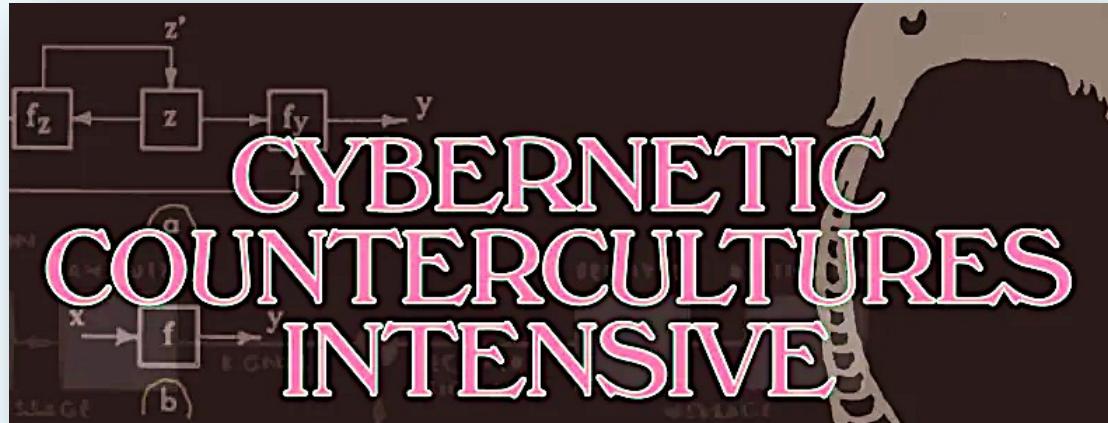


Week 10: Whole Earth Redux



Part Two: Cybernetics of Life

Cognition and Intelligence

Natural Intelligence is General Intelligence.

In “How Organisms Come to Know the World: Fundamental Limits on Artificial General Intelligence” (2022), Roli, Jaeger, and Kauffman suggest a definition for grades of intelligence relative to *general intelligence* taken as a mobile set of reasoning skills in evidence in specific capacities of living beings:

General intelligence involves situational reasoning, taking perspectives, choosing goals, and an ability to deal with ambiguous information. . . . True general intelligence can be defined as the ability of combining analytic, creative, and practical intelligence. It is acknowledged to be a distinguishing property of “natural intelligence,” for example, the kind of intelligence that governs some of the behavior of humans as well as other mammalian and bird species.

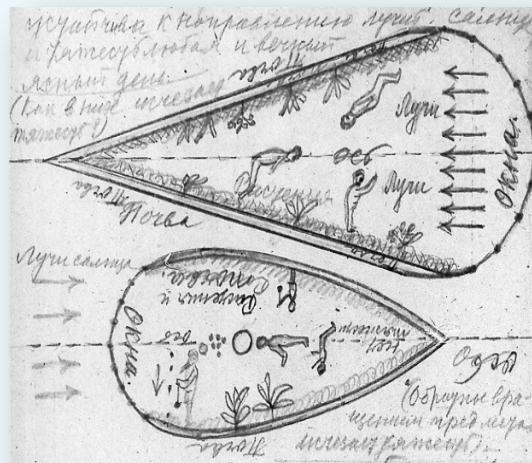
Organic intelligence is the goal of AGI. *Organic* intelligence is open-ended. It recollects, anticipates, and improvises. Roli, Jaeger, and Kauffman see the fabrication of *this* sort of general intelligence as “the foundational dream of AI”—AGI, Artificial *General* Intelligence:

A truly general AI would have to be able to identify and refine its goals autonomously, without human intervention. In a quite literal sense, it would have to know what it wants, which presupposes that it must be capable of wanting something in the first place.

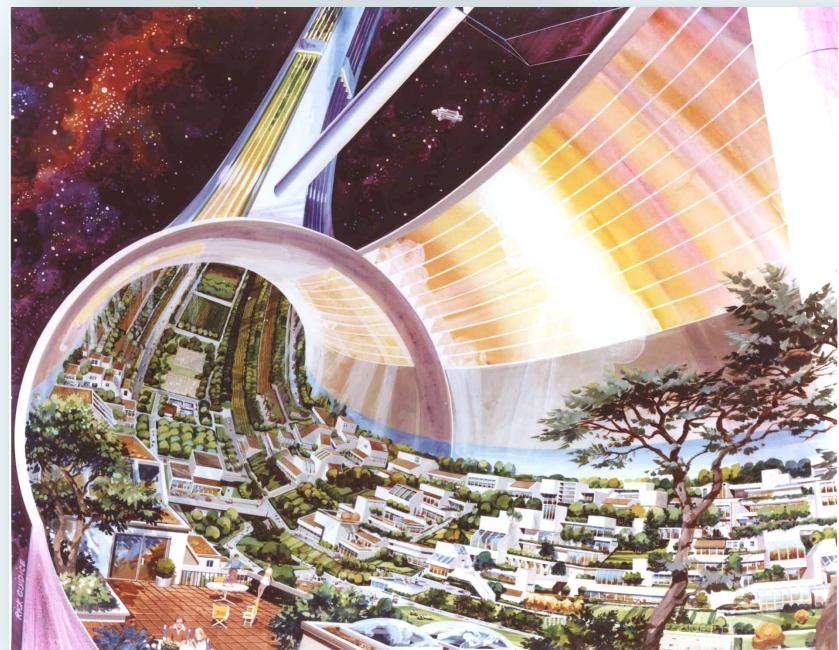
Mind-Body Matters. In *How the Body Shapes the Way We Think* Pfeifer and Bongard make the case that some mode of embodiment providing a necessary level of sensory and behavioral interaction with a distinct environment is indispensable for anything deserving the name of intelligence.

As these visionary sketches of space habitats make abundantly clear, we will have to take Gaia with us if we ever lift off from the planet altogether.

However, the seemingly obvious contingency of intelligence upon organic, biological embodiment splits apart once more within a physical world-picture in which abstract intelligence presumes to master living embodiment.



Konstantin
Tsiolkovsky,
Sketches for a
Green House in a
Space Capsule,
1932



Gerard K. O'Neill's toroidal space colony in cutaway view, @ 1976

Cognition. The sheer capacity to apprehend or experience an environment.

OED. “The action or faculty of knowing; knowledge, consciousness; acquaintance with the subject; **the action or faculty of knowing taken in its widest sense**. . . ; the action of cognizing an object in perception proper.”

Intelligence. Understanding, forethought, and choice, ranging from lesser to greater powers of application.

OED. “The faculty of understanding; intellect; . . . Understanding as a quality admitting of degree; spec. superior understanding; quickness of mental apprehension, sagacity.”

- Cognition is knowing, intelligence is understanding.
- Cognition is apprehension, intelligence is comprehension.

Organism and Artifact

The mechanistic worldview is a pervasive ideology of knowledge associated with the rise of secular Western modernity and its scientific methods. Cybernetics itself began as a 20th-century offspring of the mechanistic worldview, then matured as a discipline with a rebellious, countercultural streak, in good part because of its heterodox relations to organisms and organic considerations.

