



Cybernetics of Cybernetics: **Hypertext, Cyberspace, and Distributed Cognition**

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University of Illinois

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American Society for Cybernetics
George Washington University, 5 August 2014

Outline

I. Biological Computer Lab: From Babcock's Automaton to *Cybernetics of Cybernetics*

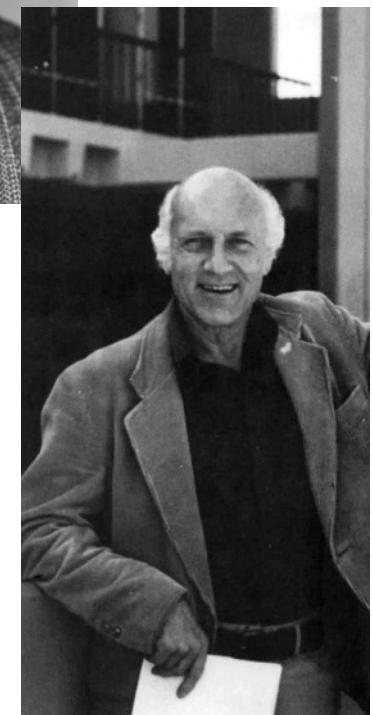
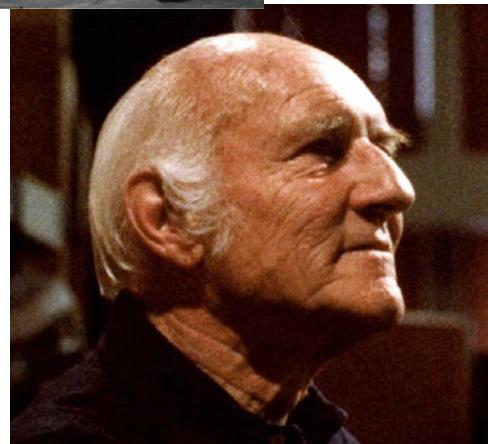
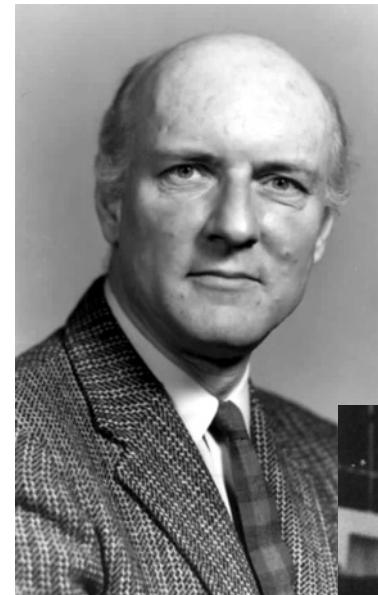
- A. Early years (1958-68): Hardware
- B. Later years (1968-75): Pedagogy

II. *Cybernetics of Cybernetics*

- A. Quick “thumb-through”
- B. Conclusion: How did we get here?

Heinz von Foerster

- Born in Vienna, Austria, 1911
- University of Illinois faculty, 1949-1975
- Macy Conferences, 1949(46)-1953
- BCL, 1958-1975
- “Retirement” in Pescadero, CA, 1975-2002



The Macy Conferences 1946-1953

- Warren McCulloch
- Norbert Wiener
- John von Neumann
- Claude Shannon
- Margaret Mead
- Arturo Rosenblueth
- Gregory Bateson



1953

Theme: Circularly causal and feedback mechanisms in biological and social systems

Biological Computer Laboratory, 1958-1975



Electrical Engineering Research Laboratory (EERL)

The Site of BCL Today



Hutchinson and Mueggenburg, 2008

BCL Staff and Visitors

Staff

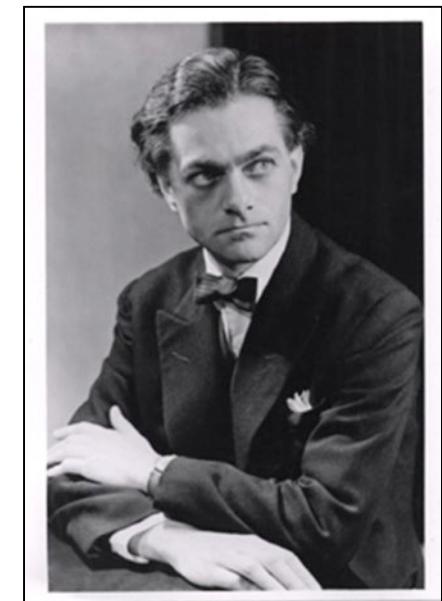
- Ross Ashby
- Murray Babcock
- Gotthard Günther
- Lars Löfgren
- Ricardo Uribe
- Von Foerster
- Paul Weston

Visitors

- John Lilly
- Huberto Maturana
- Gordon Pask
- Francisco Varela



Günther



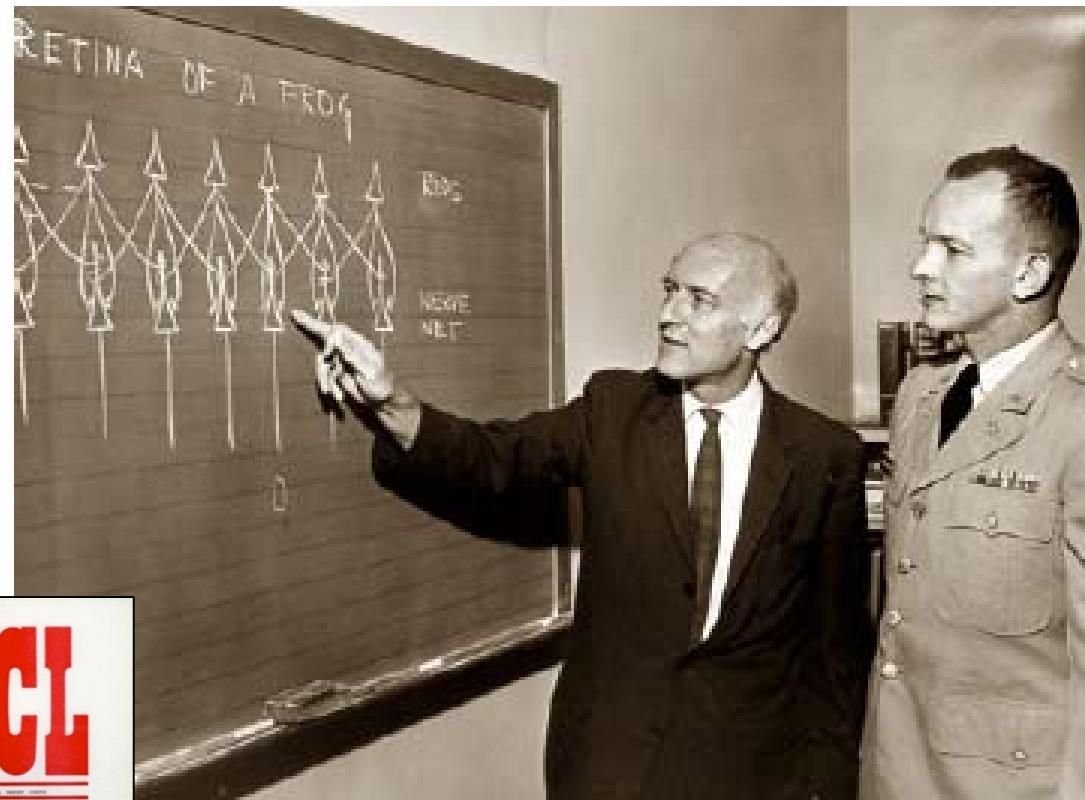
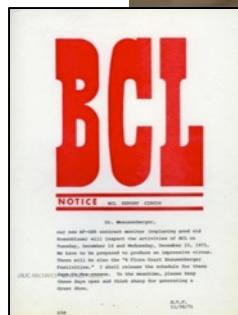
Pask

“[The students] suddenly saw that their so-called professors were their friends.” —HvF

Bionics and Self-Organizing Systems

Bionics
Symposia:

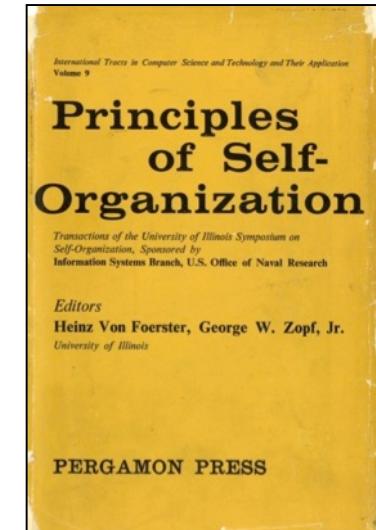
1960
1961
1963
1966



SOS
Symposia:

1959
1961
1962

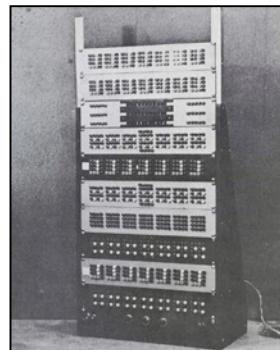
Self-Organizing Systems



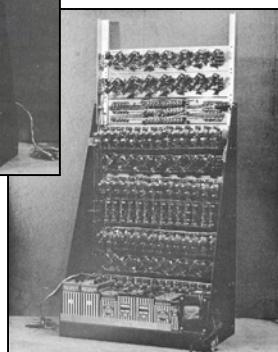
Ashby, Beer, Hayek, Lofgren, McCulloch, Pask, Rapaport,
von Bertalanffy, et al.

