BIOSEMIOTICS

INFORMATION, CODES AND SIGNS IN LIVING SYSTEMS

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Nova Science Publishers, Inc.
New York

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA
Available upon request

ISBN 13: 978-1-60021-612-1
ISBN 10: 1-60021-612-9

Published by Nova Science Publishers, Inc. † New York

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PREFACE

This new book presents contexts and associations of the semiotic view in biology, by making a short review of the history of the trends and ideas of biosemiotics, or semiotic biology, in parallel with theoretical biology. Biosemiotics can be defined as the science of signs in living systems. A principal and distinctive characteristic of semiotic biology lies in the understanding that in living, entities do not interact like mechanical bodies, but rather as messages, the pieces of text. This means that the whole determinism is of another type.

Biosemiotics: Information, Codes and Signs in Living Sysytems ISBN 1-60021-612-9
Editor: Marcello Barbieri, pp. 1-25

Chapter 1

A BRIEF HISTORY OF BIOSEMIOTICS

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Life process can be seen not as a result of organic building,
but as a rhythm, and melody, according to which
an organic body can build and rebuild itself
Karl Ernst von Baer (1864: 280)

Symphony or embryo, the principle is the same:
the more complex the pattern, the more important the silences.
Robert Pollack (1994: 76)

This essay attempts to touch on some contexts and associations of the semiotic view in biology, by making a short review of the history of the trends and ideas of biosemiotics, or semiotic biology, in parallel with theoretical biology, over a one century period, as viewed from the side of biology[2]. The latter is an important restriction, since the picture may look considerably different from the viewpoint of and within the context of semiotics. It is important to emphasize this since biosemiotics, although now accepted as a distinct branch in semiotics, has still not found its place in biology. For instance, one can find chapters devoted to biosemiotics in contemporary semiotics textbooks, and corresponding sections in large semiotic conferences, whereas the same is quite rare in biological (or even ethological) reviews or congresses. However, the situation today is already different from that of two decades ago, when D. Todt (1987) and J. Schult (1989: 261) claimed: 'There is no doubt that up to now [...] Semiotics has found nearly no access to Biology'. According to J. Deely (1990: 25), 'the introduction of symbiosis and reciprocity into the heart of the evolutionary

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[2] The earlier version of this paper, "Biosemiotics in the twentieth century: A view from biology", has been published in Semiotica 127(1/4): 385–414. I thank late Thomas A. Sebeok, late Thure von Uexküll, and many of my colleagues for supplying me with valuable information which has improved this article.

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Biosemiotics: Information, Codes and Signs in Living Sysytems ISBN 1-60021-612-9
Editor: Marcello Barbieri, pp. 165-178

Chapter 8

NATURAL HISTORY OR NATURAL SYSTEM? ENCODING THE TEXTUAL SIGN

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FOREWORD

This paper was originally delivered at the Seminar of 'Codes in Sign Systems' at the International Semiotics Institute, which met in Imatra, Finland, on 3rd-9th June 2004. As the organiser of the seminar, Dr Kalevi Kull of Tartu University, is by profession a biologist, and the Seminar was devoted to biosemiotics, I gave a brief survey of the changing concept of code in recent biological studies before shifting to my main concern of the controversy over coding in natural history and natural system. The latter part of the essay discusses how Linneaus' and Darwin's nature writings are encoded, and suggests that whilst code is indispensable to discourse, different types of discourse call for different ways of coding.

ABSTRACT

The dichotomy of system versus history is a time-honoured issue that has inflicted many scientific disciplines, including biology. Ever since the publication of his *Systema Naturae* in 1735, Carolus Linnaeus' position as father of taxonomy has been established, but his attempt at systematisation has also been severely challenged from time to time by natural historians. This paper will discuss the issue of natural system versus natural history, using Carolus Linnaeus and Charles Darwin as examples. The theoretical point of attack is Darwin's critique of systematics in his *Origin of Species* and Michel Foucault's critique of classification in his *Les mots et les choses*.

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While both Foucault and Darwin criticise Linnaeus for putting nature in the Procrastian bed of classification, the British evolutionist opts for narrativisation to present his version of natural history. This narratological project, though based on scientific observations and experiments, relies heavily on the many devices of textualisation. It can be seen especially in Darwin's voyage writings; it can also be seen in Linnaeus' less systematic writings, such as *A Tour in Lapland*, despite the latter's general reservation about rhetoric, especially in his debate with the French naturalists. If one compares the prototype of natural history, i.e., that by Pliny the Elder, one will easily find the long tradition of representing nature mediated by some set of discursive strategies. In this regard, neither Linnaeus nor Darwin is exceptional.

An interesting example showing narrative encoding is the textual parallel between the first chapter of *Origin of Species* and the Book of Genesis, especially the experience of Noah as, so to speak, a natural systematicist. On the other hand, Linnaeus' strong Christian belief and constant allusions to the Bible, not to mention his own version of the paradise myth, show another level of textual coding incompatible with that of classification. What do such natural systems reveal when opposed to natural histories? How are they encoded? What are their semiotic implications other than the two logics of dictionary and encyclopedia discussed by Umberto Eco and others? These are among the queries into which the paper will explore.

