Dave Lawrence
MATX 603 History of Interdisciplinarity and Multimedia
Abstract

# MICHAEL FOUCAULT, *THE ORDER OF THINGS*, AND THE HISTORY OF BIOLOGY

Michel Foucault's *The Order of Things: An Archaeology of the Human Sciences* argues for the existence of major changes in the organization and conception of human knowledge in the period between the Renaissance and the end of the 19th century. He argues for three epistemic periods in the growth of biological thought—the Renaissance (history), the "Classical" (natural history), and the modern (biology)—set apart by sharp discontinuities in the late seventeenth century and at the end of the eighteenth century that coincide with similar breaks in the *epistemes* of other areas of human knowledge. In the Renaissance, the Word (in both the linguistic and spiritual sense) prevailed. No distinction was made between legend and observed fact. In the "Classical" era, comparison of observed structure—primarily external structure—was used to organize the sweep of life onto a conceptual table. In the modern era, biology arose. Biologists began to look beneath the surface; function replaced structure as the organizing principle of biology. Also, in the modern era, the concept of life arose as a permanent primal force that replaced the outdated, and ephemeral, concept of being. Foucault's writing is maddening and obscure; his conclusions often at variance with the historical evidence. He confuses the importance of taxonomy in helping biologists' achieve their mission of understanding the living world with the mission itself. He reads great theoretical significance in research approaches that are better explained by pragmatic concerns. A look at the minutia of biological research casts doubt on the correspondence in the timing of events that Foucault proposes. Nevertheless, *The Order of Things* offers a maddening, but fascinating, glimpse of a key period in human history.

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Term Paper

# MICHAEL FOUCAULT, *THE ORDER OF THINGS*, AND THE HISTORY OF BIOLOGY

Michel Foucault's *The Order of Things: An Archaeology of the Human Sciences* offers a fascinating, though maddening, account of what Foucault argues are major changes in organization and conception of human knowledge in the period between the Renaissance and the end of the 19th century. His usage of the term "archaeology" in the subtitle is idiosyncratic. He does not refer the discipline that examines human culture based on excavation and analysis of tangible artifacts obtained from a physical space; instead, he examines human culture based on the extraction and analysis of linguistic artifacts obtained from a conceptual space. He argues that his method offers advantages over traditional historical investigations in that, "archaeology, addressing itself to the general space of knowledge, to its configurations, and to the mode of being of the things that appear in it, defines systems of simultaneity, as well as the series of mutations necessary and sufficient to circumscribe the threshold in a new positivity." (Foucault xxiii)

Whether or not Foucault actually achieves this goal is debatable. He makes a wise choice in focusing on language, for it reveals how humans perceive the real world around them. I doubt

many scholars would dispute the point—certainly few who study language in one of my primary specialties, geography. Language tells us much about how we "know" about the world, how we perceive reality.[1] From Foucault's writing, however, it is hard to avoid the conclusion that he sometimes confuses the perception of reality with reality itself. Nevertheless, in the moments where Foucault's writing achieves an (uncharacteristic, for this book) lucidity that sticks closer to his evidence, it offers a fascinating vision into the evolution of Western thought.

In the preface, he claims that his inquiry:

> … has revealed two great discontinuities in the *episteme* of Western culture: the first inaugurates the Classical age (roughly half-way through the seventeenth century) and the second, at the beginning of the nineteenth century, marks the beginning of the modern age. The order on the basis of which we think today does not have the same mode of being as that of the Classical thinkers. (xxii)

Foucault spends the next 400 pages of *The Order of Things* examining three areas—language, economics, and biology—which he proposes as proving grounds for the power of his archaeological method. I have no particular expertise in linguistics or economics, so have little valuable perspective to offer to with respect to his discussion of those subjects. But as a student, researcher, and teacher of biology for more than 30 years—and one with classical (for biologists) training in an aspect of the discipline he focuses on (the classification of organisms)—I can offer a working biologist's opinion on the validity and value of Foucault's musings on the history of my discipline. Given that Foucault repeatedly visited the history of biology throughout his career, from *The History of Madness* at the start of his career to *The History of Sexuality* at the end, the focus of this piece on what he wrote in *The Order of Things* may not be a fair assessment of Foucault's thought. But a fair assessment of the totality of his thoughts on biology,

[1] Given my several-decades-long study of the natural sciences, I confess to a bias that a physical (natural) "reality" exists.

evaluating evidence from all of his writings, would probably require several lifetimes' worth of study.