Adaptive Reorganizing Automaton, 1960

— ~3 ft



front



rear

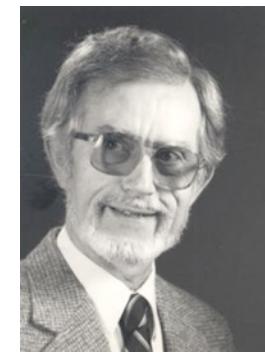


Babcock

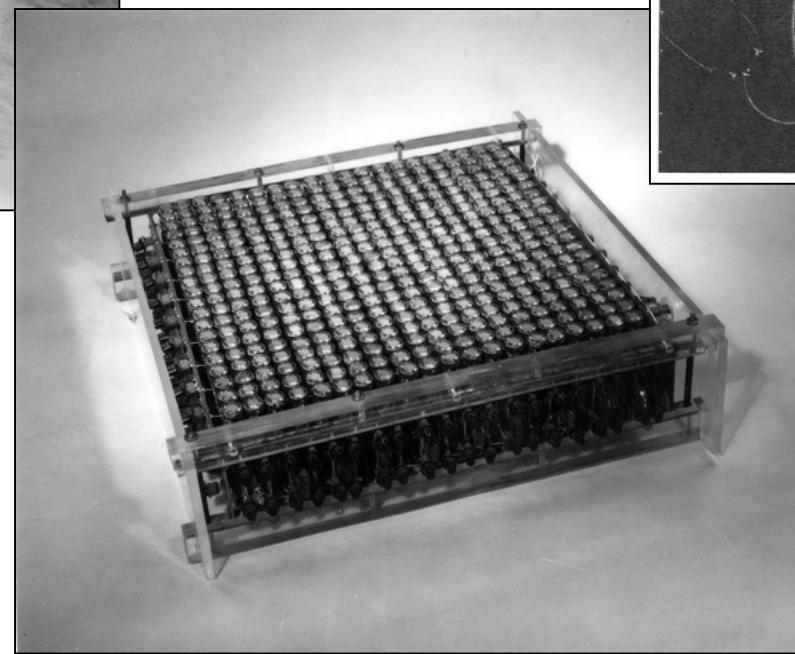
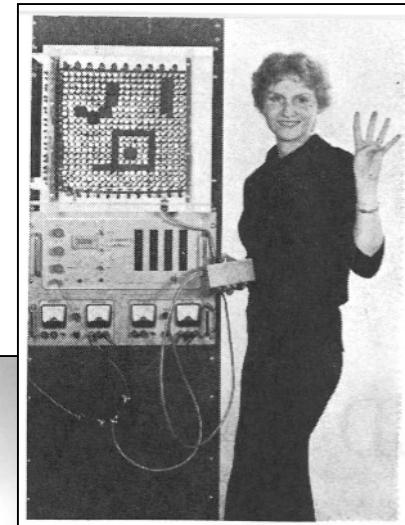
Recreation in
progress by
Hamilton &
Wiedmann



Numarete, early 1960s

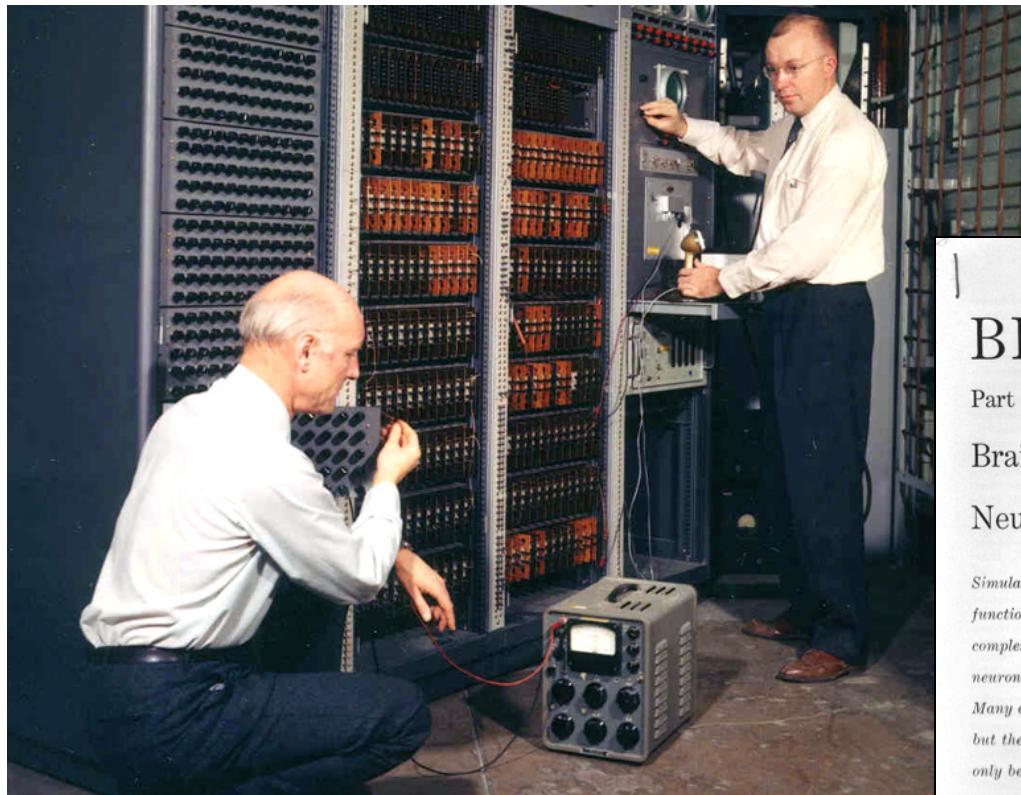


Paul Weston



Featured in
Electronics magazine,
1962, and on CBS

Dynamic Signal Analyzer



Electronics magazine, 1962

BIONICS

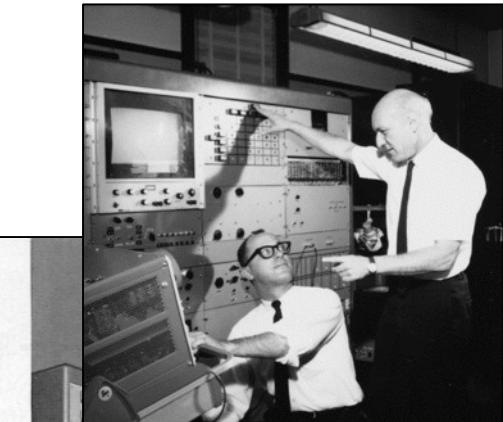
Part III:
Brain Models and
Neural Nets

Simulation of nervous functioning requires design of complex nets of neuron-like elements.

Many approaches are being taken, but the difficult problems have only begun to be tackled.

By NILO LINDGREN, Assistant Editor

THE APPROACHES to understanding and to design of neural-like nets include build-up of neuron-like elements into physical networks; simulation of neural-like structures

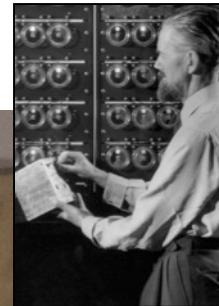


Heinz von Foerster (left) and Murray Babcock of the Biological Computer Lab., University of Illinois, test the dynamic signal analyzer they developed based on property-filtering characteristics of human aural system

logical facts about a neural subsystem and synthesizes a network that will perform useful tasks. One commentator remarks that the first investigator, Rosenblatt of Cornell discovering proofs for theorems in logic. Simon concludes a present need is for programs to explain long-term memory."

The problem of understanding

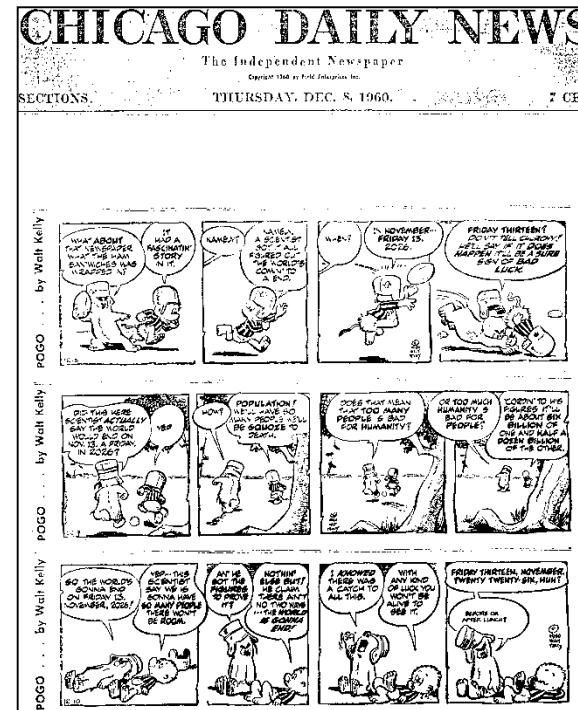
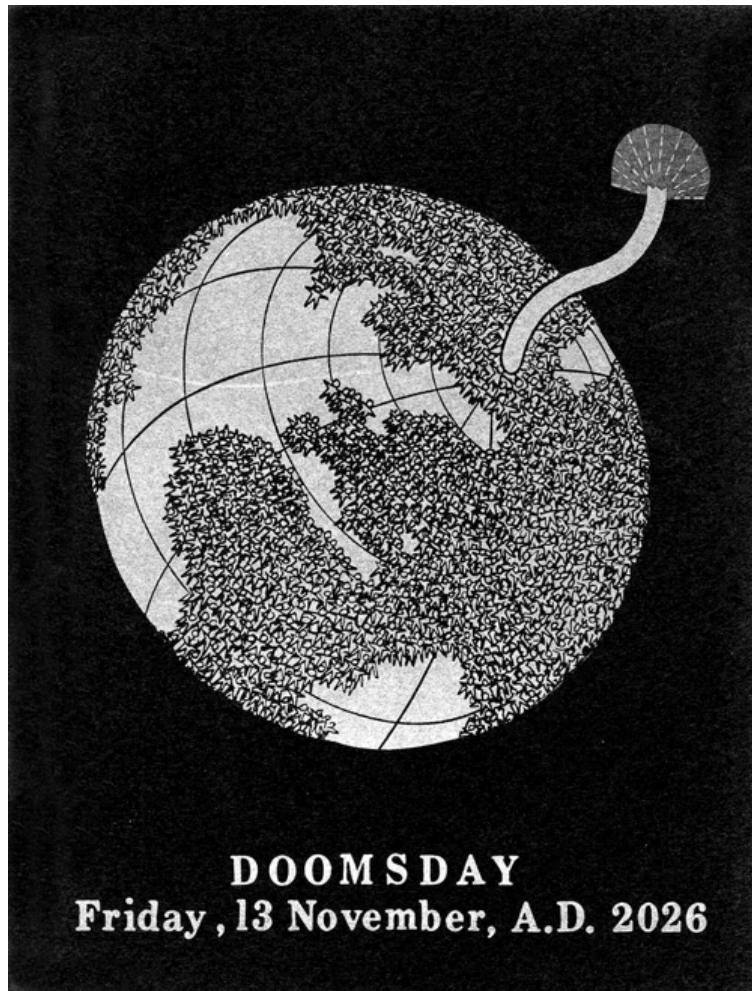
Ashby's Box