Keywords: *Natural history, systematics, classification, travelogue, textual sign*

CODE IN RECENT BIOLOGICAL DISCOURSE

The theme of this seminar, 'codes in sign systems', seems to be a permanent one in semiotic discourse. But ironically this permanent theme is also in permanent crisis because it has to be adapted from time to time to accommodate different kinds of semiotics. Here biology is introduced to complicate the matter and to offer yet another qualification. A question may be raised: Do biologists agree on the definition of code?

Not even an amateurish biologist but a veteran semiotician, I would like to give a few examples more in line of biosemiotics. Our founding father Jakob von Uexküll never used the word *code*; nor, for that matter, did Ferdinand de Saussure dwell much on it. Uexküll's description of the interaction between receptor and effector in the functional circles can be encoded to represent an elementary semiosis, involving a basically monoplanar codification. Advances after him, in particular, cellular biology and molecular biology, when coupled with semiotics, may shed light on his project. However, to date not much has been done in this regard, but the process of sign-function is often prematurely shifted from syntactic (i.e., formal) code to semantic code. Sebeok and Danesi's (2000) definition of code as '*system of signifying elements, which can be deployed to represent types of phenomenon in specific ways*' (Sebeok and Danesi, 2000: 191), is too general for biological specificity. Barbieri's definition (2003) as '*a set of rules that establish a correspondence between two independent worlds*' (Barbieri, 2003: 94) serves to identify the principle of equivalence governing inter-systemic relations. The examples he gives, Morse code, traffic lights, and language, do connect one system with another. However, his concept of code is rather confused, as evidenced by his juxtaposition of three 'fundamental characteristics', which do not belong to the same order: (1) principle of equivalence, (2) semantic mapping ('*add meaning to information*'), as in organic memory, and (3) conventionality (Barbieri, 2003: 95).[1] One could roughly equate these to the syntactic, semantic, and pragmatic aspects of code, thus evoking, unwittingly perhaps, another forerunner of semiotics, namely, Charles Morris.

Despite the confusion of terms, Barbieri provides an adequate biological instance to illustrate code as an operative category.

> *It means the existence of a real organic code is based on (and can be inferred from) the existence of organic molecules--called adaptors--that perform two independent recognition processes. In the genetic code the adaptors are the transfer RNAs, but it will be shown that adaptors also exist in splicing and in signal transduction, which means that there are at least other two organic codes in real life.* (Barbieri, 2003: 93)

Barbieri's organic codes are presumably an advancement of the genetic code, which bridges the world of nucleic acids and that of proteins through the mechanisms of transcription and translation. There is no doubt that the genetic code involving the transcription process from DNA to RNA qualifies as a *bona fide* code, but as Eco (1984) observes, it is characterized by '*a process of steric stimuli*' (Eco, 1984: 183) in which '*every element . . . interprets a previous one, and, in doing so, makes the process grow*' (Eco, 1984: 184). In terms of Peircian interpretation, it is a case of semiosis, but not unlimited.

The organic code, especially in plural form, formulated by Barbieri reminds one of the meta-language of code-duality made famous by Jesper Hoffmeyer and Claus Emmeche (1991) since its proposal more than a decade ago. What constitutes the duality? They are two different '*codes*': one digital and the other analog (Hoffmeyer and Emmeche, 1991: 126). But a little further, the two codes are seen to acquire different appellations: the digital is a language, but the analog is '*reality*' (Hoffmeyer and Emmeche, 1991: 128). If one were to talk about the genetic code only, it would be much easier because it can be digitalised and is more akin to a mathematical system. But life (and therefore semiosis) becomes difficult when that now explicitly formalised genetic code is interfered with a much more vague analogical or organic code.

NATURAL HISTORY VERSUS NATURAL SYSTEM?

Rather than dwelling on these theoretical and operational difficulties, I will bypass molecular biology, out of sheer incompetence, to talk about something outdated, namely, the time-honoured contention over natural history versus natural system, in order to see how these can be encoded. I am not alone in saying that the topic is outdated. Many subscribe to the division of labour in our days: biology for specialists and natural history for amateurs. According to the editors of an important tome, *Cultures of Natural History* (Jardine and

[1] In his e-mail correspondence with the author dated 14th October 2004, Barbieri has the following to say: '*The fact is that those three characteristics are* experimental properties*, we do have evidence for them, so it seems to me that you should not blame me for the confusion. You should put the blame where it belongs, and say that it was Nature that made a really messy job when she brought organic codes into the world. That would be a fairer assessment of the situation, wouldn't it? . . .*' This is surely a sound defense of his position, with which I entirely agree, as I replied the same day. However, I do believe our difference results from our different contexts, and mine is that of logical semantics regarding the meaning (i.e., properties) of a concept. To me the three characteristics are not mutually exclusive to be logically functional.

