

SEMIOTICS AND THE BIOLOGICAL SCIENCES: INITIAL CONDITIONS

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The lamentably woolly quality that continues to bedevil semiotic discourse has impelled the spawning of a host of more or less picturesque extended metaphoric models. Some among these, as the image of a *Web*, have proved sporadically fruitful or at least provocative. *Web* conjures up the organic world of a spider, as well as, in their ineluctable correlations, its inorganic complement, the scaffolding of dry thread that the spider spins. *Web* suggests the reciprocal lives of both invertebrate and vertebrate creatures; it depicts the interplay between hub, spokes, and periphery; it kindles the dialectic of suspense and abatement; and may summon up still further cascades of contrasts or oppositions (Sebeok 1975, Hayles 1984, Seielstad 1989, Sebeok 1987-1994, de Duve:214-221). Thus too, rather usefully, Thure von Uexküll characterized the "body as a web of semioses" (1993:9).¹

The present conference aims to privilege a different though not unrelated image of a *bridge*, envisioning, as it were, a *tertium quid*, a sort of linking entity or chainlike substance, even of living bodies which army ants sometimes intertwine seemingly to enable, say, silverfish, traversing from "hereabouts" to "yonder", to cross over a chasm.²

Surely it can be no coincidence that F. Eugene Yates, a distinguished medical engineer, delivered a paper precisely at a Symposium (the Proceedings of which were published in Vol. 5 of the official publication of the Canadian Semiotic Association) sponsored by the Canadian Institute for Advanced Research, held ten years ago this very month at Toronto's University Club. The first four words of Yates's title were: "Semiotics as a Bridge" (1985). A *bridge* is, after all, first and foremost an engineering concept, whether built (helping consolidate the city of my birth) to join Buda on the Danube's right bank with Pest on its left, or to home in on a part of my violin, nose, eyeglasses, dentures, or in the end my coffin.

What Yates attempted to do in his memorable paper -- while pointing out that science "has been permeated with semiotic issues all along" -- was to "bridge", by means of semiotics, two complementary *Weltanschauungen* of science: the world of dynamics (or physics) and that of information (or biology): "the persistent tension between linguistic and dynamic views of complex systems", he argued, generated an "extraordinary opportunity for semiotics to meld the sciences" (ibid. 359).

Adducing Yates's talk, Rauch and Carr (1989:v) asked why "the metaphor *Bridge* [is] appropriate to semiotic?" They went on to answer their own question in part: "Clearly all the sciences as well as the arts are bridged, whether by single conduit or by network configuration, through the semiotic paradigm.... This is the vital contribution of semiotics, namely, that it entails the inevitable marriage of the arts with the sciences since, as soon as either is touched by man, through his willful choice of a given method, the same human factor influences or interprets the hardest science and the softest art in identical ways."

This way of thinking presupposes the nowadays common prospect, a truism really, of the humanities, including especially the arts, and of the hard sciences as situated, if edgily, at opposite poles of a disembodied spectrum, with the social and perhaps the so-called behavioral sciences in-between. But what appears yet another academic bromide today was not always thus. In the late 19th

century, for example, a group of "humanists", influenced by new scientific trends, claimed that they too should work as scientifically as any scientist. The novelist Émile Zola, in a long essay titled "The Experimental Novel" -- conceived under powerful allure of the great physiologist Claude Bernard -- spelled this thesis out from a writerly angle; in short, Zola pleaded, "we must operate with characters, passions, human and social data as the chemist and physicist work on inert bodies and the physiologist works on living bodies... We are...experimental moralists showing by experiment in what fashion a passion behaves in a social milieu" (1880, quoted *passim* from 1963). Yet who, today, would think of belles-lettres as an experimental science?

And what did John Locke, a close friend of Isaac Newton, think about such matters two hundred years earlier? In the oft-cited Chapter XXI of Book IV, added as an afterthought to his acclaimed *Essay*, he proposed an epistemological tripartition of the "Sciences", a term by which he meant knowledge, particularly knowledge that is rationally grounded, or, more fundamentally, as in the title of his book, *Human(e) Understanding* (1975:720-721).

Locke captured the three realms of "Science" which he postulated, also called "the three great Provinces of the intellectual World", and identified each, stripped to their essentials, by a set of narrower terms: Physics, Ethics, and Semiotics. By Physics, or "external" things, he meant that department of knowledge which pertains to the Natural Sciences, or, roughly speaking, what are now simply called the Sciences in the aggregate.

By Ethics, or ideas (of right and wrong), he meant whatever pertains to the Moral Sciences, the production of values, or as they are now adverted to more vaguely -- but by a floating enumeration rather than by consensual definition -- the "Humanities."³ It cannot be stressed enough that the modern word "Humanities" derives from the Latin substantive *Humanitas*, meaning "the quality of being human" or "human(e) understanding". Hence this concept subsumed as well the "Sciences" in their absoluteness.⁴

And what of Sem(e)iotics, "The Third Branch...or *the Doctrine of Signs*", which, wrote Locke, "is aptly enough termed Logick"? According to Deely's chronicle, what Locke gave us here was "a distinction which unites: it distinguishes the different orders only in order to show how they are brought together in the sign" (1982:64). For, incontrovertibly, Locke claimed that the "business" of semiotics is to "convey" or to "communicate" the mind's knowledge by means of "a Sign or Representation", most conveniently and generally by the use of "articulate Sounds". The true end of speech, Locke emphasized and elaborated in Book III, is that it is "the easiest and shortest way of communicating..." (op. cit. 460). Thus signs are the cognitive instruments whereby "Notions and Knowledge" and "the Thoughts of Men's Minds [are] conveyed from one to another" (402-403); or, as Peirce, evidently indebted to Locke (2.649), portrayed the identical communicational trope in 1896: "In any case, the deliverer makes signals to the receiver" (3.433).