An elementary nontrivial machine

Wiedmann and Clarke,
March 2012

Population Studies



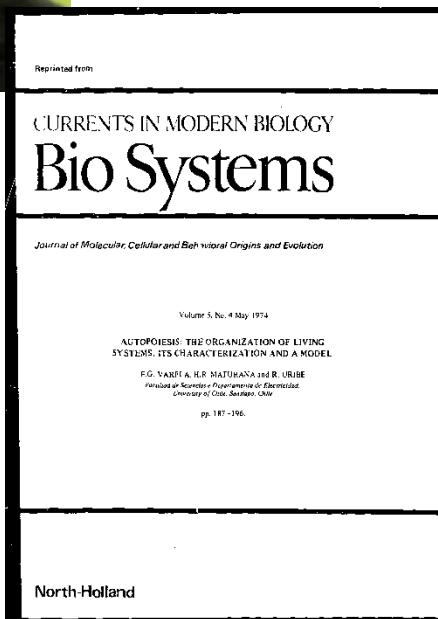
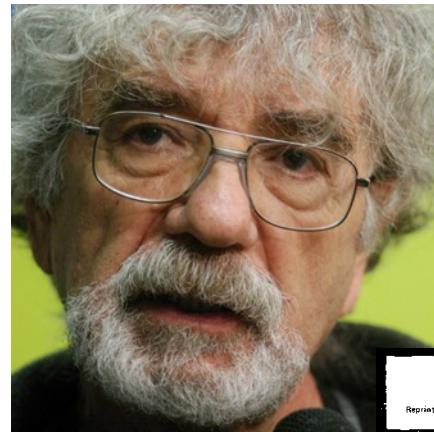
Pogo, 1960:
“Before or after
Lunch?”

$$\frac{\partial N_a}{\partial a} + \frac{\partial N_a}{\partial t} = - N_a \theta.$$

Science, 1960

Von Foerster equation, 1959

Humberto Maturana



"Autopoiesis: The Organization of the Living," Maturana, Varela, Uribe
Bio Systems, May 1974



At BCL with Heinz, 1974

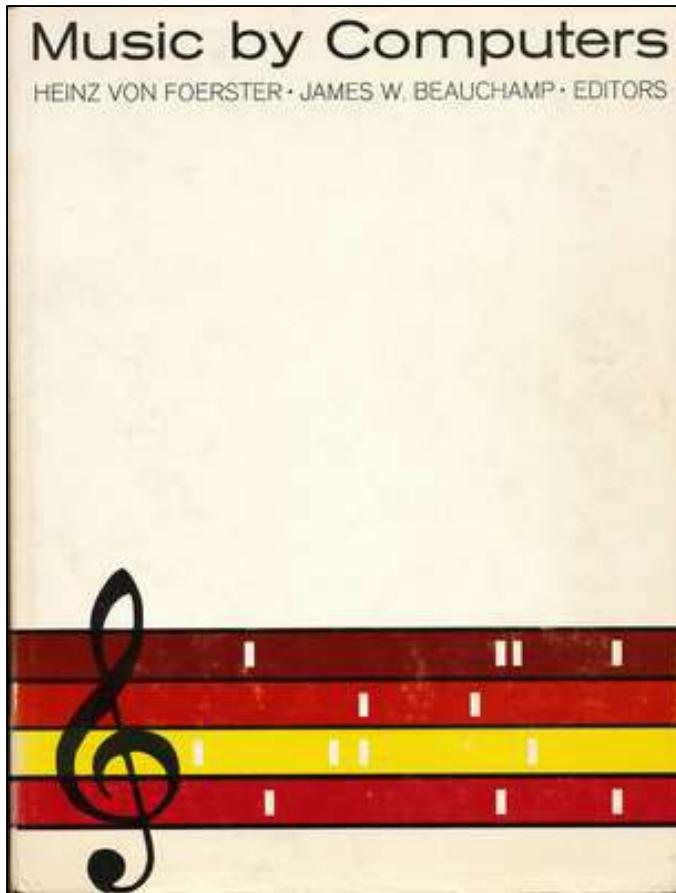
Herbert Brün and Music

Music by Computers

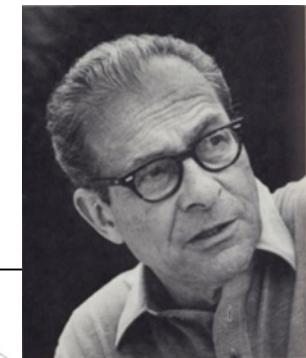
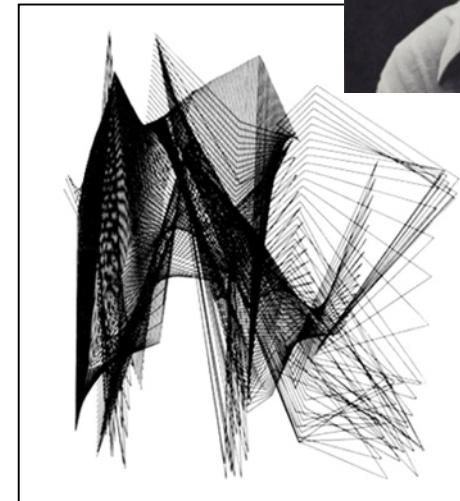
HEINZ VON FOERSTER • JAMES W. BEAUCHAMP • EDITORS

Contributors
include:

Beauchamp
Brün
Freedman
Hiller
Von Foerster



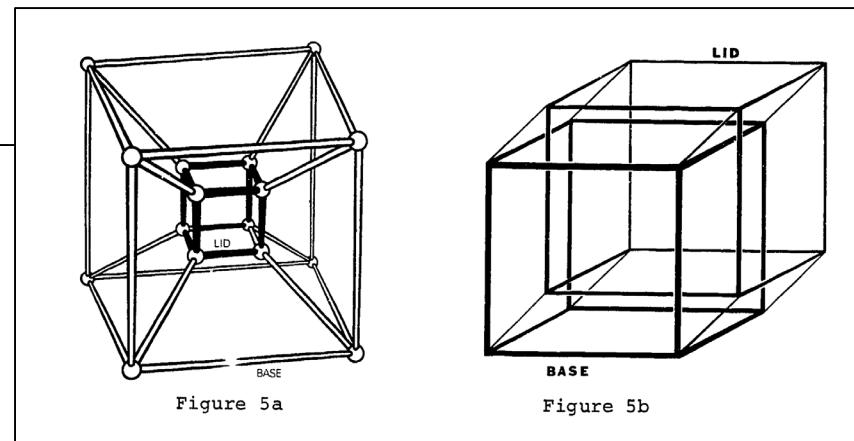
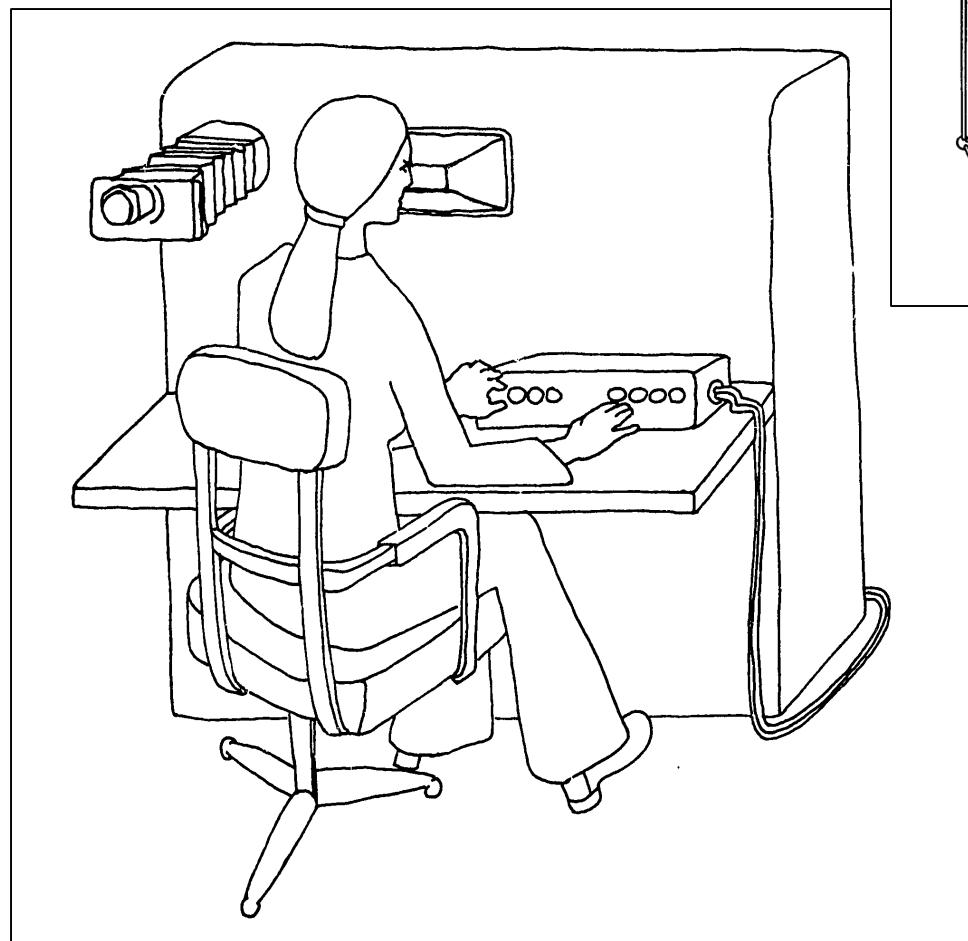
1969



