THEMATIC SECTION: FAUNA, FLORA, OTHER LIVING BEINGS AND ENVIRONMENTS IN SCIENCE AND BIOLOGY EDUCATION

Gradism and Cladism in Teaching in a Foucaultian Analysis

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ABSTRACT – Gradism and Cladism in Teaching in a Foucaultian Analysis. The analytical course of this text is directed to the spaces of knowledge constitution and glimpses power relations that problematize issues related to biological classification systems and teaching, aiming to make visible the instances in which Evolutionary Systematics can represent a discontinuity concerning the Linean Systematics. At the same time, the phylogenetic discourse is positioned as the most adequate knowledge for the establishment of evolutionary relationships, however, in teaching spaces it suffers interdictions, which allows us to suppose that teacher training does not satisfactorily deal with the dynamics of some scientific constructions. Thus, the production of scientific knowledge goes beyond the simple acceptance of truth.
Keywords: **Biology. Cladism-Gradism. Epistemology. Michel Foucault. Teaching.**

RESUMO – Gradismo e Cladismo no Ensino em uma Análise Foucaultiana. O percurso analítico deste texto se dirige aos espaços de constituição dos saberes e vislumbra relações de força que problematizam questões atinentes aos sistemas de classificação biológica e ao ensino, objetivando tornar visível as instâncias em que a Sistemática Evolutiva pode representar descontinuidade em relação à Sistemática Lineana. Contemporaneamente, o discurso filogenético posiciona-se como saber mais adequado ao estabelecimento das relações evolutivas, contudo, nos espaços de ensino ele sofre interdições o que permite supor que a formação de professores não lida satisfatoriamente com a dinâmica de algumas construções cientificas. Assim, pensa-se a produção do conhecimento científico para além da simples aceitação de uma verdade.
Palavras-chave: **Biologia. Cladismo-Gradismo. Epistemologia. Michel Foucault. Ensino.**

Introduction

The biological sciences[1] are part of philosopher Michel Foucault's work, problematized in a field in flux in which the power to signify life, the living, and their forms of classification are disputed. Thus, his teaching is a product of this movement and also of these disputed bits of knowledge, which raises the need to think of education in biological sciences as something that must be questioned in social practices, beyond the textbooks, and beyond what filters discourses. Araujo and Araujo (2014) affirm Foucault's intense interest in the history of biology, punctuating emblematic episodes such as his inaugural class at the *Collège de France*, highlighting aspects of Mendel's work; the recognition of the historical studies of François Jacob, presented in *The Logic of Life: A History of Heredity (La logique du vivant: une histoire de l'herédité)* and the defense of his doctoral thesis supervised by Georges Canguilhem, one of the most eminent epistemologists of the biological sciences in the 20th century. Questions such as "does the discipline of biology develop in a certain direction? Which ones?" arise in the science teaching scenario, to know how and what should be taught, that is, which curricular contents and which practices are legitimized.

A possible beginning for some epistemological undertaking in this direction can be glimpsed in Terra (2010), referring to the analysis of the theoretical clash that took place in biological systematics, in the second half of the 20th century, based on the model of transformations proposed by Thomas Kuhn. According to the author, the extent of rewriting of botany and zoology textbooks observed in the 1990s makes it possible to affirm the occurrence of a scientific revolution polarized in different schools of classification or systematics. The dispersion of these schools, however, does not imply that paradigms are replaced or that they disappear. Thus, the fact that a chronologically more recent school points out the "errors" of its predecessor does not eliminate its discourse, nor its effects – there is no "paradigm shift", but rather coexistence, struggles and epistemological confrontations that manufacture subjection and resistance beyond the sites of science production

Discourses become intelligible, understandable, and possible, but they are not necessarily continuous or replaced by each other. Contemporary studies contrast these knowledges and make it possible to locate them "only" as distinct discourses in another perspective, to admit that Gradist or Evolutionary Systematics and Cladist or Phylogenetic Systematics are knowledge structures capable of addressing the truth - even though they refer to, or construct for themselves, the same theme, namely: "the organization of life". Systematic schools, in short, engender knowledge that is an expression of the will to power (Terra, 2010).

