Chapter 6
Biosemiotics: Its Roots, Proliferation and Prospects

Thomas A. Sebeok (1920–2001)

Introduction and Commentary: Thomas A. Sebeok

Scarce is the polymath of the magisterial stature of, say, Charles Peirce, capable of reaching athwart more than a couple of disciplines, especially across the humanities and the sciences, which are perhaps uniquely bridged by semiotics.

T. Sebeok (2002: xxii)

Because the figure of Thomas A. Sebeok looms so large throughout this volume, cited far more here than any other thinker (except, perhaps, Charles Darwin), and because the story of his founding of the contemporary interdiscipline of biosemiotics is recounted in some detail in the introductory overview of biosemiotics that is Chapter One of this volume, we will limit the comments that appear in this reading selection preface to just the barest biographical sketch, so as to allow the reader the pleasure of reading Sebeok's own account of the founding of the "biosemiotics" project in his own words in the following selection.

Thomas Albert Sebeok was born on November 9, 1920 in Budapest, Hungary. At age sixteen, he began his university studies at Magdalene College in Cambridge, where he studied under philosopher and rhetorician Ivor Armstrong Richards (1893–1979), whose monograph *The Meaning of Meaning* (co-authored with Charles Kay Ogden (1889–1957) in 1923), was an early and lasting influence. In 1937, Sebeok enrolled at the University of Chicago, where he attended lectures by, and was briefly under the mentorship of, semiotician and philosopher of science Charles Morris (1901–1979), whose wide-ranging areas of interest were similar to Sebeok's own. At the time of his enrollment, Sebeok was hoping to pursue a career in biology, but the outbreak of World War II in 1939 convinced him that he could be more useful to the world as a linguist, and during the war, Sebeok did much work in developing training materials in Hungarian and Finnish for the United States government.

Sebeok earned his bachelor's degree in linguistics at the University of Chicago in 1941, and from there went on to Princeton, where he earned his Master's Degree in anthropological linguistics and his Ph.D. from the Department of Oriental Languages and Civilizations in 1945. It was during this time, too, that Sebeok made the acquaintance of émigré Russian linguist and literary critic Roman Jakobson (1896–1982), who was teaching both at Columbia University and at the New

D. Favareau, *Essential Readings in Biosemiotics*, Biosemiotics 3,
DOI 10.1007/978-1-4020-9650-1_6, © Springer Science+Business Media B.V. 2010

York City New School for Social Research, and who became Sebeok's doctoral dissertation advisor. Sebeok was naturalized as a United States citizen in 1944, and following his graduation from Princeton in 1945, joined the faculty of Indiana University at Bloomington, which became his home university for the next 45 years.

Ever a prolific researcher, author, and academic impresario, the resumé of Sebeok's first decade and a half at Indiana University – long before he got into his stride as world-renowned semiotician, much less biosemiotician – illuminates much about the man:

> A linguist studying Finno-Ugric languages, Sebeok's linguistic fieldwork took him to Central and Eastern Europe, including Lapland and the former Soviet Union. He also carried out studies in the former Mongolian People's Republic, Mexico and in the U.S. (among the Winnebago Indians of Wisconsin and the Laguna Indians of New Mexico). In addition to these studies in grammar and phonology, his interest in anthropology, folklore and literary studies led to early publications dealing with folksongs, charms, games, poems and the supernatural. He carried out some of the first computer analyses of verbal texts and published a path-breaking volume on *Myth* in 1955, and one on *Style in Language*, in 1960. At the same time, he contributed to the creation of the new field of psycholinguistics, publishing, with Charles Osgood, the famous classic text, *Psycholinguistics*, in 1954. By 1960, he had established himself as a scholar known for overcoming academic boundaries between subjects in his own research, in collaborations with scholars in adjacent fields, and in organizational roles as an book and journal editor, founder and officer of several academic organizations, conference organizer, and mentor (Vlahakis 2002: o.l.).

Characteristically enough, however, Thomas A. Sebeok was best known, and is remembered today, for his accomplishments in the forty-one-year period beginning *after* these first fifteen years' worth of preliminary academic accomplishment *prior* to his development of a multidisciplinary research agenda that he would name "Semiotics." Moreover, Sebeok remained intellectually and indefatigably active in intellectual circles right up until the day of his death on December 21, 2001, when he died at his home in Bloomington, Indiana, at the age of eighty-one.

Yet even in the above thumbnail sketch of his "freshman years" as a public intellectual, one can detect Sebeok's trademark "uncontainable interest in everything" and his commitment to what he described as the two fundamental academic virtues of "publishing and teaching as much as possible; and, equally importantly, doing one's best to facilitate the success of one's colleagues" (1995: 125). An inveterate chronicler of not only the traditions that he saw himself as inheriting, but also of the development of those traditions as it was taking place in his own time, Sebeok records that it was at a conference devoted to the study of "the *kinesics* and *paralinguistics* of non-verbal communication" that he had organized in 1962, where anthropologist Margaret Mead (1901–1978) suggested using the term *semiotics* as a "cover noun" to denote the study of "patterned communication in all modalities" (Sebeok 2002: xiii, Sebeok et al. 1964: 5).

This term – which at once captured historical resonance with the work of Peirce and Morris, but was yet sufficiently general to include all the possible manifestations of sign use that Sebeok was interested in actively investigating – became the

aegis under which he worked and thought from that point on.[1] The conference proceedings themselves were published by Sebeok in 1964 under the title *Approaches to Semiotics*, spawning a book series of the same name that he personally oversaw, and that eventually ran to 112 volumes over the course of its almost 30 year run.

Philosopher and historian of sign study John Deely proclaims that Sebeok's "publication of *Approaches to Semiotics* volume from the 1962 Indiana conference of surely marks the beginning in North America of semiotics as an intellectual movement" (Deely 2004: o.l.), and within five years of its publication, Sebeok would found the International Association for Semiotic Studies (Association Internationale de Sémiotique) with colleagues Umberto Eco (b. 1932), Roman Jakobson (1896–1982), Roland Barthes (1915–1980), Emile Benveniste (1902–1976), Algirdas Julien Greimas (1917–1992) and Juri Lotman (1922–1993). At this time, Sebeok was also elected as Editor-in-Chief of the association's journal, *Semiotica*, a position that he held from the journal's inception in 1969 until his death in 2001.