Spary, 1996), in the Age of Reason natural history enjoyed an important role in the commonwealth of learning, but today, it seems '*marginal to our concerns, appearing primarily as an amateur, popular, local study. It is the experimental and mathematical sciences to which debates about the 'true' principles of social and mental order appeal, and which serve as a model of expertise and professionalism*' (Jardine and Spary, 1996: 3). Who are amateurs? Carolus Linnaeus (Carl von Linné) describes them in aphorism 43 of his *Philosophia Botanica* (2003): '*The AMATEURS OF BOTANY (6) are those who have produced various* [works] *about botany, though they do not properly pertain to botanical science: such as anatomists (44), gardeners (45), physicians (46), and miscellaneous [writers] (52)*' (Linnaeus, 2003: 26; the numbers in the quotation refer to Linnaeus' original aphorism number). It is this last group, miscellaneous writers, Linnaeus himself included, that I will be dealing with in the latter part of the paper. But first, let me rehearse a fraction of this history, which, in its modern version, begins with Linnaeus.

Ever since the publication of his *Systema Naturae* in 1735, Linnaeus'position as father of taxonomy has been established, but his systematisation has also had to take challenges by natural historians from time to time. My paper's theoretical point of attack is Darwin's critique of systematics in his *Origin of Species* and Michel Foucault's critique of classification in his *Les mots et les choses*. Whilst both Foucault and Darwin criticise Linnaeus for putting nature in the Procrastian bed of classification, the British evolutionist opts for narrativisation to present his version of natural history. This narratological project, though based on scientific observations and experiments, relies heavily on the many devices of textualisation. It can be seen especially in Darwin's voyage writings; it can also be seen in Linnaeus' less systematic writings, such as his accounts of Lapland (1811), Öland, and Gotland journeys (1741, [Eng.1973]) despite the latter's general reservation about rhetoric, especially in his debate with the French naturalists. If one compares the prototype of natural history, i.e., that by Pliny the Elder, one will easily find the long tradition of representing Nature mediated by some set of discursive strategies. In this regard, neither Linnaeus nor Darwin is exceptional.

For chronological reason, I should begin with Darwin, but Foucault's critique of Linnaeus in *Les mots et les choses* (1966) (English translation as *The Order of Things*, 1970, 1973) merits first mentioning because of his full-scale exposition of the issue in its historical context. As is quite well known now, Foucault's analysis of the mode of representation in the Age of Reason focuses on the concept of resemblance and the subsequent paradigm shift from resemblance to similitude. Among the four kinds of similitude he identifies, *convenientia*, that is, contiguity or adjacency (Foucault, 1973: 18), which suggests gradation and chain of being, can be an apt description of the Linnean systematisation that Foucault is to criticise later in the book.

With the rise of the new sciences of life in the seventeenth and eighteenth centuries, there were different solutions to the questions raised by mechanists and vitalists. These conflicting solutions included '*the possibility of classifying living beings--some, like Linnaeus, holding that all of nature can be accommodated within a taxonomy, others, like Buffon, holding that it is too rich and various to be fitted within so rigid a framework . . .* ' (Foucault, 1973: 126). Foucault further points out the incompatibility inherent in the research method of natural history at a time when the discipline of biology was yet unborn.[2] One of the undesirable

[2] '*Historians want to write histories of biology in the eighteenth century; but they do not realise 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.*' (Foucault, 1973: 127-128)

consequences of the method is '*the obligation to divide knowledge into two interwoven fabrics when in fact they were alien to one anothe-- the first being defined by what was known already and from elsewhere (the Aristotelian or scholastic inheritance, the weight of Cartesianism, the prestige of Newton), the second by what still remained to be known (evolution, the specificity of life, the notion of organism)*' (Foucault, 1973: 127).

The metaphor of two fabrics interwoven may not be a good one, given the fact it was the Aristotelian-Scholastic logic, with its primary functions of categorisation and inference, which served as a model to account for the unknown. Not on equal footing, the two entities--one known, the other unknown--enter into a relationship of meta-language and object-language. Without a pre-conceived model, in this case, the Aristotelian organum, knowledge would not have been possible. What else could have natural historians done without making use of what was available? However, as its name suggests, natural history or *naturalis historia*, as Pliny (1938) used the term in the first century, consists of nature (*natura rerum*) and history (*historia*, *histoire*, history and story), then taxonomy, deprived of life (*vita*, as with Pliny) and time (*historia*), cannot hope to do justice either to nature or history. Foucault singles out Linnaeus in particular.

