibers on the circulation of blood : "It is easy to judge how many observations would be needed to verify that thought. It is enough to propose it now, in the hope that it captures some glimmer of verisimilitude"[25]. The functioning of experience should be conceived, not as a single phenomenon, but precisely as a perspective, or as a search for analogical relations between the various experiments and observations, explains Fontenelle. Only experience can definitely inscribe the discourse of nature in the register of the probable, even if this process is likely to take a long time to complete. This is what he says, when he comments on a memoir about a "petrified ox brain" : "Only experience can be allowed to attack a system as old, as natural, as necessary as one which establishes the brain for the principle of all animal movements". And further on he concludes : "We propose here only conjectures in need of confirmation by experience [...] It will only be by a large number of singular accidents of the brain, compared to one another, that the workings of this organ might be determined, its extent and its limits; though such knowledge may prove unattainable"[26].

Mathematics presupposes, on the contrary, abstraction, the elevation of the mind and the use of speculative faculties, essentially based on hypothesis and logical verification, which places the mathematical discourse in a degree of veracity that is substantially different from the disciplines categorized as "Physics" and based on observation and experimentation. In other words, "in geometry every possibility is a fact, but it is not the same in physics"[27]. The reason for this difference lies in the very nature of the object studied, because "geometry is subject to nothing in its hypotheses, only to a pure and simple possibility which is infinite and infinitely infinite in comparison with what exists, which is the object of physics"[28]. This does not mean that any mathematical system can be definitively proved: "one realizes all too often in mathematics, that what is not demonstrated with rigor, is not proven at all, and that there is no certainty if the proof is not complete"[29], said Fontenelle. But the mathematician has an intellectual freedom that one could in certain points compare to the demiurgic aptitudes of artistic creation.

Thus, the norms of scientific discourse are subject to the various methods applied to the scientific study of a range of natural and abstract objects. The same goes for the organization

[25] *HARS* 1703, p. 14.
[26] « Sur un cerveau pétrifié », *Ibid.*, p. 26 et 27.
[27] « Sur le changement des acides en alkali », *HARS* 1717, p. 36.
[28] « Sur les rapports de densité de l'air », *HARS* 1716, p. 42.
[29] « Sur la construction des égalités », *HARS* 1708, p. 71.

of this knowledge when it comes to reporting it to the public, as is the case in the *Histoire de l'Académie royale des sciences*.

Each chapter of the *Histoire* presents a complex and often heterogeneous structure : a variable number of articles, more or less short, offering, without a clearly defined order, brief information, reviews of recently published works, scientific curiosities communicated by correspondents of the Academy in the provinces or abroad, reports of works presented to the members of the institution (which may or may not be published in the same volume), and reports of the working sessions of the academicians around scientific topics. Some of the texts mentioned in the volumes had not yet been published, and, similarly, some of the memoirs that appear in the second part of the volume are not are not commented on by Fontenelle. So, if the division into chapters according to the two main categories of Physics and Mathematics imposes a form of order on the whole, the organization of the chapters themselves does not seem to respond to any predefined chronological plan or set of themes.

The difference between the "Mathematics" and "Physics" sections is not quantitative, it is mainly of a qualitative nature. Indeed, the "Physics" section contains a heading that is completely absent from the "Mathematics" section. While the latter is composed exclusively of reports of memoirs published in the volumes of the *Histoire de l'Académie royale des sciences*, problems discussed in session or books on topics of interest to the Academy, the various chapters that form the section "Physics" include a special section, called "Observations" : "Observations of general physics", "anatomical observations", "observations of chemistry", etc. The pieces gathered under this sub-category are often very pleasant presentations, noting brief information concerning scientific curiosities communicated by the correspondents of the Academy in the province or abroad, accounting for exchanges of information between the academicians and their correspondents, summarizing works presented by the members of the institution (observations or experiments made in meetings), or commenting, in the informal tone of the conversation, on the discussions of the academicians regarding the latest scientific news[30]. The observations also include examples of scientific anecdotes, which are often accompanied by general considerations about the importance of observation, or about the difficulties associated with knowledge of nature, as well as other themes. The "observations" thus constitute the part of the *Histoire* where Fontenelle is the most free to choose the subjects exposed, and the discursive modalities