Two major bibliographical surveys (Deely 1995, Umiker-Sebeok 2003) of books and journal articles authored by Sebeok at the time of his death lists five-hundred-seventy-nine single-authored or co-authored entries. "Reviews and miscellanea (forewords, encyclopedia articles, etc.)," notes John Deely, "raise the writings to eight-hundred-thirty-three. Editorial work promoting other scholars adds another three-hundred-ninety-five volumes" for a total of 1,228 published scholarly works. Yet, notes Deely

> for all of Thomas A. Sebeok's prodigious range of intellectual involvements, positions, acquaintances, presentations and writings – his visiting appointments in thirty-five universities of twenty different countries; his honorary doctorates in the U.S.A., Hungary, Argentina, Bulgaria, Finland; as president of organizations in anthropology, linguistics, semiotics; his Fulbright grants to Germany, Italy, Argentina, Uruguay, Mexico; as Fellow of the Stanford Center for Advanced Study in the Behavioral Sciences, the East-West Center, the Netherlands Institute for Advanced Study, the National Humanities Center, the Smithsonian, the Woodrow Wilson International Center; etc., etc. – it was into his shaping of the doctrine of *signs* that everything else was gathered and found its place (Deely 2004: o.l.).

Indeed, Sebeok's obituary states that of all his eighty-one years' worth of accomplishments, "he was most proud of having brought into being a group of theoretical biologists and semioticians to pursue this field of investigation" (Vlahakis 2002: o.l.).

Such "bringing together" consisted not just in Sebeok's indefatigable efforts at creating publication venues for these authors, encouraging them in their often neglected efforts, and bringing their ideas to a larger audience by citing them insistently in his own widely-read work – all of which he did unceasingly – but, much

[1] Recalls Sebeok: "By 1962, I had edged my way into animal communication studies. Two years after that, I first whiffled through what Gavin Ewart evocatively called 'the tulgey wood of semiotics'" (Sebeok 1986a: ix).

more importantly, in his tireless efforts to realize an active and ongoing, cross-disciplinary *community* of scholars who would work together on the puzzles of organismic sign-processing long after he was gone.

It is for such reasons that we think of Thomas A. Sebeok today not so much as the 'founder' of an institutionalized approach to the study of biosemiotics, but as the intellectual and inspirational 'father' of an ever-branching lineage of individual inquirers, all of whom are motivated by the same kinds of questions that motivated Sebeok – but who, were it not for Sebeok's lifelong efforts at illuminating the "family resemblances" uniting all their inquiry, may never have realized the power of that collective unity.

The story of how Thomas A. Sebeok founded the contemporary project of biosemiotics appears in the selection that begins this anthology, and has been recounted in several other highly illuminating texts as well (many of which are listed in the *Further Readings* bibliography appearing later in this volume). But in the following selection, the reader will have the signal pleasure of being taken on a brief but grand tour of the history of biosemiotics by the master of the sign himself. In the selection that follows, Sebeok situates the biosemiotic project at the intersection of its twinned larger contexts of biology and semiotics, and recounts the involvement of himself, Giorgio Prodi (1928–1987), Heini Hediger (1908–1992), and Thure von Uexküll (1908–2004), in attempting to establish the "latest iteration" of the millennia-long project of examining the role of sign relations in life processes.

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> *Cognition is simply a development of the selective attitude of an organism toward its environment and the readjustment that follows upon such a selection. This selection we ordinarily call 'discrimination', the pointing-out of things and the analysis in this pointing. This is a process of labeling the elements so that you can refer to each under its proper tag, whether that tag is a pointing of the finger, a vocal gesture, or a written word.*
>
> (Mead 1936: 350)

Throughout Western intellectual history, most semiotic theories and their applications have focused on messages – whether verbal or otherwise – in circulation among human beings, generally within their cultural setting. This kind of semiotic inquiry, characterizable as anthropocentric or, even more circumscribed, as logocentric, has been the rule since ancient times.

A partial if conspicuous, yet until recently by and large undeclared, exception to this tradition has been iatric semiotics, concerned with the arts of healing (symptomatology, diagnostics, prognostics, and the like), practiced and written about by physicians such as Hippocrates of Cos (B.C. 460–377) – called by many the Father of Medicine but by some also "der Vater und Meister aller Semiotik" (Kleinpaul 1972: 103; on medical theory and sign theory in Pre-Alexandrian times, see Langholf 1990: 57–68, 82–93, 150–164); or the great Neoplatonist Galen of Pergamon (A.D. 129–c200) (Sebeok 1996). As Baer observed of the Greeks: "Signs [*sēmeia*] are here construed as bodily clues that allow inferences based on observation" (1988: 47).

Iatric semiotics persevered with numberless modern successors of these venerable figures, to name only a few, through Thomas Sydenham (often called the "English Hippocrates") in the 17th century; F. G. Crookshank, also of London, emphatic about "the necessity to Medicine of a Theory of Signs" (1938: 354); Harley C. Shands, a distinguished New York cardiologist turned bountiful semiotician; F. Eugene Yates, a Los Angeles specialist in medical engineering who contends that science in general "has been permeated with semiotic issues all along" (1985: 359); and a host of other contemporaries.

But no pillar of the medical establishment would more crisply and trenchantly discern and signal a crucial paradigm shift in, or a consistently comprehensive semiotic overview of, the intellectual landscape than Thure von Uexküll [hereafter in this text: Thure]. To be sure, his familial as well as medical credentials are unique. So it is apposite and was presumably perhaps foreordained that he would most explicitly pinpoint *biosemiotics* as the underlying exemplar for medicine, especially so in its aspect as a natural science concerned with "illness as a disturbance of a complicated physio-biochemical machine" (1982: 206, 1991).