Forces of strength are constituted and glimpsed in the analyzes of their effects, in line with the invitation that Michel Foucault throws at us. According to Oksala (2011), we can state that in The Words and Things (*Les Most et Les Choses*), Foucault (2016) makes it possible to understand "life" as something associated with historical development,

since empirical objects came to be defined no longer in their place in a timeless system of classification, but by their place in history. In this way, the most profound changes in relation to scientific concepts can no longer be induced by scientists isolated in their time. It is admitted, in these terms, that such changes are rather the result of multiple, sometimes innumerable, causes, and thus, Foucault "[...] wanted to study the history of science as a relatively autonomous field of discursive units, regularities and transformations, without studying the intentional subject - the scientist - as the main factor [...]" (Oksala, 2011, p. 38).

In this perspective, Foucault invites us to take part in undertakings that make it possible to desubject historical knowledges in order to make them free, capable of opposition and of fighting against the coercion of scientific discourse, to which it is necessary to permanently question: "[...] what types of knowledge do you want to disqualify at the moment that you say that this knowledge is a science?" (Foucault, 2005, p. 15).

The scientific knowledge of modern biology constituted by propositions before the emergence of cladistics has suffered disqualifications through movements that cut and limit rather than perpetuate some expected path. Terra (2010) refers to biological systematics as an object whose study makes it possible to "illustrate" a dynamic and circulating scenario of scientific discursiveness in which the transitoriness of the ways of doing science is perceived. Thus, the author exposes a part of scientific discursivities, their agreements, and their effects on the scientific community itself and from texts produced in its environment or from its recommendations, referring to systematic schools as undertakings of abrupt changes. The intended discussion does not raise flags of support for the models adopted, evidenced, or forgotten in scientific discourse. Rather, the intention is to discuss their tense relations that irremediably culminate in the abandonment and adoption of one paradigm by another.

Popkewitz (2011) states that reason and rationality are central to social efforts to improve human conditions, however, such efforts are historically contingent systems of relations, the effects of which produce power and, in this perspective, disputes between bits of knowledge. It is possible to say that many biologists were/are faced with a contingency, which Darwinism does not seem to forbid - from Karl Von Linné to Robert Whittaker we have biological classifications that organize the forms of life on morphological and physiological criteria rather than molecular criteria.

Amorim (2009, p. 92) considers the existence of several schools of systematics in which it is possible to find "[...] different visions for the meaning of taxons and the methods of constructing them", contemporarily, highlighting for the intended discussion the "Lineana School", the "Gradist Systematics" and the "Cladistic Systematics".

The Lineana School considers classifications based on taxonomic knowledge, grouping beings according to their differences and simi-

larities, which originated from other eminently technical systems. The Lineana perspective is commonly imbued with the system of binominal nomenclature proposed and improved by Linné between the years 1735 and 1770. In these terms, one should consider that taxonomic rules remain in the ways of naming and communicating the existence of species, without, however, affecting classification systems based on evolutionary thinking (Polaszek, 2010).

The so-called evolutionary schools can be divided into gradist and cladist schools. Gradism considers the phylogenetic history and adaptive characteristics for the elaboration of "degrees" that can be defined as expressions of the evolutionary history of each group, while cladism forms groups considering kinship relations from a common ancestor, claiming a higher methodological accuracy by the fact of keeping the doubt in case of impossibility in obtaining a complete phylogeny (Amorim, 2009).

The existence of paradigms and the replacement of one school by another would be conceived, in a historical course devoid of conflicts, in the direction of bringing the truth closer to the eyes of scientists; however, the permanence of certain schools denotes the resistance of certain knowledge or the lack of conditions for certain discourses to have visibility. Quadrupeds, birds, amphibians, fish, and other living beings arranged in linear tables[2] are constructions that present themselves in form/morphology and in the continuity of their uses as basic criteria for thinking about them. In these terms, the goal is to understand in which instances evolutionary systematics can represent a discontinuity concerning the Linean perspective, a task that can make use of analyses that refer to epistemological exercises in modern biology and that can subsidize discussions that focus on the possibilities and interdictions of a phylogenetic perspective to the teaching spaces that assume commitments with general aspects of biological sciences in contemporaneity.

Methodological Procedures

The present work is qualitative research supported by discourse analysis linked to the theories of Michel Foucault. It is understood that the discourses of biological sciences or biology appear in the program of an institution with elements that can justify or deny certain practices, options, and productions. Foucault records a birth certificate of biology, examining what allows one to distinguish the biologist from the naturalist, the discipline of biology from natural history (Vieira, 2020). Thus, he can be considered an epistemologist of the life sciences, thinking it in his way and inviting us (biologists, mainly) to ways of seeing this life that has been inscribed and continues to be inscribed in ways of speaking and teaching. To this end, the understanding of the relations between statements and discourses is fundamental to the use of the theoretical tools present in his work.