[30] See for example a series of observations about the ability of some animals to survive without food, which reproduce a conversation in which intervene successively Jean Gallois, Jean-Baptiste Du Hamel and Maraldi. HARS 1706, « Diverses observations de physique », II et III, p. 5 et 6.

according to which they will be approached. The fact that Fontenelle favors the informal treatment of academic facts in "observations", or that he decides to summarize and comment on one or more memoirs in a report, are examples of the strategic choices he made. They need to be studied as a structured whole, giving coherent expression to a particular outlook.

Among the other structural choices, the first and most obvious is the possibility of not reporting on the work of academicians, and replacing it instead with important work done outside the Academy. At first sight, Fontenelle respects what the preface of 1699 indicated :

> When [...] a matter contained in the Memoirs was in itself so intelligible that it could not be made clearer in the History, we have spared the useless trouble of repeating it[31].

According to this principle, many memoirs deserve only summary references. One case in point is the "big collection of Mr. Mery's observations on hernias":

> It is given to the public, because it has been thought a useful practical example ; but we do not make an excerpt from it in this history, because the matter is of itself sufficiently intelligible, and because it would not be to the taste of those who seek only the brilliancy of theory, and systems.
>
> For the same reasons, nothing is said here about observations on several dropsies, made by M. du Verney[32].

Most often, the references are even more succinct : "We refer entirely to the Memoirs, two writings of M. Winslow on the circulation of the blood in the fetus and the extract from various Memoirs of M. Sarrazin on the muskrat"[33]. On each such occasion, a marginal note refers the reader to the appropriate section of the *Memoirs*. In the end, we see that fewer memoirs are subject to a report than we might have expected. Fontenelle says of such texts that they "do not contain anything difficult to understand, nor that gives new views for Systems[34]"; or that the subject does not seem worthy of mention as a significant contribution to the history of the Academy, or to the history of human discoveries.

These purely formal observations show that, even if the Academy of Sciences as an institution decided on the publication of a dissertation, its perpetual secretary would sometimes choose not to give an account of it in the historical part, thus choosing to ignore the work of a colleague. It is true that the "Preface" of 1699 had announced that,

> When a matter could not be turned in another way, and treated less thoroughly than it was in the Memoirs, which sometimes happens in the case [...] of demonstrations of

[31] *HARS* 1699, « Préface », p. iii.
[32] *HARS* 1701, p. 56.
[33] *HARS* 1725, p. 28.
[34] *HARS* 1699, « Préface », p. iii.

> geometry and algebra, it has been passed over in silence, unless there is reason to remark on some historical progress that has been made in the matter[35].

But it is not precisely the clarity of the demonstration that explains the silence of Fontenelle with regard to certain works by his colleagues. This is the case for example of a memoir by Pierre Rolle[36] published in 1703[37], and for which there is no extract or even a mention in that year's *Histoire de l'Académie royale des sciences*. The silence is due to the author's engagement with Jean Gallois in the fight against the « infinitarians » [*infinitaires*] whom Rolle accused in his memoir of obscuring geometry by errors unworthy of this noble discipline. Fontenelle would not comment further on the other memoirs of Rolle or Gallois, referring to them only in a very summary way. It thus appears that Rolle's memoir against the geometry of the infintarians did not seem to Fontenelle important enough to notice. This dissertation is a work of the Academy, but because of Fontenelle's choice, it is not part of its history. His only reference to the case occurs in an "Avertissement" placed at the head of the volume of 1704 where, in a different typography and using elliptical and impersonal formulations, he noted that:

> *In the Memoirs of 1703, page 312, a piece by M. Rolle, entitled* Of the New System of the Infinite, *was printed. The reflections that various persons have made on this writing, on the principles advanced therein, and on the consequences that might be drawn from it, oblige us to state that, although it is among the other works intended for printing by the Academy, its intention has never been to adopt anything that can be found there*[38].

