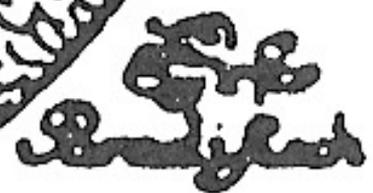


Francisco Varela in  
the Systems Counterculture

Bruce Clarke  
Literature and Science  
Texas Tech University  
[brunoclarke@gmail.com](mailto:brunoclarke@gmail.com)

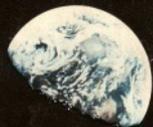


1969

The *Whole Earth Catalog* hits its groove.

# WHOLE EARTH CATALOG

access to tools



Spring 1969  
\$4

## Understanding Whole Systems



Buckminster Fuller

*The insights of Buckminster Fuller initiated this catalog. Among his books listed here, Utopia or Oblivion is now probably the most direct introduction. It's a collection of his talks and papers from 1964 to 1967, at a bargain price. An Operating Manual for Spaceship Earth is his most recent, and succinct, statement. Nine Chains to the Moon is early, and openly metaphysical. The Untitled Epic of Industrialization is lyrical and strong. Ideas and Integrities is his most autobiographical, and perhaps the most self-contained of his books. No More Secondhand God is the most generalized, leading into the geometry of thought.*

*People who beef about Fuller mainly complain about his repetition—the same ideas again and again, it's embarrassing, also illuminating, because the same notions take on different contexts. Fuller's lectures have a raga quality of rich nonlinear endless improvisation full of convergent surprises.*

*Some are put off by his language, which makes demands on your head like suddenly discovering an extra engine in your car—if you don't let it drive you faster, it'll drag you. Fuller won't wait. He spent two years silent after illusory language got him in trouble, and he returned to human communication with a redesigned instrument.*

—SB

### Utopia or Oblivion

Buckminster Fuller  
1969, 366pp.

\$1.25 postpaid

from:  
Bantam Books  
666 Fifth Avenue  
New York, New York 10019

or WHOLE EARTH CATALOG



My recommendation for a curriculum of design science:

- |                                  |                            |
|----------------------------------|----------------------------|
| 1. Synergetics                   | 7. Communications          |
| 2. General systems theory        | 8. Meteorology             |
| 3. Theory of games (Von Neumann) | 9. Geology                 |
| 4. Chemistry and physics         | 10. Biology                |
| 5. Topology, projective geometry | 11. Sciences of energy     |
| 6. Cybernetics                   | 12. Political geography    |
|                                  | 13. Ergonomics             |
|                                  | 14. Production engineering |

Here on Southern Illinois' campus we are going to set up a great computer program. We are going to introduce the many variables now known to be operative in economics. We will store all the basic data in the machines memory bank; where and how much of each class of the physical resources; where are the people, what are the trendings—all kinds of trendings of world man?

### Operating Manual for Spaceship Earth

Buckminster Fuller  
1969, 133pp.

\$1.25 postpaid

from:  
Pocket Books, Inc.  
1 W. 39th St.  
New York, N.Y. 10018

or WHOLE EARTH CATALOG



To comprehend this total scheme we note that long ago a man went through the woods, as you may have done, and I certainly have, trying to find the shortest way through the woods in a given direction. He found trees fallen across his path. He climbed over those crisscrossed trees and suddenly found himself poised on a tree that was slowly teetering. It happened to be lying across another great tree, and the other end of the tree on which he teetered himself teetering lay under a third great fallen tree. As he heeded he saw the third big tree lifting. It seemed impossible to him. He went over and tried using his own muscles to lift that great tree. He couldn't budge it. Then he climbed back atop the first smaller tree, purposefully teetering it, and surely enough it again elevated the larger tree. I'm certain that the first man who found such a tree thought that it was a magic tree, and may have dragged it home and erected it as man's first totem. It was probably a long time before he learned that any stout tree would do, and thus extracted the concept of the generalized principle of leverage out of all his earlier successive special-case experiences with such accidental discoveries.

To begin our position-fixing aboard our Spaceship Earth we must first acknowledge that the abundance of immediately consumable, obviously desirable or utterly essential resources have been sufficient until now to allow us to carry on despite our ignorance. Being eventually exhaustible and spoilsable, they have been adequate only up to this critical moment. This cushion-for-error of humanity's survival and growth up to now was apparently provided just as a bird inside of the egg is provided with liquid nutriment to develop it to a certain point. But then by design the nutriment is exhausted at just the time when the chick is large enough to be able to locomote on its own legs. And so as the chick pecks at the shell seeking more nutriment it inadvertently breaks open the shell.

A new, physically uncompromised, metaphysical initiative of unbiased integrity could unify the world. It could and probably will be provided by the utterly impersonal problem solutions of the computers.

Heisenberg's principle of 'indeterminism' which recognized the experimental discovery that the act of measuring always alters that which was being measured turns experience into a continuous and never-repeatable evolutionary scenario.

The gold supply is so negligible as to make it pure voodoo to attempt to valve the world's economic evolution traffic through the gold-sized needle's 'eye'.

Brain deals exclusively with the physical, and mind exclusively with the metaphysical. Wealth is the progressive mastery of matter by mind . . .

Stepping forth from its initial sanctuary, the young bird must now forage on its own legs and wings to discover the next phase of its regenerative sustenance.

### Nine Chains to the Moon

Buckminster Fuller  
1938, 1963; 375 pp.