Even within the bounds that I have defined this project, it will likely reveal a flawed (or, more generously, limited) understanding of Foucault's thought. While I will readily concede responsibility for some of those flaws (limits), some of the responsibility surely lays at Foucault's own doorstep, for, as in a review of *The Order of Things* in *The New York Times Book Review*, George Steiner writes that "… an honest first reading produces an almost intolerable sense of verbosity, arrogance and obscure platitude. Page after page could be the rhetoric of a somewhat weary sybil indulging in free association. Recourse to the French text shows that this is not a matter of awkward translation."

Now that the *mea culpas* are complete, it is time to start.

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In *The Order of Things*, Foucault divines three archaeological periods in the recent development of modern science: the study of life would be called "history" during the Renaissance, "natural history" during the "Classical" period that follows; then "biology" from the nineteenth century onward. (Albury and Oldroyd 187)

During the Renaissance, the Word (in a literary and spiritual sense) is supreme. During this period, compilers of knowledge sought, "… not to reflect what one knows in the neutral element of language … but to reconstitute the very order of the universe by the way in which words are linked together and arranged in space." (38) Foucault continued, "… such an interweaving of language and things, in a space common to both, presupposes an absolute privilege on the part of writing." (38) This *episteme* produced an environment in which:

> This primacy of the written word explains the twin presence of two forms which, despite their apparent antagonism, are indissociable in sixteenth-century

> knowledge. The first of these is a non-distinction between what is seen and what is read, between observation and relation, which results in the constitution of a single, unbroken surface in which observation and language intersect to infinity. And the second, the inverse of the first, is an immediate dissociation of all language, duplicated, with-out any assignable term, by the constant reiteration of commentary. (39)

Biological accounts during that time uncritically mixed fable with fact—this was in keeping with an ancient condition that applied to works of geography, such as maps (and which continues today in, for example, numerous pseudo-documentaries on cable television). Foucault quotes Georges-Louis Leclerc, Comte de Buffon, as dismissing such works by saying, "Let it be judged after that what proportion of natural history is to be found in such a hotch-potch of writing. There is no description here, only legend." (39) But Foucault argues that for Renaissance-era chroniclers of the living world, all was considered "*legenda* – things to be read." (39) He continues:

> But the reason for this was not that they preferred the authority of men to the precision of an unprejudiced eye, but that nature, in itself, is an unbroken tissue of words and signs, of accounts and characters, of discourse and forms. When one is faced with the task of writing an animal's history, it is useless and impossible to choose between the profession of naturalist and that of compiler: one has to collect together into one and the same form of knowledge all that has been seen and heard, all that has been recounted, either by nature or by men, by the language of the world, by tradition, or by the poets. To know an animal or a plant, or any terrestrial thing whatever, is to gather together the whole dense layer of signs with which it or they may have been covered; it is to re-discover also all the constellations of forms from which they derive their value as heraldic signs. (39-40)

In the seventeenth century, this *episteme* was cast aside for what Foucault refers to as the Classical era. Whereas in the Renaissance all things were believed to be connected—an expression of God's creation, if you will—in this Classical age connections among things had to be establish through the careful collection and analysis of data. Foucault summarizes the change:

> … by discovering that which is the simplest, then that which is the next simplest, one can progress inevitably to the most complex things of all. Whereas comparison by measurement requires a division to begin from, then the

> application of a common unit, here, comparison and order are one and the same thing: comparison by means of order is a simple act which enables us to pass from one term to another, then to a third, etc., by means of an 'absolutely uninterrupted' [6] movement. In this way we establish series in which the first term is a nature that we may intuit independently of any other nature; and in which the other terms are established according to increasing differences. (53)

Empiricism destroys the power of the Word. Language is reduced to the level of a tool. As Foucault writes:

> This being so, the written word ceases to be included among the signs and forms of truth; language is no longer one of the figurations of the world, or a signature stamped upon things since the beginning of time. The manifestation and sign of truth are to be found in evident and distinct perception. It is the task of words to translate that truth if they can; but they no longer have the right to be considered a mark of it. Language has withdrawn from the midst of beings themselves and has entered a period of transparency and neutrality. (56)