> *The descriptive order proposed for natural history by Linnaeus, long after Jonston, is very characteristic. According to this order, every chapter dealing with a given animal should follow the following plan: name, theory, kind, species, attributes, use, and, to conclude, Litteraria ...*
> *Thus the old word 'history' changes its value ... The Classical age gives history a quite different meaning: that of undertaking a meticulous examination of things themselves for the first time, and then of transcribing what it has gathered in smooth, neutralized, and faithful words. It is understandable that the first form of history constituted in this period of 'purification' should have been the history of nature. For its construction requires only words applied, without intermediary, to things themselves. The documents of this new history are not other words, texts or records, but unencumbered spaces in which things are juxtaposed: herbariums, collections, gardens; the locus of this history is a non-temporal rectangle in which, stripped of all commentary, of all enveloping language, creatures present themselves one beside another, their surfaces visible, grouped according to their common features, and thus already virtually analysed, and bearers of nothing but their own individual names.* (Foucault, 1973: 130-131)

What then is the epistemology that characterises the naturalist craze for inventories and archives and its specific use of language to encode the order of things? As if to engage the essential discrepancy between words and things, natural historians had to reduce the distance between language and nature, '*to bring language as close as possible to the observing gaze, and the things observed as close as possible to words.*' (Foucault, 1973: 132) This obsession with observation and the insistence on concise and precise use of language to approximate living beings underline Linnaeus' project of nature.

The value accorded to visible resemblance as the basis of designation is precisely a point on which Darwin disputes with Linnaeus. In his *Origin of Species* the British naturalist criticises the Linnean concepts of structure (in his word, '*morphology*') and homology as

against the realities of embryology and evolution. He admits there are common properties and an identical inherited '*form*', but common properties are inherited, and should not be based on and restricted to '*likeness*' (Darwin, 1964: 412). Darwin shows considerable insight in relating Linnaeus' use of language (in naming and description) to empirical visibility: '*Classification either gives some unknown plan of creation, or is simply a scheme for enunciating general propositions and of placing together the forms most like each other*' (Darwin, 1964: 414). To Darwin, external similarity makes no sense. He comments on the Linnean *Systema Naturae*, '*Such expressions* [characters, aphorisms] *as that famous one of Linnaeus, and which we often meet with in a more or less concealed form, that the characters do not make the genus, but that the genus gives the characters, seem to imply that something more is included in our classification, than mere resemblance*' (Darwin, 1964: 413). Darwin's answer to that '*something*' missing is presumably hidden '*propinquity of descent, -- the only known cause of the similarity of organic beings*' (Darwin, 1964: 413). By using the word '*propinquity*', Darwin seems to endorse the same concept of *convenientia* dear to Linnaeus, but there is undeniably a fundamental difference in the role accorded to the evolutionary concept of '*descent*'.

Having outlined this historical context, focusing on Darwin's and Foucault's representations of Linnaeus, I would like to examine more closely the language code with which Linnaeus frames his classification and nomenclature. One has to bear in mind that the author's writings are so varied--that is, so variously encoded--that one runs the risk of homogenising his discursive and rhetorical diversity. Compare an entry in any edition of *Systema Naturae*, an aphorism in *Philosophia Botanica*, an oration, and an excerpt from one of the travelogues, and you can easily tell the difference. Incidentally, Linnaeus himself attributes the latter two kinds of discourse, along with natural history, as '*rhetorician*', outside the proper domain of scientific writings.[3] In this regard, a promising semiotic project on Linnaeus' language code would start with a revisit with the traditional debate on dictionary versus encyclopedia (Eco, 1984). But first, systematics is in order.

Although Darwin criticises the Linnean systematisation, he may have not used the word *systematics*. As the new title of an existing academic discipline, it began in the mid nineteenth century. The *Oxford English Dictionary* records its earliest use in 1840 to the effect: '*A department of the philosophy of natural history*' which has been termed by some writers '*taxonomy*' and by some Germans *Systematik*. The December 1888 issue of *Nature* refers to Huxley's classification in 1867 as marking '*an epoch in the systematics of birds*'. For all its belated arrival, the substance of systematics or taxonomy has no doubt a long history, traceable to Aristotle and surviving even in our days after many changes, notably the Cladistic revisions (Ereshefsky, 2001). Two immediate predecessors on whose works Linnaeus drew are the Italian Andrea Cesalpino (1519-1603) and the French Joseph Pitton de Tournefort (1656-1708), and their links have already been documented (Cassirer, 1950; Foucault, 1966 [Eng.1973]; Larson, 1971; Mayr, 1982; Cain, 1995; Ereshefsky, 2001).

Like his predecessors, Linnaeus groups plant forms on the basis of external likeness, using the same basic conceptual elements found in the Aristotelian organum. The three

[3] Aphorism 20 of *Philosophia Botanica* takes the rhetoricians to be those who '*have expounded all things that are learned ornaments of science.*' Such ornaments include orations, natural history, like Biberg's *Oeconomia Naturae*, and emblems. (Linnaeus, 2003: 21). Linnaeus' travelogues then render him as a rhetorician.