Semiotics -- or at least that stock allotment of it which deals with "communication" (Sebeok 1991b:22-35) -- can thus be deemed as having a spanning or, perhaps more precisely, an overarching function from Locke's Natural Sciences to the Moral Sciences. Just as the idea is a sign of -- that is, signifies -- the thing, so the word, or name, is a sign of -- that is, signifies -- the idea. In brief, as Charles Morris came to write in 1938: "Semiotic holds a unique place among

the sciences.... [It] is not merely a science among sciences but an organon or instrument of all the sciences" (1971:67).

This is not the place to enter into a debate whether Vico's "Science of Humanity", however eccentric, is to be understood to constitute a "*Zeichen-Wissenschaft*" taken as a variant of sematology, as for example Trabandt claims in his recent book (1994:11; cf. Sebeok 1995). Vico was acquainted with most of the philosophical works of Locke but chose not to tag along; in fact, in relevant respects, he was opposed and even tried to undermine them. "New Science", for Vico, was a *pur metafisica* of criticism, a metaphysical history of the human mind. In fact, it was Vico's rigid distinction between the humanities and the natural sciences that Jules Michelet and Benedetto Croce came to exploit and promote as a dam to resist the rising tide of positivist philosophies of knowledge from the early 19th century onward.

Which brings me to the gap, or, in his words, "gulf of mutual incomprehension -- sometimes...hostility and dislike, but most of all lack of understanding", so memorably highlighted by C.P. Snow's expression "the two cultures", and the (tumultuous, on occasion intemperate) debates that ensued (Snow 1971). Snow had lamented that "Literary intellectuals at one pole" -- for convenience, let me broaden this congregation to "humanists" in the conventional sense -- "at the other scientists, and, as the most representative, the physical scientists" have ceased to communicate (1959:4). The remedy suggested by Snow entailed a radical reform in educational attitudes without which "the West can't even begin to cope" (ibid. 53), even though he admitted that he didn't know whether the "immense capital outlay, an immense investment in...both scientists and linguists" can possibly happen in *laissez faire* economies (ibid. 51-52).⁵

A quick reminder may be salutary here. Unfortunately, although the "two cultures" as ideal assemblages, still by and large "can't talk to each other" (ibid. 17), that is only the lesser part of our -- that is, the semiotics community's -- predicament. Much more enfeebling is the prevailing estrangement *within* the riven world-wide semiotics commonwealth itself, between the many who would style themselves humanists and a scientifically cultivated minority. In a paper, "A semiotic perspective on the sciences: steps toward a new paradigm" (Anderson 1984), six of us tried to address this dilemma, but in the short run to little avail. The number of scholars who nimbly scud back and forth between the "two cultures" remains heartbreakingly minuscule. Peirce and Morris were two among rare American paragons, exemplars who could do so with the kind of panache that, say, the late Giorgio Prodi could (e.g., 1988b), or our colleague Floyd Merrell today can muster (see 1992, 1995).

The Russian master, Yuri M. Lotman, has by contrast taken the boldly original step of doing away with the concept of a "bridge" altogether, replacing it by the semiotically sensitive manoeuvre of transcoding. A main principle of his research method was the elimination of the opposition between the exact sciences and the humanities by treating the fabrics of these complementary domains as if they were readily transmutable from one semiotic system to another (Lotman 1990:271).

Semioticians such as these merit our regardful reading and encouragement. For the rest of us, particularly for the sake of our students and successors, I am inclined to support Snow's proposed remedy of educational reform. But let me once again adduce Morris, writing in 1946, antedating Snow by

thirteen years: "An education which gave due place to semiotic would destroy at its foundations the cleavage and opposition of science and the humanities" (1971:246).

Permit me to return for a moment to Snow's concept of the "two cultures", or what Jacob Bronowski later aptly renamed "Two World Systems" (Snow 1971:53). Because of my predilection for nuanced calibrations to reinforce scholarly instruction with personal anecdote (where I think it appropriate to mix genres), I would like to report here fleetingly on an extended encounter between Snow and me which took place in California thirty-five years ago, but about which I have not written before. That Fall, in 1960, Snow was Regents' Professor at Berkeley and I a Fellow at the Stanford Center for Advanced Study, where I invited him for drinks and a chat for a Friday afternoon, November 15th. I can date the occasion exactly by his dedication on the title page of his presentation copy of his *Two Cultures*: "To Thomas Sebeok with admiration and best wishes for his campaign from C.P. Snow." What "campaign" was he referring to there?

In the context of our wide-ranging conversation (which I have no room to detail here), I had ventured to advocate that Locke's doctrine of signs might provide the very viaduct Snow had been searching for. This led to a lengthy, attentive discussion about semiotics, which Snow remembered well when we met for some hours the second and last time the following Summer at London's Savile Club. He later came to note that in the United States "the divide is nothing like so unbridgeable" (Snow 1971:77). By 1971, he thought that though it may be "too early to speak of a third culture already in existence.... [t]here are signs that this is happening" (*ibid.* 58). While, to my knowledge, he never used the word "semiotics" in his own writings, our conversations did resonate in a 1965 novel, *Cork Street, Next to the Hatter's*, the author of which was Pamela Hansford Johnson, Lord Snow's wife (see Sebeok 1972:180-181).