Unavailable until 1972



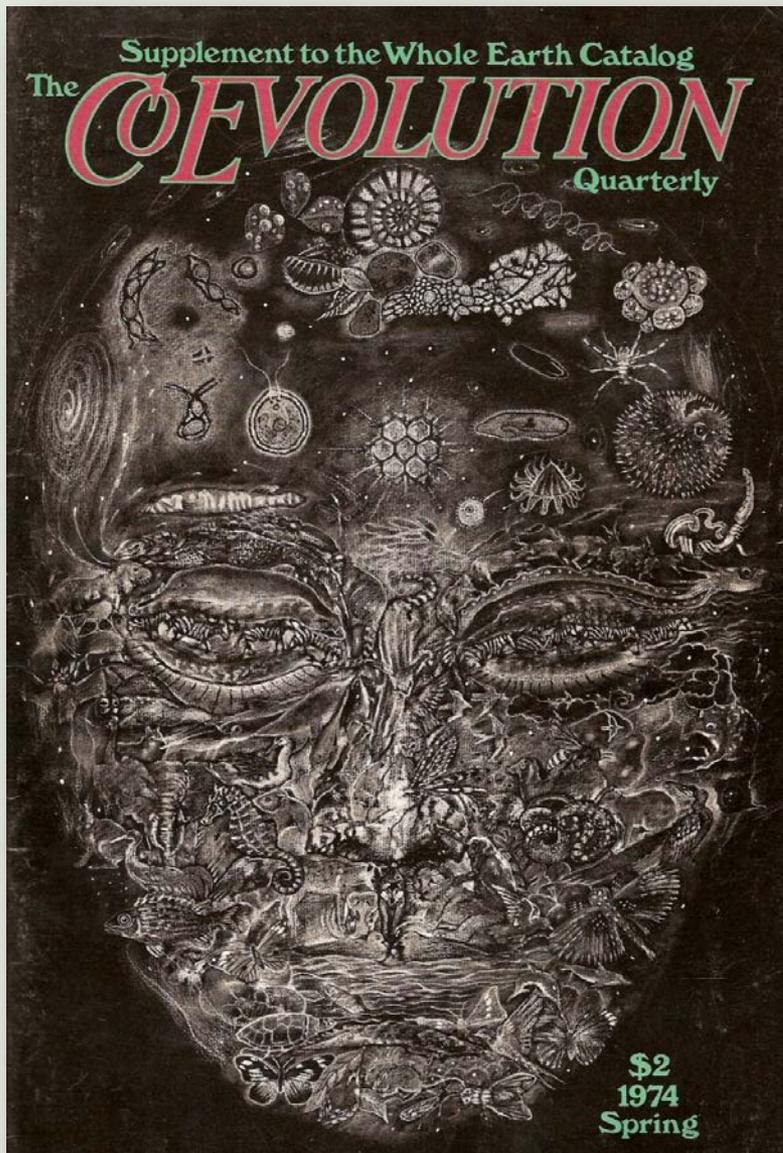
1971

Heinz von Foerster vets *Laws of Form*  
in the *Last Whole Earth Catalog*.



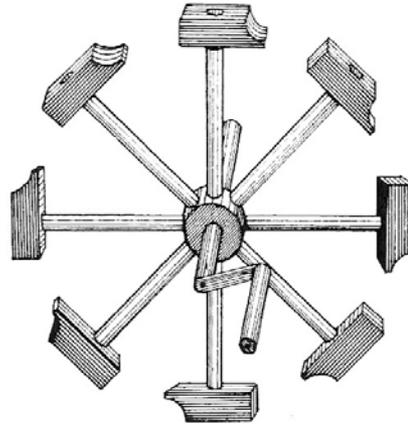
1974

Von Foerster boosts *Whole Earth Catalog* spinoff  
*CoEvolution Quarterly* with a “Catalog of  
Undiscoverable Objects.”

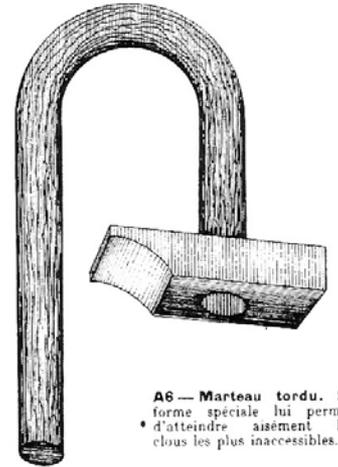


CATALOGUE D'OBJETS INTROUVABLES

[Sent by Heinz von Foerster]



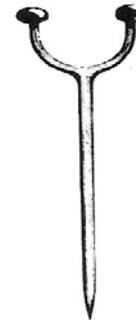
**A7 — Polymarteau.** La rotation rapide de ce marteau à huit têtes fait gagner un temps considérable aux professionnels et aux bricoleurs.



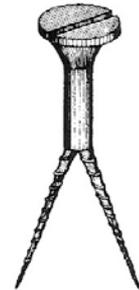
**A6 — Marteau tordu.** Sa forme spéciale lui permet d'atteindre aisément les clous les plus inaccessibles.



**A9 — Clou barbelé.** Une fois enfoncé, ce clou est garanti absolument inarrachable!



**A8 — Clou bicéphale.** Idéal pour les bricoleurs atteints de strabisme divergent.



**A10 — Vis à bois bifide.** Pour unir deux planches il suffit de faire pénétrer cette vis. Solidité garantie.

CoEvolution Quarterly 2 (Summer 1974)

1974

Von Foerster vets the English-language debut of the concept of autopoiesis with Francisco Varela as lead author.

## AUTOPOIESIS: THE ORGANIZATION OF LIVING SYSTEMS, ITS CHARACTERIZATION AND A MODEL

F.G. VARELA, H.R. MATURANA and R. URIBE

*Facultad de Ciencias e Departamento de Electricidad,  
University of Chile, Santiago, Chile*

We formulate the organization of living organisms through the characterization of the class of autopoietic systems to which living things belong. This general characterization is seen at work in a computer simulated model of a minimal case satisfying the conditions for autopoietic organization.

### 1. Introduction

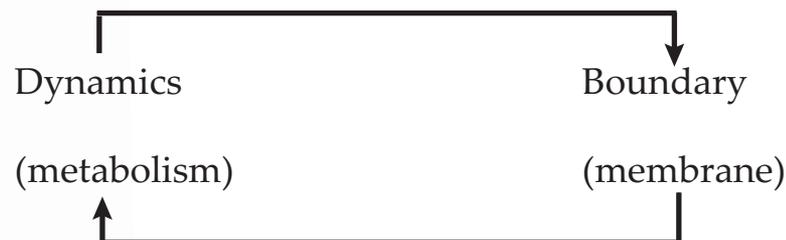
Notwithstanding their diversity, all living systems must share a common organization which we implicitly recognize by calling them "living". At present there is no formulation of this organization, mainly because the great developments of molecular, genetic and evolutionary notions in contemporary biology have led to the overemphasis of isolated components, e.g. to consider reproduction as a necessary feature of the living organization and, hence, not to ask about the organization which makes a living system a whole, autonomous unity that is alive regardless of whether it reproduces or not. As a result, processes that are history dependent (evolution, ontogenesis) and history independent (individual organization) have been confused in the attempt to provide a single mechanistic explanation for phenomena which, although related, are fundamentally distinct.

