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# MACHINE-BODY: DIALOGUES BETWEEN SCIENTIFIC DISCOURSE AND GYMNASTICS

*CORPO-MÁQUINA: DIÁLOGOS ENTRE DISCURSOS CIENTÍFICOS E A GINÁSTICA*

*CUERPO-MÁQUINA: DIÁLOGOS ENTRE DISCURSOS CIENTÍFICOS Y LA GIMNASIA*

**Edivaldo Góis Junior*, Carmen Lúcia Soares*, Vinícius Demarchi Silva Terra****

**Keywords**:
Human Body.
History.
Science.
Gymnastics.

**Abstract:** This article aimed to describe scientific discourse and modern practices about the body in the nineteenth century and the turn of the twentieth century, identifying the consolidation of the machine-body representation as influential in other practices such as literature, photography, and especially gymnastics in the context of European cultural production. Its sources were discourses of Claude Bernard and Georges Demeny. After analyzing those discourses, it concluded that the machine-body metaphor influenced gymnastics, which, in order to justify itself as a practice, in the Demeny's words, evolved to its positive phase.

**Palavras chave**:
Corpo humano.
História.
Ciência.
Ginástica.

**Resumo:** Este artigo objetivou a descrição de discursos científicos e práticas modernas sobre o corpo em um recorte temporal delimitado pelo século XIX e virada do século XX, identificando a consolidação da representação de corpo-máquina como fonte de inspiração para outras práticas, como a literatura, a fotografia e, principalmente, a ginástica, no contexto da produção cultural europeia. Teve como fontes os discursos de Claude Bernard e Georges Demeny. Concluiu, ao analisar esses discursos, que a metáfora do corpo-máquina influenciou a ginástica, que, para se justificar como prática, nos termos de Demeny, evoluiu para sua fase positiva.

**Palabras clave**:
Cuerpo humano.
Historia.
Ciencia.
Gimnasia.

**Resumen:** Este artículo tiene como objetivo describir discursos científicos y prácticas modernas sobre el cuerpo en el siglo XIX y comienzos del siglo XX, identificando la consolidación de la representación del cuerpo-máquina como fuente de inspiración para otras prácticas, como la literatura, la fotografía y, en especial, la gimnasia, en el contexto de la producción cultural europea. Se utilizaron como fuentes los discursos de Claude Bernard y Georges Demeny. El estudio concluyó, al analizar estos discursos, que la metáfora del cuerpo-máquina influyó en la gimnasia que, para justificarse como práctica, en los términos de Demeny, evolucionó hacia su fase positiva.

*State University of Campinas (UNICAMP).
Campinas, SP, Brazil.
E-mail: egoisjunior@gmail.com

**Federal University of São Paulo (UNIFESP).
Santos, SP. Brazil.
E-mail: paraovinicius@gmail.com

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## 1 INTRODUCTION

In the 19th century, more specifically in the 1860s[1] – at the peak of modernity – Claude Bernard (1813-1878), in his 1865 work *Introduction a l´étude de la médecine experimentale*, proposed the "experimental method" on which most of today's scientific literature is based. It was on the promises of that reason forged over three centuries that politics spread over life, operated by machinic desires as discussed below.

The consolidation of an experimental model for studying the body is a contemporary discourse that established itself as a historical monument in science, built on ruins and dissonances often eased by historicist anxiety. Given the complexity of that history of science, especially in the fields of disputes and their axiological changes, it would be prudent not to approach the being of science or any a priori ontology here.

We want to think of 19th-century echoes, of this clear network of solidarities and intercommunicability. Therefore, we do not assert an idea of history as progress or even as linearity. Thinking of 19th-century echoes in the constitution of this body-focused knowledge is more like finding its dynamics made of ambiguities, ruptures, discontinuities and permanences which, however, are woven into thin networks. From this perspective, we are interested in thinking about how those discourses and practices related to the body, constitutive of science and influencing the field of culture, reflect layers of social life. Hence the importance of, the need for and even the duty of reflecting on that knowledge about the body in science under a mental atmosphere of its own time, providing answers to problems of conscience that are no longer exactly ours, as Marc Bloch tells us (2010).