Statements are conceived in this movement as what "[...] belongs to a discursive formation, as a sentence belongs to a text, and a propo-

sition to a deductive set" and whose law (of statements) "[...] and the fact that they belong to the discursive formation constitutes the same thing" (Foucault, 2008b, p. 32). The analysis of the statements that one wishes to perform "[...] is, in fact, at the level of what is said - and that" (Foucault, 2008b, p. 138). The exercise to be done is a question of what effects of power circulate among scientific utterances and what their inner regimes of power are, moreover, of how at certain moments, it changes (Foucault, 2008c). Thus, it is considered that the search for a more rigorous method of classifying living things has given cladistics a higher profile in recent decades, becoming the preferred method for current classifications, changing the relationships between the different forms or methods of studying living things.

The cladistic school followed many principles formulated by the entomologist Willi Hennig (1913-1976) who published, in 1950, a book of foundations for Phylogenetic Systematics, and other works in which he applied his phylogenetic method. The revision and translation of his work from German into English in 1966 made Hennig and his methods widely known, crediting him as the leading proponent of Phylogenetic Systematics.

In Foucault's (2008a) understanding, discourses need to be thought of as discursive practices that systematically form the objects of which they speak. In these terms, Fischer (2001) points out that discourse analysis is to account for the historical relations and concrete practices present within the discourse or to account for the multiple discursive practices manifested in/by different institutions. In this sense, it is possible to understand as discursive formation the principle of dispersion and distribution of the statements supported in the same system of formation and it is through the discursive formation that one knows what can and what should be said or not within a certain space and according to the position one occupies in this space/time (Fischer, 2012).

Linné's propositions are placed in a stable niche of contemporary biological discourse, because of their historical and practical value in the system of binominal nomenclature, engendering a way of teaching the classification of living things that is intelligible, but insufficient for evolutionary theorizing. In these terms, we seek to exercise the different systematic perspectives in their places of emergence and circulation, launching ourselves to the Foucauldian ideology, above all, to increase the visibility of this knowledge and the understanding of its existence, interlocution, and power relations in the spaces of teaching and teacher training.

Charts, Grades and Clades

It was in the 18th century that classifiers established character by comparing visible structures, relating elements that were homogeneous and able to represent everyone. The break that brought biology to natural history occurred to the extent that the principles of organiza-

tion came to be related to the essential functions of living things and to relationships of importance that no longer proceeded from the description alone. Lamarck, among others, enables the use of the concept of organization, founding an order for nature, defining its space, and enabling a method of characterization that subordinated characters, linking internal and external functions (Foucault, 2016).

In the 18th century, all living things were arranged in a five-level hierarchy: Kingdom, Class, Order, Gender and Species, formed by the reunion of varieties, whose diversity came from an accidental cause due to climate, terrain, heat, winds and whose "[...] order in which the essences of beings are articulated is that which nature, and not reason, dictates" (Jacob, 2001, p.57). The good conscience of the naturalist would establish the criteria for the classification of living beings and the evolutionary precepts, although incipient, were already circulating, establishing proximities or kinships, even if by decision of a creator.

Foucault (2016) claims that the debate about evolutionism would have been opened well before Darwin and well before Lamarck by works such as those of Benoit de Maillet (1656-1738) and Denis Diderot (1713-1784) who challenged the biblical chronology and proposed associations between the transformations of organisms and the relationships of such changes with the habitat. For the author, it was in the 18th century that classifiers established character by comparing visible structures, relating elements that were homogeneous and able to represent everyone.

Organizations based on the existence of functions essential to living beings and on their relations of importance would no longer proceed only from the description. Darwin (2004, p. 445) kept something of this epistemological foundation by seeking to elect characters that were present "[...] in a vast group of beings endowed with different customs" which "[...] according to the theory of descent, that these characters were inherited from a common ancestor", which would have a special value in the classification. But what is the criteria to establish these characters? The method used will also be the observation of structures, even if embryos and fossils were used, the morphological characters were the ones to be highlighted. When Darwin refers to the general plan of organization of living things and the homology of organs he states that "The whole subject is included in the general term of morphology. It is one of the most interesting parts of natural history, of which it can almost be considered the soul" (Darwin, 2004, p. 455).