The absence of comment remains exceptional. Certainly, Fontenelle failed to make some reports, but usually only on writings that could be described as minor work. On the whole, he fulfilled his obligations to the institution, reporting on memoirs or works he could not ignore. But the official character of the *Histoire de l'Académie royale des sciences* did not prevent Fontenelle from making his opinion heard on certain delicate subjects, or from effectively effacing them from the records. Even if he was not supposed to express personal opinions, the secretary of the Academy was able to use the flexible structures of the academic reports to advance his vision of the history of the construction of knowledge.

II. Organization of knowledge and epistemological history.

[35] *HARS* 1699, « Préface », p. iii.
[36] Pierre Rolle (1652-1719), was a student academician in astronomy in 1685, then a boarder in geometry in 1699, the first holder appointed by Louis XIV. He became a veteran boarder a few months before his death.
[37] « Du nouveau système de l'infini. Par M. Rolle », *MARS* 1703, p. 312-344.
[38] *HARS* 1704, « Avertissement ». Italics in the original.

Fontenelle gives only a few lines to pieces he considers unreliable, while he examines other information, including some memoirs, in very long commentaries. Thus, on a letter received from Cadiz in 1703, mentioning a strange phenomenon on the sea: "for fifteen nights in a row was observed all over the brilliant sea a clear light, almost like liquid phosphorus". It was even claimed that "the water of the sea carried in bottles, produced the same lighting effect in the dark, and that a few drops poured on the ground shone like sparks of fire"[39]. The conclusion of Fontenelle is brief and clear : everything is false. "The Academy believes it as important to disabuse the public of false marvels, as it is to announce true ones"[40]. Though such information deserves only a small paragraph in the "observations", a memoir by Varignon on the "formation of spirals" inspires a long report, in which Fontenelle praises "the great advantage of Modern geometers over the Ancients"[41].

We also note that some topics come back regularly, not only from year to year but within the same volume. This practice makes it possible to reconstruct real series within the chapters and in the duration of the volumes, and to follow the discussions around a particularly important or controversial issue for a given period. In such cases, Fontenelle habitually mentions in the opening of his account the state of the question in the preceding volumes, and refers, in a footnote, to the different articles in the History or to the memoirs in which the question has already been analyzed. Thus, for example, one can follow the different opinions concerning the circulation of the blood in the fetus[42], the nature of fossil shells and the origin of mountains[43], or the discussions around the origin of monsters[44], to take only a few examples of thematic series in the domain of "physics".

We know the importance that Fontenelle attached to the history of the various scientific disciplines as a way of perceiving the evolution of the human spirit. As he affirms in the *Éloge* of Montmort :

> He had been working for a while on a *Histoire de la Géométrie*. Every Science, every Art should have its own history. It is very agreeable, and this pleasure contains a great

[39] *HARS* 1703, « Diverses observations de physique générale », X, p. 22.
[40] *Ibid.*
[41] « Sur les spirales à l'infini », *HARS* 1704, p. 47-57, in particular p. 53. Also « Nouvelle formation de spirales », *MARS* 1704, p. 69-131.
[42] « Sur la circulation du sang dans le fœtus », *HARS* 1739, p. 4-14. Fontenelle reviews the memoirs published on the subject since the reformation of the Academy, in 1699, 1701, 1703, 1717, 1725 and finally in 1738.
[43] « Diverses observations de physique générale », *HARS* 1703, XI, p. 22-24 ; « Diverses observations de physique générale », *HARS* 1706, X, p. 9-11 ; « Sur l'origine des montagnes », *HARS* 1708, p. 30-33, « Sur le crystal », *HARS* 1708, p. 33-34, and p. 34-35 ; « Sur l'origine des pierres », *HARS* 1716, p. 8-16 ; « Sur des empreintes de plantes dans des pierres », *HARS* 1718, p. 3-6 ; « Sur des coquilles fossiles de Touraine », *HARS* 1720, p. 5-9.
[44] Fontenelle refers to the numerous memoirs and reports published on the subject in the article « Sur les monstres », *HARS* 1740, p. 37-50.

