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# Second-order cybernetics: an historical introduction

Second-order  
cybernetics

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**Keywords** *Cybernetics, Systems theory*

**Abstract** *In 1974, Heinz von Foerster articulated the distinction between a first- and second-order cybernetics, as, respectively, the cybernetics of observed systems and the cybernetics of observing systems. Von Foerster's distinction, together with his own work on the epistemology of the observer, has been enormously influential on the work of a later generation of cyberneticians. It has provided an architecture for the discipline of cybernetics, one that, in true cybernetic spirit, provides order where previously there was variety and disorder. It has provided a foundation for the research programme that is second-order cybernetics. However, as von Foerster himself makes clear, the distinction he articulated was imminent right from the outset in the thinking of the early cyberneticians, before, even, the name of their discipline had been coined. In this paper, the author gives a brief account of the developments in cybernetics that lead to von Foerster's making his distinction. As is the way of such narratives, it is but one perspective on a complex series of events. Not only is this account a personal perspective, it also includes some recollections of events that were observed and participated in at first hand.*

## Introduction

It is well known that cybernetics came into being before it had a name. The chief source was the series of Josiah Macy Foundation conferences on *Circular Causal and Feedback Mechanisms in Biological and Social Systems*. The paper begins with a brief overview of these developments, drawing particularly on the editors' introduction to the series of volumes in which the proceedings of the later conferences were published (von Foerster *et al.*, 1953). I also make reference to Wiener's (1948) book, *Cybernetics*, which gave the discipline a name, a name which was from then on adopted by the Macy conference organisers as a title.

The author very briefly mentions the parallel developments that lead to von Bertalanffy's (1950, 1972) articulation of the need for a general theory of complex systems – developments and approaches often referred to as general systems theory (GST). I punctuate the narrative at this point by noting that, amongst many other commentaries on the relationships between cybernetics and GST, Ashby's (1956) *Introduction to Cybernetics* provides an intellectually satisfying way of bringing the two developments, synonymously, within a unifying framework. As a contrast, I note two commonly formulated alternative frameworks: one in which cybernetics is positioned as a subset of GST and the other in which both GST and cybernetics are viewed as being part of some larger whole, such as complexity studies or the systems sciences. I also note the more pragmatic usage of the terms “systems and cybernetics” and “cybernetics and systems” as a way of embracing a broad “church”



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of practitioners with different overlapping interests, but possibly, widely differing unifying frameworks and perspectives.

Next, I give an overview of developments prior to von Foerster's making the first- and second-order cybernetics distinction. I highlight two related trends: one, the speed and extent with which the concepts of systems and cybernetics were adopted by specific disciplines; and the other, the eventual emergence of competing epistemological and ontological paradigms. I group these – as many commentators before me have done – into two broad classes. Using current terminology, I name one class as “representationalist, realist” and the other as “enactive, constructivist”. I am aware this is far from satisfactory, being more of a caricature than a characterisation of different positions. I make the differences more concrete by referring to some of the specific events which indicated that a major schism was becoming manifest as particular research programmes emerged within what was by then being referred to as cognitive science.

By this stage, the scene is set for introducing von Foerster's making of his seminal distinction as a significant historical event. I share my understanding of what were von Foerster's motivations.

In the final part of the paper, I overview developments since then, paying particular attention to the domains where the concerns of second-order cybernetics have been most clearly articulated and where its associated concepts and understandings have – and are – bearing fruit. Specifically, amongst many possible candidates, I note the contributions of Pask (Conversation Theory and Interactions of Actors Theory), Maturana (autopoiesis theory), Glanville (“Objects” theory), Luhmann (social systems theory) Geyer, Hornung and others (sociocybernetics), Brier (cybersemiotics), Kjellman (the subject oriented approach to science).