Brün



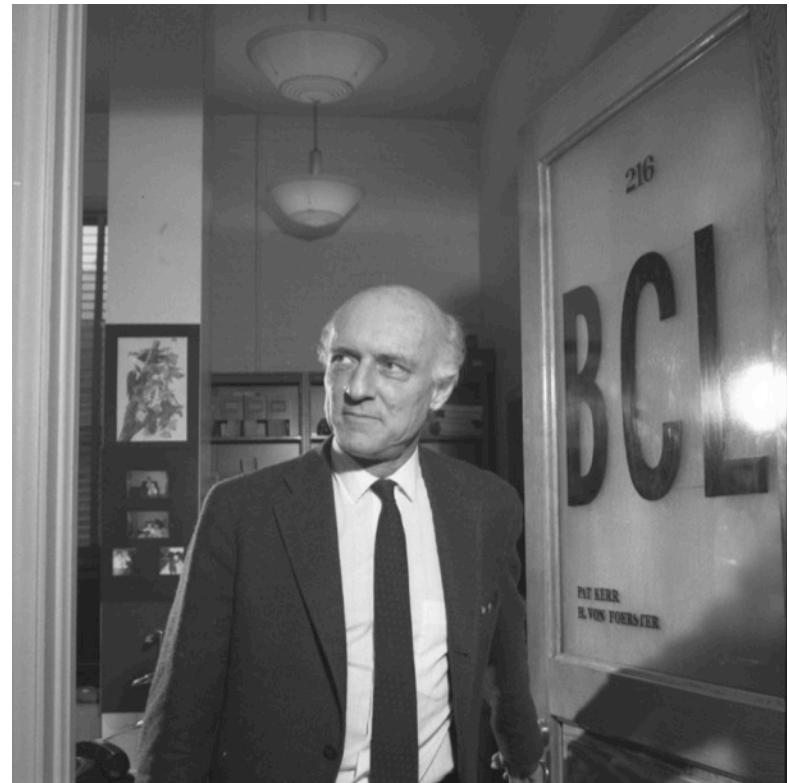
Experiencing the 4th Spatial Dimension



Grad Student Phyllis Arnold
1970-71

Decline of BCL

- Mansfield Amendment (1969)
- Result-oriented spinoffs & related fields (AI, computer science, cog sci, robotics, etc.)
- Grants drying up
- Weak university support





BCL Seminars



1972

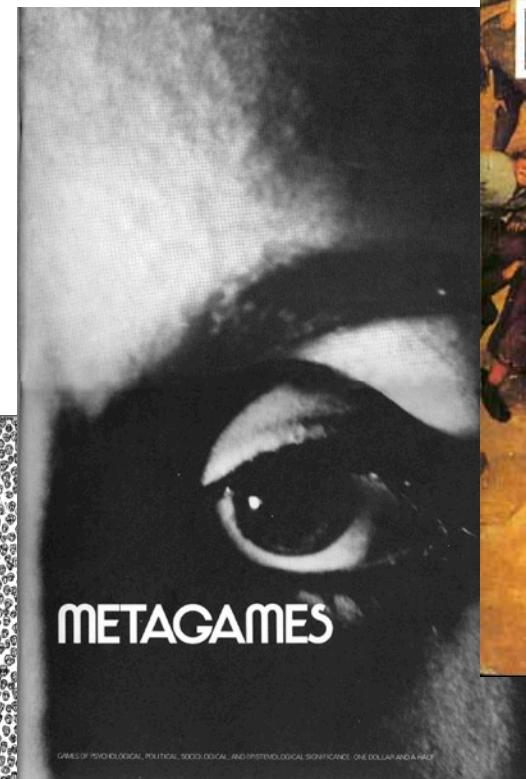
Heuristics Capstone Projects



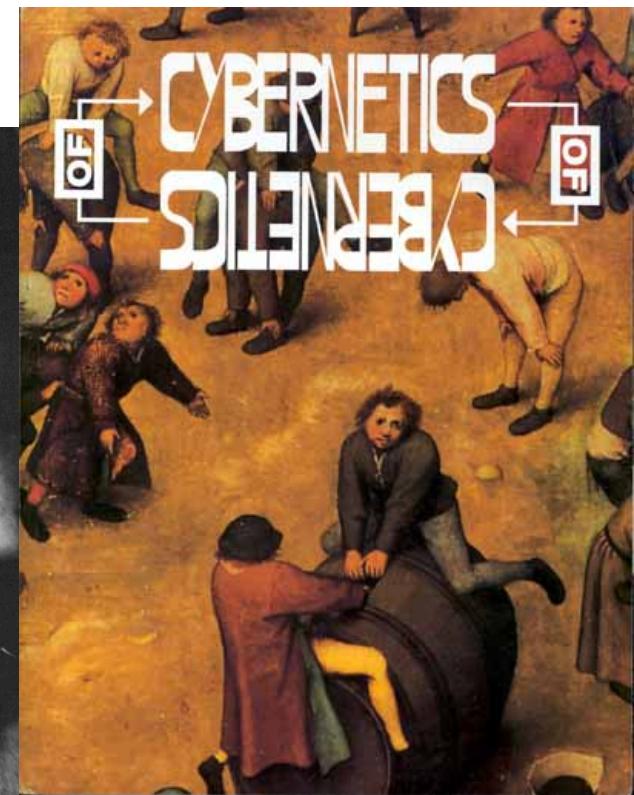
1969



1970

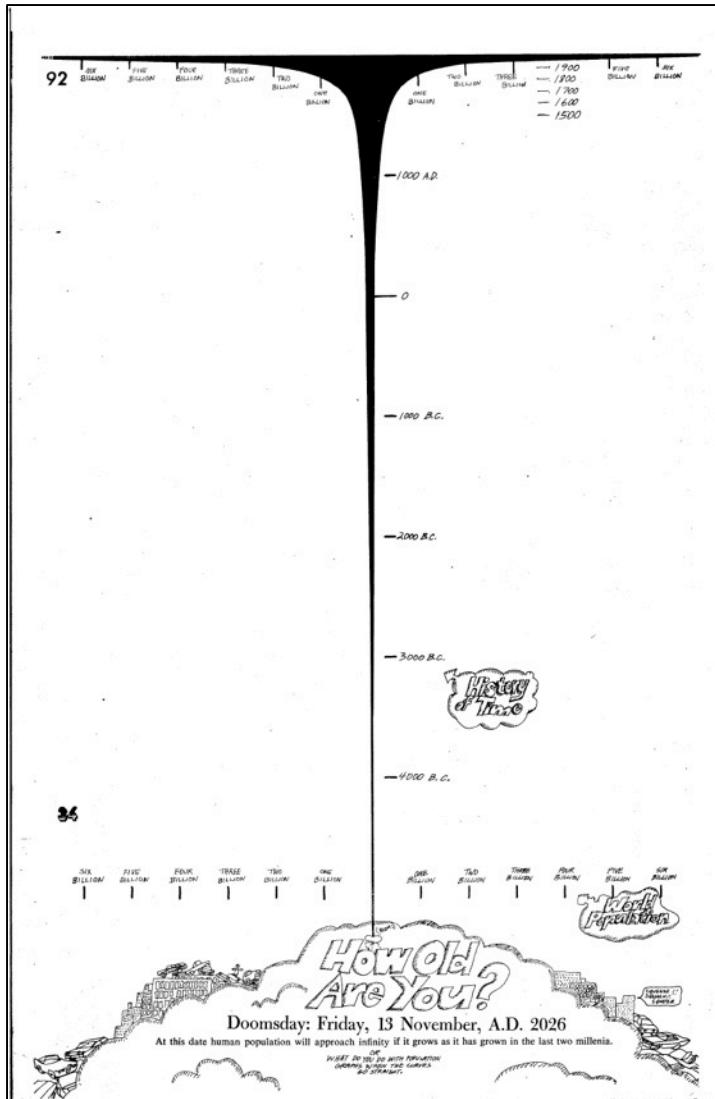


1972



1974

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FUCK THE SYSTEM

"The Time Has Come For Religious Revivalism!"

3. Now do the show, hand signals—here were excellent points for entertainment:
 - a. The first time you do the show, do it as if it's just the two of you—just as though you're about to go to bed and have to sing the song.
 - b. Operate your signals as the house, food, clothes, etc., etc.
 4. If you can construct signs or abbreviations, make them up and use them. You can't be expected to remember all the signals, so make up some simple ones, those used at the theater, where on stage, out of sight, break their furniture (ice, seats, piano, etc.) and then, when you're ready to take stage, move these furniture pieces.
 - a. No name of place, no name of person possible;
 - b. No name of place, no name of person possible;
 - c. For example—water, sofa, chair, window, etc.
 - d. Used to make certain orchestra, dress rehearsal, etc., etc.
 5. Learn stage routes.
 6. Study stage rules and procedures from last year (and now).
 7. Putting scenes over were especially pleasing if certain action followed (other acts).
 8. Stage manager, when you're in the wings, "I see will you be there?" "Yes" you want to know, "Are you here?" "Yes" you want to know.
 9. Stage manager, when you're in the wings, "Please, please, please, all sorts of introductions and other offices of these house interests."
 10. The stage manager, when you're in the wings, "The Long Whistle and when the audience are there keep the curtain up." "Yes" you want to know.
 11. Run the curtain back when you shade the stage lights. Remember that audience are shyer (and more nervous) when they're in the dark.
 12. Your stage manager, "Be sure, Madam, you run our lines for us, as we may say as possible. Each act has its own lines."

Postscript:
Stay high, straighten out your head, and dig other people's.
Get together with your brothers and sisters. Live a revolutionair life.

1. Free Revolution for the Masses XI, New York, Stal Press,
1966, pages 101-102

1. Press, Association for the Study of the New York, Vital Press,
1968, pages 187-192

The Pre-Post Test

30000

The role of the premedical student at the University of Illinois is that of a conscientious and dedicated student who is about to forge the last years of his life as the time may do his thing for meiosis. And the authors are not trying to present the premed as some sort of martyr, just men and women start to think about it, the premed is a LITTLE stressed up.

Based with out-thrust competition where schools would turn in their scores for an "A," required science courses that one couldn't give a name about, and the ever present thought that the guy sitting next to you did not he make sure he gave lots and lots before you do. The professor's note it would areas in terms of government pressure and unpopularity.

Thus the students believe, is not the way it should be. They feel changes should be made within the university as well.

that the provider's licensure is not more than six months. For example, as is required to fulfill many requirements with in the *Guidelines of Lateral Arts* that take up much of this issue, the authors suggest the provider, since he is bound by enough licensure requirements by the medical colleges already, be allowed to program the resolution of his academic career to his license, taking courses and exams as he sees fit.

Another basic change the system would like to see is the administration of a specific major for pre-med students and the creation of a degree in pre-medicine. Outside of fulfilling medical college requirements, one should be able to round out his education as well. If a person has gained the most out of undergraduate years.

The program can now communicate, and should be interested in anyone who is writing and chemistry. Here the student will be extremely competitive. The authors will need encouragement.

483

Disability courses are very important to a person. They form a solid background which is needed in medical school. There are changes needed in the University of Illinois Health Center Department which would help the pre-med get the

Medical students require a minimum of two years of chemistry, divided equally between organic and inorganic. In other words, the medical students are asking for a year of basic chemistry (General) which at Illinois can be fulfilled

By Chemistry 498, 399 or Chemistry 507, 508. Three credit hours.