A few years later, he spelled this out further: "The overwhelming majority of objective evidence of a disease belongs to those types of processes taking place within the body, which, in turn, are divided into subsystems (organ systems, organs, tissue, cells, cellular organelles)" (Thure 1986: 204). Just as, on the macroscopic

level, "evolution depends on setting up new systems of communication" (Jacob 1974: 308), so also within the organism, no less than between the organism and its Umwelt. The components listed are among the major participators in the interchange of signs that ceaselessly ebbs and flows on the interior plane; accordingly, the living things are indeed aptly regarded as a web of semioses. In 1976, I tagged such schemes "cybernetic systems within the body" and then termed their operations "endosemiosic" (1985 [1976]: 3).

By 1993, the conceptual framework for internal somatic sign transactions was comprehensively expanded by Thure and two of his medical associates. Since, as these authors point out, all sign processes within "are indirectly linked to phenomena in the organism's environment ... these endosemiotic signs which belong to an 'inner world' have to be translated into the codes of other ... sign systems" (1993: 5–7). Such other codes belong to those exosemiosic transactions which were described by means of what Jakob von Uexküll [hereafter in this text: Jakob] named a functional cycle (cf., e.g., 1973 [1920, 1928]: 151–156; see also T. von Uexküll 1987: 166–169).

"Medicine", as Thure highlighted, was ever "a semiotic discipline" (1992: 455). And, as the historian Carlo Ginzburg pointed out, this "model of medical semiotics or symptomatology", and "the 'semiotic' approach, a paradigm or model based on the interpretation of clues, had become increasingly influential [in the 19th century] in the field of human sciences". But in fact its "roots ... were far more ancient". They can be traced to Mesopotamian forms of knowledge and beyond (1983: 87–91). The medical crafts should thus be seen as the ultimate cradle of – and a lengthy if tacit prologue as well as a vivid backdrop to – not merely endosemiotics but its comprehensively encompassing domain that has become increasingly known in the last quarter of our century as *biosemiotics*. This embraces, according to one recent exposition, "all processes that take place in animate nature at whatever level, from the single cell to the ecosystem", as "concerned with the sign aspects of the processes of life itself, not with the sign character of the theoretical structure of life sciences" (Hoffmeyer 1998: 82). In a different but equally valid formulation, "the socio-semiological limits of intentional communication ... are largely overcome [by means of biosemiotics] as we are introduced to the global logic of the great ecosystem named Gaia where conceptual boundaries finally open up to the encounter between semiosis and life" (Petrilli 1999: 316). Furthermore, as Thure affirms, biosemiotics remains "of central interest for the biosciences and medicine" (1992: 456; for his most extended relation to-date, cf. 1997; for an early map of this then still ill-defined territory, see the collection by Sebeok and Umiker-Sebeok 1992). In short, the province of biosemiotics coincides in its entirety with that of the biosphere, which, in this context, is tantamount to the "semiosphere" (but in a sense far vaster than in Lotman's usage).[2]

[2] For the contrast between Y. M. Lotman's anthropological usage and V. I. Vernadsky's global usage, see Sebeok (2000).

Terminological issues abound, but this is hardly the place to rehearse the attendant philological niceties beyond acknowledging that the very label of this emerging domain of knowledge seems to have been claimed independently – at least twice in the US and once in the former Soviet Union – over the past few decades. What remains important is to corroborate that the *domain* of biosemiotics and the *field* of biosemiotics[3] surfaced a long time *avant la lettre*; and that, furthermore, its ripeness did not just happen in a simple linear progression but surged by fits and starts as a convoluted affair, winding its long but episodic way through at least three successive 20th century iterations: I register these, respectively, with the names of J. von Uexküll [1864–1944], Heini Hediger [1908–1992], and Giorgio Prodi [1928–1987]. In the telling, I must make it clear that I intend to proceed not as a professional historian but rather as an implicated deponent, a predisposed witness, variously involved in the unfolding chronicle. The following account will therefore have an autobiographical tinge; but I have never before set the better part of it forth in print.

Jakob spent his student days at the University of Dorpat, in Estonia (1884–1888). But all pilgrims' paths eventually lead to Germany – according to the canonical version of his triumphant trajectory – where he became a citizen in 1918, joining (when already in his sixtieth year) the University of Hamburg in 1924. He founded and led the Institute for Umwelt-Research there from 1925 to 1940. Although he produced the first edition of his *Theoretische Biologie* in 1920, he prepared a thoroughly revised second edition in Hamburg, to appear 8 years later then to be posthumously reprinted in 1973. The only English translation, published in 1926, was thus calamitously based on the first edition. This circumstance, aggravated by the poor quality of this rendering, alas retarded the appreciation (especially so, deplorably enough, in the Anglo world) of his Umwelt-science – and, correspondingly, the flowering of biosemiotics – by about half a century. Thomson, in his review of the English version, chose, ambivalently, to "congratulate Dr. D. L. Mackinnon on her remarkably successful translation of what we know to have been very difficult German. No one but an organically philosophical biologist could have achieved such a conspicuous success. Not that the book can ever be easy-reading, in the most lucid translation". Yet, on the other hand, he grouses that "an unnecessary difficulty seems to be raised by the use of difficult terms, which perplex the reader gratuitously" (1927: 419, 415).

I myself first read the book in English in 1936, finding it bafflingly murky; but then I read the second German edition in 1976, and found that, if not pellucid, nonetheless electrifying (Sebeok 1998a: 32–34). Some time later still, this experience led me to instigate and arrange for the publication of two of Uexküll's shorter monographs in English (1982 and 1992).[4]

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[3] For this important distinction – which is particularly pertinent to biosemiotics – between "domain" and "field", see Csikszentmihalyi (1996).