### **The emergence of cybernetics**

One of the major sources for the development of the transdisciplinary study of complex systems in modern times is the series of meetings convened by the Macy Foundation in the 1940s and 1950s on “Circular Causal and Feedback Mechanisms in Biological and Social Systems” (other sources for transdisciplinary work include von Bertalanffy's “general systems theory” and Korzybski's “general semantics”). Warren McCulloch, one of the extraordinary visionary polymaths who founded the discipline that came to be known as cybernetics (from the Greek “kybernetes”, steersman) (others included the mathematician Norbert Wiener, the anthropologists Gregory Bateson and Margaret Mead and the British psychiatrist and neurologist, W. Ross Ashby) chaired the Macy conferences. The young Heinz von Foerster was invited to take on the job of chief editor of the proceedings of the conferences, partly as a way for him to improve his English. The editors' introduction to the published proceedings contains a fascinating account of how the conferences came to be convened. It also includes a very scholarly and comprehensive historical account of a number of earlier developments in biology, psychiatry, neurology and other domains that were concerned with feedback and circular causality (von Foerster *et al.*, 1953). In 1948, Wiener published his classic work entitled *Cybernetics: Control and Communication in the Animal and Machine*. From then on, the conferences were known as the Macy Conferences on Cybernetics. From the outset, cybernetics was conceived as both art and science and was seen as encompassing traditional concerns in the study of the “governance” of human systems.

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Cybernetics is interdisciplinary. It provides concepts and terminology to build bridges between different knowledge domains (Latin “inter” – between). As an example, the concept of control by negative feedback may be applied in many different domains. Indeed, a major motivation for the founding of cybernetics was that this was the case. Engineers, anthropologists, neurologists, psychologists and economists (to name some) were constructing “similar” models, albeit with different domains of application and terminology. Thus, cybernetics as a lingua franca served – and still serves – to facilitate communication between the discipline areas. A psychologist can learn from a computer scientist and vice versa. For example, “memory” may be modelled as data storage and “remembering” modelled as data retrieval. However, the fact that models, metaphors and analogies are shared does not legitimise in itself. Other criteria of logical coherence and pragmatic usefulness must also be applied (Scott, 2000).

Cybernetics is also transdisciplinary. In the hands of the masters (Ross Ashby, Gordon Pask, Stafford Beer), the models and terminology of cybernetics were systematised as a set of inter-related concepts. Cybernetics “has its own foundations” (Ashby, 1956). With this conception it is now possible for someone to be “a cybernetician” or “cyberneticist” (both terms are current). Cybernetics becomes a “window on the world.” Wherever he looks, the cybernetician sees the ubiquitous phenomena of control and communication, learning and adaptation, self-organization and evolution. His “cybernetic spectacles” allow him to see any particular knowledge domain and the systems within it as special cases of abstract, general cybernetic forms. Brains and societies may be modelled as hierarchical or heterarchical systems (with or without an overall controller). Processes may be serial or parallel, synchronous or asynchronous; all controlled processes are subject to the law of requisite variety (“Only variety can control variety”, Ashby, 1956). All self-organising systems from amoebae to human societies adapt and evolve to become “informed” of the constraints in their worlds – or perish.

The power of cybernetics as a transdiscipline (Latin “trans” – across) is that it abstracts, from the many domains it adumbrates, models of great generality. Such models serve several purposes: they bring order to the complex relations between disciplines; they provide useful tools for ordering the complexity within disciplines; as above, they provide a “lingua franca” for inter-disciplinary communication; they may also serve as powerful pedagogic and cultural tools for the transmission of key insights and understandings to succeeding generations. However, as noted by Immanuel Wallerstein, past president of the International Sociological Association, if a transdisciplinary approach is to make a real contribution in the natural and social sciences, it must be more than a list of similitudes (Wallerstein, 1997). It must also be epistemologically sophisticated and well-grounded. Cybernetics, with its explicit distinction between the first- and second-order forms, can claim, not only to satisfy this criterion but also to be making significant contributions to epistemological debates.

Ross Ashby defines cybernetics as the formal study of “all possible machines.” In his book *An Introduction to Cybernetics*, Ashby (op. cit.) uses a simplified version of set theory notation to present concepts such as change, stability and regulation in complex systems. A simple but powerful formulation of the essence of cybernetics is that its key concepts are “process” and “product” and that its main methodology is to model the form of processes and their products, abstracted from any particular

embodiment. Thus, for example, a control process, whose product is the maintenance of some state of affairs, may be distinguished and modelled as such, irrespective of its particular embodiment as a biological, artificial or social system.