Der Mensch als Industriepalast



Teleology. Modern science held on to Descartes's mind-body dualism while rejecting earlier teleological explanations for living beings—the idea that their individual existence or evolutionary survival fulfilled some purpose or design. Traditional teleology posits God, or His design decisions, as the *final cause* for the way things are or for what they become. The classical notion is that the *telos* of any particular being—its end, aim, or goal—determines its proper purpose and behavior: to arrive at the final state that God has preordained for it. But as God's purposes can only be a mystery, this was reasonably considered to be no way to proceed toward a rational understanding of "natural events." "*That's the way God planned it*" may be reassuring for some, but it's not science.

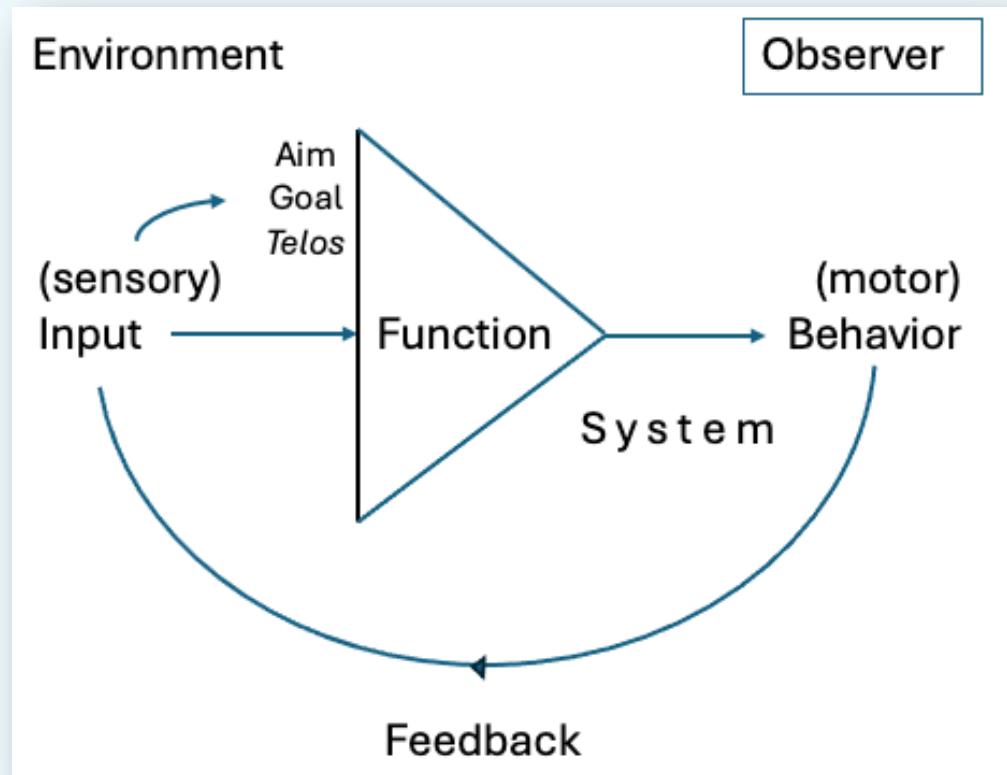
In “Behavior, Purpose, and Teleology,” Rosenbleuth, Wiener, and Bigelow redefine traditional teleology by placing organisms and artifacts on the same level and then substituting the concepts of *purpose and behavior* for *cause and effect*. “Teleological behavior thus becomes synonymous with behavior controlled by negative feedback.” On the basis of *this* stipulation, organisms may be considered to be as *purposeful* and goal-driven as machines:

We have restricted the connotation of teleological behavior by applying this designation only to purposeful reactions which are controlled by the error of the reaction—i.e., by the difference between the state of the behaving object at any time and the final state interpreted as the purpose. Teleological behavior thus becomes synonymous with behavior controlled by negative feedback . . . [In contrast,] causality implies a one-way, relatively irreversible functional relationship, whereas teleology is concerned with behavior, not with functional relationships. [from “Behavior, Purpose, and Teleology”]

Servomechanism and Feedback.

Servomechanism. A fundamental object of the original cybernetics is the *servomechanism*, artifacts of various sorts for which purposeful, goal-seeking behaviors are intrinsic to their functioning. Think: thermostats, cruise controls. But how do such servomechanisms *function* in this self-correcting way?

Feedback. Self-regulation comes about by enclosing the circulation of feedback as part of the system. An archetypal cybernetic concept, *feedback cycles behavior back into function*. In a feedback loop, current behavior sends a message that controls current function.



The cybernetic viewpoint recuperates the role of natural purposes in organisms alongside the designed purposiveness of machines.

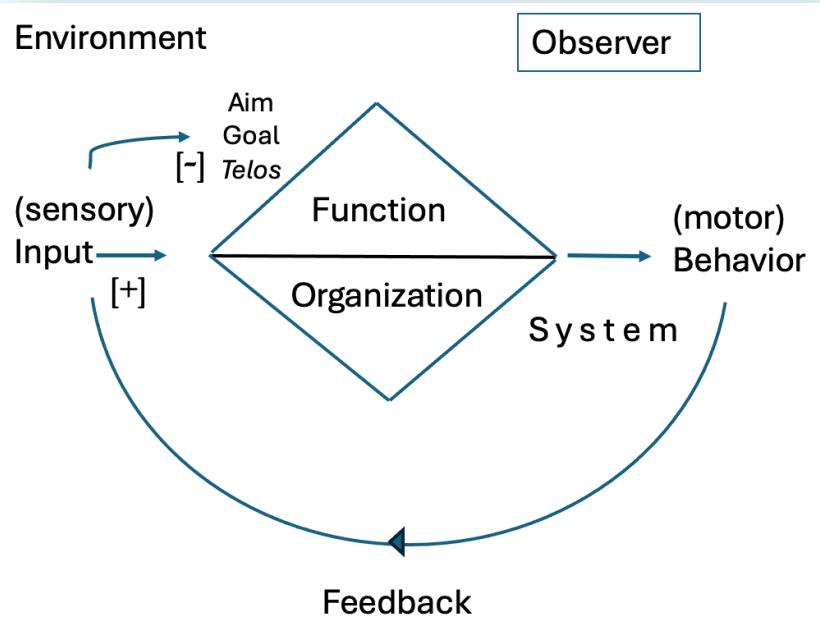
—Wiener et al redefine *teleology* as the solution to “the problem of purpose.” In these material instances, the *telos* is the completion of some purposeful effort to make (creative or destructive) contact with a desired object or to maintain a desirable state. Purposive behaviors so defined cross over the difference between organisms and artifacts:

All purposeful behavior may be considered to require negative feed-back. If a goal is to be attained, some signals from the goal are necessary at some time to direct the behavior. . . . The behavior of some machines and some reactions of living organisms involve a continuous feed-back from the goal that modifies and guides the behaving object.