The design of the body in history is done with traits outlined by the body itself, through the different ways for talking about it, with traces that we often no longer recognize in the present. It would be important to emphasize that its choice as a history's object has only recently acquired high status in the field of Human Sciences. That is because this way of making history in which the body gains status of object is typical of the Analles School and the boundaries and interactions established by intellectuals affiliated to it, of the need they suggest for approximation with the other Social Sciences, with Education, Philosophy, Psychoanalysis and Art. That understanding is indebted to thinkers such as ethnologist Marcel Mauss (1936)[2] who, with his classic study of body techniques, treated the body as the symbolic archive of societies, of their ways of educating themselves and living, of the *habitus*; Norbert Elias (1994; 1995) and his studies on civilizing processes published from 1939 on, in which he historicizes psychological economy based on the contribution of Sociology and Psychoanalysis; historians like Marc Bloch (1987, 2001), who in the 1940s argued for the need to sniff out human flesh and reflect on human beings behind all social life, and that a "[...] history more worthy of that name than the timid trials to which our possibilities limit us today would consider body adventures [...]" (2001, p. 91); Michel Foucault (1980, 1998, 2003, 2008), who in the 1970s produced numerous studies on the centrality of the body in medicine, of the power over the body and life, of biopower and biopolitics. There are certainly many other thinkers who could be mentioned here, but those we pointed out open that definition of a new object that contributes new problems and interpretations. These authors lent legitimacy to historian Denise Sant'Anna's (1994) views that there is a general idea that

1 "*We need very much a name to describe a cultivator of science in general. I should incline to call him a Scientist. Thus, we might say, that as an Artist is a Musician, Painter, or Poet, a Scientist is a Mathematician, a Physicist, or Naturalist*" (WHEWELL, 1860, p. CXIII).

2 Communication presented to the *Société de Psychologie* on May 17, 1934.

our attitudes, the most banal ones, our values, the most dear ones, our intolerance and our sensibilities, the simplest ones, are produced by history and that idea helps us understand the differences that operate in time with respect to that set of attitudes, gestures and thoughts.

We could say that it was this movement of thinking in history that allowed the emergence of new objects, new problems and new interpretations, through which it was possible to consider and configure the body as history's object of study and, above all, to historicize its own configuration in modern science.

> While the body is a multiple object, while it can represent highly different dimensions of life such as sensitivity, the very expression of an individual or a social group, or even real mechanics connected to work, it evokes so many images, it suggests multiple possibilities of knowledge, it expands territories and horizons of social life and it says more, perhaps, than indicators of poverty or wealth ... (VIGARELLO, 2000, p. 299).

In this article, we aim at describing some of those discourses within a time frame delimited by the 19th century and the turn of the 20th century, identifying the consolidation of a machine-body idea that will become a source of inspiration for other practices such as literature, photography and especially gymnastics in the context of European cultural and scientific production.

Thus, understanding how the body was described by science within a broad timeframe in Europe can teach us about its specific and common influences. Mercantilist societies that grow economically by reorganizing their mode of production in capitalism, such as France and England, can transform or preserve body practices anchored in structural conditions but also in a specific mentality.

We do not intend to sail in open sea through the turbulent currents of concepts and categories; we will limit our ship to the coast, identifying some authors and works as the bastions of knowledge and 19th-century sensibilities – bastions that have been used as defense platforms for certain practices, thus preventing assaults by other rationalities situated among those approved by science. As sources, we were particularly interested in the discourses of physiologists Claude Bernard (1813-1878) and Georges Demeny (1850-1917). They provide approximations and differences on the human, gradually characterized as a complex machine. Going over their permanences and discontinuities, we will observe their impact on body practices such as gymnastics.

## 2 THE MACHINE-BODY

A machine body would be clean, more productive, morally effective. This representation is certainly anchored on an economic view, because the body is then thought of as a machine that produces. The key to understanding the meaning of body representation at the time of capitalist consolidation is to think that in this mode of production, labor power is sold to the holder of capital, and the human body was seen at the time by governments as a producer good, somewhat belonging to the nation, which should take care of it, resulting in terms as "human capital" or "human engine" (RABINBACH, 1992).

During the 19th century, these discourses on the body contributed to a slow spread of body practices present in everyday habits such as hygiene and even in artistic practices such as literature.

Soares and Fraga (2003), for example, see a pedagogy of bodies that are straight and averse to deformities in the early 19th century. Researchers use the literature of the period as a source to describe a representation of a straight, anatomically erect body, by observing

the literature of Victor Hugo (1802-1885). The character of Quasimodo, the bell-ringer of Notre-Dame who is embarrassed of being looked at by other people because of his physical appearance, is described through a representation of denial of deformity. The aversion to Quasimodo's appearance reveals a view of the body as opposed to character, i. e., the ideal of an erect body without deformities.