[4] Aristotle identifies four predicables: genus, property, definition, and accident, and Porphyry five: genus, species, differentia, property, and accident. (Eco, 1984: 58).

elements are types, differentiae, and an integrating structure.[4] The basic units of order are fixed types of natural forms; these types are constituted from and defined by diverse but limited visual and tactile qualities, or dfferentiae; and they are integrated in a structure conceived as an ascending sequence of forms. These conceptual elements are based on two presuppositions: (1) Natural forms are compared and grouped on the basis of like or comparable parts; (2) The grouping process establishes a class hierarchy which reproduces the order of nature (Larson, 1971: 20). In essence, Linnaeus follows the practice of Cesalpino and Tournefort in using the four fundamental categories: number, shape, proportion, and situation to identify marks common to living objects, so called *notae communes*, and repeating the same process of comparison and grouping on different gradational orders, such as genera and species, class and order (aphorism 251, Linnaeus, 2003: 215).

From a semiotic perspective, one's task of encoding Linnaeus can be two-fold: (1) articulating the macro-structure of the Linnaean hierarchy, but this is predicated on (2) the initial *découpage* of his micro-structures. Let me deal with the problem of naming on the basis of resemblance; that is, the naturalist's famous binomial system which involves both genera and species. All species names contain two parts: the generic name followed by the specific name, such as *Homo sapiens*. The two names serve as mutual constraints on each other: the generic name groups species and displays their reproductive function; the specific name distinguishes itself from the other species in the same genera.[5] Thus following Foucault's argument, one could say a word (*un mot*) is employed to represent a thing (*une chose*), and another word to represent both another thing and the previous word. It is an instance of overcoding, or a subcode superimposed on the code, resulting from the facile transposition and equation of expression and content on different levels.

What word should be picked up to represent a thing? Surely there are too many, but according to Linnaeus, the best generic name, say, of a plant, is that which shows '*the essential character or habit*' of it (aphorism 240, Linnaeus, 2003: 191). Thus the whole hierarchy is founded on this interlocking chain of coding. There is no doubt the prescribed language code is Latin, a dead written language restored to life as if it were a natural language in the Commonwealth of Botany. However, there is no linguistic purism even in this matter because terms from other 'barbarous' languages are also being used to confound the (*pace* Leibniz) *Characteristica universalis*. Examples include, ironically, the non-barbarian Greek and modern vernaculars. A most intriguing and bizarre case to me is the Chinese word *thea* (tea) which Linnaeus remakes into the Greek *θεα*, meaning *goddess* (Linnaeus, 2003: 176). For all his rigidity in many aspects, Linnaeus is sometimes rather liberal. In aphorism 237 he says, '*I retain generic names derived from poetry, imagined names of gods, names dedicated to kings, and names earned by those who have promoted botany*' (Linnaeus, 2003: 183). This last category surely includes himself for his discovery of *Linnaea G.* Now this Republic of Letters, as if to counter the Commonwealth of Botany, renders a neat-looking semiotics of binomialism extremely complicated because the primary modelling system of language has to be understood not as language in the abstract, but as a whole spectrum of natural languages

[5] This generic code has a theological foundation of creationism and essentialism, parodying the creation and naming myths in the Book of Genesis. In his personal myth, Linnaeus poses as the Second Adam naming all the creatures by God.

[6] '*All human knowledge is built on two foundations; reason and experience. --These two joined together are necessary to make a good physician.*' (Linnaeus, 1775 [1977]: 5)

and on top of them the secondary modelling system constructed by numerous subcodes of history, geography, myth and poetry.

Linnaeus' theoretical work, *Philosophia Botanica*, recently translated into English (2003), makes fascinating reading not only for its theoretical insight and practical advice, but also for its unique composition and style, in other words, the interaction of message and code. Appropriating yearbook or calendar, it is encoded in 365 interlocking aphorisms, a *moraliste* genre popular in his time, hence evoking at once a generic code and period code. This work is coupled with his other writings, such as orations and travelogues, to present another persona of the author, indeed a rhetorician whom the naturalist would otherwise despise. In his lecture given at the Uppsala Academy of Sciences entitled 'The Benefit of Travelling etc.' (1775 [reprint, 1977]), Linnaeus identifies '*reason*' and '*experience*' as the two pillars of knowledge (Linnaeus, 1977: 5, cf. Larson, 1971).[6] Whilst systematic classification needs reason, observations are based on experience, suggesting, as does its etymology, both experiment and personal fieldwork. These two complementary poles of human capacity serve to define the career of Linnaeus as a naturalist. Contrary to his own insistence on the economy of language and his marginalisation of '*rhetoric*' (See note 3) as ornaments in representing nature, Linnaeus leads a productive career as travelogue writer. To add a footnote to the famous two faces of Linnaeus, one may say there are also two writers, one of systematic writings, the other of narratives and other miscellanies. In this regard, he will be joined by Darwin a century later for the latter's less known '*Romantic imagination*' (Kohn, 1996).