Elsewhere, I have sifted through the variously coordinated attempts in the United States between the 1930's and 1960's aimed to reconcile the adversarial relationships that Snow tried to palliate. I tried there, illuminating its modern historiography, to accent the role of semiotics as a universal meta-discourse which reverberated like a leitmotif through these heterogeneous endeavors (1977, 1991a:70-74). A portion of this colorful, fascinating, but highly involuted story -- in which Roman Jakobson, and Charles Morris with especial vigor, participated among a host of comparably stellar individuals more or less pertinent to the modern unfolding of semiotics on this Continent⁶ -- was competently chronicled, although not entirely captured, in *The Cybernetics Group*, Steve Heims account of a few years ago (1991; see esp. 79, 94). A whiff of semiotics was insinuated even in a 1949 piece by Charles Olson, one of the country's leading poets at the time (fragment after Heims, *ibid.* 271):

To be in different states without a change
is not a possibility
We can be precise. The factors are
in the animal and/or the machine the factors are
communication and/or control, both involve
the message. And what is the message? The message is
the discrete or continuous sequence of measurable events

distributed in time...

Before turning, shortly, to Part II of this paper in order to carry on with a few illustrative applications of the vincular figure of the bridge -- which, as a sign itself, exhibits iconic, indexical, and symbolic aspects, depending on contextual conditions -- let me say a few words about the concept of "mediation". In semiotics, the bridge metaphor is one of perhaps half a dozen vivid tropes that can be turned to account as concrete surrogates for the far more abstract term "mediation". However, in semiosis - the sign event itself, in evolution as it were, rather than semiotics, the scholarly study of semiosis -- "mediation" is a sovereignly indispensable core conceptualization, one which has been thoroughly explored in a pair of Richard Parmentier's classic essays (Mertz 1985, Chs. 2 and 15). I wish here to merely underline the distinction between semiotics and semiosis (Sebeok 1991b:97-99) for two reasons: first, to avoid being misunderstood as to my present topic; and second, to use this opportunity to urge the organizers of this pioneering symposium of the Toronto Semiotics Research Unit that the next to follow be focused on this rich, multi-valued concept of *semiotic mediation* -- a no doubt mysterious but rip-roaring journey into the heart of Thirdness.

II. Initial Conditions

The life science and the sign science at their conjunction commingle so multiformly, so abundantly ramified, that even a sampling of such conjunctures in this brief paper risks rendering a disservice to the readership. Biosemiotics, rooted in the West in Hippocratic medical theory and practice, has recently enjoyed a wide-ranging resurgence in Europe, the Americas, and Japan (see, inter alia, Sebeok 1991a:100-113, Sebeok 1992, Kawade 1992, Hoffmeyer 1996, Uexküll 1996). Furthermore, even the directly pertinent literature is rapidly proliferating out of control. There no longer seems to be any doubt, as I had buoyantly but on the littlest of evidence pronounced in a 1967 seminar held at the Collège de France, that "a full understanding of the dynamics of semiosis...may, in the last analysis, turn out to be no less than the definition of life" (Sebeok 1985:69). In this judgement, I was of course far anticipated by Jakob von Uexküll, but was at the time unaware of it. For as his son, Thure, came to write of his father, Jakob: "Of particular interest to Uexküll was the fact that signs are of prime importance in all aspects of life processes" (1987:147).

This dictum has most recently been refined by the Danish molecular biologist Jesper Hoffmeyer when he observed that "[a]dding code-duality to the autopoiesis of living systems immediately makes it clear that life itself is...a semiotic phenomenon..." (1995:18)⁷. Too, the theoretical biologist Claus Emmeche, working at the Niels Bohr Institute in Copenhagen, rightly pointed out that it was Peirce himself who inspired the modern view of "sign phenomena as occurring everywhere in nature, including those domains where humans have never set foot.... It is a history that dates back to the origin of life", Emmeche relates, because "living cells, in order to survive as complex systems, had to possess a code or partial description of their own structure, so that they could begin to collect descriptions of survival" (1994a :126).

If one accepts the intrinsic identity of the life science and the sign science, combining at their root into a "natural semiotics" -- as the late Italian oncologist Prodi re-christened biology itself *in toto* (1988a:55-56) -- the question still lingers: what is gained thereby? Emmeche addresses this tenable misgiving in a paper which concludes with a sentence highly relevant to the aims of our present assembly: "It is necessary that the conceptual obstacles to a coherent understanding of life...and sign-activity [read: semiosis] can be remedied, and there is indeed some hope that a broader perspective may emerge from the cross-disciplinary gathering around the disciplines of cognitive science, artificial life, biology, semiotics and general epistemology" (1994b:30).

In what follows, I choose to concentrate on one set of issues alone, an area of inquiry which is often referred to in traditional biology and other sciences as the problem of "initial conditions". Now the most interesting thing about "initial conditions" may be that next to nothing is known about them. Because of their inherent indeterminacy, "initial conditions" belong in Lotfi Asker Zadeh's entertainingly fuzzified world of fuzzy sets in fuzzy logic (Mc Neil 1993). However, the classic example, and by definition earliest, comes not from biology but cosmology, for no one really knows how the Universe came into being, although quite a lot is known about the ensuing three minutes (Weinberg 1977). But before the Big Bang, as Einstein's theory instructs us, there was no "before". Intuitive leaps, such as Peirce's, that the "Universe...is necessarily a great work of art, a great poem" (5.119), are beautifully evocative, but tell us naught about its provenance. Perhaps the view of the world as a self-synthesizing system of entities, an "idea-account" of the world of intercommunicating existences, one based on quantum-plus-information theory", offered by the eminent contemporary physicist John Archibald Wheeler -- himself influenced by Peirce -- provides the most promising clues, although even Wheeler allows that the communicants "thus develop all they know or ever can know about the world" and of its origins (1988:4-5).

