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Marc Ereshefsky. *The Poverty of the Linnaean Hierarchy: A Philosophical Study of Biological Taxonomy*. Cambridge: Cambridge University Press, 2007. x, 316 p. ISBN-13: 978-0-521-03883-6.

This book was published in 2000 simultaneously in hardback and as an electronic resource, and, in 2007, as a paperback. The author is a professor of philosophy at the University of Calgary, Canada. He has an impressive list of contributions, mostly addressing issues in biological taxonomy such as units of evolution, natural kinds and the species concept.

The book is a scholarly criticism of the famous classification system developed by the Swedish botanist Carl Linnaeus (1707–1778). This system consists of both a set of rules for the naming of living organisms (biological nomenclature) and principles of classification. Linné's system has been used and adapted by biologists over a period of almost 250 years. Under the current system of codes, it is now applied to more than two million species of organisms. Inherent in the Linnaean system is the indication of hierarchic relationships. The Linnaean system has been justified primarily on the basis of stability. Although it has been criticized and alternatives have been suggested, it still has its advocates (e.g., Schuh, 2003). One of the alternatives being developed is *The International Code of Phylogenetic Nomenclature*, known as the *PhyloCode* for short, a system that radically alters the current nomenclatural rules. The new proposals have provoked hot debate on nomenclatural issues in biology.

Ereshefsky's book is organized into three parts and eight chapters:

A good starting point is Chapter Six, in which it is stated that Linné's system was based on the assumption that plants have two vital functions: "nutrition which preserves the individual, and reproduction which preserves the kind. To know what kind a plant is one needs to study its function in reproduction, in particular, those parts that play a role in its reproduction" (p. 202). This was Linné's main reason to focus on reproductive organs in classifying plants. Another factor in his decision was that "fructification characters are easy to work" with because they are the "most complex organ-system of plants" and "provide a large number of characters" and "can be described with precision" (p. 202). Linnaeus used thirty-one sexual characteristics and four variables, which he calculated would "suffice for 3,884 generic structures or more than will ever exist."

He [Linné] often lacked representatives of all species of a genus and thus was unable to determine the

unique fructification system of a genus. Given the method of logical division, a classification system cannot be considered real or natural unless the true fructification systems of genera are determined. Consequently, Linnaeus saw his classification as artificial and provisional guides for yet-to-be determined true classifications (p. 204).

Ereshefsky finds that three (false) theoretical assumptions serve as the foundation of the Linnaean system: "creationism, essentialism and the belief that genera are the most important taxa in his hierarchy" (p. 205). Much of the book is an examination of how these assumptions shaped the system and how alternatives of these assumptions should inform an alternative system. Ereshefsky finds that from the perspective of modern biology the "only element of Linnaeus's original system that remains firmly intact is his binominal rule for naming species. But that rule, as we shall see, may need to be altered as well" (p. 221).

Essentialism is a target for much criticism in scientific classification today. This review will not go too deeply into the controversies here, but provide some summary. Mayr (1997, 128) writes:

> The typological or essentialistic species concept […] postulated four species characteristics: (1) species consist of similar individuals sharing in the same "essence;" (2) each species is separated from all others by a sharp discontinuity; (3) each species is constant through space and time; and (4) the possible variation within any one species is severely limited.

Mayr adds: "Philosophers referred to such essentialistically conceived species as 'natural kinds.'"

While such an understanding of essentialism is clearly refuted by Darwinism, it is less certain that the following definition of essentialism (pp. 23 & 95) is also obsolete:

> All and only the members of a kind share a set of traits; those traits make entities the kinds of things they are; thus, those traits are crucial in explaining the other properties typically associated with the members of a kind.

Cooper (2005, 47) summarized the central problem as follows:

> Several different criteria may be employed by biologists seeking to determine species: morphological futures, evolutionary lineages, the criteria of reproductive isolation, or genetic features. On examination none of these appears suitable candidates for being the essential properties of biological species.

Ereshefsky provides a good argument as to why essentialism is in conflict with a theory of (slow) gradual evolution and thus must be rejected in biology (p. 95–96). On the other hand, he seems to accept essentialism in chemistry (p. 17):

> Mendelev's periodic table is often cited as a model for essentialism. All and only the members of a particular element share a common real essence — their unique and common atomic structure. And knowledge of that structure enables us to predict and explain the behavior of instances of that element.

It is one matter to define essentialism and to judge whether or not it constitutes a problematic basis of classification. (Most philosophers today reject essentialism.) Quite another issue is whether Linné's system is based on essentialistic thinking. Müller-Wilhle (2007, 541) finds that the criticism that Linné was an essentialist is a misunderstanding:

> Historians and philosophers of science have interpreted the taxonomic theory of Carl Linnaeus (1707–1778) as an 'essentialist', 'Aristotelian', or even 'scholastic' one. This interpretation is flatly contradicted by what Linnaeus himself had to say about taxonomy in *Systema naturae* (1735), *Fundamenta botanica* (1736) and *Genera plantarum* (1737) … (1) Linnaeus's species concept took account of reproductive relations among organisms and was therefore not metaphysical, but biological; (2) Linnaeus did not favour classification by logical division, but criticized it for necessarily failing to represent what he called 'natural' genera; (3) Linnaeus's definitions of 'natural' genera and species were not essentialist, but descriptive and polytypic; (4) Linnaeus's method in establishing 'natural' definitions was not deductive, but consisted in an inductive, bottom-up procedure of comparing concrete specimens.