Victor Hugo describes the enclosure of Quasimodo's body, kept from socializing because of his appearance. Thus, deformity should be omitted, hidden, exiled in nursing homes, prisons, asylums, isolation hospitals (SOARES; FRAGA, 2003).

Also in the literary field, regarding that presence of the body manipulated by science, there was the fascinating belief about mastering nature, which did not prevent literature from resisting that optimism, reminding it of its limits. One example is Mary Shelley's *Frankenstein or the Modern Prometheus*, whose first edition appeared in 1818. That modern version of the myth of Prometheus[3] – the provident, he who foresees and thinks before acting – offers, in a sense, something of the strange and new view and perception of humans about their bodies in the period.

Mary Shelley's character, Dr. Frankenstein, wants to undertake a project within the positive spirit based on the science, that is, a perfect man consisting of isolated parts, bright and whole, made by reconstituting pieces of dead flesh. However, control of bodily nature became a failure because dead flesh compromised his positive project of superior creation and he could go no further. Anatomy was not enough, and the analysis of *natural* processes of decomposition and decay of the human body in a sense betrayed him. The body, once a place of beauty and strength, very soon becomes food for worms. In the words of Mary Shelley's Dr. Frankenstein:

> [...] I saw how the fine form of man was degraded and wasted; I beheld the corruption of death succeed to the blooming cheek of life; *I saw how the worm inherited the wonders of the eye and brain* [...] I collected bones from charnel-houses; and disturbed, with profane fingers, the tremendous secrets of the human frame. (SHELLEY, 1869, p. 43)

This literature criticizes a science that peers on life, which is not satisfied by direct observations of inert bodies typical of anatomy designed by Vesalius (TERRA, 2007). Medical science of the 19th century wanted to extrapolate the field of observation and description; it aimed at understanding life in order to master it. Examples are found in the scientific production of Claude Bernard (1813-1878), French physiologist who dedicated himself to medical studies. Although he was not the first researcher to engage in experimental physiology, he was the main articulator of a scientific method for observations of biological phenomena (CAPONI, 2001).

In this regard, Bernard created the limits and specifics of experimental medicine regarding previous medical research. In the 1878 book *La Science expérimentale*, an expanded re-edition of his 1865 classic *Introduction à l'*étude *de la medecine expérimentale*, he pointed out:

> In order to understand the peculiarity of the physiological problem, it is necessary, first of all, to limit general physiology and show that it is an experimental science rather than a natural one. Natural sciences are sciences of observation or descriptive sciences. They provide us with prediction of phenomena, but they remain as contemplative sciences of life. Experimental sciences are experiential or explanatory sciences. They go beyond the sciences of observation on which they are based and become action sciences, i. e. sciences that conquer nature. (BERNARD, 1878, p. 101)

3 According to Camus (1965), while Prometheus loved men enough to give them fire, freedom, arts and techniques, humanity is increasingly self-absorbed in the latter, in a machinal existence, dealing with art and the inconclusive world as barriers and stigmas.

Mastery of nature through scientific rationality – that form of knowledge typical of the 19th century – clearly nourishes the processes of industrialization and urbanization forged at that time and contributes to a representation of what is modern. In this sense, objectivity of physics and chemistry inspired a medical science willing to scrutinize the body as a physical object, as a machine. Claude Bernard emphasized:

> I want to demonstrate that the phenomena of living bodies are, like those of inorganic bodies, subject to absolute and necessary determinism. Life science cannot employ other methods or have other bases than those of physical science [*science minérale*] and there is no difference to be established between the principles of physiological sciences and those of physical and chemical sciences. (BERNARD, 1878, p. 40)

Object and subject are also involved in this rationality project, since, just as certain structures of the living body will be sacrificed by scientists' hand in order to discover their respective failed functions, their eyes will also rightly "armed" with special equipment so the phenomenon can be perceived, imperfect as it is, which makes the experiment a process of mediation between the subjective and the objective worlds (TERRA, 2002). Such objectivity leads Bernard to advocate theoretically that for life sciences, every phenomenon had a primary cause that, repeated under the same conditions, reproduces the same results in a deterministic causal relationship. As in mechanical physics, the body was subjected to laws. Physiology had then only one way to go: understanding the body in order to intervene in it and change it. In his 1867 *Rapports sur les progrès et la marche de la physiologie générale en France*, Bernard says that:

> In experimental sciences, where we seek the effective laws of phenomena, it is necessary to study organic differences to lead each of them back to its elementary material conditions of manifestation. That is why I said, regarding nerve properties, that by seeking to erase the differences in order to mix everything in analogies and similarities, we prevent the progress of general physiology as I understand it. I did not know that I would in fact develop it later, that is, consider general physiology as a science destined to remain in the contemplative realm of natural sciences, but much more as an experimental science intended to act on the phenomena of living beings (BERNARD, 1867).

While 20th-century physics stands out as a basis for mechanics that changed the world with new technologies, life sciences could not be out of that modern context, and one of the most frequent and successful ways to show that closeness was the metaphor of the body as a machine. In his words:

> The primary cause of life lies in evolution or the creation of the organized machine; but once created, the machine works because of the properties of its constituent elements and under the influence of physical and chemical conditions that act on them. For the physiologist and the experimental physician, the living organism is nothing more than a remarkable machine, equipped with the most wonderful properties, put into action with the help of the most complex and fine mechanisms. It is a machine in which they must analyze and determine the mechanism, in order to modify it, since accidental death is nothing but the displacement or destruction of the body as a result of disruption or cessation of the action of one or several of those vital mechanisms (BERNARD, 1867).

The hope of controlling bodily nature gains new nuances from experimentation. Once unveiled, the machine could provide science with the power of remediating its collapse. The aims were somewhat optimistic because their supporters fully believed that the objectivity of positive thinking, superior to metaphysical thinking, was able to intervene and modify the body, making it more

resistant, or even to reproduce it for replacement of damaged parts. Those were tangible applications in the medical field, but also in body practices regarded as accessories in the machine-body project through its control and maintenance, better known in that century as a rational exercise.

## 3 THE MACHINE IN MOTION: DISCOURSES AND PRACTICES ON BODIES

The body view from machinic logics gains more ground in medical discourses, which, in turn, through representation of objective and scientific rationality, influenced modern culture. The work of Etienne-Jules Marey (1830-1904) contributed to that link. As a French physiologist and photographer, he was a pioneer in capturing the movement of bodies through photography, thus contributing for science to understand it as a machine.

At first, photography was considered more like a technique, and science was enthusiastic about it for its ability to capture body movements with more precision and accuracy. It was in physiology that Etienne-Jules Marey stood out by developing photography techniques, inventing mechanical devices that helped the new studies of the body in the field of thermodynamics. One of the most notable devices produced by Marey based on photography technology was chronophotography, which captured a body movement on a single photographic plate to allow the biomechanical analysis of movement (TERRA, 2002).

Again, the machine-body is an object of empirical observation and can now be captured under a specifically modern aesthetic that, combined with scientific and mechanical analysis of body movements, associated physics and biology. Dissemination of new body practices is contemporary to those scientific representations and was certainly influenced by them. For example, gymnastics in France, through slow diffusion, gains the attention of doctors and authorities in the 19$^{th}$ century (VIGARELLO, 2003; VIGARELLO; HOLT, 2008; SOARES, 1998). Studies on the body revealed the importance of its development and training to maintain individual health, but above all social energy (RABINBACH, 1992).

According to doctors, it was necessary to methodize gymnastics, make it contemporary to physiology theories, which refuted the value of physical wear, advocating energy saving and development in training (GOELLNER, 1996; SOARES, 1996). To this end, rational and scientific gymnastics is structured, having as one of its exponents Georges Demeny (1850-1917), Marey's collaborator at *Station Physiologique*, a laboratory where he produced most of his work. While Marey approximated engineering to life, Demeny was his applied arm: a French biologist and a teacher (SOARES, 1998; SOARES, FRAGA, 2003), he was a frequent practitioner of gymnastics and stood out in the studies of movement analysis by inventing a *chronophotographic* camera (BAKER, 2007). He founded the Society for Rational Gymnastics and worked at the Joinville-Le-Pont School of Gymnastics (SOARES, 1998; MELO, 2005).