The salient point to register is this: according to Wheeler's intriguing vision of Semiophysics -- as recaptured for instance by Merrell -- "the material world provides the machinery for generating meaning, while meaning contributes the machinery for constructing physics. Existence thus becomes a closed circle of meaning" (1995:236; after Wheeler 1988:5, Fig. 1).⁸ In conformity with this perspective of Wheeler, the participatory universe constitutes a "self-excited circuit" -- or, as I would prefer to express the same idea in terms perhaps better suited to semiotics, the cosmos may be regarded as a *sign-excited loop*.

As one progresses from the age of geochemistry beyond the age of information -- the epochs where Prodi's "protosemiotics"⁹ (1988a:56) held sway -- to biotic times, embodied first in prokaryotic then also in eukaryotic cells, in multicellular organisms and the steps toward humanity and thereafter (as depicted for example in de Duve's tour de force account), the "semioticity" of originary events manifests itself ever more conspicuously and persuasively. Professionally, I have particularly occupied myself with those "initial conditions riddles" that pertain to communication and language and speech (see below), but further touching on enigmas, or matters of contention ancillary thereto, as the origin of the Hominidae and of certain categories in their semiospheres, notably including the fabrication of tools (Gibson 1993) and art (Sebeok 1979)¹⁰.

"Initial conditions", despite, or perhaps because of, their inherent intractability, remain a constant preoccupation among life scientists. A

comprehensive recent book (Maynard Smith 1995) and a review article by the same co-authors (Szathmáry 1995), are both devoted to the "major evolutionary transitions". Thus they overlap in good measure with de Duve's concurrent solo chronicle of much the same terrain (1995).

How life emerged is unknown, but that surety does not inhibit unending speculation among biologists (see, e.g., Schopf 1983). As Sonea generalized when asked how life began, "Tout le monde a une explication [mais] tout le monde est d'accord pour dire que la vie ne s'explique pas" (1995:33). Nobel Laureate de Duve's precept, "the universe was...pregnant with life" (1995:9), directly contradicts Nobel Laureate Monod's, "the universe was not pregnant with life" (1971:145). Bada's, and Stanley Miller's, surmise, that "life on earth started...in a frigid ocean, under hundreds of feet of ice" (1995:22), is challenged by other scientists who believe in a contrary dogma: that the first living entities were several kinds of thermophiles -- bacteria, eucarya and archaea -- emanating from submarine hydrothermal springs, geysers, and volcanic vents along the mid-ocean ridges. The currency of borderline phenomena betwixt the abiotic and the biotic ravel this issue further still (Sebeok 1991b:101).

The riddle acquires kaleidoscopic reconfiguration when rotated in congruence with semiotic phraseology. We ask: how did semiosis arise -- a process I take to have been co-terminous with the emergence of life. Physics has indeed provided tools for the living with which to communicate: light, pressure, sound. But it also gave chemistry and biology, "and, through them, observers-participators" (Wheeler 1988:5) and signifexes/communicators." According to prevailing opinion, this sea change transpired, or became literally viable, approximately 3,800 millions of years before present.

From its inception, semiosis must have entailed the crystallization of Umwelten, models of purlieus frequented by and appropriate to the survival of each organism and the species in which it is slotted (J. von Uexküll 1928). A paramount goal of taxonomy being the pursuit of simplicity amidst a universe of immeasurable complexity (Tort 1983), the earliest constructions (models) of the universe ("reality") must have been binary: a class of things to approach (prey), another class of things to withdraw from (predator), with an immense imperceptible remainder irrelevant to the organism either biologically or socially for the survival of the species (Sebeok 1986:13-14). This minimal but sufficient module of distinctive features of +, -, or 0, variously multiplied in advanced zoosemiotic systems, like those of the much misunderstood communication of vervet monkeys, comprises a far cry from the exceedingly complex Cosmic models Newton or Einstein came in due course to bestow upon humanity.

"The common ancestor of all living things most likely was a bacterium, or prokaryote", de Duve informs us (1995:125). And, thanks mainly to the work of Sorin Sonea of the Université de Montréal, the mind-boggling semiotic comportment of bacteria -- about three and a half billion years in depth -- is quite well understood. As Sonea recently told the Société de sémiotique du Québec, "Un système si simple fonctionne à merveille parce qu'il est passé au niveau d'une communication globale, mondiale" (1995:29; see also id. 1988 and 1990, where further references are supplied). Bacteria together "constitute the communications network of a single superorganism whose... components are dispersed across the surface of the planet." Yet the semiotic dimension of their existence also comprises associations into countless local teams plus interactions with the

eukaryotes, using us as habitats and vehicles (1988:40-42). Although I am unable to recount all the ways and means of prokaryotic social behavior, I do want my readers to credit that neither comparative semiotics nor diachronic semiotics is feasible any longer without a meticulous inventory and full comprehension of the manifold ways of prokaryotic semiosis. Although bacterial communication is radically different from, say, animal communication, we cannot fully grasp semiosis in multicellular organisms, including ourselves, without an appreciation of its ancestral operations two billion years ago, when our planet was still bereft of eukaryotes.