Physiology exists to the extent that it is intrinsically related to structure, it is a natural history physiology, that is, in a time in which knowledge is limited by the representations possible in a visible and empirical world. Although the knowledge possible in *The Origin of Species* changes the way of conceiving the emergence of life and the possibility of explaining the emergence of the various groups of living beings, the overview of the classification remains in its taxonomic structure. Such classifications are narrated in a linear way by Margulis and Schwartz (2001), who start with Linné as the main reference for the

ways of naming and establishing the groups of living beings (taxons), passing through Darwin, whose evolutionist contribution culminated in the creation of phylogenies (still in a morpho-physiological field) and reaching the 20th century, in which technological advances in areas such as developmental biology and biochemistry have provided taxonomists with new tools.

Whittaker's (1969) classification into five kingdoms initially proposed cellular organization and modes of nutrition as useful criteria. The tools available in the 20th century helped in more accurate descriptions of the cells and of the biochemical mechanisms related to nutritional processes. In effect, few modifications have been suggested to the system, unchanging its structure and original precepts. Whittaker's system has not received contributions from molecular biology at the levels of study at which they operate in contemporary times, on this, it is possible to develop the argument that instead of contribution there must be a dispute, from this perspective, the only threat to any of the five realms schemes is the three-domain system that uses molecular criteria (Margulis; Schwartz, 2001).

The Evolutionary or Gradist School will construct groups in tree-like diagrams, showing relationships of kinship among lineages and rates of morphological divergence, following Darwin's proposition to the letter (Santos; Klassa, 2012). According to Santos (2008), this can result in a classificatory practice of building overly elaborate scenarios about the evolution of certain groups, based more on the authority of a researcher in a certain area than on a repeatable method; indeed, it should be pointed out that such neglect also has a solid epistemic basis in academic dynamics, since the authority of the researcher is fundamental to scientific productivity.

The Cladistic School, which followed many principles formulated by entomologist Willi Hennig, basically holds that classifications should express branching relationships among species, regardless of the degree of difference or similarity (Hennig, 1966; Futuyma, 1997). The cladistic classification must be strictly monophyletic, that is, admitting that each group of living beings must have arisen from a single evolutionary branch. In phylogenetic systematics genealogical relationships should only be obtained from the analysis of special similarities, called derived characters, attributes that are necessarily homologous between the taxonomic groups considered, that is, that represent characteristics that may (or may not) be morphologically similar and that have arisen in a common ancestor, modifying with the passing of generations (Santos, 2008).

The search for a rigorous method brought cladistics to the forefront in a short time (the space of about two decades), becoming the preferred method for current classifications. Gradists and Cladists, however, continue to dispute over the most appropriate methodological status for organizing life, with phylogeneticists gaining greater acceptance in the scientific community today.

The teaching spaces will be precious for the circulation of discourses and, in this field of knowledge in dispute, conciliatory discourses will be limited. Instead, many de-authorization movements will appear, especially discrediting evolutionary systematics from its scientific status, highlighting its inability to be precise and, in effect, asserting it as an obscure method in the face of a clear method (Figure 1).

Figure 1 – (a) represents a cladogram and (b) a gradist diagram

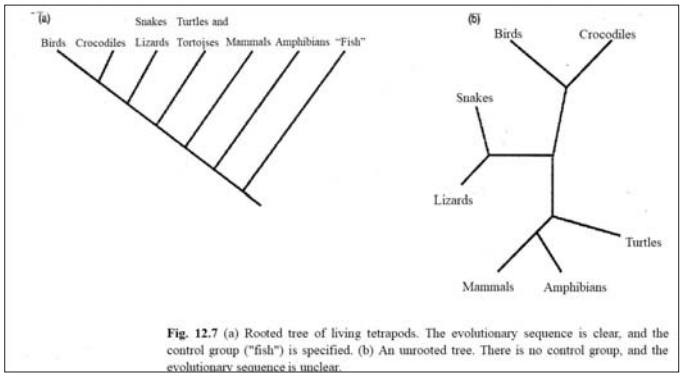

Fig. 12.7 (a) Rooted tree of living tetrapods. The evolutionary sequence is clear, and the control group ("fish") is specified. (b) An unrooted tree. There is no control group, and the evolutionary sequence is unclear.