The emphasis here is on *behavioral* (not functional) *uniformity* across system types: both organisms and artifacts can behave in ways that accomplish goals, and both kinds of systems employ feedback processes for self-regulation of goal-seeking behavior. In this way,

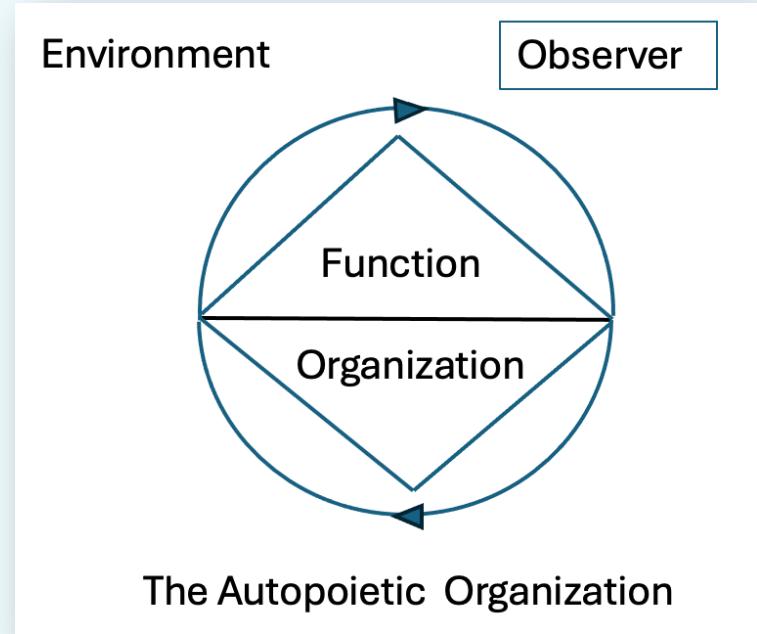
Autopoiesis

We learned from Wiener's cybernetics that negative feedback—



-is a uniform *behavior* shared by organisms and artifacts.

Maturana and Varela assert that self-production through operational recursion-

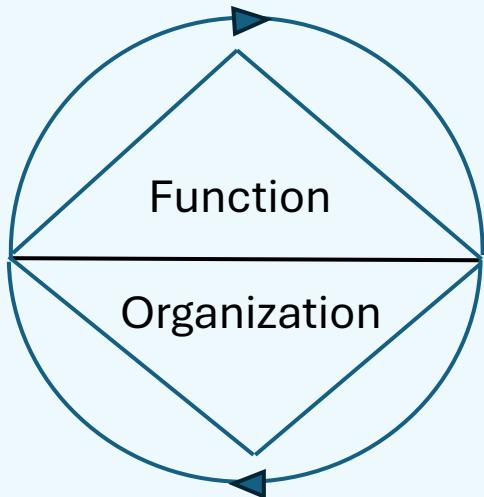


-is the *organizational closure* that defines the autonomy of living systems.

A.

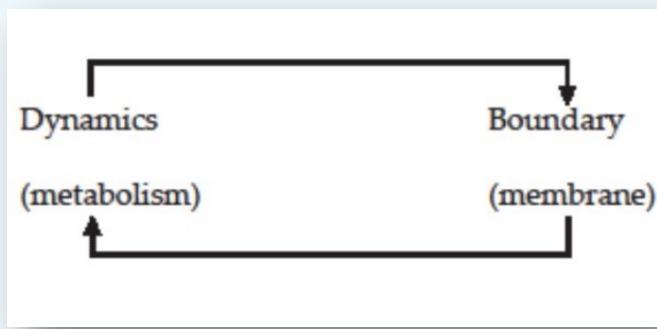
Environment

Observer



B.

The Autopoietic Organization

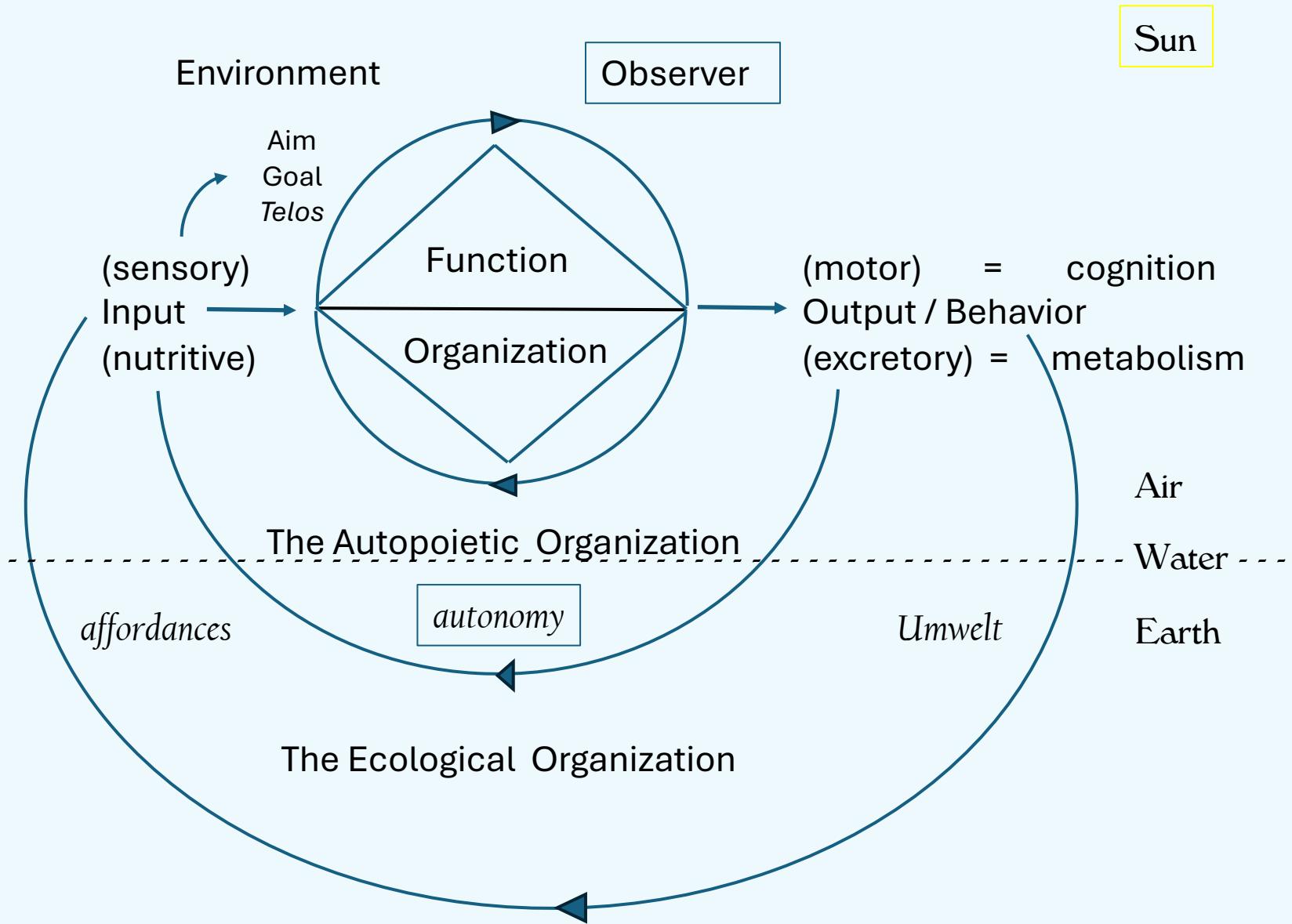


"In terms of their functional organization living systems do not have inputs and outputs, although under perturbations they maintain constant their set states."