We assert that reproduction and evolution are not constitutive features of the living organization and that the properties of a unity

cannot be accounted for only through accounting for the properties of its components. In contrast, we claim that the living organization can only be characterized unambiguously by specifying the network of interactions of components which constitute a living system as a whole, that is, as a "unity". We also claim that all biological phenomenology, including reproduction and evolution, is secondary to the establishment of this unitary organization. Thus, instead of asking "What are the necessary properties of the components that make a living system possible?" we ask "What is the necessary and sufficient organization for a given system to be a living unity?" In other words, instead of asking what makes a living system reproduce, we ask what is the organization reproduced when a living system gives origin to another living unity? In what follows we shall specify this organization.

### 2. Organization

Every unity can be treated either as an un-



### Acknowledgement

The authors wish to express their gratitude to the members of the Biological Computer Laboratory of the University of Illinois, Urbana, particularly to Richard Howe, Heinz Von Foerster, Paul E. Weston and Kenneth L. Wilson, for their continuous encouragement, discussions, and help in clarifying and sharpening the presentation of our notions.

# 1975

Von Foerster then vets Francisco Varela's paper extending *Laws of Form* with the addition of a mark of autonomy or "self-cross" to formalize the capacity of Spencer-Brown's calculus to operationalize self-reference.

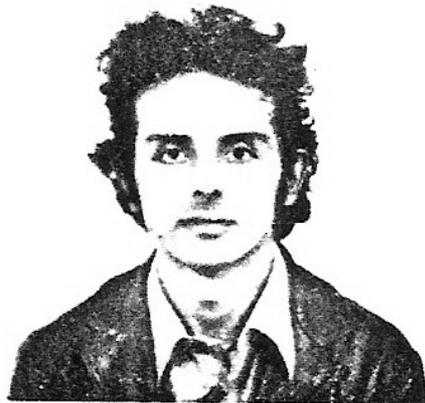
## INTRODUCTORY COMMENTS TO FRANCISCO VARELA'S CALCULUS FOR SELF-REFERENCE

RICHARD HERBERT HOWE and HEINZ VON FOERSTER

*Biological Computer Laboratory, University of Illinois, Urbana, Illinois, U.S.A.*

“Heinz was again instrumental in making my calculus of self-reference quickly accepted and disseminated, when I was stranded in Costa Rica after escaping Pinochet's Chile.”

—Varela, “Heinz von Foerster, the Scientist, the Man,” *Stanford Electronic Humanities Review* 4:2 (1995)



FRANCISCO JAVIER VARELA GARCIA was born in Talcahuano, Chile, on September 7, 1946. He received his B.A. from the University of Chile, and his Ph.D. from Harvard University in 1970.

From 1970 to 1973 he was Associate Professor of Biology at the Faculty of Sciences, University of Chile, Santiago. By the end of 1973 he was Visiting Professor at the Universidad Nacional, Heredia, Costa Rica. He is currently associated with the Department of Anatomy at the University of Colorado Medical Center, in Denver.

His scientific activity is centered around the problems of bio-computers, both molecular and cognitive, and has contributed two books and several articles to these problems.

To Louis Kauffman  
who knows better...  
Francisco

Int. J. General Systems  
1975, Vol. 2, pp. 5-24

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Printed in Great Britain

## 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.

INDEX TERMS Self-reference, self-referential systems, calculus of indications, paradoxes, autonomy.

"Was wir liefern, sind eigentlich Bemerkungen zur Naturgeschichte des Menschen; aber keine kuriose Beiträge, sondern Feststellungen von Fakten, an denen niemand gezweifelt hat, und die dem Bemerkwerden nur entgegen, weil sie sich ständig vor unsern Augen herumtreiben."

(What we are supplying are really remarks on the natural history of man; not curiosities, however, but rather observations on facts which no one has doubted and which have only gone unremarked because they are always before our eyes.)

Wittgenstein.

### 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.<sup>1-2</sup> 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.<sup>3,4,5</sup> We have mentioned some of the few reports which address themselves directly to the self-referential nature of such systems, normally avoided as undesirable difficulty (or *circulus vitiosus*).

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 epimimidean paradox, later to become, in mathematical language, Cantor's diagonal argument.<sup>6</sup> This singularity of self-referential antinomies, where a proposition is equivalent to its own negation, has been used for the establishment of internal limitations on certain formalisms.<sup>7,8</sup>

#### 2. Mechanism.

Whether in dealing with the organization of systems or with the structure of languages, hardships with self-referential situations have the same root: the distinction between actor or operand, and that which is acted or operated upon, collapses. There seems to be an irreducible duality between the act of expression and the content to which this act addresses itself; self-referential occurrences blend these two immiscible components of our cognitive behavior and engender a dual nature which, apparently, succeeds in escaping this universal behavior and thus seems peculiar in our knowledge. Their peculiarity lies in being self-indicative in a given domain, in standing out of a background by their own means, in being *autonomous* as the strict meaning of the word enounces.

dean is a liar precisely because it is *not* a liar, that is, the epimimidean sentence is, in the extended calculus, autonomous not anomalous.

#### 6. The Extended Calculus and General Systems.

I have already stated my view that the calculus of indications is a sound basis for a theory of general systems, insofar as it provides a grounding for every description of any universe. I also believe the present calculus to have a similar bearing on those systems which are self-referential in nature. In fact, I have undertaken the present work urged by the need of tools to deal adequately with the organization of living systems.<sup>1,2</sup> Lacking the actual presentation of results, I can only say here on the basis of my unpublished work, that this approach is, to say the least, very fertile.