[4] Ironically, Klopfer and Hailman wrote of his earliest classic work, the *Umwelt und Innenwelt der Tiere* (1921 [1909]), that this has "had relatively little effect on animal behavior studies compared with the great originality of its content" (1967: 126). One reason for this seems to have been that it was far ahead of its time; or, in Csikszentmihalyi's parlance, that there was no field competent

But long before then, in the mid-1970s, I resolved to investigate Jakob's writings for my own edification, and to look at what others had written about them.[5] These exploratory readings resulted in a paper titled "Neglected figures in the history of semiotic inquiry: Jakob von Uexküll", which I first presented in an abridged version in August 1977 at the III Wiener Symposium über Semiotik (Borbé 1978); the final, much longer version appeared in a book of mine, *The Sign & Its Masters* (1989 [1979]: 187–207, 290–291). This chapter, my personal appreciation of Jakob and his principal works, was widely noticed, despite the fact that it was in the main researched and, foremost, composed to educate myself. So one needs to ask: just what did this piece accomplish for my readership? The answer is: it redefined and relocated a nonpareil pioneer investigator of a *domain* (*Umweltlehre*) and sanctioned his having done so in a *field* (biosemiotics) appropriate to and by that time at last receptive of his creative achievement.[6]

Thure was among my audience in Vienna. He reacted to my paper about his father with no cavils, indeed, with enthusiasm. We had an extended talk over an ensuing dinner, in consequence of which, as a next step a few months afterwards, Thure came to call on me at my Bloomington home for a further lengthy evening's discussion. These two talks gave early impetus to, then came to decisively shape, the subsequent unfolding of biosemiotics. Among other things, it was during these initial dinner meetings that the two of us hammered out concrete publication plans in English of several works by both Jakob and Thure himself. Most of these eventually appeared in *Semiotica*, or in other series under the auspices of Walter or Mouton de Gruyter, or were issued by other houses in Germany and the US. (Representative items are listed among the references below.)

There were some other far-reaching consequences that flowed from our talks, two among them being especially worth some comments here.

First, the idea of launching a series of annual international conferences devoted to biosemiotics was broached and soon realized by Thure. Repeated about five or six times in the late eighties and early nineties, these were held on the premises of the Glotterbad Clinic for Rehabilitative Medicine in Glottertal, Baden-Württemberg, Germany, under his leadership, with the signal cooperation of Jörg M. Herrmann, M.D., the Clinic's Director. Thure, in his Introduction to one of the sessions, on "Models and methods in biosemiotics", succinctly stated the aims: "to support the experiment of bringing together Humanities, represented by semioticians; Natural

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in the domain to take control over it: "There are several ways that domains and fields can affect each other. Sometimes domains determine to a large extent what the field can or cannot do . . . No matter how much a group of scientists would like their pet theory accepted, it won't be if it runs against the previously accumulated consensus" (1996: 44).

[5] That research was in large part conducted at the Netherlands Institute for Advanced Study, where I was a Fellow during 1973–1974.

[6] See again Csikszentmihalyi (1996). Note my continued emphasis on the availability of a responsive field, which was by no means at hand in 1934, when Bühler first recognized the semiotic character of the *Umweltlehre,* "welcher von vornherein in seiner Grundbegriffen M*erkzeichen* und *Wirkzeichen* sematologisch orientiert ist" (1965 [1934]: 27).

Sciences, represented by experts in molecular biology; and Medicine, a science with an uncertain position between both of them, represented by internists, psychiatrists, and clinical psychologists". He depicted the topic of the conference as "the proposition of an order in nature which has nothing to do with causality, but which canalizes causal processes between living systems and their environment as well as in and between these systems. We maintain", he concluded, "that this order is a semiotic one or at least can be described in semiotic terms" (1990: 1).[7]

Secondly, Thure made arrangements for me to spend a week or so visiting him in Freiburg (in part intended to coincide with Rowohlt's publication of my German paperback, *Theorie und Geschichte der Semiotik*, where I characterized Jakob as "einer der grössten Kryptosemiotiker seiner Zeit" [1979: 10]). Our Freiburg discussions about multifarious biosemiotic topics were carried out, with rare intensity, from morning late into every night, and were happily augmented by the continuous participation of Giorgio Prodi, Director of the Institute for Cancer Research of the University of Bologna. Prodi, an astounding polymath (Eco 1988) who had become my friend several years earlier, encountered Thure for the first time on that occasion; the two of them met only twice more, first in Palermo in the summer of 1984, then the last time in Lucca in the early fall of 1986 (Sercarz et al. 1988). Prodi sparked the third biosemiotic iteration, to which I shall return below after sketching the second.

One of the sundry riddles that mar the gradual coming into view of modern biosemiotics – the second iteration, if you will – is the neglect of Heini Hediger, whose lifelong attempt to understand animals surely marked a milestone in the elucidation of this domain, providing it with a particularly beneficial empirical footing. This seeming indifference – or is it blindness? – to his capital achievements is the more puzzling in the light of Hediger's manifest admiration for Jakob, whose *Umweltlehre* clearly had a decisive influence on his own highly original analyses of the psychology and biology of animal flight response (or negative territoriality). For instance, touching on his 1932 dissertation and work resulting there from, he wrote: "This work was surprisingly successful; it was especially well received by J. von Uexküll at the Institute for Environmental Studies in Hamburg, where I met both him and his successor, F. Brock. For my part, I was extremely impressed by von Uexküll's Umwelt-Lehre …. Consequently, I dedicated another paper following that on my flight work, a study of tameness, to von Uexküll … these two subjects

[7] Those attending the Glottertal conferences one or more times included, besides many Germans, Swiss, Danes (e.g., Hoffmeyer), Estonians (e.g., Kull), and myself from overseas. A prominent German semiotician whom I remember being there on each occasion was Martin Krampen, who substantiated *phytosemiotics*, i.e., the semiotics of plants, putting this then novel domain on an equal footing with other recognized branches of biosemiotics (1981: 187; see discussion above). A large wind-up gathering in this series was organized in the nineties by Hoffmeyer; this took place in Denmark, with an expanded attendance on the part of Scandinavian semioticians as well as natural scientists. More recent locations for biosemiotics get-togethers (enumerating here only those which I myself was asked to participate in, several repeatedly) were scheduled in Berkeley, Denver, Dresden, Gaithersburg, Imatra, Guadalajara, Kassel, Las Cruces, São Paulo, Tartu, and Toronto.

formed the basis for my later investigation concerning the relationship between animals and man, especially in the zoo. In addition, they led to the founding of zoo biology …" (1985: 149). Hediger's seminal discoveries of the concepts of individual and social space in application to animals of many kinds were later applied to humans and further fruitfully elaborated under such labels as "proxemics" in anthropology (Hall 1968).