—Maturana and Varela,
Autopoiesis and Cognition (51)

BC] *Function* in A would be the dynamics of metabolism in B, while *organization* in A includes the formation of the cell membrane shown in B. This recursion sets the physical boundary that marks off and maintains the structure of the system.

Living systems entail their environments. Biology is embedded in ecology.



The lines of organic cybernetics explored in this course push back on the prior minimization of purpose or intention in nonhuman organisms with a new level of attention to the distribution of agency throughout the biosphere. Here's a contemporary summary of the conceptual revolution set into motion by the organic turn in cybernetic thinking, in Bateson, in Varela. Gaian cognition:

The organism's ability to act is grounded in its **functional organization**, which grants it a certain autonomy (a "freedom from immediacy"). An organism not only passively reacts to environmental inputs. It can initiate actions according to **internal goals**, which it seeks to attain by leveraging opportunities and avoiding obstacles it encounters in its ***umwelt***, that is, the world as perceived by this particular organism. These opportunities and obstacles are **affordances**, relations between the living agential system and its ***umwelt*** that are relevant to the attainment of its goals. **Organismic agency** enables a constructive dialectic between an organism's goals, its repertoire of actions, and its affordances, which all presuppose and generate each other in a process of constant emergent co-evolution.

—Stuart Kauffman (Lindisfarne Fellow) et al, “How Organisms Come to Know the World: Fundamental Limits on Artificial General Intelligence”

Ecology of Mind

Bateson's cybernetics transformed information theory through an anthropological focus on relationship rather than control.

In "Cybernetic Explanation," Bateson redefines informatic *redundancy* as a primary matter concerning mutuality of *relationship* between the sender and the receiver.

- This inverts the engineering emphasis on transmission by concentrating instead on reception, response, and observation.
- Messages take on meaning within a potentially infinite play of contexts.

In "Form, Substance, and Difference," Bateson naturalizes information theory by redefining its fundamental unit as a "difference that makes a difference," in whatever medium that may be conveyed.

—in “Form, Substance, and Difference” (1970), Bateson rethinks information as the recursion of difference:

.... *The map is not the territory.*

But what is a difference? A difference is a very peculiar and obscure concept. It is certainly not a thing or an event. When you enter the world of communication, organization, etc., you leave behind that whole world in which effects are brought about by forces and impacts and energy exchange. You enter a world in which “effects” are brought about by differences.

There is an infinite number of differences Of this infinitude, we select a very limited number, which become information. In fact, what we mean by information—the elementary unit of information—is a difference which makes a difference

BC] “A difference that makes a difference,” but *to whom, or to what?* Say, to the cognitive formation of some observing system that constructs the matter at hand as *meaningful* information.

—back to “Form, Substance, and Difference”:

In principle, if you want to explain or understand anything in human behavior, you are always dealing with total circuits, completed circuits. This is the elementary cybernetic **thought**.

The elementary cybernetic system with its messages in circuit is, in fact, the simplest unit of **mind**; and the transform of a difference traveling in a circuit is the elementary **idea**.

◎

—When one allows the organic sensibility of Maturana and Varela's *cognition* to be distributed throughout the biosphere, one gets Bateson's ecological *mind*. This is the Gaia of organic cybernetics: planetary cognition.

◎

We get a picture, then, of mind as synonymous with cybernetic system—the relevant total information-processing, trial-and-error [that is, feedback] completing unit. And we know that within Mind in the widest sense there will be a hierarchy of sub-systems, any one of which we can call an individual mind.





. . . I now localize something which I am calling "Mind" immanent in the large biological system—the ecosystem. Or, if I draw the system boundaries at a different level, then mind is immanent in the total evolutionary structure. If this identity between mental and evolutionary units is broadly right, then we face a number of shifts in our thinking.

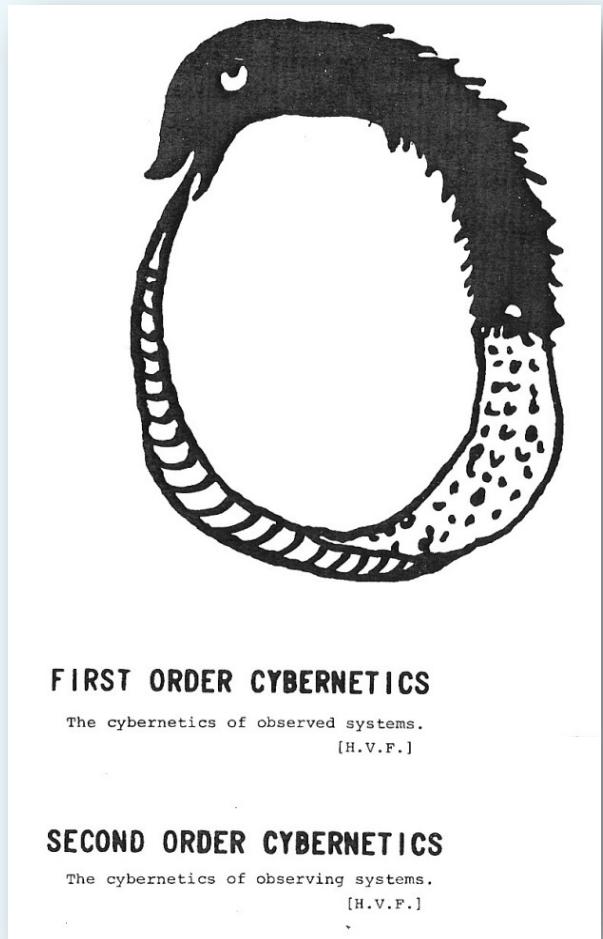
The cybernetic epistemology which I have offered you would suggest a new approach. The individual mind is immanent but not only in the body. It is immanent also in the pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a sub-system. This larger Mind is comparable to God and is perhaps what some people mean by "God," but it is still immanent in the total interconnected social system and planetary ecology.

Epistemological Constructivism

Second-Order Cybernetics.

Von Foerster's later papers turn toward epistemological matters of cognitive recursion, in close touch with the first steps of the concept of biological autopoiesis in the early '70s. And as we saw, von Foerster was literally the institutional midwife for the scientific and discursive delivery of the theory of autopoiesis.

Von Foerster's later writings on "the cybernetics of cybernetics" take on the project of cybernetic discourse's taking itself as its own object, giving an account of itself. This is the "second-order turn" at the end of the '60s: Matters of circular form and operation can now cross between philosophical and literary treatment (think *postmodernism*) and scientific discussion. Mental capacities for *reflexivity* (*self*-consciousness) are no longer a mark of human exceptionalism but a particular case of systemic *recursion*.



FIRST ORDER CYBERNETICS

The cybernetics of observed systems.
[H.V.F.]

SECOND ORDER CYBERNETICS

The cybernetics of observing systems.
[H.V.F.]

In "Thoughts and Notes on Cognition," von Foerster joined Humberto Maturana in revoking the ontological credentials of the information concept.