Demeny devoted himself to studies on energy and efficiency of movements, concerned about the harmful effects of excessive physical exercise without systematization. At that moment, it was important to consolidate a practice of gymnastics under the auspices of physical and biological sciences, opposing it to spontaneous exercises. In order to achieve that, it was necessary to build a warning discourse about the benefits of rational gymnastics and the dangers of non-systematic gymnastics (SOARES, 1998). In the preface to *Guide du Maitre: chargé de l'enseignement des exercices physiques dans les* écoles, a guide for gymnastics teachers written in 1898 and published in 1904, he argues that:

> Moral improvement of men is linked to their physical condition. Physical Education ultimately aims at enhancing the performance of each one at work and using the energy spent as well as possible; it is therefore an economic issue of utmost importance for the whole nation. Having understood that, educators play a critical role; their task will become less miserable if those truths are understood; men who govern should propagate them. In a well-organized society, each person, to the extent of his or her wisdom and strength, has the duty to put science at the service of common good (DEMENY, 1904a, p. 8).

For Demeny, the hygienic purposes of exercise would only be achieved under scientific principles, as explained in *Les bases scientifiques de l'*éducation *physique*, originally published in 1903 (DEMENY, 1931). For this, it was up to its advocates to organize gymnastics as a systematic practice, unifying its principles and demanding state intervention translated as public investment in organizing gymnasiums and in its dissemination in schools (GLEYSE et al., 2002). Central to this speech was the appreciation of gymnastics as a body care practice using the machine metaphor. In his 1904 text *Mécanisme et education dus mouviments*, Demeny writes:

> Our body is subjected to the same laws as ordinary machinery; limb movement and mass displacement of the body are the result of internal or external forces.
>
> The former have their origin in muscles, they change the shape of our body and the relative positions of the bones; they are contractions and muscle tone, elasticity and toughness of our tissues.
>
> The latter forces are external, constantly in conflict with the former. Our body and our members are heavy, just like dumbbells, bars, clubs and other portable devices we use to increase our efforts. That weight is a force for overcoming difficulties or acquiring balance; it is always exerted vertically. To change the direction of that action, it is necessary to use balancing machines, with springs and oppositions. (Fig. 1) (DEMENY, 1904b, p. 1-2)

**Figure 1 -** Demeny drawings

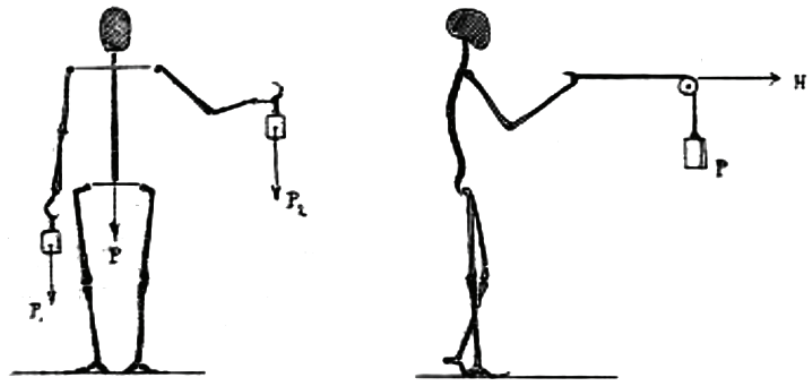


Fig 1. — Direction des résistances dues à la pesanteur du corps P ou des objets pesants $P_1$ $P_2$.

Source: DEMENY, 1904b, p. 2.

The human machine instrumentalized exercises from portable devices designed as training technology. The machine-body in interaction with external forces potentiated by

instruments and objects drew men away from an intuitive relationship with movement, to bring them closer to systematized and organized knowledge under a mechanical logic of precise calculation. Dumbbells, weights and bars were extensions of the body itself that made exercises more efficient. Thus, Demeny contributed to construct a representation that, in his words, alluded to a truer, scientific gymnastics, that is, the result of evolution, which, in those days meant the birth of a "real Physical Education". It was the ultimate project of his life: to conceive true Physical Education. For this, many choices were made while other practices and discourses were considered outdated and anachronistic. After all, in order to ratify that stance about the machine-body, about scientific Physical Education, relating bodies with physics and mathematics it was not enough; it was necessary to use the story to stand as vanguard, setting prior stages where their representation was the outcome of a linear trajectory in time. In his 1909 book *Evolution de l'*éducation *physique: L'*école *française*, Demeny, after a 30-year career in gymnastics, decides to tell this story, highlighting French Physical Education:

> The reform of our physical education should not be a failure. Let us increase our resources and bridge the gaps, but let us not make an exchange that can present disadvantages or careless action by the simple pleasure of change.
>
> We repeat at length the name of Ling, but we ignore the names of those who preceded him; we forget the efforts made among us and the remarkable work that paved the way for true scientific and French physical education. It is strikingly unfair, and it is our duty to remedy it (DEMENY, 1909, p. 8).