#### 7. The Imaginary State and the Intercrossing of Domains.

In this calculus antinomic forms are allowed to appear without restrictions and thus we have found a way to *construct* from an antinomic situation, which, formerly, we might have avoided rather than face. By not doing so, we have found a new, wider domain where all the preceding forms can be lodged. A similar case, at the numerical level is to be seen in the construction of the complex number,<sup>12</sup> starting from the antinomic form of  $x^2 = -1$ , not solvable in the real domain because it needs a number which is both positive and negative. This antinomy is solved by admitting this behavior within a larger arithmetic containing a new value  $i = \sqrt{-1}$ , and thus extending the real domain to the complex domain. In analogy, we have presented a similar construction at the Boolean level. By allowing an antinomic form (from the point of view of logic) we have constructed a new larger domain akin to the complex plane, where new forms can be lodged, including those of the preceding primary domain found to be in conflict by the introduction of re-entering expressions. Again, rather than avoid the antinomy, by confronting it, a new domain emerges.

This intercrossing of domains at the point of self-referring, hence, antinomic, situations in a given domain, repeats itself. The most impressive instance being the appearance of living systems when a set of chemical productions closes-onto itself to become a self-productive and self-constructive unity. Later on, when in a living system cognitive structures become capable of self-

description, again a significant new domain emerges, that of self-consciousness. By uniting two constituents of a domain, producer and produced, description and describer, into a third state which blends the two preceding ones through circular closing, we see the appearance of a much more inclusive domain. It appears as if different, successively larger levels are connected and intercross at the point where the constituents of the new lower level refer to themselves, where antinomic forms appear, and time sets in. We recognize this fact in ordinary speech.<sup>16</sup> When trying to convey a description of a new domain we often construct an apparent antinomy to induce the listener's cognition in a way such as to compel his imagination towards the construction of a larger domain where the apparent opposites can exist in unity. (A moral example: once you lose everything, you have everything; a philosophical one: a being is when it ceases to be).

Thus self-reference is the hinge upon which levels of serial inclusiveness intercross. Rather than recording any particular such instances (as in some of the above example) the extended calculus provides a record of the general form of this situation, and can serve, therefore, as the paradigm for all of them.

#### 8. Conclusion.

The starting point of this calculus, following the key line of the calculus of indications, is the act of indication. In this primordial act we separate forms which appear to us as the world itself. From this starting point, we thus assert the primacy of the role of the observer who draws distinctions wherever he pleases. Thus the distinctions made which engender our world reveal precisely that: the distinctions we make—and these distinctions pertain more to a revelation of where the observer stands than to an intrinsic constitution of the world which appears, by this very mechanism of separation between observer and observed, always elusive. In finding the world as we do, we forget all we did to find it as such, and when we are reminded of it in retracing our steps back to indication, we find little more than a mirror-to-mirror image of ourselves and the world. In contrast with what is commonly assumed, a description, when carefully inspected, reveals the properties of the observer. We, observers, distinguish ourselves precisely by distinguishing what we apparently are not, the world.

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

▪ from Varela, "A Calculus for Self-Reference"

p.7:

### 3. *Notation.*

Let the autonomous state be marked with the mark  $\square$ , and let this mark be taken for the operation of an autonomous state, and be itself called self-cross to indicate its operation.

Initial 2: Order

$$\overline{\square} = \quad \text{I2}$$

Initial 3: Constancy

$$\overline{\overline{\square}} = \square \quad \text{I3}$$

p.22:

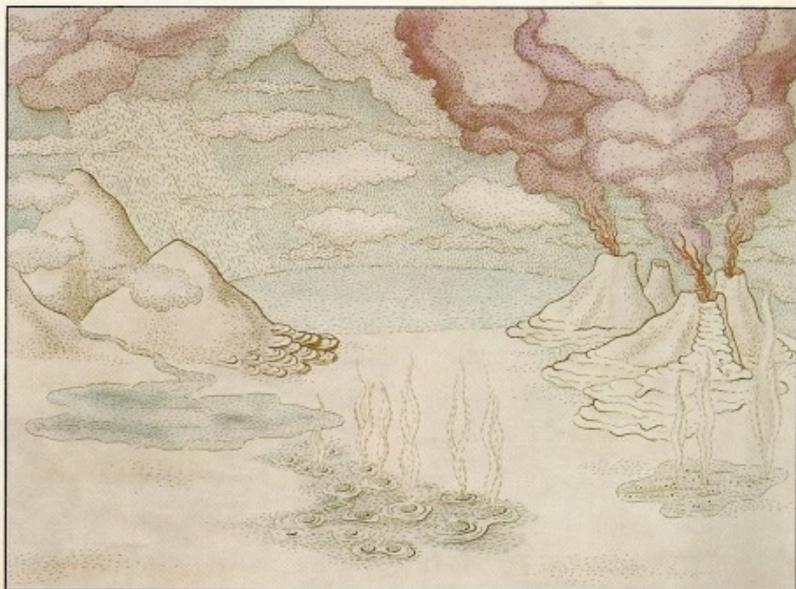
### 7. *The Imaginary State and the Intercrossing of Domains.*

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1975

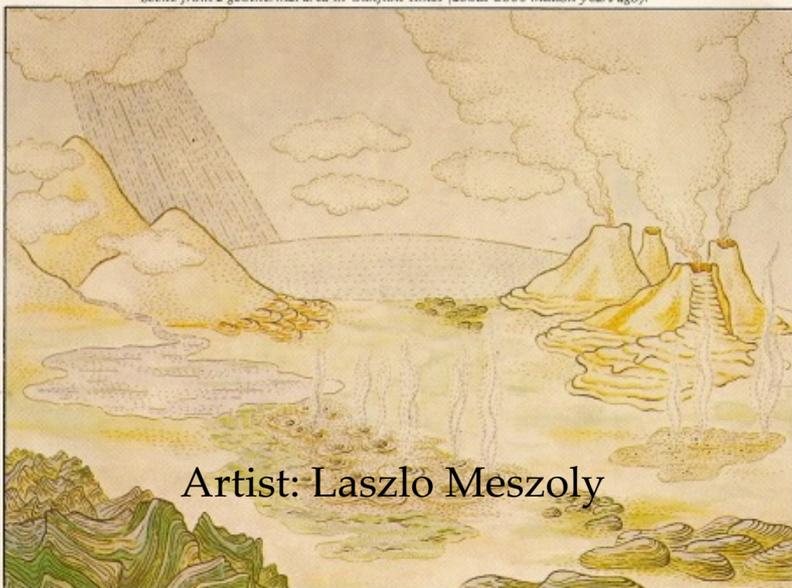
*CoEvolution Quarterly* publishes Margulis and Lovelock's "The Atmosphere as Circulatory System of the Biosphere: The Gaia Hypothesis." Their explorations begin from the concept of the biosphere as a "biological cybernetic system."