In this neocybernetics, information is no longer a freestanding transmitted input but an output or behavior internally generated by the neurological looping of cognitive processes.

- "Cognitive processes create descriptions of, that is, information about, the environment."
- "The environment contains no information. The environment is as it is."

BC] That is to say, information is *not* the cause for which cognition is the effect, but quite the reverse: cognitive function is the biological-systemic condition for the possibility of describing the environment in the mode of information.

The Cybernetic Countercultures cultivated organic systems theories that observe recursive forms throughout living systems.

Factoring different points of observation into the total picture of possible descriptions is no facile metaphysical gesture. Rather, it calls out and insists on the embodiment of cognitive systems, their delimitations as embedded in fundamentally organic affordances, their finitude.

Some key points

- Neocybernetics' epistemological constructivism is based on the recognition of cognition's biological contingencies.
- In these neocybernetic formulations, information no longer exists *as such*, or for itself, but is always the outcome of a prior cognitive process—an *organic* computation.
- Thus, "information" becomes the system-internal outcome of a cognitive loop, which process may then go on to *attribute* its construction in a stable fashion to a source in its environment.
- Sensory and semiotic correlations may then strengthen the stability of that cognitive formulation.

On Constructing a Reality

Heinz von Foerster

(1973)

This is an abbreviated version of a lecture given at the opening of the fourth International Conference on Environmental Design Research on April 15, 1973, at the Virginia Polytechnic Institute in Blacksburg, Virginia.

Abstract: "Draw a distinction!"¹

The Postulate

I am sure you remember the plain citizen Jourdain in Moliere's *Bourgeois Gentilhomme* who, *nouveau riche*, travels in the sophisticated circles of the French aristocracy, and who is eager to learn. On one occasion with his new friends they speak about poetry and prose, and Jourdain discovers to his amazement and great delight that whenever he speaks, he speaks prose. He is overwhelmed by this discovery: "I am speaking Prose! I have always spoken Prose! I have spoken Prose throughout my whole life!"

A similar discovery has been made not so long ago, but it was neither of poetry nor prose — it was the environment that was discovered. I remember when, perhaps ten or fifteen years ago, some of my American friends came running to me with the delight and amazement of having just made a great discovery: "I am living in an Environment! I have always lived in an Environment! I have lived in an Environment throughout my whole life!"

However, neither M. Jourdain nor my friends have as yet made another discovery, and that is when M. Jourdain speaks, may it be prose or poetry, it is he who invents it, and likewise when we perceive our environment, it is we who invent it.

Every discovery has a painful and a joyful side: painful, while struggling with a new insight; joyful, when this insight is gained. I see the sole purpose of my presentation to minimize the pain and maximize the joy for those who have not yet made this discovery; and for those who have made it, to let them know they are not alone.

Again, the discovery we all have to make for ourselves is the following postulate: *the environment as we perceive it is our invention.*

The burden is now upon me to support this outrageous claim. I shall proceed by first inviting you to participate in an experiment; then I shall report a clinical case and the results of two other experiments. After this I will give an interpretation, and thereafter a highly compressed version of the neurophysiological basis of these experiments and my postulate of before. Finally, I shall attempt to suggest the significance of all that to aesthetical and ethical considerations.

I. Blindspot. Hold [Figure 1] with your right hand, close your left eye and fixate asterisk of Fig. 1 with your right eye. Move the book slowly back and forth along line of vision until at an appropriate distance, from about 12 to 14 inches, the round black spot disappears. Keeping the asterisk well focused, the spot should remain invisible even if the figure is slowly moved parallel to itself in any direction.

This localized blindness is a direct consequence of the absence of photo receptors (rods or cones) at that point of the retina, the "disc", where all fibers, leading from the eye's light sensitive surface, converge to form the optic nerve. Clearly, when the black spot is projected onto the disc, it cannot be seen. Note that this localized blindness is not perceived as a dark blotch in our visual field (seeing a dark blotch would imply "seeing"), but this blindness is not perceived at all, that is, neither as something present, nor as something absent: whatever is perceived is perceived "blotch-less".

BC] The argument rests entirely on the qualification as *we perceive it*, which places cognitive function before cognitive experience. And cognitive function itself emerges from the autopoietic organization. Cognition is thus grounded—we think *necessarily* grounded—in the affordances of living systems.



Figure 1

Self-Reference

A CALCULUS FOR SELF-REFERENCE

FRANCISCO J. VARELA G.

Department of Anatomy, University of Colorado Medical Center, Denver, Colorado, U.S.A.

(Received August 15, 1974; in final form October 3, 1974)

An extension of the calculus of indications (of G. Spencer Brown) is presented to encompass all occurrences of self-referential situations. This is done through the introduction of a third state in the form of indication, a state seen to arise autonomously by self-indication. The new extended calculus is fully developed, and some of its consequences for systems, logic and epistemology are discussed.

BC] Varela's extension of Spencer-Brown's calculus of indications implicitly links the operation of autopoiesis, through the concept of self-reference, to the form of autonomy. This is a literal example of the "biological computation" sponsored at von Foerster's BCL.

ONE: THE DOMAIN

1. Presence

Self-reference is awkward: one may find the axioms in the explanation, the brain writing its own theory, a cell computing its own computer, the observer in the observed, the snake eating its own tail in a ceaseless generative process.

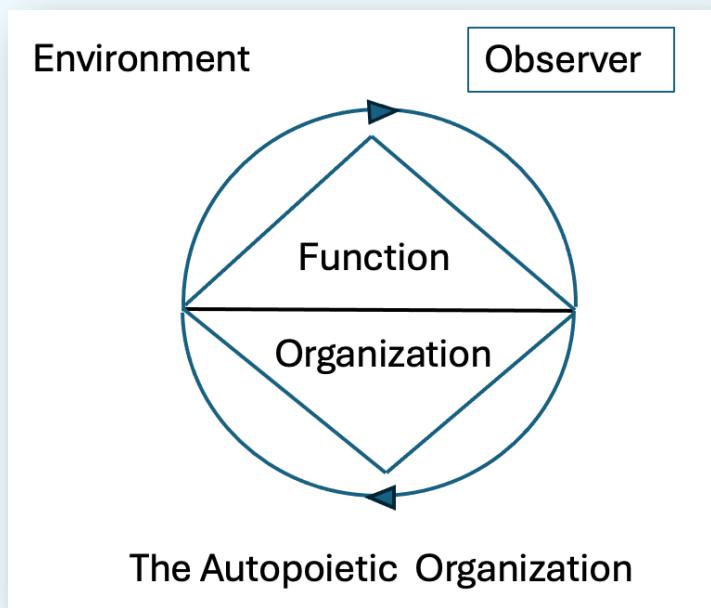
Stubbornly, these occurrences appear as outstanding in our experience. Particularly obvious is the case of living systems, where the self-producing nature of their entire dynamic is easy to observe, and it is this very fact that can be taken as a characterization for the organization of living systems. Similarly, the physiological and cognitive organization of a self-conscious system may be understood as arising from a circular and recursive neuronal network, containing its own description as a source of further descriptions. . . .

