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Methodological Parameters of the Research of Lazzaro Spallanzani

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ABSTRACT

The Italian Lazzaro Spallanzani belongs to a tradition of naturalists of the 18th century characterized by the systematic adoption of the experimental method of research in living beings, called at that time "the Art of Observation". In this paper, it is argued that Spallanzani had a epistemological model which structured the relations between the empirical findings, theory and method, although he only occasionally presented reflections on it. In a small memory which was to serve as the syllabus of the discipline of Natural History to be held at the University of Pavia, Spallanzani argues for the necessity that discoveries obtained through observation and experience be united in what he called "the systematic part of science", i.e. in theories on the living beings, which further needed to be combined with the "spirit of observation", i.e. what we came to call the "experimental method".

Keywords:

History of Biology; 18th Century; Lazzaro Spallanzani; Art of observation; Observation and experience.

RESUMO

No presente artigo, tomamos o caso do italiano Lazzaro Spallanzani (1729-1799) como exemplo de uma tradição de naturalistas do século XVIII caracterizada pela adoção sistemática do método experimental de pesquisa em seres vivos,à época chamado "arte de observar". Spallanzani dispunha de um modelo epistemológico estruturando as relações entre descobertas empíricas, teoria e método. Ele considerava que os resultados obtidos por meio de observação e experiência sobre o funcionamento dos seres vivos deveriam ser reunidos no que chamava "parte sistemática da ciência", isto é, em concepções teóricas que explicavam os sistemas vitais. Será apresentada a tentativa de Spallanzani de definir esse método de investigação e de particularizar seus componentes empíricos e conceituais. Também será mostrado de que modo ele conjugou esses elementos como condição essencial para o treinamento e formação de jovens que queriam seguir a carreira de naturalista.

Palavras chave:

História da Biologia; Século XVIII; Lazzaro Spallanzani; Arte de observar; Observação e experiência

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From an historiographical standpoint, the present work is located in a perspective in the History of the Life Sciences expanded in the 1990's, according to which, since the dawn of modern science, empirical investigation of living beings occurred intimately intertwined with theoretical constructions and methodological concerns. It opposes, thus, so-called *renewed historiography* which, in the middle of the 20th century, converged with the notion of *scientific revolution* characteristic of the History of Physics, and interpreted research on living beings from the 16th to the 19th centuries as a mere gathering of empirical data, devoid and even incapable of forming "any general and stable interpretative structure whatsoever" of the living beings.[1]

In the last two decades, analyses on the Life Sciences, such as François Duchesneau's, had shown that the "elements for a theory of the living beings" may be found from the 16th century on, from a "close correlation between philosophical invention and empirical, experimental and conceptual considerations".[2] Focusing especially on the 17th century, Duchesneau adds:

> "Philosophers, as well as practitioners of science doubtlessly try doubtlessly, to elaborate explanatory models which will orientate and influence their ulterior research and the general economy of the science of nature and philosophy in its subsequent stages. Even if the period in which we occupy ourselves cannot see biology and its main components soaring and does not design the foundational theories of the physiological sciences as we conceive them today, this does not reveal a failure or a limitation of the deep research traditions, eliminated without having been replaced. On the contrary, most of all, that period translates the effervescence of methodological attempts, sometimes convergent, sometimes divergent, to enclose nature and the properties of a project of paradoxical aspect in the frame of a new philosophical and scientific understanding of natural realities."[3]

We believe this to be a very fitting perspective to trace the epistemological model underlying the research conducted by Lazzaro Spallanzani. The books he published contain detailed reports of numerous observations and experiences about the functional systems of animals and plants, like reproduction, digestion, circulation and respiration. We consider to be well established by recent historiography that empirical findings undertaken in each of these themes were oriented by well-defined theoretical concepts. A well known case, to quote only one as an example, concerns the observations and experiences on reproduction, interpreted by Spallanzani on the grounds of the theory of preformation of living beings.