Scene from a geothermal area in Fig Tree times (about 3400 million years ago).

## The Gaia Hypothesis

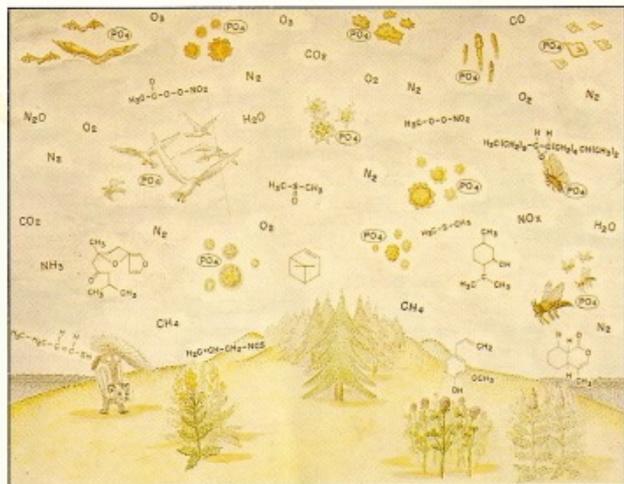
Scene from a geothermal area in Gunflint times (about 2000 million years ago).



Artist: Laszlo Meszoly

# The COEVOLUTION

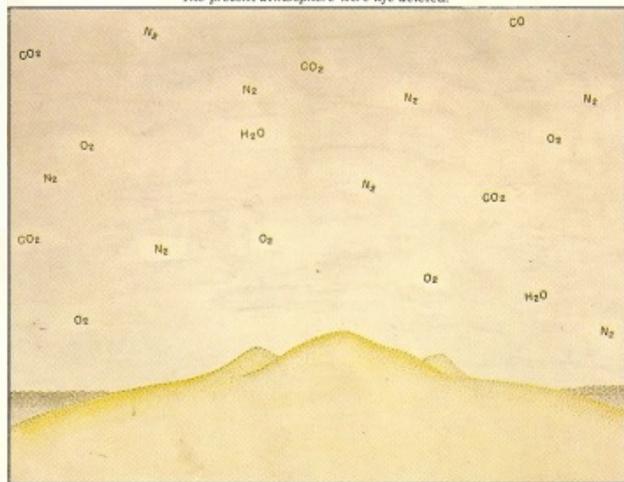
Quarterly



Earth's atmosphere at present.

## The Gaia Hypothesis

The present atmosphere were life deleted.



- from Lynn Margulis and James E. Lovelock, “The Atmosphere as Circulatory System of the Biosphere: The Gaia Hypothesis” CQ 6 (Summer 1975): 32-33.

discussed elsewhere (8). The purpose of this paper is simply to present our reasons for believing the atmosphere is actively controlled.

Traditional atmospheric studies have left us with some strange anomalies. The atmosphere is an extremely complex blanket of gas in contact with the oceans, lakes, rivers (the hydrosphere) and the rocky lithosphere. It has a mass of about  $5.3 \times 10^{21}$  grams.



*Lynn Margulis*

Many facts about the atmosphere are known — its composition, its temperature and pressure profiles, certain interactions with incoming solar radiation, and the like (7). Some of these are shown in Tables 1 and 2. However as the efficacy of long range weather forecasting attests, there is no consistent model of the atmosphere that can be used for the purpose of prediction (6). The Earth's atmosphere

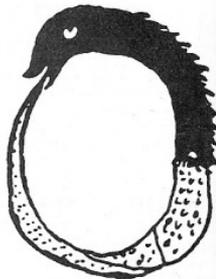


*James Lovelock*

1976

*CoEvolution Quarterly* publishes a lengthy interview with Francisco Varela, "On Observing Natural Systems."

# 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-reference 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 criteria 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.

The fact that wholes have this closed organization implies that in order to describe them we have to deal with self-referential descriptions. You wind up with functions that are functions of themselves, or interactions that interact with themselves, properties that compute themselves, and so on. This has a very weird flavor for most people, because the tradition in the scientific discourse has been that this is not something we can consider. The main trend has been to put it completely aside; anything that is self-referential is a "vicious circle." It was even called a vicious circle by Saint Thomas of Aquinas.

**Johnson:** We're all vicious circles.

**Varela:** Yes, but we were forbidden to deal with that in all its formal precision by the Russell-Whitehead Theory of Types, which requires us to completely break up any circularity by establishing a hierarchical form. This is the convention which is predominant, in classical science and therefore in system theory. It's hierarchical; you have input — system — output. You have the beginning and the end, and the beginning is the beginning and the end is the end; there is no confusion between the two. But if you are to really look at wholes, you can't do that. You have to look at the beginning and the end as a circle. So you cannot deal with them hierarchically, you have to look at them as self-referential situations.

**Johnson:** So studying the organization of a whole system is studying the nature of its self-reference?

**Varela:** That's it. That is, the kind of self-referential organization that has provided the stable properties that it shows. And this is what gives the system its nature. When you have a closed interaction of chemical productions, you can have a cell, and not before that. When you have a closed interaction of descriptions, you can have self-consciousness, and not before. When you have a closed interaction of species, you have an ecological system, and not before. That is, the closure, the self-referential-ness, seem to be the hinges upon which the emergent properties of a system turn.

**Johnson:** Are we dealing here with natural systems exclusively, or also with designed things?

**Varela:** Designed systems can be looked at as closed systems, but most designed systems can be understood in a hierarchical analysis, because they are designed to have a purpose. But how can you do that with, say, a dog? The dog has an

*Taciturn systems are those for which the observer asserts or discovers the goal (purpose in), which is thereafter equated with the purpose for the system in question. In contrast, language oriented systems can be asked or instructed to adopt goals by anyone who knows the object language and they may state and describe their own goals, using the same medium; in a very real sense these are "general purpose" systems.*

Gordon Pask in "The Meaning of Cybernetics in the Behavioral Sciences," *Progress in Cybernetics*, vol. 1, Gordon Breach, New York, 1969, p. 25.

organization which manifests itself in a certain behavior which arises from its organization — but it's not designed to have a purpose for it.