Source: Stearns e Hoekstra (2003, p. 157).

Besides, cladistic inferences and idioms will be made possible to a great extent by the use of information constructed in molecular biology and worked out in computational programs, and this will be a strong argument for affiliating to one discourse and subjecting another. Molecular techniques have brought vast independent data sets and there have been continuous advances in DNA extraction, gene sequencing, sequence alignment, and the development of computer programs for proper interpretation of the data. As a result of the increasing availability of these methods, systematists have had the opportunity to incorporate macromolecular approaches into their studies, which no longer occupy a separate domain, but are now an integral part of the tools used in systematics (Pirani, 2005).

The end of the 20th century presented a fertile space of possibilities and in this context, Woese, Kandler and Wheelis (1990) indicated new classificatory directions in the article *Towards a Natural System of Organisms: proposal for the domains Archea, Bacteria, and Eucarya*. The text, whose initial part presents the need to restructure the systematics, uses molecular information/interpretations to choose the classification criteria or the bases for a restructuring more appropriate to the living world, in this case, nucleotide sequences of ribosomal RNA. The number of differences in the sequences is the basis for inferring evolutionary relationships and demarcating the domains of life and no longer into kingdoms. Although it was criticized at first, the three-domain proposal occurs in a space of *taxonomic crisis* and in the manner referred to by Margulis and Schwartz (2001) in that context - as a threat, that is, as a new knowledge that could discredit the academic authority of numerous taxonomists and gradist systematists.

Teaching

The *biological confusion* experienced by teachers who teach biology or in the initial training in undergraduate courses in the area, especially in the late 1990s and early 2000s, was not simply explained as a change in content, understood as a "refutation of old errors and the birth of new truths" and neither by a change of theoretical form in the sense of a "paradigm renewal or the modification of systematic sets" (Foucault, 2008c, p. 04). There was no personified authority establishing the best knowledge, no current book assertively more appropriate than a traditional book. The changes in biology in the 20th century stemmed from multiple areas, possibly multiple epistemological bases, and imputed adhesions.

About such movements, we can think that "[...] the great biological image of a maturing science still feeds many historical analyses [...]. However, biology is not constituted by, 'simply' new discoveries; it happens in a new 'regime' in discourse and knowledge" (Foucault, 2008c, p. 3). Thus, the question in evidence is what governs statements and how these statements are governed to construct scientifically acceptable propositions that can be verified or disproved as scientific procedures. The place and argument of Archaebacteria were not in 1977[3] as it was in 1990. Four, five or six kingdoms differ greatly from the three domains, and similarity criteria based on the number of cells, the presence of an organized cell nucleus or forms of nutrition will not be improved or enhanced by the genealogical criterion of sequential nucleotide analysis.

The association between molecular studies and classification practices at the end of the 20th century will not be presented in a conciliatory manner, there will be a break. The biological sciences enunciate the abandonment of a language or a way to represent the living object. There are no types or relations between types, what comes to exist is the course of an evolutionary film with actors that change all the time, the relations are, no longer are, there will be mutability, transformation, instability and movement. It is not/will not be the time to overcome evolutionary systematics, but to admit that the tools and *modus operandi* of the construction of gradist genealogies did not represent a break from classical episteme, due to the inability of its practitioners to decide, as did the Lineans, what was natural, what was more relevant, what was or should be considered in the face of so many things to consider.

For a generation of biologists, both Linné's categories and the ways of representing genealogies in gradist or evolutionary systematics can be presented in terms defined by Foucault when referring to "subjected knowledges," understood as a series of knowledges that were disqualified and insufficiently elaborated, that were/would be "[...] naive knowledges, hierarchically inferior knowledges, knowledges below the level of acquired knowledge or scientificity" (Foucault, 2005, p. 12).

This subjection of knowledge occurs through a discourse that establishes a new field of possibilities, not a new paradigm or an improvement, at least in a certain perspective in which we can glimpse a discon-

tinuity in the discursiveness of modern biology, something that appears before the naturalist's eyes and emerges in another space of knowledge, in which "[...] the semi-subjective authorities in Systematics have been supplanted by teams employing rapidly developing analytical methods and computers empowered to employ them more and more efficiently" (Pirani, 2005, p. 3).