Thus, a major line of argument in Ereshefsky's book seems to be based on a controversial interpretation of Linné's principles.

Chapter Seven considers post-Linnaean taxonomy and contains a number of recommendations for changes, such as R11: "Where possible, taxon names should be given phylogenetic definitions" (p. 266). All the suggestions are made in order to provide a classification of organisms based on modern biological research. In this review, we shall not further consider the different alternatives in biological taxonomy today, but rather concentrate on the complex of problems involved in scientific classification, which is the main theme of the first two parts of the book.

Part II (Chapters Four and Five) concerns pluralism. Ereshefsky argues for the view of metaphysical pluralism, i.e. that the forces of evolution produced at least three different types of base lineages (interbreeding, ecological and phylogenetic) that cross-classify the organic world, which is why a plurality of equally legitimate classifications exists. Science should "carve nature at its joints", but perhaps the world is carved in multiple ways, each corresponding to a particular taxonomic approach. Biologists face different commitments to various rules, each of which motivates different avenues of research and different classifications.

Part I is termed "The Historical Turn". It refers to what might be understood as a paradigm shift in classification theory. I believe, however, that it would have been better to have given Part I the title "The Philosophy of Classification", which reflects the different views presented and not just the new paradigm.

In Hjørland (2003, 107) and elsewhere, this reviewer has argued that four basic philosophies of classification correspond to four basic epistemological schools: empiricism, rationalism, historicism and pragmatism.

Ereshefsky seems not to defend a particular epistemological position in relation to biological taxonomy. On the other hand, he seems to be in accordance with the reviewer's rejection of empiricism and rationalism as defined above. Overall, the book seems to confirm the reviewer's epistemological understanding in this domain, underscoring the different paradigms at play in modern biological taxonomy: "Contemporary biology contains no fewer than four general schools of taxonomy: evolutionary taxonomy, pheneticism, process cladism, and pattern cladism" (p. 7). In many ways Ereshefsky, seems to confirm the reviewer's view, although this conclusion must be drawn by inference.

Ereshefsky's presentation of logical division (termed essentialism) as a method in knowledge organization seems to correspond to rationalism and his presentation of cluster analysis and of pheneticism, which divides entities into groups whose members share a cluster of similar traits, corresponds to empiricism.

In Ereshefsky's use of the term, a system following "the historical approach" classifies entities according to their causal relations rather than their intrinsic qualitative features. This corresponds only partly to historicism in epistemology. What Ereshefsky terms "the historical approach" Gnoli (2006) terms "phylogenetic classification" (which, according to Gnoli, includes the classification of musical instruments). Perhaps "genetic classification" or "genealogical classification" would be a better term (understood broadly as the identification of the causes producing a phenomenon, as Michel Foucault uses it). My point here is that Ereshefsky's use of the term "historical" only refers to the object of study, not to the researchers' way of understanding the object (as reflected in, for example, the hermeneutic circle and in Fleck's (1935) study of syphilis). If Ereshefsky had argued that it is necessary for the biological taxonomist to consider the different conceptions and theories (as, for example, those presented in his own book), historicism would be at work. For Ereshefsky's book to correspond to epistemological historicism properly speaking, this additional reflection on theory would be necessary.

Finally, let us consider pragmatism in relation to this book. It is worth mentioning that pragmatism evolved out of the evolutionary biological view, which is why this view should not be strange or unfamiliar to biologists. Ereshefsky carefully considers the purpose of classification and also, at several points, the practical issues related to classification. But at a deeper level, the pragmatic view is connected to the argument that a certain way to classify organisms is in accordance with certain goals of biological research. Perhaps Ereshefsky's defence of metaphysical pluralism can be seen as an attempt to answer to the overall interests of biology. If only one of the three different types of base lineages mentioned (interbreeding, ecological and phylogenetic) were considered, this might have negative implications for biological science. For example, interbreeding works only for the minority of organisms which have sexual reproduction. If this definition of species was the only one used, the systematics of all non-sexual organisms would suffer. If this argument is acceptable, Ereshefsky can be interpreted as being a pragmatist.

In the rest of this review, I shall consider some implications this book may have for knowledge organization (KO) and library and information science.