In that book, Demeny creates a timeline describing three stages of Physical Education's evolution. The first one is empirical Physical Education, devoid of scientific basis, found since Greek and Roman influences from Antiquity to the mid-20th century, such as the propositions of Francisco Amóros, Eugène Paz, Napoléon Laisné. He called the second stage "*tâtonnements*" – an intermediate stage between empiricism and scientific thinking, characterized by trial and error, and by slow progress in understanding physical exercises. In that stage, Demeny highlights Swedish gymnastics, seeing it as pre-scientific exercise. In his words:

> Newcomers were tasked, no one is quite sure exactly why, with introducing the Swedish system among us, with the absolute and immutable idea of imposing it, without responding to our arguments, with its dogmas and mistakes. Can we accept such a way of proceeding? If the Swedish system is truly scientific, could it not be easily established through procedures of modern science? Are its results not tangible and measurable? (DEMENY, 1909, p. 121).

In the third and final stage, called "positive stage" [*phase positive*], Demeny elected positive Physical Education as the truly scientific gymnastics practice. Of course, the principles he advocated, such as economics of energy and efficiency of exercises, were present in positive Physical Education. Based on individual records, that gymnastics was based on experimentation, ascribing scientificity to his pedagogy. In the clash between different traditions and gymnastics propositions, Demeny stood as representative of experimental science, and thus saw his method as the truest one – the last step in the history of the evolution of Physical Education. He considered that only his proposition had physiological and mechanical basis for understanding that:

> Physical education is necessary; it is part of general education; it is inseparable from moral education and intellectual education. It does not consist in seeking athletic strength or overcoming hardship imagined without reason; it teaches man to give his best in a useful work, with minimal spending and fatigue (DEMENY, 1909, p. 279).

As an expression of scientific thinking, the gymnastics conceived and methodized by Demeny produced a discourse excluding bodily practices that escaped its design. Producing a rational body, perhaps near a machine-body design still in vogue, that gymnastics would be attuned to the ideals of nation in which the struggle for life and homeland through army and work was what nourished and solidified the social body. It is under this framework that we can say that rationality of body exercises carried a strong moral character, because the body is primary the place for moral limits; it is through human gestures that we know the moral limits of a society (SOARES, 1998; VIGARELLO, 2001).

## 4 FINAL REMARKS

The construction of the machine-body mentality had its representations in scientific discourses and practices. In the long term, we see permanence of the body metaphor as a tool, as matter, without subjectivity, as *res extensa*. But that does not mean uniformity, because each discourse produced representations that converged to and diverged from the body. However, modernity reinforced the machine-body metaphor through science and realist aesthetics. The 19th century brought new technologies and observation possibilities for bodies and, with them, new practices were disseminated and confronted, using, in turn, the argument of authority of science.

According to Denise Sant'Anna (2001), since the 16th century each body tends to be considered a machine. From the 18th century on and especially in the 19th century, the understanding of that machine gains unprecedented complexity, raising doctors' and educators' interest in changing it daily through science, which undoubtedly also systematized gymnastics under its parameters since the end of that century. Rational and scientific gymnastics was presented as a result of evolution because Demeny saw it as linked to positive thinking and having advantages such as objectivity and overcoming of physical practices without control, without theoretical basis, still influenced by "trial and error".

Echoes of the 19th-century discourses on body scientificity are strongly seen nowadays. As a bastion of objectivity, the body tends to be described and analyzed, mostly through the logic of the experiment, the result of a performance translated into numbers and percentiles, in a clear attempt to reduce narrative possibilities and broader scientific analysis. On the contrary, an effort might be necessary to narrate that materiality comprised of fleshes and entrails by reading its ambiguity, both material and immaterial and made of subjectivity. In this movement of thinking, it might be important to remember that their anatomy is also historical and that the design of that body at the disposal of science, if referred to history and culture, will provide other information.

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