Cybernetics is also a metadiscipline, a “discipline about disciplines” (Greek “meta”, above). It comments on the forms and procedures that constitute particular disciplines. It sees the physicist as a builder of models, constrained by the properties of the domains and systems he distinguishes and interacts with. It sees the biologist the economist, the sociologist, the psychologist likewise. It comments on their activities as modellers, controllers and predictors. Science, pure and applied, is a cybernetic pursuit and art “L’art d’assurer l’efficacité de l’action” (Couffignal, 1960, p. 3). The metadisciplinary aspect of cybernetic thought was explicit in its founding. As below, it reached full fruition with von Foerster’s articulation in the 1970s of the fully reflexive metadisciplinary activity where cybernetics is used to study its own workings: the cybernetics of cybernetics, also referred to as second-order cybernetics. Von Foerster’s particular contributions are discussed in more detail below.

Other approaches to inter, trans and metadisciplinary working were also emerging and attracting enthusiastic followings. The “general semantics” of Korzybsky deserves special mention. It is a direct influence on the thinking of early cyberneticians as acknowledged by, in particular, Gregory Bateson (Bateson, 1972) and Heinz von Foerster. As its name suggests, general semantics is a general theory of meaning. As such it is also a theory of what it means to know, it is an epistemology, a theory of the knower and what may be known. Its concerns are a direct precursor of the second-order cybernetic concerns with the epistemology of the observer.

Here in a nutshell is a summary statement from Korzybsky of his understanding of knowing as an intrinsically self-referential process, taken from *Science and Sanity* (first published in 1933, 4th ed., 1958, page 12): “Language... represents the highest and latest physiological and neurological function of an organism. It is ... of uniquely human circular structure, to use a logical term – or of spiral structure, to use a four-dimensional or a physico-chemical-aspect term... In these processes an ‘effect’ becomes a causative factor for future effects, influencing them in a manner particularly subtle, variable, flexible, and of an endless number of possibilities. ‘Knowing’, if taken as an end-product, must be considered also as a causative psychophysiological factor of the next stage of the semantic response... This structural and functional circularity introduces real difficulties... Before we can be fully human... we must first know how to handle our nervous responses – a circular affair.”

Both Bateson and von Foerster cite Korzybsky’s. “The map is not the territory”, with approval.

In contrast to Korzybsky (1958), von Bertalanffy’s primary emphasis in developing a general system theory (GST) is on developing an ontology of forms of systems. GST in its various guises has continued this trend of providing taxonomies of systems. For natural systems (“physical”, “chemical”, “biological”, “psychological”, “sociological”) there is also usually some account at least descriptive if not explanatory, of system emergence. Although von Bertalanffy takes pains to stress the holistic nature of GST and that systems are defined relative to an observer’s intentions and personal constructs, it remains the case that GST tends to assume the natural world is there and it has a form and structure that scientific investigation will reveal, albeit in Peircean way, as the truth of science that is approached asymptotically.

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In current GST/systems sciences circles, cybernetics is often distinguished as a specialist sub-discipline concerned with processes of control and communication. As noted in the introduction, there is also the view that GST and cybernetics are essentially synonymous. Ross Ashby's summing up of the relationship between GST and cybernetics is that "Cybernetics might in fact be defined as the study of systems that are open to energy but closed to information and control – systems that are 'information tight'" (Ashby, 1956). Notice the innocent sounding use of the phrase "closed to information". It is important to note that this use of the term "information" is clearly different from the usage in computer science ("information processing" meaning, strictly, data processing, the transmission of data and the transformation of one data "pattern" into another) or by Shannon and Weaver (1949) (a measure of the surprise value of a "message") or Stonier (1990) (a measure of the extent to which a system is "ordered"). The use of the term by Ashby is essentially the same as that of Bateson (1972) in his aphorism "Information is a difference that makes a difference" and that of Konorski (1962), ("Information cannot be separated from its utilisation") and that of von Foerster (1970, 1974) ("The environment contains no information; it is as it is"). In brief, an organism does not receive "information" as something transmitted to it, rather, as a circularly organised system it interprets perturbations as being informative. In this definition of Ashby's we can see emergence of the key concept that lead to the second-order concerns with the epistemology of the observer. Rather than "information tight", later writers, such as Pask and Maturana, have preferred the term "organisationally closed".