During this period, Europeans rapidly colonize most of the known world. Expeditions go forth, specimens are collected, and great scientists like Carl Linneaus make great strides in cataloging the incredible diversity of life on Earth. In this period, Foucault claims that "natural history," or "the science of the characters that articulate the continuity and the tangle of nature," is born. Natural historians, by their efforts to classify life, create a new conceptual space on which acquired knowledge can be written:

> If the Western world did battle with itself in order to know whether life was nothing but movement or whether nature was sufficiently well ordered to prove the existence of God, it was not because a problem had been opened up; it was because, after dispersing the undefined circle of signs and resemblances, and before organizing the series of causality and history, the *episteme* of Western culture had opened up an area to form a table over which it wandered endlessly, from the calculable forms of order to the analysis of the most complex representations. And we see the marks of this movement on the historical surface of the themes, controversies, problems, and preferences of opinion. Acquired learning spanned from one end to the other a 'space of knowledge' which had suddenly appeared in the seventeenth century and which was not to be closed again until a hundred and fifty years later. (75)

In order to populate this space, Foucault argues that the classifiers of life—what we now call taxonomists—focused on what can be seen. Evidence from any other realm of the senses need

not apply. He proposes this as evidence of the great conceptual shift from the Renaissance to the Classical era:

> Natural history did not become possible because men looked harder and more closely. One might say, strictly speaking, that the Classical age used its ingenuity, if not to see as little as possible, at least to restrict deliberately the area of its experience. Observation, from the seventeenth century onward, is a perceptible knowledge furnished with a series of systematically negative conditions. Hearsay is excluded, that goes without saying; but so are taste and smell, because their lack of certainty and their variability render impossible any analysis into distinct elements that could be universally acceptable. The sense of touch is very narrowly limited to the designation of a few fairly evident distinctions (such as that between smooth and rough); which leaves sight with an almost exclusive privilege, being the sense by which we perceive extent and establish proof, and, in consequence, the means to an analysis *partes extra partes* acceptable to everyone: the blind man in the eighteenth century can perfectly well be a geometrician, but he cannot be a naturalist [3]. And, even then, everything that presents itself to our gaze is not utilizable: colours especially can scarcely serve as a foundation for useful comparisons. The area of visibility in which observation is able to assume its powers is thus only what is left after these exclusions: a visibility freed from all other sensory burdens and restricted, moreover, to black and white. This area, much more than the receptivity and attention at last being granted to things themselves, defines natural history's condition of possibility, and the appearance of its screened objects: lines, surfaces, forms, reliefs. (132-133)

The goal of this new way of classification was to produce a name that would encapsulate all that is known about the organism in question:

> The plant thus recognized in its essential character and desig-nated upon that basis will express at the same time that which accurately designates it and the relation linking it to those plants that resemble it and belong to the same genus (and thus to the same family and the same order). It will have been given at the same time its proper name and the whole series of common names (manifest or hidden) in which it resides. 'The generic name is, as it were, the official currency of our botanical republic'[27]. Natural history will have accomplished its fundamental task, which is that of 'arrangement and designation'[28]. (141)

During the eighteenth century, Foucault claims the Classical system based on the comparison of visible structure began to be replaced by classifications based on the "classifying character," characteristics that may still remain in the realm of the visible, but which also include phenomena not visible to the naked eye.

> But, the transition from described structure to classifying character took place wholly at the level of the representative functions exercised by the visible with regard to itself. From Jussieu, Lamarck, and Vicq d'Azyr onward, character, or rather the transformation of structure into character, was to be based upon a principle alien to the domain of the visible – an internal principle not reducible to the reciprocal interaction of representations. This principle … is *organic structure*. (226-227)

In an unpublished discussion of The Order of Things, I summarized four ways in which Foucault argues the concept of organic structure takes the stage:

1) as a hierarchy of characters in which some types of characters are more useful in classifying organisms than others;
2) as characters linked to functions, such as digestion, locomotion, and reproduction;
3) as a tool indispensible to the classification of organisms;
4) in the dissolution of the parallelism between classification and nomenclature.