The difficulties in dealing with self-referential systems are rooted in language. Antinomies are to be expected when the self-referential capacity of language is used upon itself, as known for long in the capsular form of the epimenidean paradox . . .

—“A Calculus for Self-Reference” indicates that the point of Varela’s engagement with *Laws of Form* is to adapt its abstract notation to the description of living systems and neuronal networks, which are variously “self-producing,” or autopoietic, or “circular and recursive.”

The conclusion of “A Calculus for Self-Reference” drives home and amplifies von Foerster’s own constructivist program and its implicit reinforcement in *Laws of Form*:

We then see that we stand in relation to the world by mutual negation, and that the union *of us two* has therefore an autonomous structure whereby the negation engenders a distinction which leads to its own negation in a ceaseless circular process which is, in fact, the symbol which tradition has chosen to represent the creation of everything since time immemorial. . . .



≈



On Observing Natural Systems



FRANCISCO VARELA IN CONVERSATION WITH DONNA JOHNSON

Donna Johnson: Many people, almost as a matter of principle, of knowing what they're doing, make an effort to think "holistically," in terms of whole systems. But many of us often face a confusion stemming from our knowledge that "you can't consider a rabbit without considering his forest." We don't quite know how to go about considering the rabbit without fading into the forest, the local ecology, the planet, etc., and quickly into Everything. We know too that "the whole is more than the sum of its parts," but please Francisco what is a whole?

Francisco Varela: Well, yes, wholes, or whole systems, are arranged like Chinese boxes. One whole contains another whole and every whole is contained in another whole. There's a recursion principle there. But that does not mean that you cannot stop your unwinding at some point and consider a system.

And I have come to the conviction that the key to understanding the holism of such systems, the whole-ness of systems, is to understand that they are organized, their

Francisco Varela is a mathematician and neurologist whose special interest is the logic of self-reference. This sounds abstruse, but I share the opinion of Ludwig Wittgenstein, Gregory Bateson, G. Spencer Brown, Heinz von Foerster and others that failure to understand self-referentiality is the poison in the brain of most Western misbehavior, public and personal.

In his recent landmark paper, "A Calculus of Self-Reference" and in this interview, Francisco is helping build what Von Foerster calls "a cybernetics of observing-systems," which is the rest of the story after "the cybernetics of observed-systems" — feedback, goal-seeking, and such.

After several years with Von Foerster's Biological Computer Laboratory at the University of Illinois in Urbana, Varela is now teaching and doing research at the University of Colorado, Denver. Donna Johnson, 28, is an intellectual nomad who goes around making people's ideas clearer.

—SB

Four laws of ecology: "(1) everything is connected to everything else; (2) everything must go somewhere; (3) nature knows best; and (4) there is no such thing as a free lunch."

Barry Commoner in *The Closing Circle*, A. Knopf, New York, 1971, p. 18.

parts are organized, in a circular form. That is, every part interacts with every other part. That gives us a total self-referential system.

And of course the analysis of the parts does not account for the emergent properties when these parts are put together.

There has not been a lot of clear, disciplined thinking about wholes. We have a hell of a lot of technology, and ideas, and mathematics, about control of systems, that is, how to design them and how to get them to do whatever you want them to do. That is one step toward talking about systems in general regardless of their specific parts, that is, a proper system theory. But there hasn't been a lot of thinking, as a matter of fact very little thinking, on emerging properties of whole systems, natural systems.

Johnson: So how do you identify the circle that defines your system?

Varela: By the boundaries you put into the system. You say, this is the system I'm going to consider, this dog, or this society. To be sure, there are many ways of splitting up the world into different wholes, but once the criteria for separating one system from the other are given, you have a stable description.

So if you're interested in ecology, a certain kind of ecology, you split up the world in a certain way. If you're interested in economy, you split up the world in a different way. But given a criterion of distinction, you always come up with systems that have some sort of closure of their organization. And if you're a biologist, that's pretty clear, right? In the subject matter of the biologists, every one of the interactions in any organism interacts with every other interaction in a very closed fashion, a closed network of interactions.

DJ] . . . Please, Francisco, what is a whole?

FV] Well, yes, wholes, or whole systems, are arranged like Chinese boxes. One whole contains another whole and every whole is contained in another whole. There's a recursion principle there. But that does not mean that you cannot stop your unwinding at some point and consider a system.

And I have come to the conviction that the key to understanding the holism of such systems, the wholeness of systems, is to understand that they are organized, their parts are organized, in a circular form. That is, every part interacts with every other part. That gives us a total self-referential system. . . .

There has not been a lot of clear, disciplined thinking about wholes. We have a hell of a lot of technology, and ideas, and mathematics, about control of systems. . . . But there hasn't been a lot of thinking, as a matter of fact very little thinking, on emerging properties of whole systems, natural systems.

DJ] So how do you identify the circle that defines your system?

FV] By the boundaries you put into the system [by your choice of distinction]. . . . To be sure, there are many ways of splitting up the world into different wholes, but once the criteria for separating one system from the other are given, you have a stable description.

So if you're interested in ecology, a certain kind of ecology, you split up the world in a certain way. If you're interested in economy, you split up the world in a different way. But given a criterion of distinction, you always come up with systems that have some sort of closure of their organization. And if you're a biologist, that's pretty clear, right? In the subject matter of the biologists, every one of the interactions in any organism interacts with every other interaction in a very closed fashion, a closed network of interactions.

can be represented as very well-defined mathematical expression. And lo and behold! Once you start fiddling around with these re-entering, self-informing expressions, you find that an entirely new extension of Brown's initial ground is necessary.

It is something like this in an analogy to the numerical domain: suppose you start with an initial ground composed just of the integers (i.e., 1, 2, 3, ...). Then you fiddle around with them, making more and more complex expressions. At a point, new kinds of numbers will emerge, real numbers (something like π or $\sqrt{2}$). Thus it becomes necessary to extend the initial ground on which we started.

In the domain of indications, of course, numbers do not exist yet. This domain precedes their appearance. But a similar situation arises: as soon as self-reference is introduced, the ground has to be expanded considerably. And this says, to me, that in its most basic forms, self-reference is a very unique domain, that cannot be trapped into non-self-referential grounds. Which we knew all along, but didn't want to acknowledge. So this is what my own work¹⁰ has been concerned with, exploring this brownian foundation for a general theory of systems where closure and self-reference takes the place it deserves. It is a very beautiful subject, and there is lots to do.

Now, for me, one of the most attractive features of this approach, this brownian view, is that it combines in one conceptual stroke the act of seeing systems (i.e., some universe)



Varela: I have two related points to make here, which I feel very strongly about. One, I would reformulate what you just said about this "objective" business. When you realize that whatever you see reflects your properties, instead of putting so much intent, so much energy, investing so much, in a particular content, you turn back and focus on your capacity to do such a thing as a distinction. So the capacity to compute a reality becomes much more interesting than the content of the reality. Not so much intent, thus, on the something, but on the process of doing what we do to arrive at the something.

It seems to me that what is properly human, our responsibility (and John Lilly would say the next stage of evolution), is to have a hold on these laws of cognition and reality, rather than on any specific, particular realities.