In the 1950s and 1960s cybernetic concepts were embraced and adopted by many disciplines. Examples include the book *Plans and the Structure of Behaviour* by Miller *et al.* (1960) which helped launch the "cognitive revolution" in psychology; the work of Waddington (1975) on genetics and embryology; Wynne-Edwards (1962) on animal communication; Bateson (1972) and others on family therapy and, somewhat later, the work of Brian Arthur and others on the interaction between positive and negative feedback in the dynamics of economic systems. For a brief while practitioners from any discipline with different research programmes came together to explore and share how the new ideas could and were being applied. Seminal events included the National Physical Laboratory Symposium on *The Mechanisation of Thought Processes* (Uttley, 1959) and two symposia on self-organising systems (von Foerster and Zopf, 1962; Yovits and Cameron, 1960).

At the NPL Symposium seeds of later schisms can be seen. The "symbolic" approach to artificial intelligence was represented by Martin Minsky and others. "Sub-symbolic" network approaches were represented by papers by Rosenblatt and others concerned with special purpose pattern recognition and learning machines. Stafford Beer presented a paper developing his holistic view of businesses as cybernetic viable systems. Gordon Pask presented a paper on "physical analogues to the growth of a concept" and introduced the world to his idea of self-organisation in chemical networks as a model for brain activity. The later dominance of the symbolic AI approach within the newly defined cognitive sciences was particularly pernicious as other research areas were starved of funding. Arguably the cardinal error of this approach is the concept that "brains and computers are physical symbol systems" (Newell, 1990; Newell and Simon, 1976). This innocent phrase puts the problem of "what is a symbol, what is meaning?" in an intellectual blindspot and is characteristic



of representationalist, realist epistemologies and is to be contrasted with enactive, constructivist epistemologies

In the 1980s a resurgence of work on connectionist network based sub-symbolic approaches to AI redressed some of the injustices. However, the problem with all of these computer-based approaches to intelligence and cognition is that they have neglected the importance of the organisational closure of complex natural systems. A brain can only be fully understood as an organ of cognition when it is recognised that it is part of a complex organisationally closed whole and where, to add to the confusion, there is a failure to appreciate that the distinguishing of a “brain” as a part of a whole is itself an act of distinction and abstraction carried out by an observer who, in classic Aristotelian manner, wishes to classify and name parts. As is now understood, following the work of Pert (1997) and others, at the molecular level neural, hormonal and immunal systems are one inseparable complex system. To put this another way, the distinctions between cognition and emotion, thinking and feeling have no substance in the reality of what living systems are and how they work. Against this background of schism and conceptual confusion, Heinz von Foerster’s Biological Computer Laboratory (BCL) at the University of Illinois stood out as an island of sanity.

On McCulloch’s recommendation, in 1951, von Foerster had taken up the position of Professor of Signal Processing at the University of Illinois. In 1958, he founded the BCL and remained Director thereof until his retirement in 1976. At the BCL, he hosted a collegiate of visiting scholars, a formidable list that includes Ross Ashby, Gotthard Gunther, Lars Lofgren, Gordon Pask, Humberto Maturana, Ernst von Glasersfeld, Stafford Beer and Francisco Varela. Arguably, without the leadership and inspiration of von Foerster, we would not have Pask’s Conversation Theory, Maturana and Varela’s theory of autopoietic systems, von Glasersfeld’s radical constructivism, the theory of social systems developed by Niklas Luhmann, Glanville’s “Objects” theory or the sociocybernetics of Felix Geyer and others.

The development of cybernetics as a holistic transdiscipline was brought to fruition in the 1950s and 1960s with major contributions from the polymaths already mentioned. Von Foerster’s contributions included a classic paper published in 1960, “On self-organising systems and their environments” (von Foerster, 1960), in which he argues that systems that are truly self-organising will always expand beyond the frames of reference adopted by observers to model their behaviour; they are in principle unpredictable unless training, conditioning or other constraints make them become so, in which case they become “trivial machines” rather than the interesting “non-trivial machines” they were formerly. (Note: following Ross Ashby (op. cit.), in cybernetics “machine” and “system” are synonyms for any observed entity “that persists”).