According to Foucault, the concept of organic structure was not new to the post-Classical era. What was new was its role in determining the relationships among organisms. The study of structures not normally visible, such as the skeletons of vertebrates or the vascular structures in plants, now contributed to our understanding of life, as did the study of the functions of those structures. In Foucault's analysis, the linking of structure, function, and the relationships—including ultimately evolutionary relationships—among organisms spelled the end of natural history and gave rise to what we now call biology. (230-231)

Furthermore, Foucault argues that the Classical era comes to an end with an emphasis on understanding the functions of the structures independent of those structures' role in helping natural historians arrange the taxonomic table of life. He credits Georges Cuvier with introducing this change:

> In his project for establishing a classification that would be as faithful as a method and as strict as a system, Jussieu had discovered the rule of the subordination of characters, just as Smith had used the constant value of labour to establish the natural price of things in the play of equivalences. And just as Ricardo freed labour from its role as a measure in order to introduce it, prior to all exchange, into the general forms of production, so Cuvier freed the subordination of characters from its taxonomic func-tion in order to introduce it, prior to any classification that might occur, into the various organic structural plans of living beings. The internal link by which structures are dependent upon one another is no longer situated solely at the level of frequency; it becomes the very foundation of all correlation. It is this displacement and this inversion that Geoffroy Saint-Hilaire expressed when he said: 'Organic structure is becoming an abstract being ... capable of assuming numerous forms' [6]. The space of living beings pivots around this notion, and everything that until then had been able to make itself visible through the grid of natural history (genera, species, individuals, structures, organs), everything that had been presented to view, now takes on a new mode of being. (263-264)

Cuvier looks beneath the surface—the skin or epidermis—to see the internal structures not normally visible to the naked eye (except in road kill): these structures are the organs. (The skin/epidermis also counts as an organ, by the way.) Foucault argues that in the Classical era, natural historians could define organs by their structure or function—starting from either viewpoint, one would arrive at the same conclusion—but that natural historians considered structure and function independent of one another. Cuvier rejects this independence, arguing that function is more important:

> … doing away with the postulates of both their coincidence and their independence, he gives function prominence over the organ – and to a large extent – and subjects the arrangement of the organ to the sovereignty of function. He rejects, if not the in-dividuality of the organ, at least its independence: it is an error to believe that 'everything is important in an important organ'; our attention must be directed 'rather upon the functions themselves than upon the organs' [7]; before defining organs by their variables, we must relate them to the functions they perform. (264)

Foucault argues that the change in perspective urged by Cuvier—one of the most influential scientists of his day, a pioneer in comparative anatomy and paleontology (even though he was a staunch opponent of any concept of evolution)—had a powerful effect on taxonomy:

> It must now be apparent what an immense reversal all this presupposes in relation to the Classical *taxonomy*. This taxonomy was constructed entirely upon the basis of the four variables of description (forms, number, arrangement, magnitude), which could be scanned, as it were in one and the same movement, by language and by the eye; and in this deployment of the visible, life appeared as the effect of a patterning process – a mere classifying boundary. From Cuvier onward, it is life in its non-perceptible, purely functional aspect that provides the basis for the exterior possibility of a classification. The classification of living beings is no longer to be found in the great expanse of order; the possibility of classification now arises from the depths of life, from those elements most hidden from view. Before, the living being was a locality of natural classification; now, the fact of being classifiable is a property of the living being. So the project of a general *taxinomia* disappears; the possibility of deploying a great natural order which would extend continuously from the simplest and most inert of things to the most living and the most complex disappears; and the search for order as the ground and foundation of a general science of nature also disappears. ' Nature', too, disappears – it being understood that nature, throughout the Classical age, did not exist in the first place as a 'theme', as an 'idea', as an endless source of knowledge, but as a homogeneous space of orderable identities and differences. (268)

Aside from destroying the natural order that scientists sought in the Renaissance and Classical eras, Cuvier's ideas have another powerful effect, giving birth to the concept of life and connecting life with the non-living world that surrounds it:

> Perhaps for the first time in Western culture, life is escaping from the general laws of being as it is posited and analysed in representation. On the other side of all the things that are, even beyond those that can be, supporting them to make them visible, and ceaselessly destroying them with the violence of death, life becomes a fundamental force, and one that is opposed to being in the same way as movement to immobility, as time to space, as the secret wish to the visible expression. Life is the root of all existence, and the non-living, nature in its inert form, is merely spent life; mere being is the non-being of life. For life – and this is why it has a radical value in nineteenth-century thought – is at the same time the nucleus of being and of non-being: there is being only because there is life, and in that fundamental movement that dooms them to death, the scattered beings, stable for an instant, are formed, halt, hold life immobile – and in a sense kill it – but are then in turn destroyed by that inexhaustible force. The experience of life is thus posited as the most general law of beings, the revelation of that primitive force on the basis of which they are; it functions as an untamed ontology, one trying to express the indissociable being and non-being of all beings. (278)

After Cuvier, life becomes a permanent permanent, a primal force. Being, however, becomes ephemeral—a state created by, and ultimately destroyed by, life.