Some years afterwards, I myself discussed nine specific circumstances (among no doubt several others) in which man may have "semiotic encounters" with animals (Sebeok 1988: 68–71). These juxtapositions include taming, training in several interdependent variations (*apprentissage*, *dressage*, domestication, and the like). My understanding of such procedures was immensely enriched by Hediger's wealth of experiences in shaping behavior, especially in zoos and circuses. Hediger totally accepted the principles of zoosemiotics – which of course constitutes a substantial segment of biosemiotics – "[the two of us] have been working together for some time" (Hediger 1985: 151; see further his 1980 book, with numerous examples and references under this heading).[8] As he noted, we "often met in Zurich or Amsterdam", and, in 1980, he was my guest in New York City. In all these venues, we frequented zoos and watched the training and performances of animals in circuses, some large enterprises (like Barnum & Bailey) and others small (such as the Swiss Circus Knie). His powers of observation and their subtlety far exceeded mine, so he taught me many things about applied biosemiotics which I could never have learned on my own (see, for example, his stunning 1974 article, with striking illustrations, on reciprocal semiosis between man and wild animals, viz., panthers, elephants, etc., in the circus). Hediger's appreciation of the quintessentially biosemiotic constitution of the Clever Hans phenomenon was also uncommonly insightful (Sebeok and Rosenthal 1981: 1–17). He foretold "that eventually an explanation for the extremely complex and, so far, underresearched problem of the relationships between man and animals will be obtained by means of signal study or semiotics, specifically zoo-semiotics" (1985: 177). Over-all, his legacy is a many-sided, profuse research program for biosemiotics that can easily extend for several

[8] At the risk of being overcome by terminological surfeit (or vertigo), I can offer the following non-exhaustive rundown – with a basic reference or two – of the currently labeled component branches of biosemiotics that I am aware of: protosemiotics ("the basic feature of the whole biological organization [protein synthesis, metabolism, hormone activity, transmission of nervous impulses, and so on]", cf. Prodi in Sercarz et al. 1988: 55); microsemiotics (in prokaryotes, cf. Sonea 1988, 1990, 1995); cytosemiotics (in cells, renamed microsemiotics by Yates 1997); endosemiotics (in the *milieu intérieur*, T. von Uexküll et al. 1993); phytosemiotics (plants, cf. Krampen 1981, 1997); zoosemiotics (speechless animals, cf. Sebeok 1972, 1990); mycosemiosis (fungi, Kraepelin 1997); and cybersemiotics (cf. Sebeok 1997: 116; androids, robotics, cyborgs, sensor and muscle augmentation, prostheses [eye-glasses, hearing aids, dentures, artificial limbs, mirrors, etc., cf. Eco 1986: 220–222]). Anthroposemiotics (speechifying animals) is usually excluded. Exosemiotics has been used in two different senses: as the opposite of endosemiotics, or in passing reference to the sign behavior of putative extraterrestrial creatures.

generations ahead; (his 1980 book is a veritable treasure house for a research agenda).[9]

Hediger was a visionary innovator who reached from the inside outwards. He felt entirely comfortable within Jakob's Umwelt paradigm, but, implicitly, with (zoo)semiotics too, which he came increasingly and quite explicitly to embrace and profitably apply in his later years. Giorgio Prodi, to the contrary, was a maverick: a prolific physician and experimental oncologist by profession, a novelist by avocation, but also an intermittent if resolute contributor to biosemiotics. However radically idiosyncratic, Prodi's recreation of a domain for biosemiotics was with little hesitation matched up with an existing field, or academic niche, a luxury not enjoyed by Jakob and only indirectly so, and only after his mid-sixties, by Hediger.[10] His first major book on the subject – which claimed to deal with "la preistoria nelle sue pesanti conseguenze sulla storia e sulla teoria della semiosi" (1977: 5) – was promptly accepted for publication by Umberto Eco; he was asked to deliver a paper on the topic at the Third International Congress of the IASS in 1984 (1988b); and invited to prepare a long English version of the former to appear in *Semiotica* (1988a). He was also chosen to be a key participant in the 1986 workshop on immunosemiotics, organized by Sercarz and others, where he spoke on "Signs and codes in immunology" (1988: 53–64).[11] Here he took a decided position against "semiotics as a pure human domain", in contrast to his own perspective of "a general semiotic domain", and introduced the notion of a "protosign", which belongs to "proto-semiotics . . . the basic feature of the whole biological organization" – protein synthesis, metabolism, hormone activity, transmission of nervous impulses, and so on (1988: 63, 55).

More extensively, he labeled the domain, over-all, "natural semiotics" (1988c: 149–170), which seems to be roughly equivalent to mathematician Kergosien's "nature semiotics" (1992: 145), as well as to the phrase "semiotics of nature", occasionally used by Hoffmeyer and Emmeche (1991: 117–118) (but who currently seem to favor "biosemiotics").

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[9] A lengthy, illustrated memorial essay of mine, "The Swiss pioneer in nonverbal communication studies: Heini Hediger [1908–1992]" (Sebeok 2001), was prepared for delivery at a conference on "Semiotics and the Communication Sciences", University of Lugano, Switzerland, May 2–4, 2001. The written version is to appear in a volume of transactions being edited by Peter Schulz.