We should remark that when we talk about natural systems, in no way do we imply that a man-made or designed system is "unnatural." That is, the word "natural" here is functioning in an ambiguous sense. Every man-made system



Francisco Varela and his daughter

is of course also natural, in the sense that whatever we humans do belongs to the same natural order as what birds do. The connotation of "natural" here, then, as in "natural system," is only one of non-design, in contradistinction to manmade or designed.

**Johnson:** So any system can be looked at in terms of its closure. . . .

**Varela:** As a matter of fact a system is stable because of its closure of organization, that's the source of its stability. Now this was already identified by Wiener, by his central concept of feedback. The notion of feedback is a self-referential one, but it was seized by the engineers who made it appear hierarchical. They apply a reference signal, identify input and output, and the output affects the input with a little delay. So the self-reference becomes hidden underneath, because of the trick of dealing with it in time.

But time, that trick of dealing with in time, can work only at a very concrete or numerical level of description. As soon as you abstract properties a little bit more, for instance in a situation where you don't have access to a time delay, you are stuck with a self-reference language. And the structure itself is of course timeless, the computation of the structure is timeless, so it's a self-referential organization.

**Johnson:** Do you think it's an obvious point that all whole systems are self-referential?

**Varela:** I think it's obvious once we see it. It's not obvious in general because the history of modern Western thinking has pressed upon us the convention of putting self-reference in a cognitive blind spot.

But everybody intuitively understands mutual interactions in a whole system. If I try to understand how my brain interacts with my liver, I know right away that it is not that my brain acts on my liver in hierarchical form but that my liver also acts on my brain, in a simultaneous fashion.

Unless you confront the mutualness, the closure, of a system, you just lose the system. It is the simultaneity of interactions that gives whole systems the flavor of being what they are.

[more →]

1976

That fall Varela is invited to a symposium hosted by *CoEvolution Quarterly's* Stewart Brand and Gregory Bateson and also attended by Heinz von Foerster, Gordon Pask, Mary Catherine Bateson, and Terry Winograd.

# MIND/BODY DUALISM CONFERENCE

## POSITION PAPERS

*Organized by Gregory Bateson and myself, a conference addressing the pathology of Cartesian mind/body dualism was held at the Wheelwright Center in Marin County, California, July 27th to 30th, 1976. Participants were Gregory Bateson, Francisco Varela, Heinz Von Foerster, Richard Baker-roshi, Ramon Margalef, Gordon Pask, Alan Kay, Terry Winograd, Mary Catherine Bateson, Steve Baer, Stewart Brand, Robert Edgar, and Carol Proudfoot. Below is Gregory's invitational paper, followed by three of the position papers. Portions of the proceedings and some more of the position papers will appear in later CQs.*

—SB

### **Invitational Paper**     *by Gregory Bateson*

1. The human species, perhaps since the evolution of language, has attached strange importance to "spiritual," "mental," "moral," and even "supernatural" aspects or components of life and death.

proposes the same dualism, and I hope that the conference members will be able to agree at the start that the old compromises between "supernatural" religion and "materialist" science are artifacts of a false division and by-products of the meeting between unsophisticated theology and equally unsophisticated science.

1976

At that meeting Varela presents “Not One, Not Two,” a tour de force rethinking dialectics along second-order lines as “Star Cybernetics.”

# NOT ONE, NOT TWO

## Position Paper for the Mind-Body Conference

BY FRANCISCO J. VARELA

This paper has two parts. In the "Notes on Dialectics" I develop some ideas that apply to dualities quite generally. In the "Epilog," I have stated my ideas on the Mind-Body Problem from the perspective taken in the notes.

Briefly stated, my feeling is that if there is going to be a change in our perception of the Mind-Body relation, there has to be a change in the context in which the problem is seen to arise. This implies, at least, a change

- (i) in the logic used to understand that dialectics and wholes are;
- (ii) in the scientific ideas about what mind is, (moving away from the brain-secretion image, towards an understanding of mind as conversational domain); and
- (iii) in the cultural conceptions about mind, (which restrict the kind of experience that are socially and individually accessible).

Points (i) and (ii) are treated in the following Notes. In the Epilog, (iii) is considered separately.

### I. NOTES ON DIALECTICS

Thus the slash is to be taken as a compact indication of a way of transiting to and fro both sides of it.

0.3 In the sections that follow I would like to show

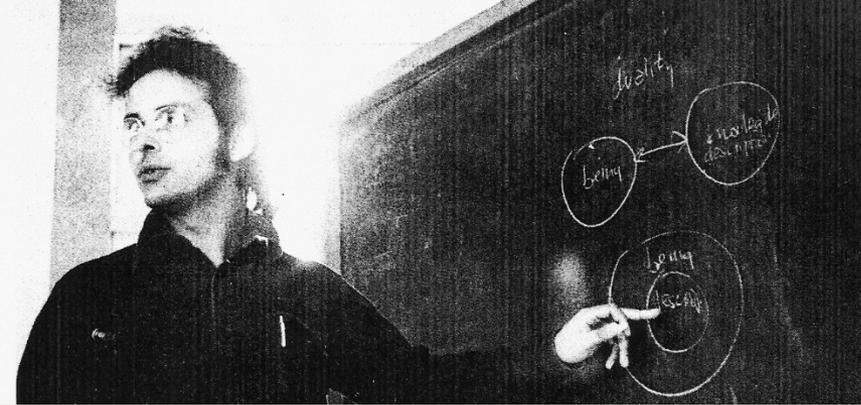
- (i) that the Star \* is effective, i.e. it is a way to proceed from disjoint pairs to their unity in a metalevel, and;
- (ii) that one can map (project, reformulate) in Star a number of dualities, the Mind-Body included, and;
- (iii) that Star is (can be taken to be) a compact expression to signify a broad paradigm encompassing that series of convergencies rightly demanded by Bateson:  
cybernetics ↔ epistemology ↔ evolution ↔  
ethics ↔ cognition ↔ ecology

### 1. Star Cybernetics

1.1 The first aspect (i) of Star that I want to consider is the cybernetics contained in it. Let us transcribe Star into the more convenient form of

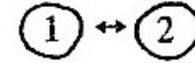
\* = "network/trees constituting the network."