The West has always been sold on a certain, particular way of doing things. What an understanding of what we have talked about today would bring about, is a recognition that the more we know about these things, the more we know about how to compute any universe whatsoever. So the more "objective" we would be in the sense that we would know what the contents of any universe would really mean.

This is what von Foerster has called the "cybernetics of second order,"¹¹ i.e., not the cybernetics of observed systems, but the cybernetics of observing systems. I think this is quite central. It's really the same theme that from the cognitive point of view Bateson⁷ and Lilly¹² and von Foerster¹³ and Spencer Brown⁹ and Joseph Chilton Pearce¹⁴ and John Brockman¹⁵ and Ornstein¹⁶ are addressing, which fits hand-in-hand with the traditional spiritual techniques, but seems to me the more Western way of embodying it, rather than the more disembodied kinds of spirituality.

The second point in relation to your question is that once you realize the full cognitive impact of these ideas, which I don't think we really have, you begin to understand that your participation in this reality has a limit, i.e., that you're a part of it, and you cannot possibly hope to comprise the whole of it. The establishing of the limits of our actions as a result of our epistemological understanding, seems to be very fruitful in the light of world models, urban growth,

FV] . . . And lo and behold! Once you start fiddling around with these re-entering, self-informing expressions, you find that an entirely new extension of Brown's initial ground is necessary. . . . As soon as self-reference is introduced, the ground has to be expanded considerably. And this says, to me, that in its most basic forms, self-reference is a very unique domain, that cannot be trapped into non-self-referential grounds. Which we knew all along, but didn't want to acknowledge. So this is what my own work has been concerned with, exploring this Brownian foundation for a general theory of systems where closure and self-reference takes the place it deserves. . . . It combines in one conceptual stroke the act of seeing systems (i.e., some universe) and he who does the seeing, so that the formal ground fits hand in glove with our previous point about the observer, the interlocking between what is seen and who sees it.

DJ] It's interesting how this also fits into the many spiritual traditions that say that the only way to know what you're doing is to know yourself, as much as you can, to know what is knowing. . . .

FV] When you realize that whatever you see reflects your properties, instead of putting so much intent, so much energy, investing so much, in a particular content, you turn back and focus on your capacity to do such a thing as a distinction. So the capacity to compute a reality becomes much more interesting than the content of the reality. . . .

This is what von Foerster has called the "cybernetics of second order" . . . It's really the same theme that from the cognitive point of view Bateson and Lilly and von Foerster and Spencer Brown . . . are addressing, which fits hand-in-hand with the traditional spiritual techniques but seems to me the more Western way of embodying it, rather than the more disembodied kinds of spirituality. . . . You begin to understand that your participation in this reality has a limit, i.e., that you're a part of it, and you cannot possibly hope to comprise the whole of it. The establishing of the limits of our actions as a result of our epistemological understanding, seems to be very fruitful

Thus we cannot escape the fact that the world we know is constructed in order (and thus in such a way as to be able) to see itself.

This is indeed amazing.

Not so much in view of what it sees, although this may appear fantastic enough, but in respect of the fact that it can see at all.

But in order to do so, evidently it must first cut itself up into at least one state which sees, and at least one other state which is seen. In this severed and mutilated condition, whatever it sees is only partially itself. We may take it that the world undoubtedly is itself (i.e., is indistinct from itself), but, in any attempt to see itself as an object, it must, equally undoubtedly, act so as to make itself distinct from, and therefore false to, itself. In this condition it will always partially elude itself . . .

We see now that the first distinction, the mark, and the observer are not only interchangeable, but, in the form, identical.

G. Spencer Brown in *Laws of Form*, George Allen & Unwin, London, 1969, p. 105, p. 76.

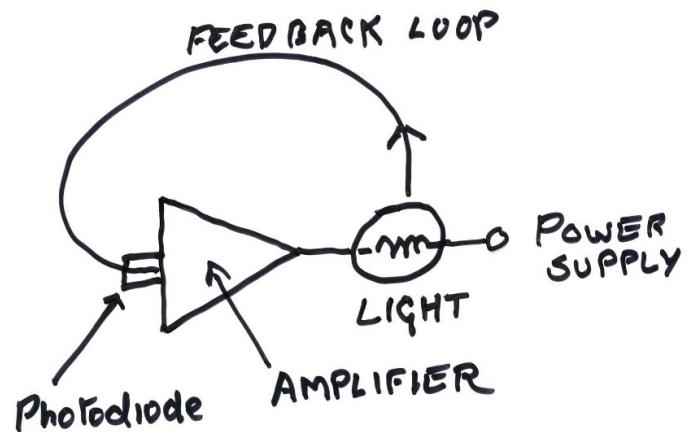
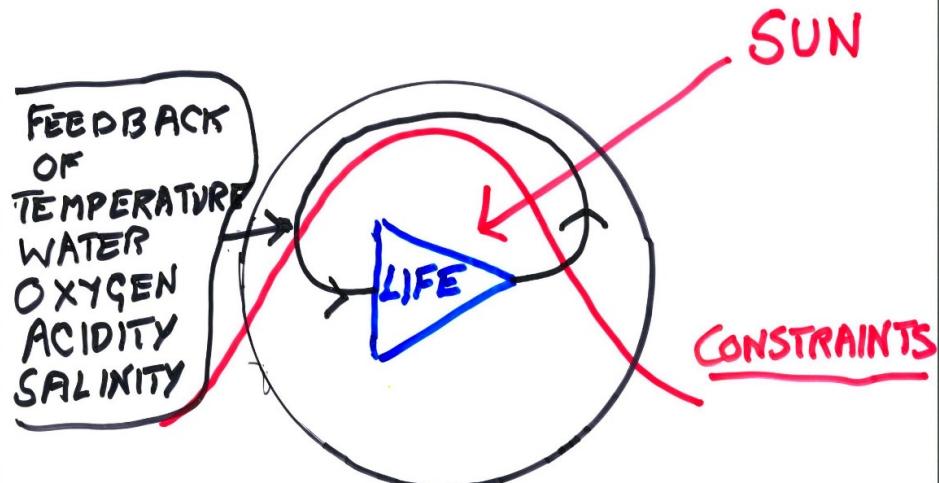
and he who does the seeing, so that the formal ground fits hand in glove with our previous point about the observer, the interlocking between what is seen and who sees it.

Johnson: It's interesting how this also fits into the many spiritual traditions that say that the only way to know what you're doing is to know yourself, as much as you can, to know what is knowing. That entails a frightening responsibility, if you have those sensibilities. I wonder about the question of people "becoming more objective" as many say, by ridding themselves of, or at least recognizing, their ego trips, their preconceptions, false beliefs, etc. Is there a way to talk about these things in Spencer Brown's language, perhaps more clearly than in the previous languages?

Gaia's Cybernetics

GAIA

The EARTH SYSTEM



In this undated diagram, Lovelock sketches Life as the amplifier in a Gaian feedback loop. Fully identified now with the “Earth System,” here is Gaia on the way to its post-countercultural career as “Earth System Science.” But as we have seen, Gaia’s cybernetic foundations were present from its conception:

“There is little doubt that living things are elaborate contrivances. Life as a phenomenon might therefore be considered in the context of those applied physical sciences which grew up to explain inventions and contrivances, namely, thermodynamics, cybernetics, and information theory.”