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Foucault's analysis is most certainly fascinating. Few would argue with his thesis that there was a great evolution in Western thought from the Renaissance to the modern age. But I, as a student of biology rather than philosophy, have to question whether the great discontinuities he insists upon were as great or as discontinuous as he claims. Here is an example of where he seems to overplay his hand:

> Historians want to write histories of biology in the eighteenth century; but they do not realize that biology did not exist then, and that the pattern of knowledge that has been familiar to us for a hundred and fifty years is not valid for a previous period. And that, if biology was unknown, there was a very simple reason for it: that life itself did not exist. All that existed was living beings, which were viewed through a grid of knowledge constituted by natural history. (127-129)

I concede that the term "biology" may not have come into existence until 1766 (McLaughlin 2), but given its definition as the study of life, and given the fact that it—under its modern definition—encompasses two of its main subdisciplines, botany and zoology, both of which are far older, Foucault's assertion that biology did not exist until the nineteenth century does not seem to me to hold up. In perusing a current introductory biology textbook (such as Campbell et al.) one can find large elements of what was traditionally called botany and zoology. The great taxonomists of the Classical era, such as Linneaus, spent a great deal of time working on plants, and animals, and fungi, and even the bastardized grouping commonly referred to as the protozoa (or, more recently, protists). I would argue that distinctions between botany and zoology stemmed more from matters of professional convenience or interest—individual researchers focusing on phenomena they were more interested in, skilled in, or more likely to get funding for. In that case, the situation in the past is not that much different than in today. Furthermore, in the broader culture there seemed to be a realization that plants and animals had much in common. If they were as different as they would have to be for Foucault's assertions to be valid,

the Biblical character of Onan would have been struck dead by God for spilling something other than his "seed" on the ground.

Likewise, Foucault's assertion that life did not exist strains credulity. Even Foucault acknowledges that living beings cannot exist without life itself. Buffon proposed a scientific theory of life in his *Histoire Naturelle* in 1749 (Tiraud 215-215). Philosophical conceptions of life date back to at least Aristotle (Ruiz-Mirazo et al., 204). Ruiz-Mirazo does try to argue that Aristotle's conception was largely forgotten by the eighteenth century—in which the natural world was divided into three kingdoms, animal, vegetable, and mineral—but I remain skeptical. Definitions of "life" so far depend on the effects and/or characteristics of life, therefore, any attempt to objectively—scientifically—define life is biased by the circular relationship with the subject of the definition itself. For example, Dorinda Outram translates two early nineteenth century definitions of life, first by Xavier Bichat:

> Life is the ensemble of functions which resists death ... Inorganic bodies act on them without ceasing; they themselves continually exert a reciprocal action on each other; they would soon succumb if they did not have in themselves a permanent principle of reaction. This principle is that of life; unknown as to its nature, it can only be so by its results. (325)

Cuvier's definition drew heavily on Bichat's. He wrote that living things, "…resist for a certain time, the laws which govern inorganic bodies, and even to act on the environment in a way which is entirely contrary to those laws; we use the terms 'life' and 'vital force,' to designate these apparent exceptions to the general laws of nature." (325)

The fact is that scientists still struggle to come up with a universally accepted scientific definition of life today, especially one that does not rely on empirical observations (Tiraud et al., 1003). If we accept Foucault on this point with respect to the nineteenth century, anyone familiar with current scientific literature on the topic could argue that we still do not have life today, and if we do not have life, we cannot have biology.

Much of Foucault's discussion of the development of biology in *The Order of Things* focuses on attempts to classify life. He certainly understands the purpose of any classification system well enough, it is, "to determine the 'character' that groups individuals and species into more general units, that distinguishes those units one from another, and that establishes them to fit together to form a table in which all individuals and all groups, known or unknown, will have their appropriate place." (226)

I think Foucault errs in assuming that the development of a taxonomic table was the sole *raison d'etre* of natural historians, botanists, zoologists, biologists, etc. The classification of organisms was certainly a major focus of those who studied life in the period covered by Foucault. As Vernon Pratt wrote:

> We shouldn't really have needed Foucault, of course, to tell use that classification is a central activity in the study of living things, and therefore of deep interest in any attempt at understanding its history: the fact that taxonomy dominated natural history in what Foucault calls the 'classical' period (and I follow his terminology) shouts at us in a rather vulgar and superficial way; much more important we have only to reflect for a moment to realize that without classifying we have only individuals and therefore no possibility of scientific study. (163)

Nature is full of noise, so to speak, so without some method of discerning a signal—reducing an infinite variety of individual objects to a manageable set of discrete classes—there is little hope of deriving any kind of useful generalization that helps us understand our world.