Besides taking in consideration the close link between theory and empirical research, Spallanzani did not withhold attention from the role of the "Art of Observation" in the development of research, although not in a systematic mode, as he himself wrote in a 1780 small paper, *Picciola memoria relativa al modo con cui il Professore di Storia Naturale della Regia Università di Pavia suole combinare la parte sistematica della Scienza che insegna con lo spirito di osservazione*: "I never stop reflecting about it in my explanations, [although] not in any

[1] A.R. Hall, *A Revolução na Ciência*, 1500-1750 (Lisboa: Edições 70, 1988), 246.
[2] F. Duchesneau, *Les Modèles du Vivant de Descartes à Leibniz* (Paris: Vrin, 1998), 11.
[3] Ibid., 12-13.

particular treatise, but disseminated along all those places where I judge that I may come to talk about it".[4]

It is appropriate to make a stop here, as it is a text published only very recently, in the *Edizione Nazionale delle Opere di Lazzaro Spallanzani*, which collects 22 volumes of published and posthumous works, letters, literary writings, manuscripts, besides lessons in several fields he taught throughout his career.[5]

Picciola memoria belonged with a broad project of university reform in Italian Lombardy, at the time of the government of Austrian Empress Marie Therese.[6] Launched in 1753, this reform included a project approved by the Empress in 1771, titled *Direction, Discipline and Economy Plan of the University* and, two years later, a *Scientific Plan*.[7] These documents, worked out in Vienna, drew the guidelines for university disciplines, the syllabus of which the professors ought to work out and send to Vienna for evaluation and approval. A few years later, in 1780, Spallanzani, chosen to inaugurate the chair of Natural History[8] in the University of Pavia, wrote his "grounded program for the biannual course of its classes, combining the systematic part with the spirit of observation", viz. the *Picciola memoria*, addressed to prince Kaunitz.[9]

The link to the Austrian authorities may also be assessed by the inscription made by Spallanzani, on that same year, on the work *Opuscoli di Fisica Animale e Vegetabile*, which contains his famous studies about digestion and reproduction, to the Royal Court Minister of Vienna, baron di Sperges e Palentz, Royal Counselor of the Department of Italy. Spallanzani thanks him for the gathering in Germania, Bohemia and Hungary of the "most beautiful collections of natural products" to be integrated to the collection of the Royal Cabinet of Natural History of Pavia, which he directed.[10]

Picciola memoria, however, more than describing the program for the discipline of Natural History, had the explicit goal of emphasizing the importance of "directing the young in the difficult art of observing well". Spallanzani believed that the best way for the young to learn the method was to repeat the studies of observers "well versed in the art", and as examples, he mentioned Malpighi, Lyonnet and Réaumur. The reason for the young to walk in the steps of such "first-line naturalist" was to be enable themselves to adapt "taken for granted theories on the difficult art of observing well" to their own practice. He detailed some of the observations on insects (organisms "easy for us to find in the spring") that his students repeated every year according to Réaumur's studies. Spallanzani also

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[4] L. Spallanzani, "Picciola memoria relativa al modo con cui il Professore di Storia Naturale della Regia Università di Pavia suole combinare la parte sistematica della Scienza che insegna con lo spirito di osservazione", in *Edizione Nazionale delle Opere di Lazzaro Spallanzani* (Modena: Mucchi, 1984-2004), Parte seconda: Lezione, volume primo, 12.

[5] Spallanzani, *Opere*.

[6] At that time, the University already had, since 1742, a chair of experimental Physics, although equipped with a small number of instruments. In November 24th 1765, a *Reggia Deputazione* was established to enact the reforms which constituted the framework for the university teaching of Natural History. It included a reform of the syllabus and the physical space, such as the increase of rooms for the "library, experimental Physics instruments, the botanical garden and even some furniture for Natural History". A. Ferraresi, "Spallanzani Docente di Storia Naturale all'Università di Pavia: Gli Esordi", in *Il Cerchio della Vita*, Ed. W. Bernardi & P. Manzini (Firenze, Olschki, 1999), 264, 267.

[7] *Piano di Direzione, Disciplina ed Economia dell'Università*, approved in October, 13th, 1771; *Piano Scientifico*, November, 4th, 1773; Ibid, 282.

[8] The chair of Natural History was created in the Philosophy Faculty in 1769 through a *Temporary Delegation* of the University. R. Milani, "Faunística, Ecologia, Etologia e la Variabilità degli Organismi nel Pensiero e nella Didattica di Lazzaro Spallanzani", in *Lazzaro Spallanzani e la Biologia del Settecento: Teorie, Esperimenti, Istituzioni Scientifiche: Atti del Convegno di Studi: Modena, Scandiano, Pavia, Reggio Emilia*, March, 23-27, 1981, Ed. G. Montalenti & P. Rossi (Firenze, Olschki, 1982), 84.

[9] Spallanzani, *Picciola memoria*, 11.