In this paper, Varela describes a crucial shift out of Hegelian dialectics as a move from *asymmetry* focused on antithetical opposites to *self-reference* focused on emergence and imbrication.



Francisco Varela, "Not One, Not Two: Position Paper for the Mind-Body Conference," CQ 11 (Fall 1976)

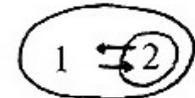
3.1.1 In what I call the classic or hegelian paradigm, the notion of dualities is tied to the idea of polarity, a clash of opposites. Graphically:



3.1.1.1 The basic form of these kind of dualities is symmetry: both poles belong to the same level.

The nerve of the logic behind this dialectics is negation: all pairs are of the form  $A/\text{not-}A$  (e.g.,  $+/-$ , *oppressor/oppressed*).

3.1.2 In our (shall we say) cybernetic or post-hegelian paradigm, dualities are adequately represented by imbrication of levels, where one term of the pair emerges from the other. Graphically:



3.1.2.1 Several paraphrases for what I want to say are the following:

Mythology: female gives birth to male which fertilizes female.

Cognition: intuitive understanding gives a ground for logical thinking which leads to intuitive understanding.

Cybernetics: a whole decomposes in parts which generate processes integrating the whole.

Formalism: a net chopped into trees that generate the net by infinite branching.

3.1.2.2 The basic form of these dualities is asymmetry: both terms extend across levels.

The nerve of the logic behind this dialectics is self-reference: pairs of the form: *it/processes leading to it*.

1978

Lindisfarne Association founder William Irwin Thompson takes the podium at the Whole Earth Jamboree celebrating the 10<sup>th</sup> anniversary of the *Whole Earth Catalog*.

**SB:** William Irwin Thompson is one of those authors where people grab you by the arm and say, "Have you read . . .?" In my case, it was, "Have you read *The Edge of History?*" By one of the ironies of edges of history, William Irwin Thompson's book and the *Whole Earth Catalog* (I've got to phrase this carefully) were both up for the Contemporary Affairs Category of the National Book Award in 1972. And in the flukey politics of that business, one of the judges, a fellow named Gary Wills, was so outraged that the *Whole Earth Catalog* would be considered for such an award that he quit as a judge, and the other two judges, Harrison Salisbury and Digby Diehl looked at one another and gave the prize to the *Catalog*. So when we first met, I felt that Bill Thompson was a little uncertain toward me. I thought that he should be uncertain toward Gary Wills. Since then Bill has done other good books, but he has been most active as the co-founder and head of Lindisfarne Association, which has put together a remarkable number of people and events somewhat more private but in many ways very similar to this.

## WILLIAM IRWIN THOMPSON

It is absurd to give a lecture in five minutes, so I'm going to be even more absurd to try to give a mini-lecture on one end of history to the other in 4-1/2 minutes. The geologists who spoke before me have tried to give us a sense of where we are as a way of gaining a sense of where we are going, so I want to talk about history by talking about cultural change, about six great cultural transformations: the Hominization of the primates, Symbolization and the origins of notation and art in the Upper Paleolithic, Agriculturalization in 9000 B.C., Civilization in 3500 B.C., Industrialization in the eighteenth century A.D., and the cultural transformation we are in now, Planetization.



Larry Keenan, Jr.

the internal life of the womb, with ovulation at the full and menstruation at the dark of the moon. In observing this synchronicity between their bodies and

CQ 20  
(Winter  
1978)

1978-79

Varela becomes the second Lindisfarne Fellow-in-Residence (Bateson is the first), residing at the Manhattan campus while completing *Principles of Biological Autonomy*.

Varela at Lindisfarne



# 1981

Varela co-organizes the 1981 Lindisfarne Fellows Conference on the theme “Biology and the New Image of Humanity.” Attendees include Heinz von Foerster, Humberto Maturana, Lynn Margulis, and James Lovelock.

Heinz von Foerster and Francisco Varela at the 1981 Lindisfarne Fellows meeting, Wheelwright Center, Green Gulch Farm Zen Center



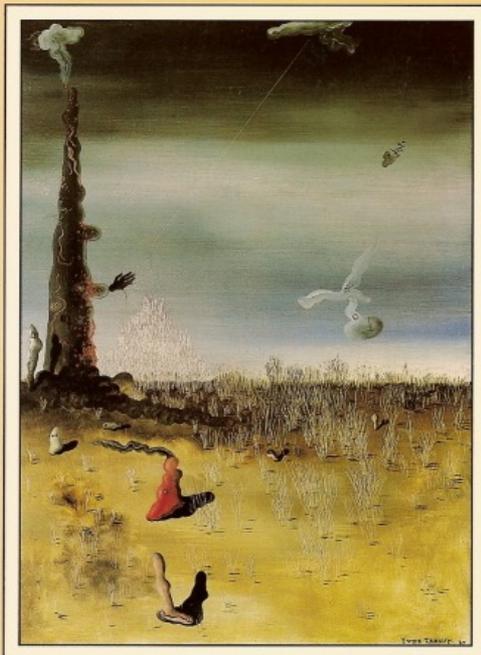
1981, 1988

The inventors of autopoiesis Maturana and Varela encounter the developers of the Gaia hypothesis Lovelock and Margulis at two Lindisfarne Fellows meetings that lead to two volumes of essays.

# 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

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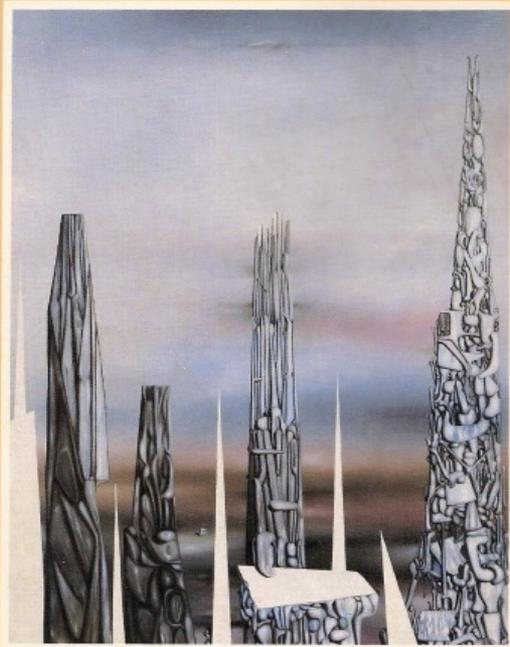
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Lindisfarne Press, 1987