> deal of instruction, to see the road which the human mind has followed, and to speak geometrically, that kind of progression, the intervals of which are at first extremely great, and then naturally draw ever closer together[45].

The *Histoire de l'Académie royale des sciences* gives the author the opportunity to contribute to this work, as shown by the existence of the thematic series mentioned above. Certainly, the result constitutes only chapters within the history of a given discipline, and not a history of every discipline. But Fontenelle was aware of his limits, and did not claim to propose a historical synthesis of physics, anatomy, or mathematics. The *Préface sur l'utilité des mathématiques* was already perfectly clear in this sense :

> The Academy of Sciences has so far taken Nature only in small parts. No general system is constructed, for fear of falling into the error of precipitous systems, to which the impatience of the human spirit is only too readily inclined[46].

This famous statement has always been interpreted as an epistemological principle governing the elaboration of a general theory of the knowledge of nature. But the elaboration of this general knowledge is inseparable from the production of a historical discourse on nature, of which the *Histoire de l'Académie royale des sciences* is one of the first examples. Fontenelle actually rejects dogmatic systematizing, even though that view does not prevent him from advocating the collection of the scattered elements which necessarily constitute this knowledge and which will make it possible, step by step, to constitute the memory of the discoveries of which the human mind is capable, and with which scholars will one day be able to write the history of the different scientific disciplines :

> The time may come that we will be able to join these scattered limbs into a regular body; and if they are as we would wish them to be, they will in a sense assemble themselves spontaneously. When several separate truths exist in sufficient number, their relations and their mutual dependence strikes the mind so vividly that, after having been detached by a kind of violence from one another, they seem naturally to gravitate together[47].

Fontenelle manifests the same conviction in the volumes of the *Histoire de l'Académie royale des sciences*, and in his work as historian and regulator of scientific methods and practices. Each account, each disciplinary chapter, can be seen as one of those "separate truths" which, though interesting in themselves, do not in themselves constitute sure knowledge. But, on the other hand, a sufficiently long series of articles may offer to the mind

[45] *Éloge de Montmort HARS* 1719, p. 92.
[46] *HARS* 1699, p. xix.
[47] *Ibid.*

a more secure form of knowledge, based on constants, on relations between isolated facts: in other words, based on laws.

This principle makes it possible to explain Fontenelle's historical practice in a different way and to see the processing of accounts as something other than the construction of the memory of the institution. The paratexts (notes and marginalia) that characterize the different articles of the *Histoire de l'Académie royale des sciences* written by Fontenelle weave relationships between the different "separate truths", until these truths appear in number sufficient to be able to propose a new certain knowledge. It is besides Fontenelle himself who gives us this key, when, at the end of his term in office as secretary, he proposes some articles of synthesis on the big questions which traversed the *History*. We can mention the article entitled "Sur les monstres" that Fontenelle published in 1740, and which, besides the historical review of the theme, analyzes several new memoirs: so that "the whole could be more easily seen at a glance"[48]. He proceeds in the same way on the question of the circulation of blood in the fetus, in a synthesis that he published in 1739, taking up two memoirs by Louis Lemery published in the same volume[49]. The opening of the article explains the importance of the issue:

> This question has occupied the Academy since its reformation in 1699*. It was continued in 1701*, in 1703*, in 1717*, and finally in 1725*, and although so often and so continuously agitated, the matter remained rather undecided, not by the obstinacy of a vanquished party which refused to surrender, but because the weakest party indeed was not entirely defeated. [...] It would be best for all such questions, including those just enumerated, to be consulted in their original settings because we believe we must spare the reader a long and tiring repetition of a hundred things already said, and most of them more than once[50].