[10] L. Spallanzani, "Dissertazioni di Fisica Animale e Vegetabile", in *Opere*, Parte quarta: Opere edite direttamente dall' autore, volume quarto, 9.

drilled the students "who have strength to pursue this career", by disclosing to them "without any mysterious veil, the road to obtain the truths of physics", found out by himself in, for instance, "the blood, the animal reproductions, the microscopic animalcules".[11]

The idea that the art of observation was learned through imitation is present in naturalists of that time, such as Jean Senebier, Benjamin Carrard and Georg Zimmermann, who published works devoted to the *Art of Observation*.[12]

It is even possible that Spallanzani would have written his *Picciola memoria* inspired by Senebier, with whom he maintained constant and steady correspondence for 23 years. As it is known, Senebier translated several of Spallanzani's works into French, to which he added notes and commentaries about the *Art of Observation*. Thus, Senebier's interest on this subject was kept alive even after he published *L'Art d'Observer*, in 1775, urged by Charles Bonnet. However, not satisfied with the book, and wishing to write a new expanded edition, Senebier frequently asked for Spallazani's opinion, as we can read in the letters they exchanged.[13] Although sober in his commentaries, Spallanzani seems to be close to the notions presented by Senebier regarding the "spirit of observation". It is, says Spallanzani, a matter of "a faculty of good understanding of an object in all its parts, of discovering its relations, of combining it with other beings, to come to the discovery of some truth or consequence".[14]

Among the requirements for developing the spirit of observation, in the first place, an empirical profession of faith: "Frequently, it is helpful to be, let us put it that way, like a *tavola rasa* concerning the subject of examination. In this way, the opinions of the Philosopher and Nature's answer are not mixed up."[15]

We should be careful not take this as a complete denial of theory, because it means, according to his words, to accept "only the ideas that, upon the examination of the object, communicate themselves to the soul by the senses", and understanding would be "more clear and certain" the more all the five senses were used. Spallanzani brings the testimony of the procedures used by Boerhaave, who in the *Treatise on Fire*, "opens his study presuming that he knows nothing about that element, so as to try to understand its real character". He quotes, furthermore, Redi to whom "the organs of the senses would be like so many windows and doors to which reason shows up in order to look at natural things or where they come through in order to be known".[16]

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[11] Spallanzani, *Picciola memoria*, 12, 14.

[12] B. Carrard, *Essai qui a remporté le prix de la Société Hollandoise des Sciences de Haarlem en 1770, sur cette question. Qu'est-ce que est requis dans l'Art d'Observer; & jusques-où cet Art contribue-t-il à perfectionner l'Entendement?* (Amsterdam: Marc-Michel Rey, 1777); J. Senebier, *L'Art d'Observer* (Genève: Cl. Philibert & Bart. Chirol, 1775); J. Senebier, *Essai sur l'Art d'Observer et de Faire des Expériences*. 2nd ed. (Genève: J.J. Paschoud Libraire, 1802); G. Zimmermann, *Traité de l'Expérience en Général, et en Particulier dans l'Art de Guerir* (Paris: Vincent, 1774).

[13] There are several places in the letters from Senebier to Spallanzani which attest to this; here we only quote the first of them, dated December, 4th, 1776, "when I would have written perfectly on the art of observation, and I am infinitely far from perfection… I will sacrifice my pride, you will realize immediately upon reading my [book] art of observation… and your kindness will make you teach me the lessons I need". Spallanzani, *Opere*, Carteggi, Vol. Ottavo, *Carteggio* con Jean Senebier, 28.

[14] Spallanzani, *Picciola memoria*, 12.

[15] Ibid., 13.

[16] Ibid.

> "By making that use of the senses, the judgments we emit on the bodies will be exact, because the observations upon them will also be exact. The wise naturalists that do use such a method are famous for their discoveries; opposite to so many others, who despising the aforementioned method, have paid with their errors".[17]

Deriving from that first premise, and attuned to the "horror for systems" recurrently announced by the wise men of the century, Spallanzani also echoes the necessity for the observer to be free and safe from "all party preventions, all spirit of party system whatsoever". Such an *a priori* fondness for a given system, the Reggian naturalist explains through the metaphor of "a pair of glasses badly designed, which alters colors and the proportion of objects more or less". As an example, he repeats the critique expressed in *On the nature of organic beings, refuting the views of Needham and Buffon on the nature of infusion animalcules* (1765), to the errors of Buffon, of whom Spallanzani says, in a Cartesian manner, "has constructed an imaginary world with his *organic molecules* as to give sustainability to the epigenetic theory of the breeding of living beings.[18]

We know that an equal "predilection for a system" led Spallanzani himself to limited, and even mistaken interpretations of his microscopic observations, largely due to his eagerness to defend the competing position against Buffon and to favor the theory of the preformation of living beings.