# GAIA · 2

## E·M·E·R·G·E·N·C·E

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

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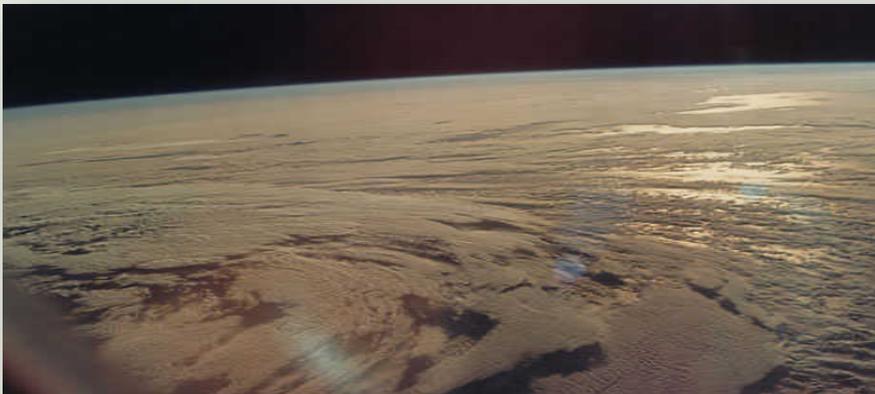
Hierarchical Levels, Emergent Qualities,  
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Lindisfarne Press, 1991

In the transcript of the “General Symposium” held at the end of the 1988 meeting in Perugia, Italy, Varela reconceived the Gaian system as “a fully autonomous system . . . whose fundamental organization corresponds to operational closure.”



Lynn Margulis and Francisco Varela in Italy

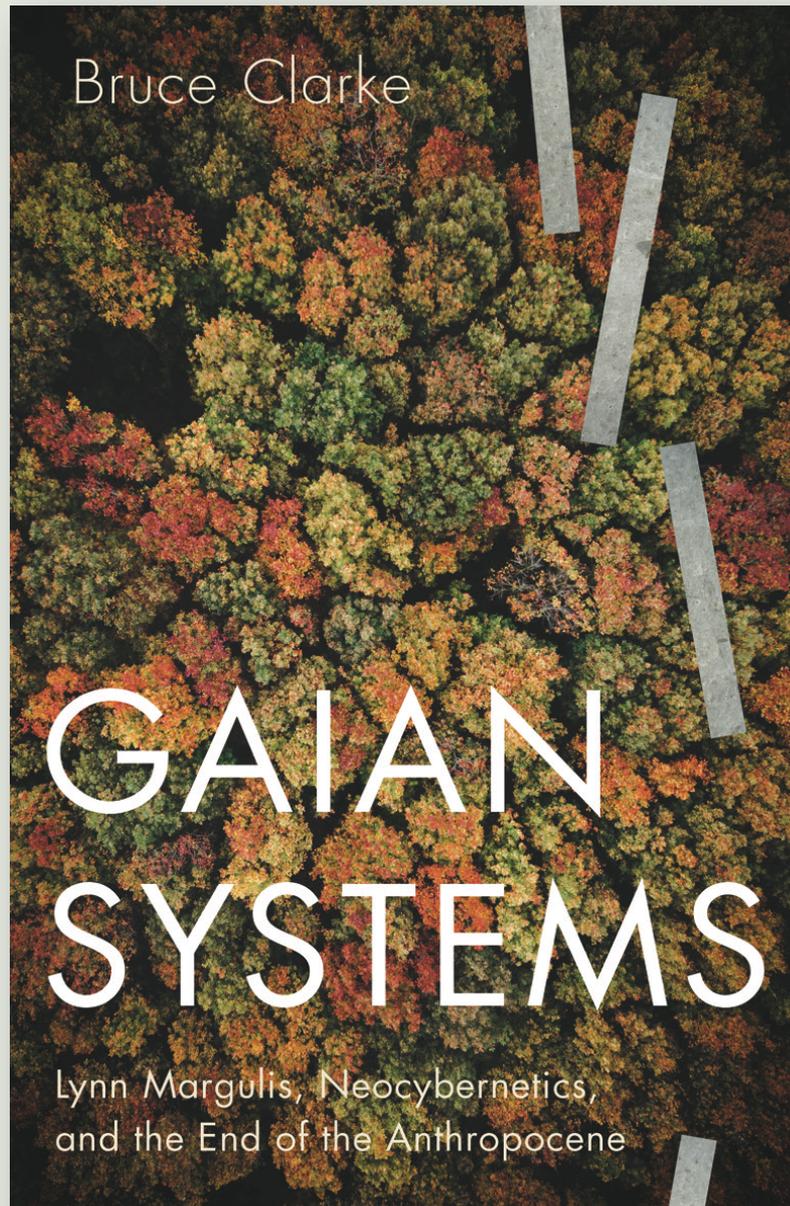


▪ Francisco Varela, from “From Biology to Cognitive Science: General Symposium on the Cultural Implications of the Idea of Emergence in the Fields of Biology, Cognitive Science, and Philosophy,” in Thompson, ed., *Gaia 2: Emergence, The New Science of Becoming* (1991):

“The quality we see in Gaia as being living-like, to me is the fact that it is a fully autonomous system . . . whose fundamental organization corresponds to operational closure . . . a form, if you like, of fully self-referential network constitution that specifies its own identity. . . . Autonomy, in the sense of full operational closure, is the best way of describing that living-like quality of Gaia.”

1990

Lynn Margulis extends the concept of autopoiesis  
from cellular dynamics to planetary dynamics.



Whereas the smallest recognizable autopoietic entity in today's biota is a tiny bacterial cell, the largest is Gaia, the organismal-environmental regulatory system at the Earth's surface.  
—Lynn Margulis, "Kingdom Animalia" (1990)

Cells and Gaia display a general property of autopoietic entities: as their surroundings change unpredictably, they maintain their structural integrity and internal organization, at the expense of solar energy, by remaking and interchanging their parts. — Lynn Margulis, "Big Trouble in Biology" (1990)