Approved by Berlin

mentaries, etc., although not always required, a student needs a background in quantitative analysis. Quantitative analysis is included in Chemistry 100 but not in Chemistry 102. The other courses open to the student who takes Chemistry 102 for non-quantitative analysis background involve a ridiculous amount of hours per week. The Chemistry Department should add a three or four hour course, requiring as more than six class hours per week, to the fundamentals of quantitative analysis.

... we feel organic chemistry should be required and should be heavily emphasized by Chemistry 110 or 120 and Chemistry 220 or 230. These courses have had in the past very good enrollment; however, they, especially Chemistry 230, have been directed and geared for the chemistry major, not the general. We believe that when the organic courses should have a special mission for the present.

The biology sequence for the premedical students consists of Biology 110-111. This is a survey course of biology and is basically an interesting course. It is with Biology 110 that one first gets a taste of what is involved in all subjects. It is hoped that the University is not to get press for as we at present, the course is mostly taken by non-medical students.

The authors assessed other biology courses which may be included in the student's program. These are shown in Table 2.

• 04109 431047 0

courses are very interesting and are handled on a very natural level. After a year of competition in this course one will know many discouraged students.

There is one last way this course could be a more helpful one to the student. The students can be given a diagnostic curve and a point system set up. This, in effect, would enable every student in the course to get an "A" if he

or one in eighteen, but does not prevent one from thinking a high grade because a certain percentage of students are doing slightly better work.



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THE UN

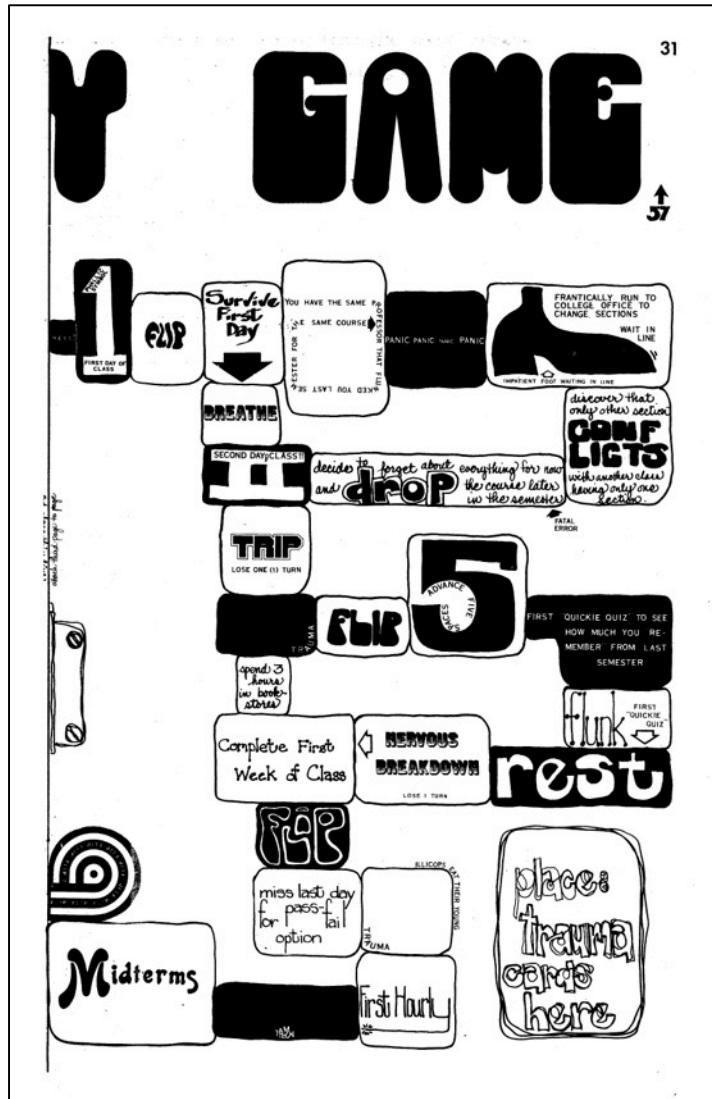
29

IVERSIT

check back often



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HOW TO PLAY THE UNIVERSITY GAME

TO ASSEMBLE THE GAMEBOARD: Turn to Page 31 and carefully tear it from the magazine. Cut along the line aproposely marked "cut along this line" and attach to Page 29 along the line marked "attach third page here." Next, cut out the markers and trauma cards on the bottom half of this page. These can first be mounted on cardboard if desired. The trauma cards are then placed on the space provided in the lower right corner of the assembled gameboard. A cut-out coin is also provided but a real one will work much better. If the cut-out coin is used, it should be mounted on cardboard to ensure the proper flippancy for the game.

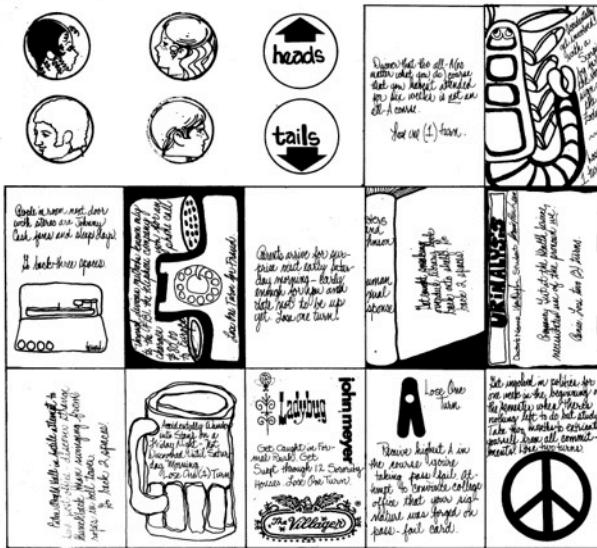
DIRECTIONS FOR PLAY: The game begins at the rectangle marked "Registration." The general direction of play is clockwise but arrows are generally provided to guide the players through bottlenecks. Each player begins on the space at the top of the otherwise unmarked "Panic" section. If ever reaching "Panic" space a coin (or the homemade scale mentioned in the previous paragraph) is flipped. If tails are tossed, the player advances 1 space; if heads appear, 2 spaces. If heads are thrown, the arrows and instructions following the "Panic" space are completely ignored. That is, if diagram (a) is used, the player proceeds directly to the space marked (b) on the diagram.

PROPER FLIPPING OF COIN: The coin is to be flipped in the following elaborate manner to provide players with a false sense of control over their destiny: (1) coin is tossed into air with flipping motion of thumb and fingers. (2) coin begins to fall according to law of gravity. (3) coin's path of descent is obstructed by player's upturned hand. (4) upturned hand snatches coin and closes. (5) coin is placed on back of other open hand and snatching hand withdraws. (6) coin is read, either by looking at it or by the sound it makes.

GOALS OF THE GAME: The object of the game is to reach the outside world (hereafter affectionately referred to as "the pit") by way of graduation. Although the pit is also reached by flunking out or contracting mononucleosis, the only legitimate way to complete the game according to the rules (see below) is to graduate. Variations on the above object may be used such as who can stay on the gameboard the longest without reaching the outside world.

RULES OF THE GAME: (1) Regulations Applying to All Undergraduate Students. (2) Student Handbook. (3) Illini Guidelines. (4) et al.

DIAGRAM:



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DRUGS AND THE UNIVERSITY or THE WHOLE?



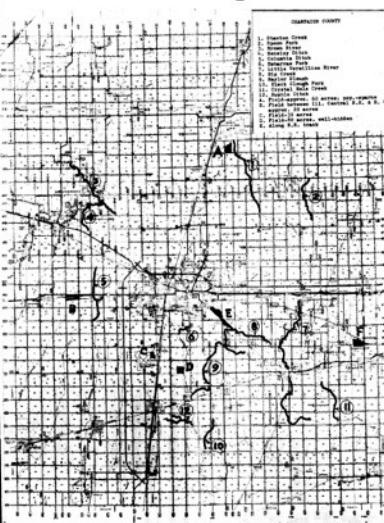
Some of the most popular drugs used at the University are being used by an increasing number of students. The University of Illinois has a large number of students, faculty, administrators, professors, and other persons involved with drugs. These drugs are often used to relax, to relieve stress, to escape from reality, or to experience new sensations. Drugs can be used to relieve pain, to increase energy, or to improve mood. Drugs can also be used to relieve depression, anxiety, or other physical or emotional problems.



ILLEGAL USE OF DRUGS IS SPREADING AT THE UNIVERSITY-TODAY ALL ARE SUSPECT

OPERATION INTERCEPT AND THE ECONOMICS OF MIND EXPANSION

The following map shows the areas where Operation Intercept has been conducted. It highlights the areas where marijuana has been seized and the amount of marijuana seized. The map also shows the locations of major cities and towns in the state of Illinois.



THE DRUG USER PICKS UP HIS DOSE WHICH IS LEFT IN PRE-ARRANGED PICK-UP SPOTS ON CAMPUS.

DRUGS

69

When the university or society in general has you down its nice to get away from it all. Travel provides both rest and relaxation. You can visit various places on the earth or explore the many worlds of your mind. Unfortunately, only a few people can do this without any artificial stimulation. Certain drugs are a means by which you can visit the many different dimensions of thought. Drugs enable you to see realities other than that which society dictates. Basically drugs intensify your thoughts with LSD being the most intense and Marijuana being the least. We recommend that you neither try drugs nor that you stop using them for it is the consequences that we are uncertain of. We only attempt to catalogue the dope available to students on this campus.