The charge of "fondness for a system" was a frequent weapon among the natural philosophers of the 18th century and it was understandable in the context of so stirred up theoretical disputes as the ones concerning animal and vegetable reproduction at that time. Thus, we should understand that the real issue at stake was the one regarding the relationship between theory and empirical evidence, which could only be guaranteed by means of exact observations. It was not a matter of discarding theories in the name of the impressions of the senses, but to take the empirical evidences "engraved in the soul" as legitimate means, if we are allowed to use present-day language, to corroborate hypotheses and validate theories. This was the meaning of the glasses metaphor, because a pair of *well-designed* glasses would be faithful in showing the colors and proportions of an object.

Having established those general methodological guidelines, Spallanzani went on to prescribe the way and order in which observations were to be carried out. An object was to be examined "in all its possible points", a reference that shows that regarding the way of describing organisms, Spallanzani was perfectly aligned with the Parisian Royal Garden naturalist.

Some years later, in 1788, Spallanzani would largely expand this option in a lesson titled *Abbozzo della mia prima lezzione*. There he opposed what he called the "description method", used and described by Buffon, to the "definition method" adopted by Linnaeus. While the former concerned himself with detailed descriptions of all the aspects that singularize an organism, the latter adopted a telegraphic description style, on the grounds of a small number of characters chosen for classification purposes. In fact, in his zoological lessons, especially the ones dealing with vertebrates, Spallanzani adopts Buffon's *Histoire Naturelle* as textbook for the students. In his works, like *Saggio* or *Dissertazione*, he presented that same kind of complete descriptions of organisms.[19]

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[17] Ibid., 14.
[18] Ibid., 13.
[19] The full second chapter of the *Saggio* is a lesson on what it must be observed in each kind of organism: description of its external shape, relative size, internal structure, the motions performed and, finally, the "ruses and habits" they present. In *Generazione*, the first five chapters, devoted to the description of each species of amphibious, follow the same structure.

In *Picciola memoria* that commitment was sealed: one must use the widest possible set of living beings characters, describing their "nature and properties", as well as examining their "external" and "internal surface". And at the places where "the smallness of the parts shall make them escape the naked eye, one must resort to the lens, to the microscope".[20]

Here it is worthy to remark on some peculiarities that help us compose the context in which Spallanzani was writing *Picciola memoria*. The authorities responsible for Vienna university reform had recommended the adoption of Linnaeus' classification and naming system, which Spallanzani accepted with many restrictions. In his Zoology and Botanics lessons, he presented animals and vegetables ordered according to the large classification divisions established in the tenth edition of Linnaeus *Sistema Naturae*. But he did not go any further.

It surprises us the many occasions that Spallanzani took profit to point out to mistakes by Linnaeus, and equally he persevered in the criticism to the nomenclature, which, on the other hand, is rarely present in his own books, where almost always the vulgar names of organisms are used. Spallanzani tried to prevent potential criticism coming from Vienna, by stating that he had added the "names of animals and plants… mostly from Linnaeus" in the notes and commentaries appended to the Italian translation of Charles Bonnet's book *La Contemplation de la Nature*.

Vienna authorities had already expressed aversion to Bonnet's text and had only temporarily given permission for its use in 1775.[21] Yet, Spallanzani wanted to keep it as his students' handbook, arguing that the Royal Court had given freedom to professors to resort to "their own writings or to a published text, preferably the latter". Thus, it seemed to him highly appropriate to keep that work, as its "supplements and instructions", written by Spallanzani himself, were kept in the many reprints made not only in the Italian, but also in the French, German and Dutch editions.