ENCODING LINNAEUS' AND DARWIN'S TRAVEL WRITINGS

Once in the realm of narrative, other textual constraints are inevitably introduced to define the genre, and to render justice to natural history by resurrecting it to life and time. Here I refer to the narrator's point of view and the narration's time sequence, two essential

[7] A digression is needed here to justify my making Linnaeus the creationist and Darwin the evolutionist strange bed-fellows. Their own lyricism notwithstanding, Stauffer (1960) has the insight to point out Linnaeus' influence, partly via Charles Lyell, on Darwin, especially regarding the master tropes of polity of nature and economy of nature and the tropes' ecological implications. Stauffer notes, in 1841 Darwin read Benjamin Stillingfleet's translation (which contains *Oeconomia Naturae*) and F. J. Brand's translation (which contains the *Politia Naturae*), the *Philosophia Botanica*, the *Tour in Lapland*, and the *Fauna Suecica* (Stauffer, 1960: 239). He further observes:

> *Lyell's references in regard to the economy of nature point directly back to the major earlier source: the writings of Carl Linnaeus. The importance of Linnaeus in the evolution of ecology is very great, and it is striking that among the naturalists writing after Linnaeus and before Darwin, it is the geologist Charles Lyell who shows the clearest grasp of Linnaeus' ideas on the economy of nature and who makes the fullest use of them in his own work.* (Stauffer, 1960: 236-237)
>
> *The familiar themes* [of ecology] *appear in primitive form in Linnaeus, reappear in Lyell, and then are transmuted by Darwin into vital elements of his theory of evolution. The economy of nature exhibits cycles of propagation, preservation, and destruction. An equilibrium of populations is maintained through the police of nature with checks to increase in numbers involving, implicitly or explicitly, the struggle for existence. Naïve teleology in Linnaeus gave way to agnosticism in Darwin, but ecological science grew in factual content and in significance.*
>
> *We conclude with a paradox. The conventional statement is that Darwin overthrew the work of Linnaeus in so far as he replaced the orthodox dogma of fixity of species by his theory of evolution. But in regard to Linnaeus' concepts of an economy of nature Darwin used these ideas as major explanations of the workings of natural selection. So Linnaeus supplied major assistance for Darwin's arriving at his theory of evolution.* (Stauffer, 1960: 241)

devices that characterise the narrative mode. It is these subcodes, among others, that help to construct travelogue as genre. In the following I will 'compare', via verisimilitude, excerpts from Linnaeus'*Lachesis Lapponica, Or A Tour in Lapland* (1811) and Darwin's *Journal of Researches into the Natural History and Geology of the Countries Visited during the Voyage round the World of H.M.S 'Beagle' under Command of Captain Fitz Roy, R.N.* (1907).[7]

Since Gustav Flaubert and Henry James, the literature on narrative point of view, mainly in Anglo-American criticism, has undergone a long evolution. French narratologists like Gérard Genette have offered alternative concepts, such as perspective and focalisation; on the other hand, the Bakhtinians have attempted to valorise the vocalic polypony and discursivity at the expense of visual perception. To be consistent with the naturalist's obsession with observation, let us retain the concept of perspective to focus on the narrator's perception on which his act of telling is based.

As a sub-genre of ill-defined literariness, the naturalist travelogue has not received much notice by narratologists. By virtue of the naturalist/narrator's vocation, it is a genre noted for constant shift of perspectives, from panoramic vision to minute focalisation. Its almost invariable first-person point of view cannot hope to claim omniscience, nor can this point of view be interior, befitting that of the modernist novelist, because it cannot possibly penetrate into the observed Nature's 'psychology', albeit the narrator's inner mind--feelings, sense of value, or even ideology--can be revealed from time to time. Let us look at Linnaeus at somehappy moments during his tour in Lapland.[8]

[7] A digression is needed here to justify my making Linnaeus the creationist and Darwin the evolutionist strange bed-fellows. Their own lyricism notwithstanding, Stauffer (1960) has the insight to point out Linnaeus' influence, partly via Charles Lyell, on Darwin, especially regarding the master tropes of polity of nature and economy of nature and the tropes' ecological implications. Stauffer notes, in 1841 Darwin read Benjamin Stillingfleet's translation (which contains *Oeconomia Naturae*) and F. J. Brand's translation (which contains the *Politia Naturae*), the *Philosophia Botanica*, the *Tour in Lapland*, and the *Fauna Suecica* (Stauffer, 1960: 239). He further observes:

> *Lyell's references in regard to the economy of nature point directly back to the major earlier source: the writings of Carl Linnaeus. The importance of Linnaeus in the evolution of ecology is very great, and it is striking that among the naturalists writing after Linnaeus and before Darwin, it is the geologist Charles Lyell who shows the clearest grasp of Linnaeus' ideas on the economy of nature and who makes the fullest use of them in his own work.* (Stauffer, 1960: 236-237)
>
> *The familiar themes* [of ecology] *appear in primitive form in Linnaeus, reappear in Lyell, and then are transmuted by Darwin into vital elements of his theory of evolution. The economy of nature exhibits cycles of propagation, preservation, and destruction. An equilibrium of populations is maintained through the police of nature with checks to increase in numbers involving, implicitly or explicitly, the struggle for existence. Naïve teleology in Linnaeus gave way to agnosticism in Darwin, but ecological science grew in factual content and in significance.*
>
> *We conclude with a paradox. The conventional statement is that Darwin overthrew the work of Linnaeus in so far as he replaced the orthodox dogma of fixity of species by his theory of evolution. But in regard to Linnaeus' concepts of an economy of nature Darwin used these ideas as major explanations of the workings of natural selection. So Linnaeus supplied major assistance for Darwin's arriving at his theory of evolution.* (Stauffer, 1960: 241)