The report then extends over a dozen pages, most of which is reserved for the history of the controversy, and, above all, the presentation of the hypotheses defended by the two camps (Lemery against Méry and later Winslow), punctuated by many marginal references to reports published in the various volumes of the *Histoire*. The presentation that Fontenelle makes of the memoir which serves as his point of departure thus problematizes the history of the debate, as if this were the most propitious ground upon which to seek a resolution. Then, after showing what has been settled in the matter, he concludes :

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[48] *HARS* 1740, p. 35.
[49] « Sur le trou ovale. Premier mémoire », *HARS* 1739, p. 31-50 ; « Sur le trou ovale. Second mémoire », *Ibid.*, p. 97-118.
[50] « Sur la circulation du sang dans le fœtus », *HARS* 1739, p. 4. Asterisks refer, in the margin, to memoirs and accounts dealing with the issue for each of the years mentioned.

> If the light that we have just shed on the question of the circulation of the blood in the fetus could finally resolve it, this example would help to prove that the debates of philosophers, though protracted, are not never-ending, and that instead of reproaching them with their uncertainties, we should praise them for the wise patience with which they wait on the necessary clarity[51].

Thus an episode in the great history of human anatomy offers several lessons to the reader : first, the increasingly precise knowledge of how maternal blood passes into the body of a child, which is an achievement of Science. But equally important, if not more, a methodological and epistemological lesson : there is no absolute knowledge in itself, especially in physics ; science is built over time in successive "chapters" and requires the patient work of the historian, able to establish a relationship between the "separate truths" which, through their meticulous confrontation, allows an institution like the Academy to build up an ever more secure truth. Fontenelle's *Histoire de l'Académie royale des sciences* aspires to participate, through patient discursive work, in the progressive construction of these truths.

The form taken by the *Histoire de l'Académie royale des sciences* corresponds perfectly to the principles on which Fontenelle bases the very possibility of scientific knowledge, particularly as regards the broad category of 'physics'. The knowledge of nature is based on the possibility of discovering relationships between singular natural phenomena. This work, put into practice in everyday writing, can be appreciated only over time, and the construction of scientific knowledge is combined with the progressive historical narrative of the "history of the human mind"[52].

Indeed, the elaboration of scientific discourse benefits from the serial treatment adopted by Fontenelle. Admittedly, this approach results from a generic constraint (the historical model), as well as the scientific policy of the Academy, eager to build up the history of its discoveries as a story of scientific conquests. But the choice in the presentation of the reports, and the system of references by which Fontenelle weaves together the threads of this story, confirm the epistemological attitude that characterizes the whole of Fontenelle's work : scientific knowledge is a historical production, built on the denunciation of errors, in search of the principles that ground truth. This essentially discursive conception of knowledge about Nature seems to reflect the influence of Gassendi's thought, which has been explained by Olivier Bloch in the following terms:

> Our concepts are not essences : they are human works, just as the thought that shapes them is human; they contain nothing but what has been produced by experience and reasoning, that is to say, the more or less definite and more or less rich series of attributes

[51] *Ibid.*, p. 13.
[52] Jean Dagen, *L'Histoire de l'esprit humain dans la pensée française de Fontenelle à Condorcet*, Paris, Klincksieck, 1977.

> and accidents of the thing which we seek to know. As such, they only ever represent one stage in the progress of knowledge, and their content is a function of the degree we have reached in that indefinite process[53].

To Fontenelle, the empirical study of nature does not produce a self-sufficient structure (capable of grasping and fully interpreting the reality in question, as is the case with mathematics), but it is a necessary step in the elaboration of conceptual instruments allowing the interpretation of Nature, the ultimate goal of scientific inquiry. The discursive organization of knowledge thus becomes an analytical structure essential to the elaboration of authoritative knowledge: "Every subject exactly considered becomes infinite, and the attention we pay to it acts as a sort of microscope, which magnifies and multiplies it always, in proportion as our knowledge of it becomes more perfect"[54].