Upon pointing out to its only shortcoming, the fact that it did not treat the three kingdoms of nature as it excluded minerals and fossils, Spallanzani stated that such a complete book did not exist, while excluding from the range of possibilities the works on "mere Nomenclature", because they did not speak "historically and with philosophical principles".[22] Spallanzani then directed his critique to nomenclatures, on the grounds of their methodology, and advised the young:

> "To combine things observed, to take the convenient consequences and to make, upon them, the due reflections. It is of little use the accumulation of observations, if we do not make a rational body out of them, a systematic body. We will gather materials without raising a building. On the other hand, observations devoid of reflections almost do not deserve a place in Natural History, as, if philosophical reflections are the soul of History in general, they equally also are the soul of the History of Nature".[23]

Here he highlights the relationship he had traced between discoveries and the construction of theoretical systems that would gather them. It was by the theories of digestion, reproduction or respiration that the naturalists should guide themselves in their

[20] Spallanzani, *Picciola memoria*, 14.
[21] P. Di Pietro, "Spunti di Metodo Didattico", in *Opere*, Parte seconda, Lezioni, vol. Primo, 9.
[22] In the classes on the vegetal kingdom, Spallanzani employed the *Treaty of Mineralogy* by J.G. Waller and A.F. Cronstadt, besides T.O. Bergman's; for animal descriptions, the works of Buffon. Spallanzani, *Picciola memori*a, 12.
[23] Ibid., 15.

observations and experiences. This is what he called "the part of the System", which he considered to be well enunciated throughout the book by Bonnet he had chosen for his students. Since such book already contained all those "systems", or as we say today, all the contents of the lessons, Spallanzani explained that the only task left to *Picciola memoria* was "to offer a few ideas that can relate to the Art of Observation"[24], which he believed were lacking both in Bonnet's book and in the Reform Plan.

Another aspect to be emphasized is the distinction between observation and experience. In his first book, *Saggio di Osservazioni Microscopiche,* Spallanzani used both terms, "observation" and "experience", now isolated, now together, now almost as synonyms, now as distinct.[25] In *Picciola memoria*, however, he established a clear distinction between both terms. In his suggestions to naturalists, he recommended that upon opening an organism to learn its internal parts, to be careful to unite such "observation" to "the experience that would try to explain the body by its components, through proper means, that is, through friction, fire or the chemical fluids and other solvents".[26]

The choice to examine certain bodies would require from the "inquirer to surprise nature in a way that it, so to speak, would be forced to manifest its workings".[27] This idea, originated in Bacon, as it is known, appears many times in the books of Spallanzani;[28] in his correspondence with Senebier, it becomes a commonplace, used by both each time they wanted to refer to the experimental method.[29]

We want to point out to a last trait that brings Spallanzani closer to the Baconian lessons, also present in the books of Senebier, Carrard and Zimmermann. Once versed in the art and fit to attempt at his own observations, the young naturalist should choose, "in the first place, the most useful objects and the most closely interesting to man", even though one cannot say that "any observation or experience is absolutely vain or idle", as it "may become useful someday".[30] Second, he should choose to study "the novelties", that which has not yet been discussed by others or only in a faulty way, to "make new steps in Natural History", as Trembley did when enlarging the limits of the physical world with the "freshwater polyps".[31]

In the present paper it was emphasized the role Spallanzani attributed to the *Art of Observation*, that is, the method of observation and experience as conjugating the empirical and theoretical elements of the science he practiced. It was also sought to show the value that he attributed to the *Art of Observation*. We would like to finish with a quotation that makes very clear the place that, according to Spallanzani, observation occupied in the production of knowledge:

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[24] Ibid., 12.

[25] In *Saggio*, Spallanzani employed the term "experience" as a) the practice of life: "everyday experience teaches that there is no body in the universe..."; b) a synonym for observation, taken as the passive sense with which the naturalist describes the structures visible under the microscope: "The experience being repeated many times, the result was always the same. New observations made afterwards…"; and c) the procedure devoted to the verification of a phenomenon: "Last, Mr. Buffon experienced that the spermatic vermin suffer when exposed to a slight increase of temperature". L. Spallanzani, "Saggio di Osservazioni Miscroscopiche", in *Opere*, Parte quarta: Opere edite direttamente dall' autore, volume primo, 134; 126; 108.

[26] Spallanzani, *Picciola memoria*, 13.

[27] Ibid., 14.

[28] For instance, "As much as I have tried to question Nature on such a fact". Spallanzani, *Saggio*, 122.

[29] An example of this happens when, upon volunteering to perform the French translation of Spallanzani's *Opuscoli di Physica Animale et Vegetabile*, Senebier treats the work as "a model for all who would like to be trained in the difficult art of questioning nature". L. Spallanzani, *Opere*, Ottavo, Carteggio con Jean Senebier, 8.

[30] Ibid., 14.

[31] Ibid., 15.

"It is not restricted to Natural Philosophy not to any other part of Physics, but it is the universal spirit of the Sciences and the Arts."[32]

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[32] Ibid.