[8] The book of Lachesis Lapponica or Tour in Lapland (1811) had a most extraordinary fortune. Linnaeus wrote it as diary and never intended for publication. After his death, his widow sold the manuscript, together with others and his library to the Englishman James Edward Smith, who founded the Linnaean Society of London with the acquisition. In 1811 Smith had the manuscript edited and translated into English and published for the first time. The Swedish translation from the English appeared towards the end of the century, and in the early twentieth-century another Swedish edition based on the original manuscript was published, followed by an English translation in our days. This strange history itself witnesses the phenomenon of inter-semiotic transcoding, and is worthy of a textual critic's enquiry. Incidentally, after Linnaeus had completed his journey, he reported it to the funding Academy, in a more condensed but presentable version, thus complicating the intertextualisation processes and enlarging the space.

Charles Linnaeus, Student of Physic and of Natural History, set out on 12 May 1732 of the Old Calendar. It marks his first day, a day full of delight.

> *I set out alone from the city of Upsal on Friday May 12, 1732, at eleven o'clock, being at that time within half a day of twenty-five years of age.*
> *At this season Nature wore her most cheerful and delightful aspect, and Flora celebrated her nuptials with Phoebus* (Linnaeus, 1811: 2)

> *Omnia vere vigent et veris tempore florent,*
> *Et totus fervet Veneris dulcedine mundus.*
> *Spring clothes the fields and decks the flowery grove,*
> *And all creation glows with life and love.* (Linnaeus, 1811: 3)

> *Now the winter corn was half a foot in height, and the barley had just shot out its blade .*
> *The lark was my companion all the way, flying before me quivering in the air.*
> *Ecce suum tirile, tirile, suum tirile tractat.* (Linnaeus, 1811: 6)

This outpouring of lyricism, with Ovid and Shakespeare invoked to adorn the mythical Nature, may surprise his readers more familiar with the systematicist. The text is encoded in handwriting, with Swedish and Latin (and possibly Latin translation of an English song); in other words, at least two natural language codes and several poetic subcodes, verse, rhyme, allusion, etc. are being employed. As diary, the text was not meant to be read, and Linnaeus had withheld its publication until his death. Did he wish to hide his lyrical self?

The next record is of May 15.

> *Next morning I arose with the sun in order to examine this wonderful tree, which was pointed out to me from a distance. It proved nothing more than a common Elm. Hence however we learn that the Elm is not a common tree in this part of the country.*
> *I observed that in these forests plants of the natural family of bicornes (with two-horned antheras) predominated over all others, so that the Heath, Erica, in the woods, and Andromeda*, in the marshes, were more abundant than any thing else. Indeed we meet with few other plants than Vaccinium Myrtillus and Vitris-Idaea, Arbutus Ura-Uris, Ledum palustre, andc. The same may be said of the upper part of Lapland.*
> *The spiders had now spread their curious mathematical webs over the pales and fences, and they were rendered conspicuous by the moisture with which the fog had besprinkled them.*
> *The Red-wing (Turdus iliacus), the Cuckoo (Cuculus carrorus), the Black Grous (Tetrao Tetrix), and the Mountain Finch (Fringilla Montifringilla), with their various notes made a concert in the forest, to which the lowing herds of cattle under the shade of the trees formed a base. The weather this morning was delightfully pleasant.* (Linnaeus, 1811: 22-24)

In this beautiful passage, several things can be observed. First, it opens with a suspense built up by the lapse of time. The narrator's recording time, or time of enunciation, which is the presentist '*now*', maps the time of the enunciated, which is past ('*next morning*'), but the enunciated involves another temporal axis, namely, an earlier moment (the unenunciated day before) when the tree was pointed out (by someone) to the hero--the narrator's other self, as observed in recollection. And that earliest moment is finally, which means initially, coupled with space, the tree seen '*from the distance*'. This marvellous manipulation of time and space surrounding the narrator's relationship to an unidentified, indeed unidentifiable tree, because

of its distance, produces some kind of suspense on the psychology of the narrator and shared by the yet-to-be born reader. All these are encoded in one prose sentence. And the suspense is resolved in the next sentence: '*It proved nothing more than a common Elm.*' What is suggested here? There is apparently another lapse of time, a montage effect, so to speak, during which the traveller/hero has crossed the distance to see the tree, and at this moment of discovery reveals his identity as botanist. From then on, he begins to observe (focalise) like a botanist, naming in Swedish (i.e., English after transcoding) and Latin all the plants he recognises. Even in this process, his (the traveller's) perception (or the narrator's perspective) shifts to other non-scientific things, things of beauty, such as the 'semiotic webs' of spiders and the concert in the forest, both being aesthetically encoded in figurative language. It is only in such records of Nature do we see another Linnaeus freely making use of literary code.