The concerns of cybernetics with metadisciplinary issues were imminent in cybernetic debates from the earliest discussions. It was understood that it is the observer who distinguishes a system as such. It was understood that the epistemology of the observer, how she, as a system comes to observe and know her world and the systems therein, was a complex matter. The great Swiss Psychologist, Jean Piaget, devoted his life to a study of these processes. For him, the study of child development was “genetic epistemology”, a study of how we come to know. In his later writings, Piaget (1972) firmly aligned himself with the aims of cybernetics, saying, for example, that his account of child development begins with the concept of “cybernetic circuits in equilibrium”.

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*Artorga*

I witnessed exchanges between Pask, Maturana, Gunther and von Foerster. They met regularly, exchanged papers, they worked collaboratively. I witnessed the ways and incidents by which cybernetics, as a holistic discipline, was marginalised. I saw the courage and nobility with which the cyberneticians maintained their views and convictions in the face of criticisms that they were old fashioned and misguided. I now give a personal anecdote of one particular event, a conference organised by Oliver Wells, the editor of *Artorga*.

*Artorga* was a periodic newsletter published in the 1960s and early 1970s. The name was a contraction of “artificial organisms”. The owner and editor of the publication was a retired businessman and philanthropist called Oliver Wells. *Artorga* had several hundred subscribers from around the world drawn from a range of disciplines and emerging disciplines: computer science, cognitive psychology, brain studies, philosophy, linguistics, cybernetics and the systems sciences. Wells was a well known figure on the cybernetics conference circuit and had many friends and contacts. As well as his own editorial commentaries, readers’ letters and the occasional submitted paper, Wells used *Artorga* to disseminate papers and research reports, often in pre-print form, that he himself thought to be seminal and outstanding. These included papers on perception and cognition, with notable contributions from Heinz von Foerster and Humberto Maturana. As a reader of *Artorga*, it took me a little while to realise that Wells had recognised that a new epistemological paradigm was emerging, one that questioned realist assumptions about “objectivity”, “knowledge” and “intelligence”. In later years, the terms “radical constructivism”, “second-order cybernetics” and “autopoiesis” were coined to capture aspects of this new paradigm. Wells’ enthusiasm for the new ideas was captured in the slogan, used as a recurring theme and sub-title in *Artorga*: “How could you be so naïve?”

Sadly, *Artorga* ceased publication with Wells’ death in the early seventies. One of his last acts was to convene the “First International Conference on Self-Referential Systems”. This was his choice of title, which he saw as capturing the idea that earlier work on self-organising systems had now matured to the point where the epistemological consequences of “observers explaining themselves to themselves” could be clearly addressed. Under the new paradigm, all knowledge and all knowing is observer (self)-referenced. That conference was a decidedly small affair, convened at short notice by Wells on a trip to London at a time when Heinz von Foerster and colleagues from the BCL were also visiting. Essentially the conference was a meeting between members of the BCL and members of Gordon Pask’s research team based at Systems Research (SR) Ltd, Richmond, Surrey. In the event, von Foerster could not make the meeting. The BCL participants were Gotthard Gunther and Humberto Maturana. As well as Pask himself, the SR participants were myself and the Dionysius Kallikourdis. At that time I was Senior Research Associate and Scientific Coordinator at SR. Kallikourdis was completing a PhD thesis on the structure of knowledge and was contributing to the development of CASTE (Course Assembly System and Tutorial Environment) (Pask and Scott, 1973). On account of the small numbers involved, the conference took the form of an informal meeting in Wells’ hotel suite. Maturana at that time had outlined his ideas of the brain/body system as an organisationally closed system, later to be elaborated as a general theory of autopoietic (self-creating) systems. Pask’s Conversation Theory (CT) had recently emerged, after



a long gestation, as a profoundly comprehensive and deep theoretical framework for addressing issues to do with human cognition, learning and conversation, with particular applications to education and epistemology (Pask, 1975, 1976; Pask *et al.*, 1973, 1975). CT contains a sub-theory of conversational domains with methodologies for knowledge and task analysis and knowledge representation.