Fontenelle thus operates a reversal of epistemological perspective that distances his thought from that of Descartes: in the discourse on nature proper to scientific knowledge, it is impossible to "dismiss the facts" in the Cartesian manner. As in Gassendi's work, it is not the principles that make possible the construction of knowledge, it is knowledge in construction by discourse that reveals the laws. The epistemological, rhetorical, aesthetic, even stylistic attitude of the *Histoire* help to make meaning. The choice of observations, the use of the principle of analogy as a form of experience of thought; these are the sorts of choices that render empirical knowledge unstable and subject to criticism. Fontenelle felt he could not offer a definitive history of 'science' because he was conscious that such knowledge was as yet far from securely established. But he hoped that his history of the imperfect pathway towards proper 'science' would constitute a corrective to methods and practices, and thus make the realisation of the ideal more likely in the future. these are the sorts of choices that have to be made for a form of empirical knowledge that is never definitive[55].

Conclusion:

Fontenelle inscribes nature and discourse on nature in a constant dynamic tension, opening wide the perspectives of the progress of knowledge, and makes of this movement the object of an aesthetic but also an intellectual pleasure totally breaking with the Christian vision of the

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[53] Olivier Bloch, *La Philosophie de Gassendi. Nominalisme, matérialisme et métaphysique*, La Haye, M. Nijhoff, 1971, p. 113-115.
[54] *HARS* 1706, « Sur la formation de la voix », p. 15.
[55] M.S. Seguin, « Le statut discursif de la Lune entre fictions et mathématiques dans les écrits de l'Académie des Sciences », dans *La Lune au XVII^e siècle*, sous la direction de Chantal Grell, Turnhout, Brepols, 2014, p. 185-202.

world[56]. As in the *Digression sur les Anciens et les Modernes*, the history of the human spirit represented by the history of sciences, is never ending.

In the volumes of the *Histoire de l'Académie royale des sciences*, Fontenelle praises the libido sciendi, or the pleasure of Nature, whose multiple forms perpetually launch new challenges to the spirit of man ; also the philosopher's pleasure, constantly trying to apprehend it, even if he knows that it will always escape him a little. Finally, behind his worldly mask and his official duties, Fontenelle shows a radical freedom of spirit, which makes him one of the most daring libertines of the late seventeenth century and, already, one of the boldest spirits of the Enlightenment[57].

Fontenelle's work, organizing and interpreting knowledge between the seventeenth and eighteenth centuries constitutes an essential articulation in the diffusion of new ideas and the illustration of a transformation of the strategy of diffusion of novel philosophical conceptions. Intended for a wide audience, cultivated but not always erudite, written in a polished literary tone, but apparently devoid of the brilliant and polemical effects of some of its contemporaries, the volumes of the *Histoire de l'Académie royale des sciences* written by Fontenelle from 1699 to 1740 contributed undoubtedly more than other works to impose in a subtle and conciliatory way a certain vision of nature and knowledge on an audience of European dimensions. Fontenelle's elaboration of the detail of the implications of the empirical epistemology for specific disciplinary practices puts him in the vanguard of the encyclopaedism which would take off so significantly in the mid to late eighteenth century, in France and elsewhere.

[56] M.S. Seguin, « Des idées matérialistes dans le discours officiel sur les sciences : Fontenelle à l'Académie des sciences », in *Matérialisme(s) en France au XVIIIe siècle. Entre littérature et philosophie.* Adrien Paschoud/ Barbara Selmeci, eds., Berlin, Franck et Timme, 2019, p. 51-79.

[57] M.S. Seguin, « Fontenelle, au tournant des XVII^{e} et XVIII^{e} siècles », in *Philosophie et libre pensée. Philosophy and Free Thought. XVII^{e} et XVIII^{e} siècles.* Textes réunis par Lorenzo Bianchi, Nicole Gengoux et Gianni Paganini. Paris, Honoré Champion, 2017, p. 347-361.