Another rationality will establish the knowledge that should be considered scientific. It is not a matter, in these terms, of questioning the Darwinist metanarrative, but of making visible interdictions, subjections, and productivities. There will be, in this time, what is desirable and what is outdated, one practice condemned and another accepted, and, from this disputed field, resistances appear, and other places for the subjected knowledges are delimited. Establishing kingdoms and relating morphophysiological characteristics to classes will be something considered fundamental or basic in science/biology teaching, perhaps a wish for initial training is present – before we know about genome we have to know about the type of respiration, the shape of the heart or the amount of yolk in the egg.

This observation is not a criticism or a proposition for change, but should rather be thought of as the device that *makes biology work* in schools, textbooks, and national university entrance exams. Until that point, one should not expect conflict but rather the establishment of a view of biology that is naturalistic, morphological, empirical in a common sense that recognizes forms and ratifies statements.

The insertion of the phylogenesis content is indicated in contemporary times as something necessary to improve the teaching of biology. In a research, Lopes and Vasconcelos (2012) analyzed 13 biology textbooks and found inaccurate or conceptually distorted terms in relation to hegemonic discourses dealing with ways of classifying and establishing evolutionary relationships. Within this discussion, the conceptual error is not the focus, but rather the understandings and representations possible in epistemes. According to Carvalho (2007), the transformations pertaining to the epistemological field can be apprehended and demonstrated by understanding the different ways and approaches dispensed to a series of historical endeavors, whose core is discontinuity and this is something important in science education and teaching. Issues related to regimes of knowledge constitution underlie science learning processes, as they change our view of and relationship to scientific knowledge.

Education can be thought of as something that must address conflicts, heterogeneous fields, and above all, the understanding that thinking with knowledge is different from simply accepting it. In these terms, as Joaquim and El-Hani (2010) point out, a concept such as gene can be better explored in education from its multiplicity rather than from its alleged uniqueness, as well as the definitions of biological species that suggest a more effective comprehensibility when discussed in their different historical contexts (Vieira; Chaves, 2014). There will not

exist, in a broad cross-section of what we call biology, more certainties than doubts. It is a platform full of fissures – if we were to look at the picture of biology from a certain height this is what we would see.

The secular paths in biology are not able to blur its paths, although there is a desire to trace truths, improvements and prescriptions, and, for dictates of this order, other questions can be produced. At any given moment, what enters and what leaves the teaching space? Which episodes from a continuing history will be discussed? And which ones will be forgotten? Surely something will be cut out or adjusted, because not everything will fit in the time of a school subject. Prescription-based ways of thinking about teaching have a prominent place in discourse related to science education/education.

It is not the function of this text to condemn them, but rather to invite you to think with other tools. For years one has read texts explaining the conceptual misconception, present for decades in basic education, that set Darwin against Lamarck, failing to mention that many Darwinian propositions had conditions of possibility in the acceptance that acquired characteristics were hereditary (Bizzo, 1988), however, we can go to any textbook at the beginning of this century to find pictures with giraffes and texts talking about a right Darwin and a wrong Lamarck.

Prescribing truths and techniques or resorting to teaching half a dozen words that we consider capable of ordering the biological sciences will bring effects. Those who have lived the truth of the gradist school, will live in the coming years the assertiveness of the cladistic school; those who have lived the lie of the transmission of acquired traits will have to rethink the successes of epigenetics. It is necessary, at this time, to deal with the scientific dynamics and the ephemerality of some truths.

Understand... never deny

Scientific transience is a secular object of study, the criticism directed at the dogmatic teaching of a neutral science should not be proposed as something that corroborates the denial of science. Gaston Bachelard, Georges Canguilhem, Michel Foucault, among others, are authors capable of promoting the understanding of the scientific enterprise, its nuances and changes, and not the denial of its results.

Biological classifications, divergent in their epistemic bases, whether fixist or evolutionary and within gradist or phylogenetic evolutionism are not invitations to deny the existence of the living object. The critical exercise in scientific and teacher education, of those who teach science, is essential for the understanding of the making of science and consequently of its understanding. The evolutionist idea, for example, will have distinct systems of choices operating on equally distinct epistemes. The gradist and phylogenetic schools can be claimed to belong to the same "Kuhnian paradigm," as Santos and Klassa (2012) put it.