Highlights in the discussions around the conference theme included noting that biological and psycho-social systems, while logically distinct, could both be characterised as being organisationally closed and hence, necessarily self-referential, although the sense of self-reference is different with respect to the different ontologies. In Pask's (1969) terminology, biological systems are "taciturn systems". The external observer infers organisational closure from observations about the systems behaviour and the persistence of a stable organisation. Psycho-social systems are "language orientated" systems. With them the observer is a participant observer and may converse with them pro-nominally, using the anaphors "I", "you", "we".

I recall a fascinating exchange between Gunther and Kallikourdis. Pask had drawn an hierarchical topic map, an "entailment structure" which shows how subordinate topics are logically entailed as parts in the construction of higher order topics. Gunther asked where do we get to if we continue the process of analysing topics into their components. Kallikourdis asserted that conceptual domains are by their nature cyclic, closed networks. Gunther quite excitedly agreed. He very much appreciated that the "conversational domains" of CT model conceptual systems as intrinsically circular. As I have discussed elsewhere, this circularity in conceptual systems is a static image of the organisational closure of a Paskian psycho-social individual. Main stream philosophers have been late in acknowledging that circularity in conceptual networks may be "virtuous" rather than "vicious" (Barwise and Moss, 1996; Strawson, 1992).

### **Cybernetics of cybernetics**

During the 1960s and 1970s and drawing on, amongst others, the work of Piaget (1972), Schroedinger (1944) ("the scientific observer places himself outside the domain of his own descriptions"), Alfred Korzybsky ("the map is not the territory"), Jerzy Konorski ("information cannot be separated from its utilisation"), von Foerster published a series of elegant papers where he addressed the foundational issues of how it is that a system becomes an observing system. He summarised many of his insights as pithy aphorisms. His research programme was that of "explaining the observer to himself". The observer as a Piagetian constituter of "objects" is his own "ultimate object". The environment of an observing system "contains no information; it is as it is". Von Foerster's achievement was momentous: he shows that as we draw on our science to explain how we ourselves work we find ourselves in a hermeneutic circle of explanation. As he puts it "we need a brain explain a brain". If a brain is a constructor of maps and models, it behoves us to acknowledge that all our theories and explanations are constructions. Our experience of being part of a "reality" is also a construction. It behoves us to take responsibility for the worlds we construct. He advises us to "act towards the future you desire". He notes that as good cyberneticians in an unpredictable world we should "act so as to maximise the alternatives". He notes that in a world that is intrinsically social, where observers are always part of a community in their very constitution as self-aware systems, "A is better off when B is better off". This is the cybernetician's version of the great commandment "Love thy neighbour".

Von Foerster (1974) set out his main area of concern. He said he was doing “cybernetics of cybernetics”. He clarified this terse phrase by making a distinction which has since been adopted as a core tenet of cybernetics, the distinction between a first- and second-order cybernetics, where “First-order cybernetics is the study of observed systems” and “Second-order cybernetics is the study of observing systems”. As a gifted cybernetician, von Foerster was a gifted communicator. The reader can sample for herself one of von Foerster’s most accessible summaries of his concerns in the paper “Ethics and Second-Order Cybernetics” (von Foerster, 1992).

First-order study is of “observed systems”, where we may deploy the research paradigms of the natural sciences and seek falsification of hypotheses. However, all this should take place under the rubric of the second-order study of “observing systems”. First-order systems are defined from the perspectives of our second-order concerns and understandings. Von Foerster went on to discuss the epistemological limits and ethical implications of second-order understandings: “we think, therefore we are”; “to know is to be”. He invites the observer of systems to “enter the domain of his own descriptions” and accept the responsibility for being in the world, thus echoing the longstanding discussions in sociology about the “reflexive” nature of the “social”. As mentioned above, Gordon Pask had already addressed second-order concerns by developing a cybernetic “theory of conversations”, with particular applications in education and epistemology (Pask, 1975, 1976).