Terms such as "symbiosis", "endosymbiosis", or derivatives thereof, are commonly used by biologists, especially when discussing the evolution of the eukaryotic cell (cf. Margulis 1993, Ch. 7), to register that "mitochondria and chloroplasts are descended from originally free-living prokaryotes." So possibly is the microtubular cytoskeletal system (de Duve 1995:160-168, Maynard Smith 1995:125), and even the nucleus (ibid. 136-137), the cardinal feature of eukaryotic cells. Margulis notes "the near ubiquity of the symbiotic state, the persistence through time of most symbioses, and the profound consequences for the partners", for instance, in that "symbiotic partnerships may be more fit than individual partners (bionts)" in any environment (1993:167, 171). When two or more species live together (Margulis 1986, Ch. 8), we may be sure that energetic sign transmission (Scannerini 1988), or, as Mc Farland had intimated (1982:540), dense communication, solders such alliances. Therefore, inasmuch as processes of sign transmission outside and inside organisms are at play, it appears not unreasonable to suppose "symbiosis" to be a token of "semiosis" and "endosymbiosis" to be a token of "endosemiosis" (Uexküll 1993). Nor is this mere word magic: the scrupulous positing of tokens within the types to which they naturally belong is surely both of heuristic and epistemological import, as applied for example to the quintessentially transdisciplinary, or rather hybrid, area of psycho-neuro-immunology (Kappauf 1991).

We can now state with confidence that, besides bacteria (microsemiosis) and animals (zoosemiosis), plants exhibit ample (phyto)semiotic functioning. They therefore communicate as well: "if meaning-based behavior of animals is classified into matter exchanging behavior, reproductive behavior, information seeking behavior and defensive behavior, it must be concluded that all four classes occur likewise in plants..." (Krampen 1994:727). Notwithstanding that we lack a present opportunity to consider semiosis ostensibly in the remaining two of the Five Kingdoms of terrestrial life, the Protoctista (semiotic practices scarcely explored) and the Fungi (mycosemiosis; cf. Sebeok 1991a:112), we are prepared to formulate the following prime abduction:

THEOREM I: COMMUNICATION

All, and only, living entities incorporate a species-specific model (Umwelt) of their universe; signify; and communicate by nonverbal (chiefly chemical and/or motor, later optical and/or acoustic) signs. Many are also capable of intercommunicating in limited ways with some individuals of other species¹².

Lemma IA: Lotman's Schema Modified

Man's nonverbal communicative repertoire, in its totality, corresponds to the Moscow-Tartu school's "primary modeling system" concept, as now modified.¹³

Lemma IB: Popper's Schema Compared

In Popper's schema, man's nonverbal communicative repertoire can be located at the interface of World 2 and World 3 (Popper 1977, passim; cf. Sebeok 1989:203-206).

Bearing the foregoing in mind, let me now turn to one of the busiest areas of research -- or abductive inference -- conducted with hopefully enlightened but sympathetic agnosticism -- this concerning a zealous revival of an ancient obsession with the "origin of language". As Jakobson said in his 1968 Olivetti lecture in Milano -- and not many linguists would disagree with him -- "The uniqueness of natural language among all other semiotic systems is manifest in its fundamentals" (1971:707). Speculating about the "initial conditions" of language is admittedly fun, but all deliberations about this matter have led to, *tout court*, dead ends. In the pithy assessment of the English linguist David Crystal, with which I by and large concur, questions like these are "fascinating, and have provoked experiments and discussion whose history dates back 3,000 years. The irony is that the quest is a fruitless one" (1987:288). A more radical view, which I share, was declared by Marantz (echoing Chomsky): "If language had an origin it might indeed make sense to talk about its creation.... But human language cannot be considered to possess an identifiable origin, any more than can the human heart" (1983:20).¹⁴

Since, as mentioned, I argued for my own set of surmises in readily accessible venues, I shall refrain from repeating them to set down instead, in the following three cautionary paragraphs, certain markedly pesky Idols of the Market-Place (as Francis Bacon would have called them) which, in my view, have given rise to some of the avoidable clutter which afflicts many -- dare I say it -- pseudo-scientific proceedings.

(1) Resist the temptation to jumble three incommensurate semiotic practices and their corresponding appellations: "communication" (see also Theorem I, above), "language" and "speech" (Theorems II and III, below). Communication is a universal attribute of the living. Language is a universal attribute of hominids -- a "languageless human" is an oxymoron. (For speech, see below.) These three phenomena evolved quite separately in phylogenesis as well as emerge severally in human ontogenesis. The labels are thus by no means interchangeable.

It needs to be emphatically reiterated that language and speech did not co-evolve. On the contrary, in each word-pair displayed in the next paragraph, the second (much later) semiotic operation *presupposes* the (much earlier) first, not vice versa. To put it in another way: one cannot speak without having a language, but having a language does not enjoin that it be vocally exhibited or indeed externally manifested in any other manner (such as script [Sebeok 1989: 251-252], Sign Languages of the Deaf [Stokoe 1972], Monastic Sign Languages [Umiker-Sebeok 1987], Drum and Whistle Speech [id. 1976], or the like).

Natural languages, Indo-European and others, recognize by encoding on the "folk" level crucial distinctions between terms such as "language / speech", "Sprache / Rede", "langue / parole", "yazik / reã", "kieli / puhe" (Finnish), "nyelv / beszéd" (Hungarian), "hizkuntza / mintzaldi" (Basque), and so on around the globe.