[10] A reminder: one of the central components of creativity is the *field*, "which includes all the individuals who act as gatekeepers to the domain. It is their job to decide whether a new idea or product should be included in the domain". Publishers and journal editors figure prominently among the "field of experts" who recognize and validate innovation, as are academic administrators, officers of public and private sources of financial support, or, to put it briefly, persons with control over access to critical resources (cf. Csikszentmihalyi 1996: 28, 6).

[11] Tomio Tada's definition of immunosemiotics is: "the study of the general principles underlying the structure of sign systems perceived by different cells of the immune machinery", according to which "restrictions in partner cell interactions must exist as part of an intercellular semiotic system" (Sercarz et al. 1988: vii).

In my judgment, these quasi-synonymous terms are poor substitutes for "biosemiotics", There are several reasons for this, some narrow, others broader. The narrow reason is that the word "nature" is used with quite different technical connotations by Jakob, as explicated in Thure's Glossary: "Systematically ordered and complete structure of all *Umwelts* whose meaning is sought in overlapping composition" (1987: 236). Yet, at other times, Jakob equated "nature" with "true reality": "Da die Tätigkeit unseres Gemüts das einzige uns unmittelbar bekannte Stück Natur ist, sind seine Gesetze die enizigen, die mit Recht den Namen Naturgesetze führen dürfen" (J. von Uexküll 1973 [1920, 1928]: 40).

The over-arching context for biosemiotics is our biosphere in the sense of the organic whole of living matter (cf. footnote 2); and this is the only geosphere which contains living matter. Because there can be no semiosis without interpretability – surely life's cardinal propensity – semiosis presupposes the axiomatic identity of the semiosphere with the biosphere. As Short persuasively argued, "there is no basis for the assertion that semiosis occurs outside of living things" (1998: 49) (except, one may add, man's inert extensions, such as automata, computers, or robots). Local nature (Gaia), however, additionally comprehends the inorganic matrix for the place wherein organisms dwell – the enveloping gaseous mass, waters, and rocks; while cosmic nature further includes the totality of extraterrestrial objects (Sebeok 2000).

Another eccentricity of Prodi's is his avoidance of references to the works of others. For example, in his English article, although dealing with intrinsically biosemiotic issues, viz., of "natural semiology" (1988a: 206), he cites only Frege and the 1923 edition of Ogden and Richards. While this composition style perhaps adumbrates Prodi's striking originality, it fails to align him with any predecessors or successors in semiotics, so his untutored readers may flounder for lack of familiar signposts. But having said this, it was also the case that, during the week we spent together in our open-ended 1979 "intensive seminar" in Thure's company on the practical and conceivable ins and outs of biosemiotics, the three of us got along extremely well; as I commented afterwards, "this uniquely stimulating experience enabled me to enhance my writing and teachings . . . in biosemiotics in its various topical subdivisions" (Sebeok 1998b: 34–35).

In 1988, some months after Prodi's untimely death at the age of 59, I received an invitation from the officers of a medical association in his country to attend a sizable memorial gathering at an isolated resort in Southern Italy, where I was to delineate Prodi's contributions to biosemiotics. As it turned out, my fellow participants were all physicians or biologists. His colleagues seemed genuinely respectful of, indeed, fascinated by, the semiotic side of Prodi's scholarly endeavors, yet none publicly declared a commitment to his line of research.

Such appear to me to have been the three principal biosemiotic iterations of the past century. But these evidently do not exhaust the prehistory of this domain. Other creative figures could be named (although, arguably, in a minor key): for one, Kenneth Craik [1914–1945], the reclusive don of St. John's College, Cambridge, who independently invented "another kind of *Umwelt* theory" (Craik 1943; see Sebeok 1991: 104); and for another (if perhaps tangentially) René Thom [b. 1923], the mathematician whose catastrophe-theoretical excursions into areas of biological

morphogenesis were powerfully impacted by Jakob's theorems of the dynamic of life (Thom 1975, passim).

Biosemiotics tends sometimes to be promoted, though I think mistakenly, to contrast with cultural semiotics. But "culture" is not much more than that realm of nature where the logosphere – Bakhtin's dialogic universe – impinges in infant lives then comes to predominate in normal adult lives. Yet in fact even mainstream semioticians range over a wide spectrum of attitudes toward biology. Ernst Cassirer's writings are, for instance, saturated not just by biological intimations – Jakob's impress is palpable throughout (e.g., 1944: 23–26; cf. Thure in J. von Uexküll 1992: 311, footnotes 2 and 3). For A. J. Greimas, zoosemiotics looms somewhere in a hazy if rosy future: "it is destined to become a genuine semiotic realm, both autonomous and promising", he once declared (Greimas and Courtès 1979: 376). Umberto Eco, who once banished zoosemiotics to "il limite inferiore della semiotica" (1975: 21), now concedes that "in the depth of biological processes lie the elementary mechanisms from which semiosis springs" (in Sercarz et al. 1988: 15). Louis Hjelmslev remains silent on the matter. And so on . . .

In an attempt to ascertain dispositions in some depth rather than by a mere impressionistic sampling, I was able to persuade an array of colleagues to scrutinize the *oeuvre* of five pre-eminent semioticians of yore – Peirce, Lady Welby, Charles Morris, Roman Jakobson, and Yuri Lotman – "for harbingers of biosemiotic discernments, judgments, prognostications, or at the very least congeniality" (from my Foreword to Hoffmeyer and Emmeche 1999). Readers interested in pursuing the fascinating results of these searches are referred to *Biosemiotica*, constituting Part I of Vol. 127 (1999) of this journal.[12]