GROUP	NAME & COLOR	TYPE	QUALITY	ORIGIN	PRICE	COMMENTS	Shoot
ACID	orange Onley	flats	4*	Calif.	\$3	really fine	yes
	purple	hard wax	0*	T	free		yes
		tab					
	purple	domes	4*	Berkeley	\$2		yes
	yellow	tab	0*	Hall	free	cut with strichnine	no
	orange	domes	2*	Calif.	\$2	Average	yes
	blue double	dimple	4**	Calif.	\$2	100 mgs. of the best	yes
		domes*					
	acidizing white	domes	4***	Calif.	\$2	750 mgs. of the blue dimple domes	yes
	smokers						
	pink double	Hubcaps	4*	Berkeley	\$2		yes
M.D.A.	drop on salox		4*	Madison	\$3	exquisite	no
	drop on something			Champaign	\$1	150 mgs. pure; real good	yes
S.T.P.	Quinn (orange)	huge tabs	the sun	Calif.		made me quit dropping	yes
		tab					
MESCALINE	orange			Berkeley	\$2	blitzcut with M.D.A. no	no
	brown	tab	3*	Berkeley	\$2	ith a gas; better than orange; color fulset with T.M.	no
		caps	2*	Berkeley	\$1	Fair	no
PSYLLICHEM	blue	caps	4*	Berkeley	\$2	lots of colors	no
MARIJUANA	Panama Red		3*	Panama	\$12/oz.	good high	yes**
	Korean Black		3*	Korea	\$8/oz.	somewhat visual	yes**
	Michoacan		4*	New Mexico	\$10/oz.	real good	yes**
	Zacatenoas		4*	Zacatenoas	\$15/oz.	about same as above	yes**
	Acapulco Gold		4***	Mexico	\$25/oz.	best everyone hits	yes**
						super visual/real	
	local		1*	Indiana, Iowa	\$8/oz.	got to think your on. self high.	yes**
	local		2*	Indiana, Iowa	\$8/oz.	cured with cocaine or opium	yes**
SPEED	blackbirds	caps	2*		.20	strictly study	yes
	dex.	domes	2*		.20	strictly study	yes
	dex.	caps; clear,white	3*		.20	good 12 hr. trip	yes
	dex.	big caps	2**		.20	white inside	yes
	beny	white cap	1*	.15	.15	nothing	yes
	chrystral meth. powdered		3*		\$5/gz.	cut approx. 50%	yes
	diet pills				.10-	take two to study	yes
					.15		

**some people can boil down grass and shoot it and get really high others will get sick



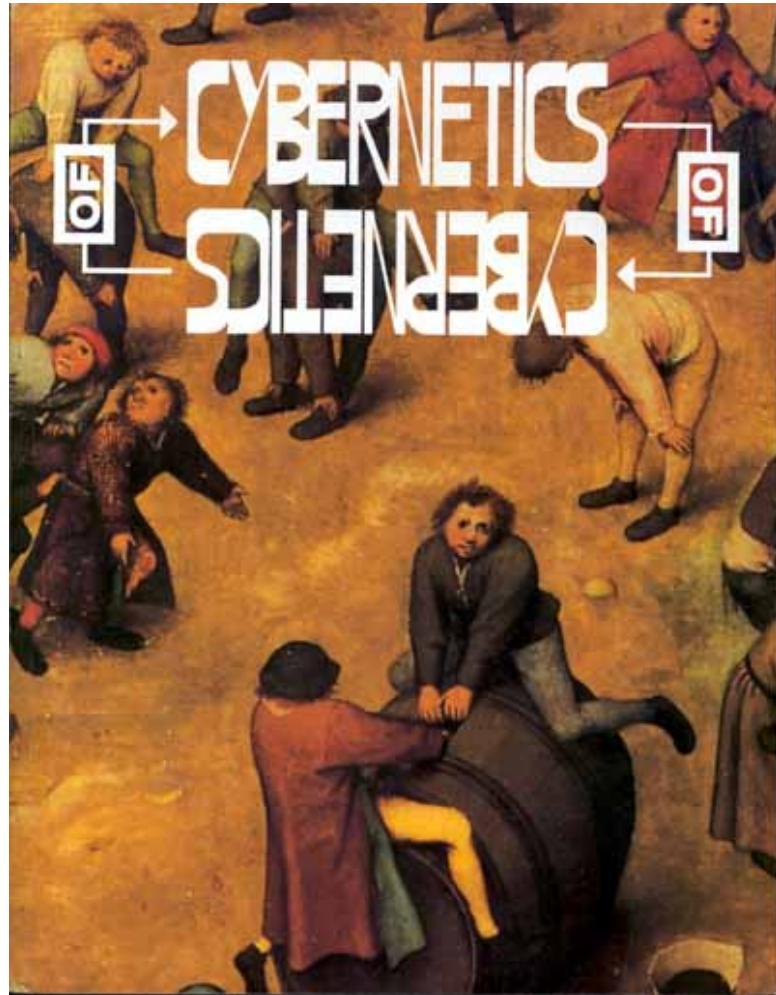
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94 the WAR and the UNIVERSITY

The page contains several historical images and documents:

- A small rectangular photo at the top center shows a banner with "UNIVERSITY OF ILLINOIS" and "ALUMNI".
- A large horizontal photo below it depicts a group of people walking along a path or road.
- To the left of the central image is a column of text with a portrait of a man above it. The text is from a speech by President Franklin D. Roosevelt.
- In the center is a portrait of a man with a mustache.
- To the right of the central image is another column of text with a portrait of a man above it. This text is from a speech by President Harry S. Truman.
- At the bottom, there are four smaller images arranged in a row: two people standing outdoors, a person's head in profile looking up, a landscape with a tree, and a landscape with a bridge.
- A long horizontal photo at the very bottom shows a large crowd of people gathered outdoors.
- Text at the bottom of the page reads: "The American flag has a saying in one part of the text and another in another part of the text, so the American flag will be used to put the text in two parts."

Cybernetics of Cybernetics

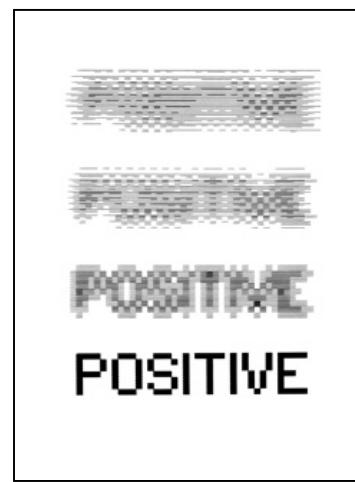
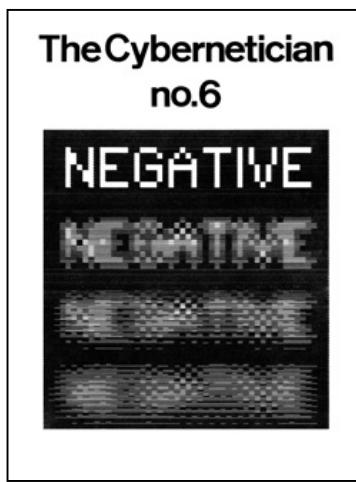
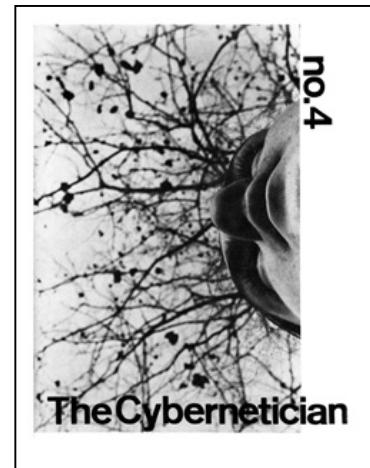
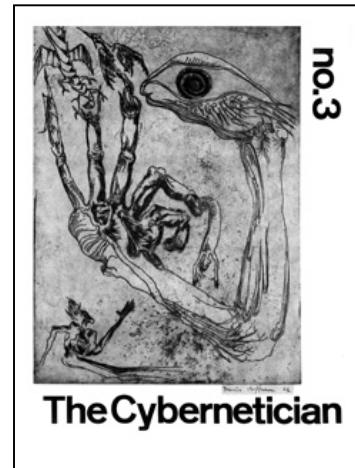
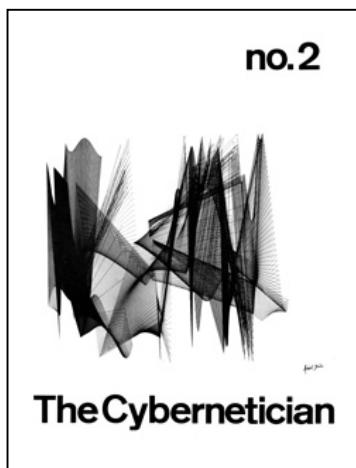
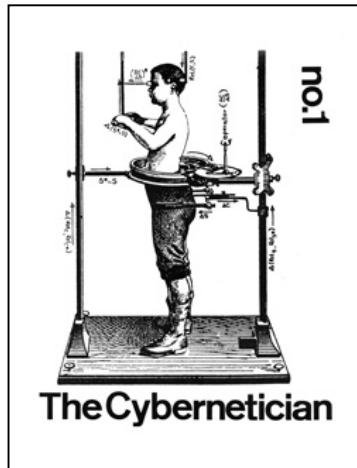