However, in the Foucauldian perspective, what makes it possible to individualize a discourse is the fact that an independent existence can be attributed to it, it being insufficient to seek in a theoretical option the general foundation of a discourse and the global form of its historical identity, "[...] because the same option can reappear in two types of discourse; and a single discourse can give rise to several different options" (Foucault, 2008a, p. 105).

Although the observation of *several biologies* is not something uncommon in discussions related to teaching, the uniqueness questioned in the context of this text does not refer exclusively to the subjects, contents, disciplines, or researchers. Furthermore, it describes a field in movement that disputes the power to signify the idea of life, in this specific case, that of classifying the living, producing a teaching that is the fruit of this disputed knowledge, discussed from spaces or fields of the possibility of knowledge – epistemes.

The discussions we find among the systematic schools raise the possibility of positioning them as complementary or antagonistic knowledge. This occurs because between these discourses there are intersections, whose analysis, at the level of their discursive formations, necessarily implies disregarding such discourses in their systematic ordering, no longer considering them as the state or final phase of an elaboration related to language, thought, empirical experience, contingency of events, etc. (Foucault, 2008a). There is a need to see the biological sciences and their teaching as a field in motion, unstable enough to settle structures on it, or as Foucault puts it (2008b, p. 62), "[...] the study of living things is not the game of concepts that we see appearing, it does not obey such strict conditions: its history is not, stone by stone, the construction of a building". Such an understanding is directed toward an understanding that admits the non-spray or disintegration of a system of thought completely - elements of its possibility will remain dispersed in the spaces of knowledge.

The possibility of describing a set of relations between events and other systems outside of it should not be taken as a remedy for the problems of teaching sciences, still, many investigative paths make it possible to conclude, in a way, that this kind of discussion makes it possible to see the enunciative gap in the position of the subjects who classify or who list the most relevant criteria to be used in the classification (sometimes the field naturalist / sometimes the geneticist in the laboratory).

Michel Foucault, sometimes presented as a critic of truth, raises questions about truths and about thinking of things as they are rather than as they always were or always will be. Thus, the concepts investigated here can occupy different spaces and subjectivities and in all these cases, produce a science that is space and field in movement, with discourses capable of disputing over the power to order its objects – Its teaching is a product of this movement and is a product of this disputed knowledge. This becomes the unspoken of biology that is already taught as such. Understanding it is necessary, and never denying it.

Final Considerations

In this essay, we seek to understand in what instances evolutionary systematics may represent a discontinuity concerning Linean systematics in light of the theoretical and epistemological assumptions of philosopher Michel Foucault. Epistemological exercises in biology/science are important movements for science teaching professionals, especially for the teacher, since they can serve as an auxiliary tool in curricular debates, planning of didactic strategies and lesson plans, among other elements that surround the universe of the classroom.

Biological systematics constitutes a stage for power struggles, in which discourses of gradist or evolutionary systematics and cladist or phylogenetic systematics dictate truths, what can be said and what must be silenced. Historical, social, and technological analyses, among others, enable possible understandings and representations in epistemes. This dynamism in the scientific environment influences the teaching of these contents.

Finally, we encourage reflection on an approach to these theories that enables thinking of knowledge beyond the simple acceptance of truth; in the perception that theories do not have a continuity and that the emergence of one view does not replace or annul the other, but rather the existence of conditions that allow their emergence and acceptance. Thus, we invite, especially biology/science teachers, to embark on this epistemological exercise critically and reflectively so that the provocations made here can encourage this path to become fruitful and - who knows - transformative in Teacher Education and Science Teaching.

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Notes

1 This article is based on data presented in the chapter *Ser Classificado* from the doctoral thesis entitled *Ser vivo, ser espécie, ser classificado: epistemes, dispositivos e subjetivações no ensino de Ciências e Biologia* with enlargements and updates (Vieira, 2013).

2 Reference to the categories proposed by Linnaeus in *Systema Naturae*, 1735, where it is possible to see names and characteristics arranged in a table. The original digitized version can be accessed at the following link: https://commons.wikimedia.org/wiki/File:Carl_linne_1735_systema_naturae_s1.jpg.

3 The separation between the Bacteria and Archaea domains occurred in the 1970s, when microbiologist Carl Woese (1928-2012) verified the possibility of separation after comparing ribosomal RNA sequences from various species. His propositions were published in 1977 in an article entitled *Phylogenetic structure of the prokaryotic domain: the primary kingdoms*.

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