As a rule, several highly complex sets of successive capacities are tacitly compressed into and entailed by the single word "speech" (or its congeners and derivatives) in common parlance: at the encoding end, or the production of sounds, the airstream process, the phonation process, the articulatory process, and the radiation process; and at the decoding end, the perception of auditory events (hearing) and listening (Handel 1989). Both complementary coding deployments have quite distinct evolutionary histories, with hearing the older propensity by far. In the course of human evolution and history, although the performance and reception systems of phonemes have coalesced to a degree, they have not to-date been perfectly co-ordinated. One far-reaching reason that a speaker's speech -- defined as vocal communication by means of a natural language -- is often misheard and misunderstood by a listener is that the integration of these two capacities may still be evolving.

(2) Avoid the presumption that just because some transaction is labeled "language" this is equivalent to the technical usage of professional linguists. Expressions such as "language of the bees", even when used with the authority of a Nobel Laureate as Karl von Frisch, are metaphors. As a rule of thumb, picturesque conjunctions of the word "language" with the generic word "animal" (e.g., Bright 1984), ape or dolphin, or a category of domestic pets (cat, dog), or in phrases like "the language of flowers", are unscientific nonsense, rhetorical tricks designed to mislead by assuming as part of the premise the conclusion that is supposed to be demonstrated (*petitio principii*).

(3) Shun pseudo-Darwinian posturings which contend that attempts to inculcate "language" in captive apes (or, more absurdly, in marine mammals cf. Sebeok 1981:170) are motivated, even justified, by the scientifically commendable goal of discovering "The Origin of Language" -- the pretentious title, for one, of the chaotically polemic, misinformed no less than irrelevant, penultimate chapter of a book by Savage-Rumbaugh and Lewin (1994:223-250).¹⁵

About of the status of language in human evolution, let me propose:

THEOREM II: LANGUAGE

All animals paleontologists classify generically as Homo, and only such, embody, in addition to a primary modeling system (Theorem I), a secondary modeling system, equivalent to a natural language. The difference amounts to this: while the Umwelten of other animals model solely a (for each) "existent world", man can, by means of the secondary system, also model a potentially limitless variety of "possible worlds" (containing sentences with alethic, deontic, or epistemic modalities).

Lemma IIA: Twin Modeling Systems

All species in Homo -- *habilis*, *erectus*, *neandertalanensis*, *sapiens*, etc. -- disposed of this pair of interactive systems, as does the sole extant species, *sapiens sapiens*; but while they were each capable of signifying by *both* nonverbal *and* verbal means (i.e., natural

language), solely *Homo sapiens* can, with the eventual development of speech and/or equivalent spatio-temporal realizations, so communicate.

Lemma IIB: Popper's Schema Compared

In Popper's schema, World 3, relating uniquely to man, is the world of language and of its products (cf. Sebeok 1989:204). It roughly corresponds to Humboldt's *Sprachwelt*, as well as all I had assigned to the domain of anthroposemiotics (1974:213).

Lemma IIC1: Syntax in Language

The pivotal role of syntax in language has been recognized (if far from fully understood) by linguists from Wilhelm von Humboldt to J. Wackernagel (cf. Sebeok 1966:2:54) to Jespersen (ibid. 168), and Zellig Harris. Humboldt famously pointed out the potential of language "to make infinite use of finite means" (Sebeok 1991a:29; Pinker 1994:84), what, after Chomsky, is styled its generative capacity. (This needs no elaboration here, but see the next Lemma for applications to domains prior to language.)

Lemma IIC2: Syntax in Evolution

Syntax appears to be the hallmark of every "major transition in evolution." The "age of chemistry" was subjected to Dimitri Mendeleev's omnipresent periodic law (1869), the universal syntactic features, or electronic configurations, of which are commonly displayed in the Table of Elements.

In the world of the living, syntax-controlled semiotic systems appear to be, among others and in addition to the verbal code, the following:

Genetic Code, aka "language of life" (Beadle 1966; Berlinski 1986; Sebeok 1991b:85-86, 154);

Immune Code (Jerne 1985; Sercarz 1988; Sebeok 1991b:87, 154-155; Tauber 1994:169-171; the Hungarian immunologist Academician János Gergely, recently characterize this as "the most perfect semiotic system in the Universe" [personal remark]).

Metabolic Code (Tomkins 1975; Wright 1988:103-104; Sebeok 1991b:87-88).

Neural Code (Sebeok 1991b:88-89). Recent growth of a distinct discipline sometimes named "Neurocommunications" has been so dramatic that no account can be furnished in any work short of a handbook. One example: a flurry of discoveries of a range of guidance proteins (semaphorins, netrins), which, in the manner of road signs, usher some ten trillions of neurons the way to their appropriate destinations in human embryos (Howard 1995:12, 47). Would not Crick's "astonishing hypothesis" of the origin of consciousness also belong under this rubric (1994)?

As far as zoosemiotic processes are known to-date, no evidence of syntactic structures has been found, not even in any of the alloprimates. Accordingly,

Jackendoff answers his own question, "do apes have a mental grammar that allows them to combine signs in regimented fashion [read: syntax]?" thus: "The evidence seems to indicate that they don't.... In short, Universal Grammar, or even something remotely like it, appears to be exclusively human" (1994:137-138; cf. Sebeok 1980; Wallman 1992:139-143).