1974

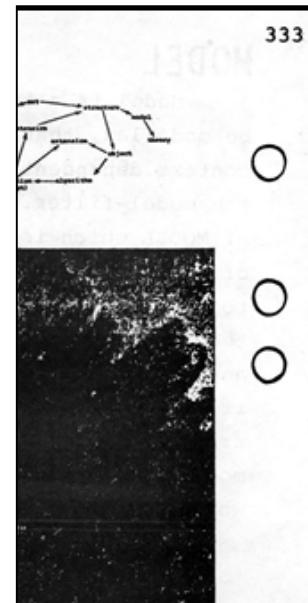
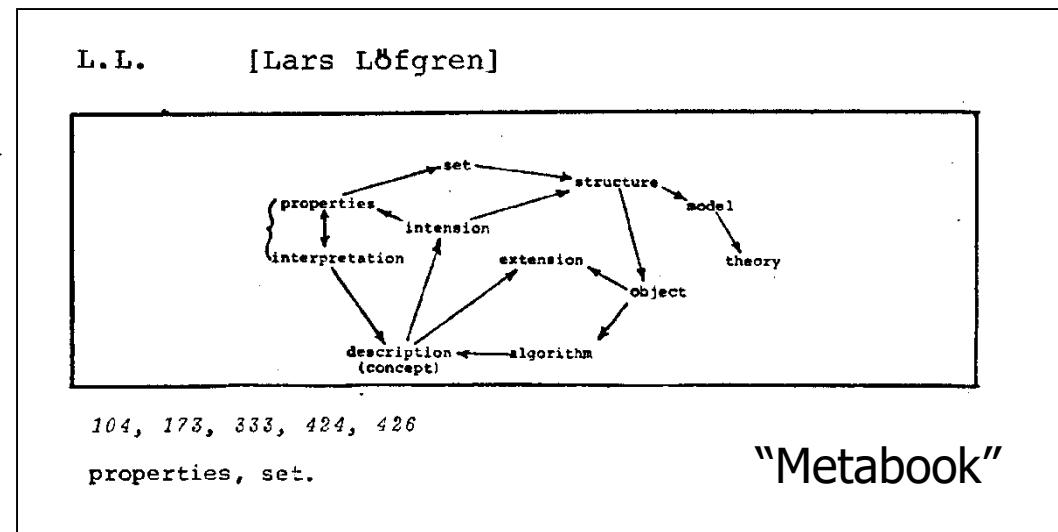
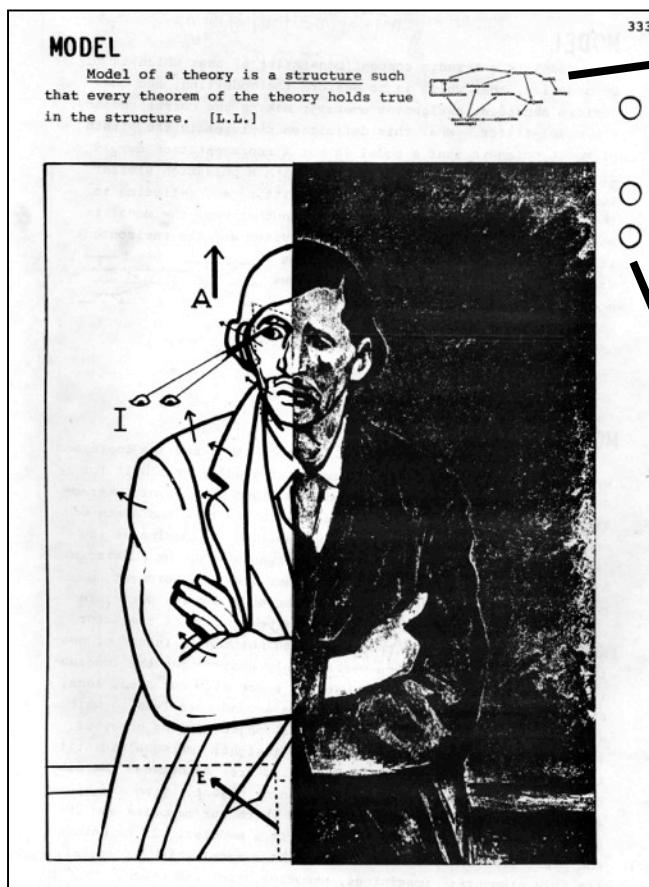
- Anthology
- Periodical
- Glossary
- Index/directory
- Encyclopedia
- Seminar record
- Portfolio
- Bibliography
- Forum
- Textbook
- Coffee table book
- Technical handbook
- Catalog
- Primer
- Source book
- *Network*



The Cybernetician (Periodical)

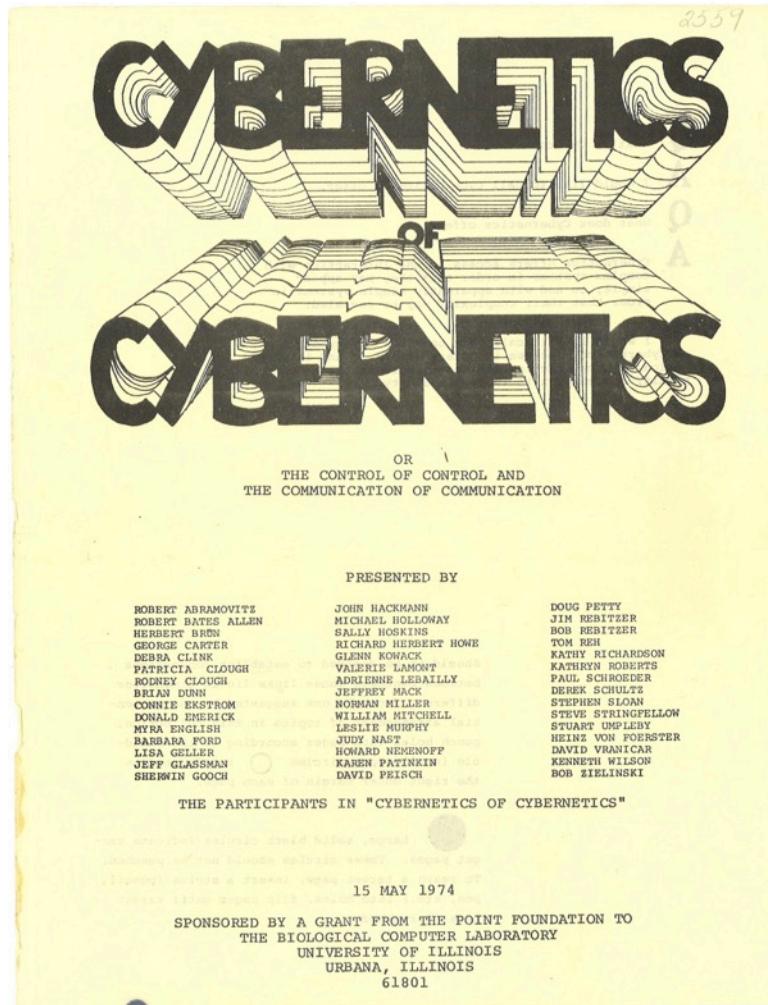


"A Web Site before Its Time"





C of C – Front Matter





C of C – Front Matter

Q

What is Cybernetics?

A

I would like to call Cybernetics an offer.

Q

What does Cybernetics offer?

A

Cybernetics offers access to and interaction with complex systems in order that they may appear simple; to and with apparently simple systems in order that their complexity may be revealed.

A

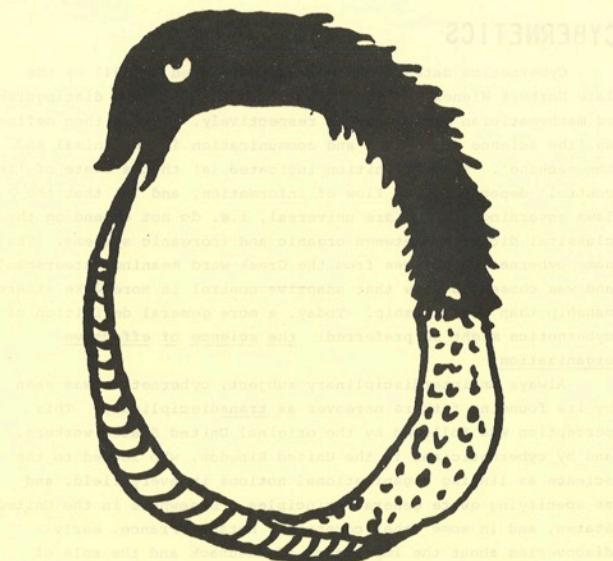
I would like to call this book the "Cybernetics of Cybernetics" because it offers access to and interaction with cybernetics that are simple in their complexity and complex in their simplicity.

B. Rebitzer

Should it be desired to establish connections between concepts whose links lie in dimensions different from the one suggested by the sequential arrangement of topics in this collection, punch holes into pages according to the schedule (small, open circles) indicated on the right outer margin of each page.



Large, solid black circles indicate target pages. These circles should not be punched. To reach a target page, insert a stylus (pencil, pen, etc.) into holes, flip pages until target page is reached.



FIRST ORDER CYBERNETICS

The cybernetics of observed systems.

[H.V.F.]



SECOND ORDER CYBERNETICS

The cybernetics of observing systems.

[H.V.F.]



C of C – Glossary

2

CYBERNETICS

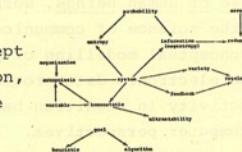
Cybernetics dates from 1942 and was named in 1947 by the late Norbert Wiener and the late Arturo Rosenbleuth, distinguished mathematician and physician respectively. It was then defined as 'the science of control and communication in the animal and the machine'. This definition indicated (a) that a state of 'in-control' depends upon a flow of information, and (b) that the laws governing control are universal, i.e. do not depend on the classical dichotomy between organic and inorganic systems. The name cybernetics derives from the Greek word meaning 'steersman', and was chosen to show that adaptive control is more like steersmanship than dictatorship. Today, a more general definition of cybernetics might be preferred: the science of effective organization.

Always an interdisciplinary subject, cybernetics was seen by its founding fathers moreover as transdisciplinary. This perception was followed by the original United States workers, and by cyberneticians in the United Kingdom, who looked to the science as linking organizational notions in every field, and as specifying quite general principles. Elsewhere in the United States, and in some other countries, notably France, early discoveries about the importance of feedback and the role of entropy focussed the subject on its engineering aspects, at the expense of its biology, its economics, its ecology, and so on. In the USSR, cybernetics was officially treated as an 'imperialist device' until the mid-fifties. At this time, Soviet work in the field, heavily dependent on mathematics, achieved such importance internationally that the Soviet authorities admitted the science officially.

There remains disagreement about the generality of the science, especially in relation to General Systems Theory which has identical objectives to those expressed by the founders of cybernetics. Thus for some, cybernetics and GST are co-extensive, while those could be found who regard each as a branch of the other. In their origins, at least, they express the same intentions.

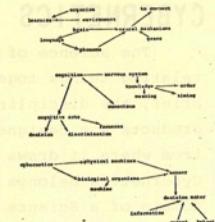
3

Thanks to the academic forces that will always seek to classify in a reductionist way, one may hear of engineering cybernetics (as mentioned above), of neurocybernetics (which deals especially with the brain), of bio-cybernetics (sometimes called bionics), of computer cybernetics, of management cybernetics, and so on. A clear perception of cybernetics must accept these distinctions by areas of application, but will not take them as undermining the transdisciplinary unity of cybernetics itself. [S.B.]



CYBERNETICS

Cybernetics is a word used to convey the idea of comparing physical machines with biological organisms in regard to how their behavior is controlled. Both possess a sensor that feeds information into a decision-maker which then regulates the output, or behavior, up or down. Since 1751, when Robert Whytt (pronounced White) clearly described the pupillary reflex (light in the eye, pupil gets smaller) biologists have conceived organisms to be "machines" wherein the motor output can be controlled by the sensory input through a central processor whose rules of operation would be fascinating to know. When Norbert Wiener invented the word cybernetics in order to reify his idea, only the word, not the idea, was new to these biologists. Whether the intellectual ferment generated by Weiner's new word has made much difference to biologists as they make experiments upon their system is debatable. His word, however, has generated a lot of thinking, talking and writing, by non- and quasi-biologists. [R.G.]