Foucault places great emphasis on the fact that Classical scholars relied primarily on the study of what was visible to the exclusion of information that can be acquired through other senses. But here again, I think he overplays his hand, seeing philosophical shift where I see practical approach to a specific problem. At the dawn of the Classical era, microscopes (both compound and dissecting scopes) were just becoming widely available. They were heavy, often fragile, and very expensive. Neither eighteenth century microscopes, nor their twenty-first century counterparts, were well suited to the rigors of the field. Whether one studied plants or animals,

specimens usually had to  be transported back to a lab before they could be thoroughly studied. Animal and plant specimens, therefore, had to be preserved. For plants, they could be pressed and dried (Knudsen 46-53), but dried specimens are generally more brittle, their shapes often greatly distorted, compared to their living counterparts. With respect to animals, refrigeration was nonexistent, chemical methods of preservation often either unavailable or exceedingly expensive. Birds and mammals specimens, for example, are generally skinned, stuffed, and dried in a manner that facilitates storage and visual examination (Knudsen 249-262, 270-282). Where skeletons are to be preserved, the carcasses are defleshed as much as possible, then fed to small beetles who complete the task of cleaning the bones without damaging them (Knudsen 284-292). The problem was not so much a lack of belief in the unseen structure or its importance, but a realization that was more practical for the Classical natural historian to follow John Locke's suggestion to focus on what was accessible (visible) and verifiable rather than on what was not. (Sloan 22-26, Pratt 168).

Another overreach by Foucault, I feel, is his contention that function was of little importance to Classical-era scholars rather questionable. Linnaeus, for example, was most certainly aware of the functions of the flower when choosing it as one of the key structures with which to devise his classification of plants. Staffan Müller-Wille points out that one of Linnaeus's first publications was a monograph on *Musa Cliffortiana* (Clifford's banana tree) which focused on his successful efforts to induce the plant to make fruit in a greenhouse. This was an example of one of many experiments Linneaus conducted on the reproduction and hybridation of plants. I would seem logical that his understanding of the function of the reproductive parts of plants, which likewise tend to vary quite a bit less than the vegetative parts (roots, shoots, and leaves), influenced his decision to focus on reproductive structures in his classification.

Foucault is on more solid ground in describing two opposing approaches to classification, that of the system and that of the method:

> In order to establish the identities and differences existing between all natural entities, it would be necessary to take into account every feature that might have been listed in a given description. Such an endless task would push the advent of natural history back into an inaccessible never-never land, unless there existed techniques that would avoid this difficulty and limit the labour of making so many comparisons. It is possible, *a priori*, to state that these techniques are of two types. Either that of making total comparisons, but only within empirically con-stituted groups in which the number of resemblances is manifestly so high that the enumeration of the differences will not take long to complete; and in this way, step by step, the establishment of all identities and distinctions can be guaranteed. Or that of selecting a finite and relatively limited group of characteristics, whose variations and constants may be studied in any individual entity that presents itself. This last procedure was termed the System, the first the Method. (139)

The "System" was promoted by Linnaeus, who assumed that some characteristics were of greater importance in the classification of organisms than others. Foucault correctly highlights Linnaeus's premise that the reproductive structures of plants were more useful than vegetative structures, but incorrectly argues that non-reproductive characteristics of the plant would be ignored. The system has an advantage in that it, though limited in its focus, can eventually be used to derive a "natural system" of classification. By "natural system," taxonomists mean a classification that reveals the natural relationships among taxa (or defined groups) of organisms. (Woese et al., 4578) Today, that generally means evolutionary relationships among taxa, but even in Linneaus's day, when many students of living world still believed that species were individually and specially created by God, they would accept that some species, such as bison and musk ox, have a closer relationship to one another than others, such as bison and cork oak.