THEOREM III: SPEECH

Homo sapiens, and only conspecifics, are singularly but not universally able to communicate by language recoded in the acoustic channel. While "speech" occurs only in humans, it doesn't manifest itself in all: not in infants (Trevathan 1990), mutes, some hearing impaired (Stokoe 1972), some stroke victims, types of aphasics or autistics (on "clinical semiotics", see Sebeok 1977:190-192), and some people in their "second childhood"; total speech loss can also be induced by the intake of certain designer drugs which destroy the substantia nigra (a chronic symptom of classic Parkinson's patients) (Langston 1995).

III. Erato's Coda

In these meditations, I tried to chime with, in my own fashion and within reasonable limits, the leitmotif our illustrious convener set for us: boundaries and ways of transgressing them. So I think it would be in order for me to conclude with a characteristically terse but apposite lyric by the incomparable American poet, Emily Dickinson, who, understanding her condition and its boundaries only too well, luminously challenged and miraculously overcame them:

Love is anterior to life,
Posterior to death,
Initial of creation, and
The exponent of breath.

NOTES

*I conceived and wrote the initial draft of this paper during the first half of my tenure (March 1- May 31, 1995) as a Senior Fellow at the Institute for Advanced Study (Collegium Budapest). This penultimate draft is intended to be my Keynote Address for delivery on November 2, 1995, at the First Annual Conference of the Semiotics Research Unit of The University of Toronto, on the over-all topic, "Semiotics as a Bridge Between the Humanities and the Sciences".

¹ Beside *Web* -- now also featured in designating a new user interface known as the *World Wide Web* -- there is the metaphor *Internet*, or simply *the Net*, for a rather outdated system designed originally for data exchange between small local networks. (The Web is sometimes described as the Internet with pictures.) Then there are variations on the metaphor *Highway*, as in "Data Highway", or "Infohighway", or "Global Digital Highway", each roughly equivalent to "Global Information Infrastructures", and of course "Roads". Kindred popular motifs include "landscape" and "maps", or the like. A separate study on the prevalence of figures of speech and, broadly speaking, their uses in semiotics cries out to be written (cf. Keller 1995).

² As captured in a dramatic photograph reproduced in Wilson 1971:62. Ants do not, however, construct "bridges" to cross obstacles.

³ Eschewing definition in the enabling legislation that created the National Endowment for the Humanities in 1965, Sec. 3 (a), the United States Congress stated: "The term 'humanities' includes, but is not limited to, the study and interpretation of the following: language, both modern and classical; linguistics; literature; history; jurisprudence; philosophy; archeology; comparative religion; ethics; the history, criticism, and theory of the arts; those aspects of the social sciences which have humanistic content and employ humanistic methods; and the study and application of the humanities to the human environment with particular attention to reflecting our diverse heritage, traditions, and history and to the relevance of the humanities to the current conditions of national life." Evidently, semiotics was licensed to receive the support that it has enjoyed over the past thirty years by virtue of the clause "but is not limited to..." I can claim some credit for having persuaded the first (1966-1970) Chairman of the Endowment, Barnaby Keeney (a Medieval Historian, d. 1980), in the course of a petrifying flight the two of shared in a tiny plane from Washington to Princeton, to look with favor (if we survived our mercifully brief journey) on semiotics and to pass this tradition on to most of his successors.

See also, defying summation, Peirce's "Outline Classification of the Sciences" (1:180-202) and his detailed modifications thereto (1:203-283).

⁴ Locke knew perfectly well that the antithesis of *Humanitas* was never *Scientia* but *Divinitas*. Although the antagonistic confrontation of the humanities and the sciences, based on an etymological perversion, can be ascribed (among others) to Vico, it became commonplace by the middle of the 19th century. "Divinity", loosely speaking, then and thereafter found a home among the humanities.

⁵ Snow also cautioned in his 1959 Rede Lecture (wrongly, as it turned out) that, "if we don't do it, the Communist countries will in time" (53).

⁶ Among these were Gregory Bateson, Rudolf Carnap, Yuen Ren Chao, Karl Deutsch, Heinz von Forster, Warren S. McCulloch, Margaret Mead, I.A. Richards, Jurgen Ruesch, Claude E. Shannon, Norbert Wiener, and numerous others.

⁷ Autopoiesis is defined as "the imperative set of continuing energetic biological processes...by which all living beings maintain themselves" (Margulis 1986:283; Margulis 1993, *passim*). Briefly put: living systems create themselves. Code duality, as used in various works by Emmeche and Hoffmeyer concerning the construction of body cells and organism, refers to the transmutation of the digital genetic code of DNA into an analogue code.

⁸ "Semiophysics is concerned in the first place with the seeking out of significant forms; it aims to build up a general theory of intelligibility" (Thom 1990:vii). (The term appears to have been coined by Jean Petitot in 1985.) Merrell, like myself, was strongly impressed by Wheeler; see especially Merrell 1995:xiv, Chs. 9, 10, and *passim*; and Sebeok 1991a:48, 135, 1991b:21, 84, 143, 153.

⁹ Prodi applied his neologism, *protosemiotics*, in a phylogenetic sense. This must of course be distinguished from the study of *protosigns*, as Trevarthen calls the signs of *infant semiotics* in ontogenetic perspective (1990:716, 689).

¹⁰ On March 30, 1995, I had conducted a seminar at the Institute for Advanced Study (Collegium Budapest) that dealt largely with such conundrums as the foregoing and others. I want to thank my colleagues at the Institute, particularly the members of the Theoretical Evolutionary Biology group working with Eörs Szathmáry, and the audience at large, for valuable input during the discussion that followed. Some of this is reflected in my subsequent work, including Part II of this essay.