In some crudely simple quantitative terms, biosemiotics can certainly be said to have proliferated over the past decade: for example, as compared to the Sebeok and Umiker–Sebeok volume on *Biosemiotics* (1992), which ran to less than 500 pages, the Hoffmeyer–Emmeche volume *Biosemiotica* (1999), ran to 660 pages; but that was, as well, shortly preceded by another over 250-page double issue of the same journal devoted to a closely kindred topic, "Semiotics in the Biosphere" (Vol. 120 [1998]); plus it was closely followed by the present volume, dedicated to the memory, appreciation, and influence of the domain's chief architect, Jakob. Single-author booklength publications in biosemiotics, like Merrell's (1996) or Hoffmeyer's (1993) or Kull's (in preparation), are multiplying, as are collections such as the one by van der Vijver et al., with yet others in sight. Significantly, new reference books are now routinely graced by separate entries, as in Walter de Gruyter's *Handbook of Semiotics* (Posner et al. 1997–1998: 1: 436–591), the Oxford University Press's *Encyclopedia* (Hoffmeyer 1998: 82–85), *Routledge Companion to Semiotics and Linguistics* (Paul Cobley, ed., 2001), and the expanded second edition of *Handbook of Semiotics* (Winfried Nöth, 1990). Too, I have already listed

[12] Two among these subjects were my former teachers. To gain a still more rounded historical perspective of this cardinal domain of learning, we hope to arrange for similar probes of writings by other such respected figures, for instance, Susanne Langer.

(in footnote 6) scores of recent conventions on biosemiotics, of diverse sizes and varying composition, assembled at venues over four continents.

It is on the other hand also true that biosemiotics – as general semiotics itself – has not typically become a conventional university-based discipline, nor, in my view, should it have.[13] This is not the place to document, or argue again for, my preference, but it is clear that such formal units of knowledge production are by no means the only possible, let alone the most desirable, type of reputational system of work organization and control. Semiotics, and, *a fortiori*, biosemiotics, is, or should be, a field committed to producing novelty and innovations, not much else. Whitley rightly emphasized (1984: 13) that there exists an "'essential tension' between novelty and tradition, or co-operation and competition", a notable feature of certain kinds of modern scientific works, surely inclusive of biosemiotics. He observed that a "broader and more general social unit of knowledge production and co-ordination is the intellectual field". Such fields, conceived as "relatively well-bounded and distinct social organizations which control and direct the conduct of research on particular topics in different ways", possess identities that are by no means always identical with employment or education unit boundaries. They "vary in the degree of cohesion and autonomy from other [academic] structures, but constitute the major social entities which co-ordinate and orient research across a wide variety of situations. . .. They reconstruct knowledge around distinct 'subjects' and their organization and change are crucial aspects of intellectual work and knowledge production in the modern, differentiated sciences" (Whitley 1984: 7). By "science", Whitley has of course in mind all forms of modern scholarship, not just the natural sciences; and each intellectual field, or craftwork, he stresses, "has a distinctive language for describing cognitive objects and communicating task outcomes which reduces lay participation in the assessment of contributions and enables results from different production sites to be compared and co-ordinated" (Whitley 1984: 34). In a useful tabular form, he differentiates between scientific fields, in which biosemiotics obviously belongs under his type (e) (Whitley 1984: 158, Table 5.2).

Note that each of our three biosemiotics trailblazers was an intrinsically unconventional academic. Jakob, in support of his consecutive faculty engagements in Germany, was, in addition to his affiliation with the Zoological Center in Naples, particularly active in his own Institute for Umwelt-Research at the University of Hamburg. Hediger was, to be sure, a Professor of Psychology at the University of Zurich, but his concentrated intellectual efforts radiated out of a succession of zoological gardens, first at Dählhölzli (Bern), then Basel, finally, effective 1954, his beloved Zurich Zoo. Prodi, who held the Chair in Experimental Oncology at the University of Bologna's School of Medicine, worked out of his own Instituto di Cancerologia. The functions of these distinctions, which may seem to academic outsiders mere subtle refinements, or frosting atop of a cake, are perfectly understood by professors like me, for I too was the chairman of a Research Center at my

[13] For glimpses of the relation of semiotics and biosemiotics, see T. von Uexküll (1998: 2189–2190).

institution for 37 years. This is also why the University of Tartu's Jakob von Uexküll Center – a modernized reincarnation (under Kalevi Kull's direction) of the Hamburg prototype – is fraught with such promise of new research departures, supplementing his university's time-honored departmental structures necessarily dedicated to upholding traditional paths of teaching and learning propagation.

An interesting condition specified for the establishment of scientific fields as distinct systems of work organization is that "each field has to control a separate communication system", that is, a benchmark set of shared vocabulary items of its own that differentiates this field from all others as a sort of monopolistic exclusion device (Whitley 1984: 29, 31–32). This is why Jakob's seemingly arcane terminology, often remarked on by biologist commentators and other readers, is so advantageous, even when – or especially because – it provokes an often felt need to have recourse to an accompanying formal Glossary (e.g., in 1982: 83–87). This was pointed out by Thure himself when he insisted that the differences in Jakob's "terminology are not to be regarded simply as a source of difficulty; they may also prove helpful where the various semiotic theories diverge". Here he surely refers to the unavoidable disparities between his father's idiom and Peirce's and Saussure's (1987: 148; see also Krampen 1997: 512).[14]

Although Jakob's research interests in principle encompassed the comportment of *all* organisms, he in fact spun his theory of models and of the attendant functional cycle almost entirely out of his observations of "the worlds of animals and men", particularly marine animals (jellyfish, sea-urchin, octopus, trout) and insects (annelids, ticks, dragonflies). He is therefore justly to be counted among the founders of ethology (Bleibtreu 1968: 13), for this "certainly owes more to his teaching than to any other school of behaviour study" (Lorenz 1971: 277); and many of the phenomena and operational concepts that "gave focus to classical ethology were first described, or at least anticipated" by him (Dyer and Brockman 1996: 529). His design was also commonly used by early investigators of synchronic animal communication processes, as well as for the testing of the hypothesis of "ritualization" – or what I have elsewhere called "the semiosis of *gene-dependency*" – an intriguing special case of diachronic sign science (Sebeok 1989 [1979]: 29–30, Fig. 2.1). Inasmuch as any animal's communication system must be a natural extension of its sensorium, which invokes an understanding of its Umwelt, it is easy to appreciate how indispensable Jakob's insights were to the origins and development of