The "System" is arbitrary. Foucault correctly argues that there can be numerous systems depending on the criteria selected. There can be only one "Method," however. The "Method"

compares all observable and measurable characteristics without bias, producing vertical as well as horizontal order in the taxonomic table:

> The method, on the other hand, because it proceeds from identities and differences of the most general kind to those that are less so, is capable of bringing out vertical relations of subordination. It enables us, in fact, to see which characters are important enough never to be negated within a given family. In relation to the system, the reversal is very important: the most essential characters make it possible to distinguish the largest and most visibly distinct families, whereas, for Toumefort or Linnaeus, the essential character defined the genus; and it was sufficient for the naturalists' 'agreement' to select a factitious character that would distinguish between classes or orders. In the method, general organization and its internal dependencies are more important than the lateral application of a constant apparatus of variables. (144)

Foucault suggests the "Method" is preferable, but in a rare burst of pragmatism, concedes, "Indeed, such a tech-nique would probably be the most reliable, only the number of existing species is so great that it would be impossible to deal with them all." (142) Both systems survive today. The "Method" has its best expression in phenetics, a form of numerical taxonomy based on objective comparisons of a large number of observable characteristics. (Jones and Luchsinger 64-66) The "System" as practiced by Linneaus in the 18th century has been replaced largely by cladistics, which tries to produce a natural system of classification based on the evolutionary relationships—not merely observable similarities—of groups of organisms. (Jones and Luchsinger (66-70) When key characters in the classification are chosen wisely, as Linnaeus and other followers of the "System" tried to do, the similarities generally do reflect evolutionary relationships.

Finally, it is time to address Foucault's overall theme of discontinuities in the episteme of biological thought: first, between the Renaissance and the Classical era, then between the Classical and the modern eras. When one paints with as sweeping generalizations as Foucault does in *The Order of Things*, one runs the risk of having those generalizations marred by data that do not fit on the canvas. Ernst Mayr, one of the founders of the modern evolutionary

synthesis, took the advice of John Emerich Edward Dalberg-Acton (Lord Acton) to heart in researching and writing his massive 1982 monograph, *The Growth of Biological Thought*. In a lecture in 1906, Acton admonished future historians to "…study problems in preference to periods." In studying the history of the major problems in biological though over the last four centuries, Mayr came to the following conclusion:

> Some historians of science like to distinguish different periods, each with a single dominant paradigm (Kuhn), episteme (Foucault), or research tradition. This interpretation does not fit the situation in biology. Ever since the later seventeenth century, one finds more and more often that even within a given biological discipline or specialization, two seemingly incompatible paradigms may exist side by side, like preformation and epigenesist, mechanism and vitalism, iatrophysics and iatrochemistry, deism and natural theology, or catastrophism and uniformitarianism, to mention only a few of the numerous polarities. This creates formidable difficulties of interpretation. How can it be explained, on the basis of the total intellectual, cultural, and spiritual context, that is, the zeitgeist of the period, that two diametrically opposed interpretations could have originated and been maintained?
>
> Two additional problems exist for the historiographer. The various controversies, a sample of which I have just listed, do not coincide with each other, and their terminations (by whatever means) fall in separate periods. Worse than that, as I have already described, the sequence of events in different countries is often very different: *Naturphilosophie* was largely confined to Germany … natural theology dominated British science in the first half of the nineteenth century but had played out in eighteenth century in France and Germany. Foucault's ideal, to paint the progress of science (and its milieu) as a series of consecutive *epistemes*, is clearly not encountered in the real world. (113)

Science is far from a monolithic endeavor. Influential scientists may forestall progress in some fields by their bullying of little-known researchers with different ideas. Ideas accepted by scientists in one region may be rejected by those in another. Political, financial, or social obstacles may slow the development of science in some regions and not others. Battles over hypotheses long thought dead may resume decades later as new evidence or new ways to test those hypotheses arise. I get the impression Foucault seems to loves to make sweeping statements—possibly out of the joy in provoking outraged reactions among those whose fields he

intrudes upon. But I wonder if a more measured and more accurate approach would have netted wider acceptance of his work in the physical and natural sciences. Nevertheless, his work is nothing if not a beautiful mess. As Pratt writes in his opening paragraph:

> In studying the history of 'biological' classification during the 18th and 19th centuries one is drawn mothlike to the flame of Michel Foucault. Difficult, tantalizingly obscure writing which one would prefer to avoid, but which compels irresistibly, illuminating the darkness, not so much a searchlight as a firework display, brilliant, theatrical, bewildering. (163)

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