—Lovelock and Margulis, “Atmospheric Homeostasis by and for the Biosphere” (1974).

Source: Science Museum, London

—The advent of Lovelock's collaboration with Margulis confirms the cybernetic inspiration of the Gaia hypothesis.

It contained two crucial and interlinked statements. First, directly documenting the tenor of his current systems thinking, Lovelock informed her,

"I am in the course of writing a paper on the Earth's atmosphere as a biological cybernetic system."

Lovelock's second key statement in his initial letter to her may be read as an explanation of the first:

"I am now tolerably certain that all of the components of the Earth's atmosphere other than the rare gases and perhaps water vapor are biologically maintained."

J. E. LOVELOCK

Telephone : BROADCHALKE 387

BOWERCHALKE
Nr. SALISBURY
WILTS.

11th September, 1970.

Dr. L. Margulis,
Boston University,
Boston,
Mass.

Dear Dr. Margulis,

Thank you very much for your letter and papers on Early Cellular Evolution; these I found most interesting.
I am in the course of writing a paper on the Earth's atmosphere as a biological cybernetic system. My comments on yours and a draft copy I'll send when it is ready, which should not be later, I hope, than the next few weeks.
I am now tolerably certain that all of the components of the Earth's atmosphere other than the rare gases and perhaps water vapour are biologically maintained and this ofcourse includes nitrogen.

I shall be paying a visit to JPL towards the end of September and maybe can give you a call from there.

Yours sincerely,

Jim Lovelock.

Planetary *cognition* on the Gaian model appears to be the precursor of intelligence, a kind of test-of-concept for a *prehuman* planetary intelligence. Grinspoon et al speculate that this approach “would require some form of collective cognition to have been a functional part of the biosphere for considerably longer than the relatively short tenure of human intelligence on Earth. If true, then the inherently global nature of the complex, networked feedbacks which occur in the biosphere may itself imply the operation of an ancestral planetary intelligence” (48).

The “collective cognition” in question here implies some sort of networked aggregation of species, and so places a Gaian conception of cognition at the base of these planetary considerations. I think this *is* the more intelligent way to ground our future plans. What we must try to do is grasp ever more firmly how to integrate our built environment with Gaia’s inexorable contingencies.

David Grinspoon,
Sara Walker, and
Adam Frank ,
“Intelligence as a
Planetary Scale
Process,”
*International Journal
of Astrobiology*
(2022).

A Planetary Culture

This notice for the Lindisfarne Association appears in the second number of *CQ* (Summer 1974: 130) in the section on Learning. For much of its first decade, Lindisfarne ran a residential operation with a dedicated campus, first in Fish Cove, then in downtown Manhattan, and finally in Crestone, Colorado.

Lindisfarne

Lindisfarne seeks to help the individual achieve a transformation of consciousness through the esoteric teachings and practices of the great universal religious including Buddhism, contemplative Christianity, mystical Judaism, Sufi and Yoga.

For the mind there will be seminars, workshops and lectures in philosophy, the physical sciences, Jungian psychology and world order models.

The body disciplines of Hatha Yoga and Tai Chi complete the balance of the program.

To bring the centralizing spiritual and planetary vision of Lindisfarne into sharp focus, William Irwin Thompson, Lindisfarne director, will offer a course on the Transformations of Human Culture.

Lindisfarne is located on the Peconic Bay near the eastern tip of Long Island about 4 miles north of Southampton, N.Y. The 11-acre Lindisfarne property is surrounded by water and woods and has its own beach which is about 1/5 of a mile long. There are 29 log cabins facing the water and a large main building overlooking a cove. This building houses dining facilities, seminar space, meditation room, library and additional bedrooms.

The community's summer session, May 25 through August 20, will be in 2 self-contained parts: May 25 - July 5 and July 8 - August 20. If space is available a limited number of residents may be accepted for only one part rather than the full session.

A ten day conference August 24 to September 2. PLANETARY CULTURE AND THE NEW IMAGE OF MAN. Participants from the arts, sciences, and religion will be announced later in the spring. The cost for the summer program is \$1,600, if you stay on for the 10 day conference the cost is \$1,850. If you can only come for one of the self-contained parts of the session the cost is \$900 for the six weeks. The ten day conference will cost \$400. For a limited number of residents Lindisfarne will offer a self-contained weekend program. The cost is \$900 for the full weekend summer session. Costs include an individual study-bedroom, all meals and tuition.

If you are interested in becoming a resident please tell us something about yourself - where you are now and where you feel you want to go is the only basis for qualifying. A deposit of \$100 will secure your place. If it turns out we cannot accept you or that you do not wish to become a resident, the deposit will be refunded.

Lindisfarne operates communally. There is structure in terms of the fixed program but within this structure each person is free to pursue his own path using the teaching fellows and the community as a whole to help in his development. We live as a community each seeking to help the other and with all of us helping the community by contributing two hours of work daily to the community.

For more information write to: The Lindisfarne Association, P.O. Box 1395, Southampton, N.Y. 11968. Phone: 516-283-8210.



We learn in
Thinking
Together at the
Edge of History
that participants
in this first
Lindisfarne
Conference
included
Stewart Brand,
Carl Sagan,
and John Todd.

G·A·I·A

A WAY OF KNOWING

Political Implications of the New Biology



Henri Atlan
Gregory Bateson
Hazel Henderson
James Lovelock
Lynn Margulis
Humberto Maturana
William Irwin Thompson
John Todd
Francisco Varela

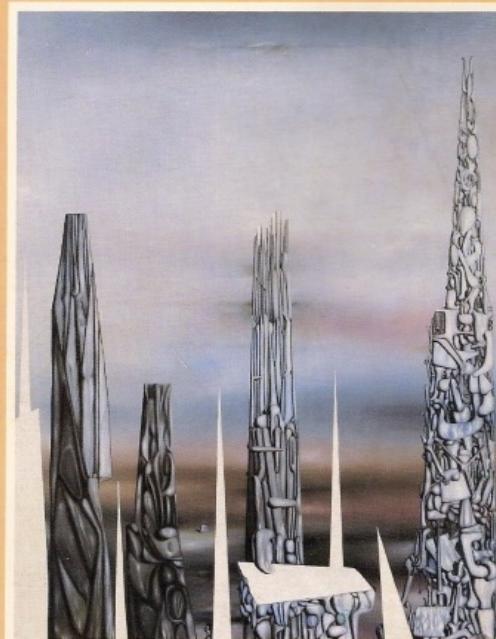
edited by WILLIAM IRWIN THOMPSON

Lindisfarne Press, 1987

GAIA · 2

EMERGENCE

The New Science of Becoming



Gianluca Bocchi & Mauro Ceruti
Wes Jackson
James Lovelock
Lynn Margulis & Ricardo Guerrero
Susan Oyama
Evan Thompson
John Todd
Nancy Jack Todd
Francisco Varela
Arthur Zajonc

edited by WILLIAM IRWIN THOMPSON

Lindisfarne Press, 1991