[14] There is no evidence that these three masters of the sign were aware of one another. The meandering, diffuse arguments at last June's (1999) twin Uexküll-related meetings (Tartu, Imatra) over matters of basic terminology underline these points. There were sharp debates about the meaning even of such a pivotal term as *Umwelt* and its correct rendering into English, ranging from such approximations as "perceptual universe", "selfworld", or "phenomenal world", to such absurdities as "environment" (but see Immelman and Beer 1989: 88) or "niche". Despite the fact that the closest English equivalent is manifestly "model", the only palpable group consensus reached was the unhelpful surrender, that the German word should be retained in English. Nevertheless, seemingly recondite concerns about technical vocabulary, leading toward a standardized symbol system, tend to reinforce the unity of a field like biosemiotics.

zoosemiotics (Sebeok 1972: 61). Doubtless, the most cited example of the zoosemiotic aspects of Jakob's explorations is his fabled scrutiny of *Ixodes rhitinus*, the cattle tick (whose story Bleibtreu opens his 1968 book with), often revisited, and reinterpreted in a Dresden lecture by Udo Figge as recently as February 1999 in strictly semiotic terms (See now Figge 2001).

Hediger had a sweeping yet intimate knowledge of the behavior of an exceptionally wide range of animals – especially terrestrial vertebrates – based on extensive field work as well as acute observations both in and far beyond the zoo. At the very outset of his remarkable book he specifies: "Insbesondere werden wir uns mit der Zoosemiotik zu befassen haben, also mit den Signalen, die zwischen Tieren und besonders zwischen Tier und Mensch in beiden Richtungen wirksam sind, gewissermassen hin und her schwingen", Later he adds: "Der Zoosemiotik bleibt noch ein weites Feld zu bearbeiten" (1980: 10, 144), but already Hediger himself impressively contributed to this field. Following in Jakob's footsteps, he consistently applied both biological and semiotic criteria to the study of animal communication. Jakob did so implicitly, Hediger eventually in quite categorical terms.

Some have suggested that "Biosemiotics has evolved from the study of animal communication to more general considerations of biological codes" (e.g., Peter Cariani in van de Vijver et al. 1998: 360). This, however, simplifies, even skews, an, in truth, far more labyrinthian sequence of events culminating in biosemiotics to which zoosemiotics is but one contributing factor (Sebeok 1998a: 10). This notwithstanding, zoosemiotics is doubtless "a particularly rich branch of biosemiotics because animals are in some sense semiosic mediators between creation and decay. On a macroscopic scale, they can be viewed as transforming agents fixed midway between the 'composer' plants, organisms that set interpret ants in motion, and 'decomposer' fungi, which break them down", viz., between phytosemiosic and mycosemiosic operations. Too, in their role as gobetweens, animals process signs through media embracing the entire sensory spectrum, each – in conformity with Jakob's teachings – according to, but only commensurate with, its specific array of sense organs (Sebeok 1988: 65; 1997: 116).

Others chose to pursue different pathways to stoke the biosemiotic superstructure, an enticing case in point deriving from some casual remarks of Jakob's to the effect that plants lack a function cycle. Krampen has shown the predominance of indexicality in plant semioses, that plants nonetheless do have feedback cycles connecting sensors and regulators, and how "meaning factors" function in the vegetal (vs. animal) realm – or, in a nutshell, how phytosemiosis differs from zoosemiosis (1981, 1997).

Not surprisingly, the guiding preoccupation of medical practitioners from Hippocrates to our day, notably including both Thure and Prodi, has focused on endosemiosis or "protosemiosis" from the cell to the highest integration level, up to the sphere where the non-conscious inner world may in humans and certain other animals become transmutable, by means of sign connections via neurotransmitters,

neurohormones, and other neurobiological processes still far from understood, into consciously experienced reality.[15]

Research at the ephemerally woven frontiers of biosemiotics – evolutionarily the highest and the lowest planetary limits of which are circumscribed by two suggestive metaphors (both, as it happens, of Canadian vintage) – are of quotidian concern. The upper periphery, a virtual community, was dubbed a *global village* by Toronto's Marshall McLuhan (1962: 31). This electronically mediated global forum, located nowhere on the superhighway called the Internet, is a very real, if volatile, network of networks. It is populated by biomimetic creatures with unconventional communication schemes and emotive manifestations actualized by media embodiments, such as animation, robot languages and robot speech, and text. Regular and occasional users are subject to the vagaries of cybersemiotics (cf. footnote 7). (According to a report just issued by the Department of Commerce in 2000, 67% of Americans still do not use the Internet.)

The scalar opposite metaphor was coined by Montreal's Sorin Sonea: the *global organism*. Nor did the similitude with the Internet escape him, as he notes: "Like an electronic communications network the bacterial world possesses an enormous data base, in this case in the form of bacterial genes. . .. This biological communications network, which possesses more basic information than the brain of any mammal, functions in a manner that sometimes resembles human intelligence" (Sonea and Panisset 1983: 85). Furthermore, the ensemble of bacteria resemble "a vast computerized communications network – a superorganism whose myriad parts shift and share genetic information to accommodate any and all circumstances" (Sonea 1988: 45). The smallest known autopoietic entity is a single self-maintaining bacterial cell: the "biosemiotic atom."

The analogy is powerful, yet not absolute. While being wired is optional – we, who are nonusers, think we have rational grounds for our skepticism – the global prokaryotic community inescapably perfuses the Earth. In a way that is literally mind-boggling, all of us eukaryotes are fashioned of bacteria; we are both their habitats and vehicles for further dispersal. In particular, our central nervous system may be characterized as a colony of interactive bacteria. For this reason alone, any biosemiotic theory failing to take into account the multiform data of bacterial semiosis is as flawed as would be one that ignored the complexities of the verbal code in its social ramifications (Sebeok 1997: 114).

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[15] On nitric oxide, that "pantheon of messenger molecules", and so-called "hedgehog genes", cf. Sebeok (1997: 120, footnote 13).

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