Consider, for example, the principle of logical division, which is a basic method in the facet analytic tradition. As Vickery writes (1960, 12): "Facet analysis is therefore partly analogous to the traditional rules of logical division, on which classification has always been based." Ereshefsky criticizes this method throughout the book. He writes, for example: "If taxa lack essences, then the method of logical division has no role in classification—there is no essences on which it can operate. Accordingly, that method has been dropped from biological taxonomy" (Ereshefsky, p. 211). Furthermore, he notes (p. 296):

> Mayr (1982, 174, 179, 191) and Atran (1990, 108), for instance, offer a historical case against the method of logical division. According to that method, entities are sorted into a hierarchy of classes such that each class is subdivided into two [sic!] lower classes by a set of differentiating properties [= a criterion of division?]. As Mayr and Atran observe, the method of logical division breaks up natural groups (see Section 1.1). Thus that method fails to provide empirically accurate classifications that serve as a basis for making inferences about the organic world.

(That a class be subdivided into two lower classes is not a requirement. I believe that Ereshefsky has made a mistake at this point. One logical principle of division, e.g. division by age, may result in a number of classes, not just two. In the index of the book, the method of dichotomous division is considered equivalent to the method of logical division, which seems to be inconsistent with what is written about Linné's use of this method on p. 201–202.)

Insofar as Ereshefsky's criticism of logical division is valid, the whole school of facet-analysis in library and information science seems to suffer, for logical division is the basis of facet-analysis. At least, it seems important for information science to reconsider its approach in light of the recent developments in scientific classification.

Another implication of Ereshefsky's book is a problematization of Mai's (2004) understanding that the classification of documents is distinct from the classification of biological organisms (and from physical objects). Mai (2004, 41) maintains:

> Scientific classification and logical division has [sic] worked fairly well in the classification of natural kinds, such as Linnaeus' classification of living things. The reason is that the characteristics chosen, such as the shape of a fruit, are easy to perceive and describe. Furthermore, all biologists and botanists would agree on the interpretation of the characteristics (Lakoff, 1987). Such taxonomies do not intend to analyze the meaning of the terms, but are merely classifications of kinds of things. The chosen characteristics by which the genus is divided into genera are properties of the things classified and the characteristics are subject to inspection. However, the users of such taxonomies know that the use of the classification requires some sort of interpretation. That is why a zoologist would not dispute a statement like "this cat has three legs," since he knows that there can be handicapped cats. He would still classify cats as four legged mammals and he would still say that the property of being four-legged belongs to cats, but he would not say that cats are four-legged necessarily or analytically (Eco, 1984). In other words, nothing specific is said about individual cats in such a classification.

And further (Mai 2004, 42):

> It is my contention that scientific classification of natural objects, and the bibliographic classification of the content of a document, are distinct for two main reasons. The first has to do with when and how the items are classified, and the second has to do with the nature of the classified items.

Ereshefsky claims in many ways the opposite of what Mai expresses above. He does not find that "Scientific classification and logical division has [sic] worked fairly well in the classification of natural kinds" or that criteria for classify organise "are easy to perceive and describe". Mai's claim "that scientific classification of natural objects, and the bibliographic classification of the content of a document, are distinct" seems also problematic because each school of biological taxonomy has different criteria, which may be applied to both organisms and their descriptions in documents. It should be mentioned, however, that Mai himself also questions some of the cited assumptions based on Broadfield (1946).

A third and final consideration for knowledge organization is the distinction made between classification and categorization. Jacob (2004, 15) contrasted classification with categorization and defined "classification" in a restricted way that does not account for Ereshefsky's "three general philosophical schools [of classification] […]: essentialism, cluster analysis, and historical classification." Although Jacob claims that Ereshefsky misuses the term "classification", thus confusing "classification" and "categorization," we might ask for textual evidence showing that Ereshefsky's terminology is faulty. My own feeling is that it is not.

Conclusion

Ereshefsky (2000) has been cited once in this journal. The citation concludes (Gnoli 2006, 144):

To summarize what we have seen in various domains, classification can be based on two major principles: similarity, and common origin.

Gnoli here seems to have overlooked the fact that Ereshefsky (2000) discusses three major principles: logical division based on essential characteristics, cluster analysis based on similarity measurement and historical classification based on common ancestors. (He has also overlooked that Hjørland (1998 and 2003) discusses four major principles of classification based on, respectively, empiricism, rationalism, historicism and pragmatism.)

I believe that Ereshefsky's book has much to offer to KO and that we really need to consider the literature of scientific classifications.

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Rachel Cooper. *Classifying Madness: A Philosophical Examination of the Diagnostic and Statistical Manual of Mental Disorders*. Berlin: Springer, 2005. vii, 172 p. (Philosophy and Medicine, vol. 86). ISBN: 978-1-4020-3344-5 (hbk.). (Also available as electronic "Kindle" book from Amazon.com).

The author, Rachel Cooper, Senior Lecturer at Lancaster University, holds a Ph.D. in History and Philosophy of Science from Cambridge University. The title of her thesis is also *Classifying Madness*.

Classifying Madness: A Philosophical Examination of the Diagnostic and Statistical Manual of Mental Disorders concerns a particular classification system for mental disorders, the DSM, published by the American Psychiatric Association. The DSM is the classification system used most often in diagnosing mental disorders in the United States. Although the International Classification of Diseases (ICD) is a commonly-used alternative outside the U.S., the DSM still holds immense weight internationally. Today, the DSM has almost the status as a bible within