Careful reading of Maturana, von Foerster and Pask shows a circularity. The constructivist phenomenal domain of the observer may be taken as a starting point to account for the joint construction of the scientific domain. In turn, the “scientific” may be taken as a starting point for an account of how observers evolve to become members of a community capable of constructing consensual domains. This circularity is imminent in Spencer Brown’s logic of distinctions. It is indicated globally in Maturana’s (1970) seminal prose poem “Neurophysiology of Cognition”. There, Maturana suggests that his essay makes sense as a whole by the way the parts hang together. The circularity is quite explicit in von Foerster’s (1974) “Notes pour un Epistemologie des Objets Vivants”, where he constructs a circular set of propositions from “Everything that is said is said by an observer” to “The environment contains no information; it is as it is”. In similar spirit, Pask’s Conversation Theory is explicitly reflexive. It is a theory of theory building that accounts for its own genesis.

### Radical constructivism

The concept of “radical constructivism” (RC) has been promulgated particularly by Ernst von Glasersfeld, drawing on Piaget but also, very directly, on the work of von Foerster, Pask and Maturana. RC is contrasted with the “transmission model”, where “knowledge” is directly taught and where knowledge is conceived as being a representation of an external “objective” or “mind-independent” reality.

“Language frequently creates the illusion that ideas, concepts and even whole chunks of knowledge are transported from a speaker to a listener . . . rather each must abstract meanings, concepts and knowledge from his or own experience” (von Glasersfeld, 1991).

*Radical constructivists* are those who “have taken seriously the revolutionary attitude pioneered by Jean Piaget . . . the concept of knowledge as an *adaptive function* . . . that cognitive efforts have the purpose of helping us cope in the world of experience,

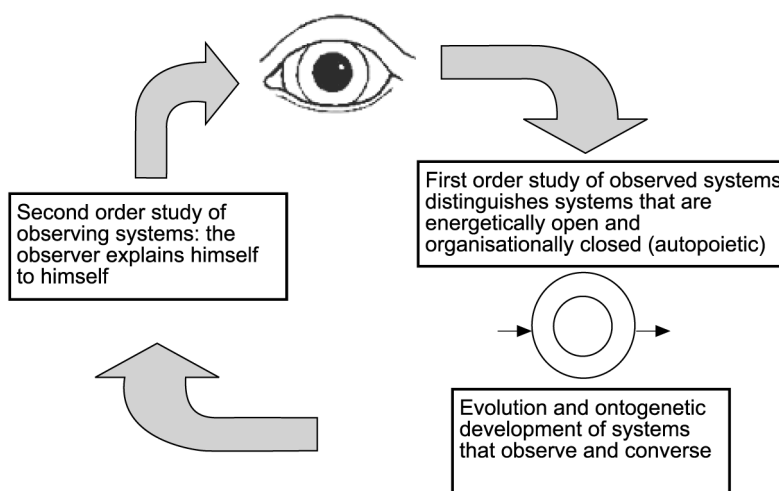
rather than the traditional goal of furnishing an ‘objective’ representation of a world as it might ‘exist’ apart from us and our experience” (von Glasersfeld, 1991).

von Glasersfeld emphasizes that observers construct “consensual domains” by what Maturana calls the “structural coupling” of system and environment. The life trajectories of the members of a species create shared ecological niches and consensual domains of interaction and communication, with “objects”, “events” and classes of them (Maturana and Varela, 1980). There is then the explicit reflexive acknowledgement that RC, as a research programme, is itself a consensual domain, with the aim, as von Foerster puts it, of “explaining the observer to himself.” A secondary aim is to characterise the shared predications that constitute a given consensual domain as a system of beliefs. As an example, the key predication of “science” is the acceptance of the “objectivity hypothesis”, however it is stated, in realist or constructivist terms, as “there is a reality independent of the observer” or “let us proceed to construct a consensual domain whose structure and behaviour is deemed to be independent of (i.e. not ‘structurally coupled’ to) the observer”. Whatever the *a priori* predications observers adopt, it becomes critical to recognize that there are such *a priori*s and that it behoves observers to become reflectively aware of what they are.

### The epistemology of the observer

Figure 1 is intended to sum up the main thesis about the epistemology of the observer that second-order cybernetics and associated approaches promulgate.