Brief remarks about tool use and language in *Homo*, a relationship Maynard Smith and Szathmáry claim (1995:293) was suggested by P.M. Greenfield in 1991, may be appropriate at this point. In fact, I made the same association in a talk I had given in Montréal in December 1964, subsequently published as Sebeok 1967:363-369 (reprinted in id. 1972:84-92; see also Bickerton 1990:138-140). Paleoanthropologists are currently focusing on a set of dates for tool-making 2.6 million years ago; it is not yet clear whether these remarkably early stone tools, from the desiccated fossil fields of Ethiopia, were forged by a variety of *Homo* -- presumably *habilis* -- or by hominid australopithecene ancestors. The distinction is an important one for students of "initial conditions" of human (and thus language) origins especially because the period between 3 and 2 million years ago is still rather opaque.

¹¹ A "signifex" is any organism performing semiosis. This useful, although (in the framework that I advocate) redundant, locution -- because every organism, *ipso facto* and whether *in esse* or *in posse*, does perform semiosis -- appears to have been coined by Watt (1993:428), presumably to steer clear of the equivocality of "signifier", which more commonly means (as used for instance by Morris) to act as a sign in a process of semiosis or (as in the Saussurean tradition) a sign-emitter, intended to translate the Latin *signans* or French *signifiant*.

¹² Jakob von Uexküll's *Umweltlehre*, put forward as a theory and technique for the biological analysis of species-specific modeling of the universe, in fact constitutes this century's most original, coherent, fecund, and far-reaching theory of signs (1928). The semiotic implications, distorted and misconstrued for nearly half a century, were elucidated in modern terms and much extended by his elder son

Thure in various publications; see especially "Die Umweltlehre als Theorie der Zeichenprozesse" (1980:291-388; also 1982, 1987; cf. Sebeok 1989:187-207).

The term "communication", as used here, specifies one of three forms of semiosis, "the only sign process in which emitter and receiver share the semiotic tasks", namely, by informing one another about the interpretant, or the code, which attaches to the emitted signs the meaning "intended" by the source (Uexküll 1996; *id. et al.* 1993:48). George Herbert Mead, in the early 1930's, called this same process "intelligent gestures" (Sebeok *ibid.* 142). More generally, see Sebeok 1991b:22-35.

It is worth recalling that many speech communities have no native equivalent to our Latin-derived "communication," but only borrowings (Basque "komunikazio") or calques (Hungarian "közlés", Finnish "tiedonanto"), etc.

¹³ Actually, by the expression "Primary Modeling System" the Soviet scholars meant language. Their proposal was emended by me in a 1987 study titled "In What Sense is Language a 'Primary Modeling System'?" (Sebeok 1991b:49-58), where I argued that language is a temporally and hierarchically secondary superstructure over humanity's inborn stock of nonverbal semiotic devices. What the Soviet colleagues called "Secondary Modeling System" (roughly: culture) thus necessarily becomes a tertiary superstructure over both underlying strata.

¹⁴ For "zealous revival", I refer mainly to the foundation a decade or so ago of the *Language Origins Society* and its many publications, one recent item being Wind, Jonker, Allott, and Rolfe (1994). The "old obsession" becomes apparent, *inter alia*, from browsing through Gessinger and Rahden's twin tomes (1989), running to 1,263 pages; see also Hewes 1975, with over 11,000 entries.

The surest, most sophisticated linguist's guide to the subject thus far remains Bickerton's; his account of the "Origins of Representational Systems" (1990:75-104) is in good conformity with the *Umweltlehre*, although he seems to be unaware either of the work of the Uexküls or the sprawling literature the innovatory thrust of their writings engendered, especially in recent years. Kenneth Craik's influence, however, does make itself strongly felt (cf. 1990:x). Craik was a singular Cambridge don, a crypto-semiotician who independently invented a version of the *Umwelt* theory in the late 1930's, and who thought that "the organism carries a 'small-scale model' of external reality and of its own possible actions within its head" (see Sebeok 1991a:104-105).

Biologists Maynard Smith and Szathmáry wrestle with the issue of the emergence of language, though arguing from sources of uneven reliability, for some thirty pages (1995, Ch. 17), only to head, along with everyone else, towards a black hole; and so does de Duve, by blithely passing over elementary distinctions between apples, oranges, and bananas when he leaps from "the tantalizing question [of] the origin and evolution of language" to the "ability to speak and, with it, the power to communicate" (1995:234).

A number of talks by Fellows (including one, serendipitously, by myself) and guest speakers were devoted, in full or in part, to this topic during the 1994-1995 session of the Institute for Advanced Study (Collegium Budapest); versions of these are being assembled into a volume under the editorship of Jürgen Trabant. For some of my own previous narratives, see, e.g., Sebeok 1986:10-16, 1991b:83-96.

¹⁵ The senior author is modestly identified on the jacket as "one of the world's leading ape-language [*sic*] researchers", while her co-author is a

journalist. For an informed critical discussion, not mentioned by the foregoing, of "Pursuing the roots of language" and related matters, see Wallman 1992:113-115 and *passim*. Pinker (identified on *his* book's jacket as "one of the world's leading scientists of language and the mind") thinks that, within the field of psychology, "most of the ambitious claims about chimpanzee language are a thing of the past", but this sanguine sentence was written before the appearance of the book about Kanzi, whose "language [*sic*] abilities, if one is being charitable", Pinker grants, "are above those of his common cousins by a just-noticeable difference, but no more" (1994:341).

Incidentally, the wide-spread allegation that certain apes have been taught ASL is another fairy tale.

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