Obviously, there is an unaccounted gap between (the moment of) focalisation and (the moment of) writing/enunciation. Many elements get involved during the gap, one of which is the writer/naturalist's specialised knowledge. One is not told whether these botanical names are evoked immediately and intuitively at the moment of focalisation or recalled later after examination, sorting, and consultation. I raise the question not to cast doubt on narrative reliability, but to usher in an overlooked dimension of focalisation encoded in naturalist travelogue. The example is from Darwin's *Journey*.

> *March 18th. --We sailed from Bahia. A few days afterwards, when not far distant from the Abrolhos Islets, my attention was called to a reddish-brown appearance in the sea. The whole surface of the water, as it appeared under a weak lens, seemed as if covered by chopped bits of hay, with their ends jagged. These are minute cyclindrical confervae, in bundles or rafts of from twenty to sixty in each. . . . Their numbers must be infinite: the ship passed through several bands of them, one of which was about ten yards wide, and, judging from the mud-like colour of the water, at least two and a half miles long. . . .*

> [scene change] *Near Keeling Atoll, in the Indian Ocean, I observed many little masses of confervae a few inches square, consisting of long cylindrical threads of excessive thinness, so as to be barely visible to the naked eye, mingled with other rather larger bodies, finely conical at both ends. They vary in length from .04 to .06, and even to .08 of an inch in length; and in diameter from .006 to .008 of an inch.* (Darwin, 1907: 14)

In the two observations, Darwin uses two points of view in describing the same fish: from panoramic perspective he shifts to close-up focalisation. What makes it possible for this shift? The expressions of visual perception suggest the narrator's stance in relation to the object of observation: '*my attention was called . . .* ', '*barely visible to the naked eye*'. How could the narrator, or Darwin if you like, tell the small size of the conferva except the latter was removed from its habitat? The immediately subsequent episode provides the answer. '*Some of the water placed in a glass was of a pale reddish tint; and, examined under a microscope, was seen to swarm with minute animalcula darting about, and often exploding*' (Darwin, 1907: 15). Only here and now does the belated introduction of microscope serve to justify the detailed description of the confervae's sizes. This is an instance of what I would term, literally, 'microscopic focalisation', made possible by technological instruments, a necessity to the naturalist, but useless to the ordinary writer, however subtle his perception. Is it a literary device? The answer can be both 'yes' and 'no'. Yes, because it is textualised. No,

because it's a specialised textual code made available to the naturalist by his daily gadget the microscope.

I hope the two excerpts respectively from Linnaeus' and Darwin's travel writings are enough to show how the naturalist can be a writer like any other writer, but he is very special in his choice of subject matter--searching, observing, collecting, naming, writing about objects in Nature, his manipulation of various conventional codes, such as perspective and time sequence, and, above all, a permanent desire to reconcile two conflicting logics, one of systematic knowledge, the other of writing to encode that knowledge. A final word must be said about the personal myth (or theology) of our two writers. Both writers have been mediated by the Book of Genesis. Whilst Linnaeus has his own version of the creation myth and poses as the second Adam in naming creatures, Darwin, in his *Origin of Species*, draws heavily on the experience of domestication told in Genesis, and his unnamed hero is Noah the first breeder. In this sense, one could say there is a hidden Great Code providing an intertextual space for both writers, their religious beliefs being out of the question.

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Biosemiotics: Information, Codes and Signs in Living Sysytems ISBN 1-60021-612-9
Editor: Marcello Barbieri, pp. 179-205

Chapter 9

BIOSEMIOTICS AS A STRUCTURAL SCIENCE
BETWEEN THE FORMS OF LIFE AND THE LIFE OF FORMS

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ABSTRACT

Structural sciences are transdisciplinary formalization programmes that try to discover abstract analogies between research problems of different empirical sciences in order to contribute to their solution. As a young structural science, biosemiotics uses information and sign theory to explore the evolution of living systems. By drawing analogies with other disciplines like linguistics, biosemiotics may help biology to make our knowledge of evolutionary processes consilient (*1*). From a historical point of view, biosemiotics continues the tradition of formal Darwinism, which has constructed a wide variety of mathematical models of evolution since the 1920s (*2*). From a systematic point of view, biosemiotics is a structural science acting as an interface between Artificial Life, the structural science that explores the evolution of possible life, and traditional biology, the empirical science that inquires into the history of real life on Earth (*3*).

Key Words: *Consilience, structural science, formal Darwinism, organic codes, Artificial Life, information theory*

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