As observers, we may begin with the first-order study of observed systems. We may do so from the perspective of a “naïve realist”. However, as our observations provide us with accounts concerning the evolution and social constitution of observing systems, we are faced with the challenge and obligation of von Foerster “to enter the domain of our own descriptions”. At that point we are obliged to accept that, as organisationally closed systems, our observations are not direct observations of a “reality”, rather they are constructions based on particular sets of assumptions, for example, the assumption that there is a stable, lawful “reality”. If we accept the



**Figure 1.**  
The epistemology of the  
observer circularity in the  
domain of explanation

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Prigogine (1980) view that we are placed as observers within a cosmos that is “developing”, “becoming”, “evolving” or “unfolding”, that the observer is irrevocably a part of what he or she observes, we are ineluctably caught in a hermeneutic loop, where, as a “beings in time” we construct concepts of “being” and “time”. As Spencer-Brown (1989), Maturana, von Glasersfeld and others stress, our conceptions of cosmos are the constructions we make in order to make sense of our experiences of being living systems. This is where cybernetic explanation and scientific explanation generally confronts the limits of the “ineffable.” But, though “explaining” has limits, cybernetics is also a praxis, an art, as earlier: “l’art d’assurer l’efficacite de l’action” (Couffignal, 1960). We may still will and do.

### Concluding comments

I have now witnessed a resurgence of interest in the classic cybernetic themes from a number of directions. Peter Cariani, who studies the neurophysiology and the emergence of sensory systems, has the concept of organisational closure placed centrally in his theoretical models (Cariani, 2000). Luhmann (1995, Chapter 12), who has developed a theory of social systems, positions the second-order concerns with the epistemology of the observer at the heart of his thinking. Brier (1995), with his conception of cybersemiotics, draws directly from C S Peirce in emphasising that key concerns of cybernetics are human knowing and human communication. My friend Ranulph Glanville embraced cybernetics as a young architecture student. His PhD thesis is a *tour de force* in which he lays out a comprehensive account of the observer as an object among objects and in which he argues most convincingly that an object to exist as such must be capable of self-observation (Glanville, 1976), Glanville uses upper case for these entities (objects) that self observe. Glanville’s direct mentors were Gordon Pask, Heinz von Foerster and Laurie Thomas.

Arne Kjellman, in an evolving series of researches spanning half a lifetime, has developed an account of the “subject-oriented approach to science” which he contrasts with realist, “object-oriented approaches to science”. He has developed a “model of model building” which gives profound underpinnings to constructivist epistemologies (Kjellman, 2002). He places his work in a long line of subject-oriented approaches going back to the pre-Socratics, noting, amongst others, the significant contributions of DesCartes, Kant, Husserl and Mach, as well as the contemporary work of von Foerster and von Glasersfeld. Kjellman argues that it is not just enough to accept the constructivist position of second-order cybernetics that our third person models of the world our constructions, we must also fully accept that all our theorising and decision making are taken from a first person perspective. Kjellman is essentially launching a research programme concerned with elucidating and explicating a wide range of problems and concerns in logic, mathematics and the natural and social sciences that appear in a new light when viewed from a first person, subject-oriented approach.

Another camp in which concerns with cybernetics and second-order cybernetics thrives is that of sociocybernetics, a term used to capture the interest and activities of those who “apply cybernetics and the systems sciences to the social sciences”. They are convened as Research Committee 51 (on Sociocybernetics) of the International Sociological Association. As a collective of practitioners, they represent many different views across the GST, cybernetics spectrum (Geyer, 1995, 1997; Lee, 2002). What appears to be a constant, sustained and elaborated theme of its conferences

and associated publications is a concern with epistemology and ethics. Many draw fruitfully on Luhmann's writings, some draw directly on second-order cybernetics. Some recognise the deeper origins in the history of ideas for the themes and issues which many think are the key concerns of a post-modern world. In essence, sociocyberneticians share a belief that, both as scientists and participants, it behoves us to do our best to know who and what we are as living systems, as observers, as persons in a social world, where every contact leaves a trace and where every act may affect the whole.

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**Further reading**

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