C of C – Glossary

4

CYBERNETICS

It is demonstrated that information flow in scientific or aesthetic inquiry can be modelled via conceptual communication and conscious cognitive control of information. In The Human Use of Human Beings, Norbert Wiener defines "cybernetics" as "the science of communication and control". Traditionally, conceptual modelling of problems in cybernetics have employed an electronic data processing paradigm: for example, neural activity in cognition has been modelled via digital and analog computer perspectives. In problem solving, such an approach is exemplified by Newell Simon's Human Problem Solving. This grasp of cybernetics is too narrow: cybernetics is most generally, an heuristic by which one conceptually notes a problem through parameters of communication (or relation) and control (or effect). The second-order heuristic presented earlier is such a cybernetic model of problem-solving. Information can be input into such a cybernetic heuristic, processed, and subsequently output. Considering cybernetics as a heuristic expands the scope of the "science of communication and control" to relevantly encompass nearly all epistemological domains. Make cybernetics an heuristic, and apply it to nearly any problem. [D.S.]

CYBERNETICS

The science of effective organization or the art of relating things together so that it happens what is desired, in brief, the discipline of human action. Cybernetic notions and products are designed to satisfy human needs and expectations from where it draws its source and inspiration. As a science Cybernetics belongs to the more inclusive domain of a Science of Organization at large. (Thus there is no cybernetics of a cell; there is cell organization from where cybernetic notions can draw). [F.V.]





C of C – Anthology

• **Cybernetics**
by
Norbert Wiener

introduction

1948 was a successful and stimulating year for Norbert Wiener. Two papers close to his heart appeared now in print, one reporting the results of his and his student's Walter Pitts enjoyable stay in Mexico with his long time friend Arthur Rosenblueth (Rosenblueth, A., N. Wiener, W. Pitts and J. Garcia Ramos with the assistance of F. Weber: "An Account of the Spike Potential of Axons." *J. Cell. and Comp. Physiol.* 32, 275-318 (1948)), the other one was his ambitious address to the New York Academy of Science on teleological mechanisms (Wiener, N.: "Time, Communication, and the Nervous System." *N.Y. Acad. Sci.* 50 (4) 197-220 (1948)). The highlight of this year, however, was the publication in mid-summer of his favorite brainchild "Cybernetics" that became a similar unexpected public bombshell as Alfred C. Kinsey's report on the sexual behavior of the human male, published in the same year.

In anticipation of such a success, the alert publishers of the recently streamlined Scientific American approached Norbert Wiener with the request to write a short account of his newly established science for their November issue. The following article is the result. It is scientific journalism at its best: relaxed, clear, informative and deeply concerned. A "Norbert Wiener" as he wished to be seen by his contemporaries, the



C of C – Anthology, Bibliography



12

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C of C – Anthology



18

Pask

1 The Background of Cybernetics

Introduction

CYBERNETICS is a young discipline which, like applied mathematics, cuts across the entrenched departments of natural science; the sky, the earth, the animals and the plants. Its interdisciplinary character emerges when it considers economy not as an economist, biology not as a biologist, engines not as an engineer. In each case its theme remains the same, namely, how systems regulate themselves, reproduce themselves, evolve and learn. Its high spot is the question of how they organize themselves.

A cybernetic laboratory has a varied worksheet – concept formation in organized groups, teaching machines, brain models, and chemical computers for use in a cybernetic factory. As pure scientists we are concerned with brain-like artifacts, with evolution, growth and development; with the process of thinking and getting to know about the world. Wearing the hat of applied science, we aim to create what Boulanger,¹ in his presidential address to the International Association of Cybernetics, called the instruments of a new industrial revolution – control mechanisms that lay their own plans.

The crux of organization is stability, for 'that which is stable' can be described; either as the organization itself, or some characteristic which the organization preserves intact. 'That which is stable' may be a dog, a population, an aeroplane, Jim Jones, Jim Jones's body temperature, the speed of a ship, or indeed, a host of other things.

In chemistry, for example, Le Chatellier's Principle is a statement that the equilibrium concentration of reactants in a closed vessel is stable, for it asserts that the assembly will react so as to nullify thermal or chemical disturbances. But the equilibrium, which is always implied by the word stability, is rarely of this simple kind. Jim Jones is in dynamic equilibrium with his environment. He is not energetically isolated and his constituent material is being continually built up and broken down and



C of C – Anthology

ASHBY

WHAT IS NEW

1/1. Cybernetics was defined by Wiener as "the science of control and communication, in the animal and the machine"—in a word, as the art of *steermanship*, and it is to this aspect that the book will be addressed. Co-ordination, regulation and control will be its themes, for these are of the greatest biological and practical interest.

We must, therefore, make a study of mechanism; but some introduction is advisable, for cybernetics treats the subject from a new, and therefore unusual, angle. Without introduction, Chapter 2 might well seem to be seriously at fault. The new point of view should be clearly understood, for any unconscious vacillation between the old and the new is apt to lead to confusion.

1/2. *The peculiarities of cybernetics.* Many a book has borne the title "Theory of Machines", but it usually contains information about *mechanical* things, about levers and cogs. Cybernetics, too, is a "theory of machines", but it treats, not things but *ways of behaving*. It does not ask "what is this thing?" but "what does it do?" Thus it is very interested in such a statement as "this variable is undergoing a simple harmonic oscillation", and is much less concerned with whether the variable is the position of a point on a wheel, or a potential in an electric circuit. It is thus essentially functional and behaviouristic.

Cybernetics started by being closely associated in many ways with physics, but it depends in no essential way on the laws of physics or on the properties of matter. Cybernetics deals with all forms of behaviour in so far as they are regular, or determinate, or reproducible. The materiality is irrelevant, and so is the holding or not of the ordinary laws of physics. (The example given in S.4/15 will make this statement clear.) *The truths of cybernetics are not conditional on their being derived from some other branch of science.* Cybernetics has its own foundations. It is partly the aim of this book to display them clearly.

1/3. Cybernetics stands to the real machine—electronic, mechanical, neural, or economic—much as geometry stands to a real object in our terrestrial space. There was a time when "geometry" meant such relationships as could be demonstrated on three-dimensional objects or in two-dimensional diagrams. The forms provided by the earth—animal, vegetable, and mineral—were larger in number and richer in properties than could be provided by elementary geometry. In those days a form which was suggested by geometry but which could not be demonstrated in ordinary space was suspect or unacceptable. Ordinary space *dominated* geometry.

Today the position is quite different. Geometry exists in its own right, and by its own strength. It can now treat accurately and coherently a range of forms and spaces that far exceeds anything that terrestrial space can provide. Today it is geometry that contains the terrestrial forms, and not vice versa, for the terrestrial forms are merely special cases in an all-embracing geometry.

The gain achieved by geometry's development hardly needs to be pointed out. Geometry now acts as a framework on which all terrestrial forms can find their natural place, with the relations between the various forms readily appreciable. With this increased understanding goes a correspondingly increased power of control.

Cybernetics is similar in its relation to the actual machine. It takes as its subject-matter the domain of "all possible machines", and is only secondarily interested if informed that some of them have not yet been made, either by Man or by Nature. What cybernetics offers is the framework on which all individual machines may be ordered, related and understood.

1/4. Cybernetics, then, is indifferent to the criticism that some of the machines it considers are not represented among the machines found among us. In this it follows the path already followed with obvious success by mathematical physics. This science has long given prominence to the study of systems that are well known to be non-existent—springs without mass, particles that have mass but no volume, gases that behave perfectly, and so on. To say that these entities do not exist is true; but their non-existence does not mean that mathematical physics is mere fantasy; nor does it make the physicist throw away his treatise on the Theory of the Massless Spring, for this theory is invaluable to him in his practical work. The fact is that the massless spring, though it has no physical representation, has certain properties that make it of the highest importance to him if he is to understand a system even as simple as a watch.



C of C – Anthology, Bibliography



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C of C – Directory

30

Societies

American Society for Cybernetics
2121 Wisconsin Ave., N.W.
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American Society for Information Sciences
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Artorga
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Artorga Research Group
10 College Place
Southampton, England

Cybernetica
International Association for Cybernetics
Place Andre Rijchmans
Namur, Belgium

Cybernetics
Plenum Publishing Corp.
Consultants Bureau
227 W. 17th St.
New York, New York 10011

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29 Rue d'ulm
Paris 5e France

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Washington, D. C. 20005

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Suite 716
1130 17th St., N.W.
Washington, D. C. 20036

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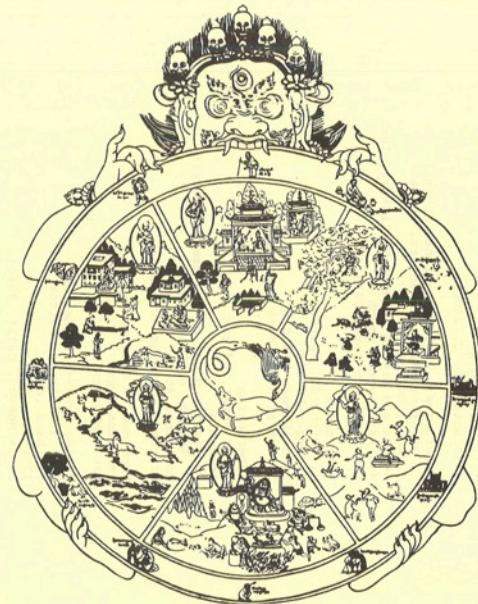
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The Rand Corp.
1700 Main St.
Santa Monica, Calif. 90404

Systems, Man and Cybernetics Group
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Engineers
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C of C – Glossary, Graphics

32



GENERAL SYSTEM THEORY

General System(s) Theory (GST) is a general science of organization and wholeness. It is generally agreed to have been founded by the late Ludwig von Bertalanffy, and he dated its inception from 1940. However, he acknowledged the same debts to precursors as did the founders of cybernetics, and denied the identity of GST and cybernetics only by delimiting the definition of the latter in a way which is probably too restrictive. The objectives of the Society for General Systems Research, founded in 1954, would certainly have had the agreement of the early cyberneticians in 1942. On the other hand, they may be more general than some scientists (notably in the USA and France) would allow to cybernetics today.

[S.B.]



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SYSTEM

A system is the set of elements and relations, or operations on these elements, that is specified by an observer. Alternatively, a system is a set of variables specified by an observer. See the paper "System versus Collection". [K.L.W.]

SYSTEM

Any distinction done by an observer, with the intention of further explaining in a consensual network the distinction done and its content. [F.V.]



FEEDBACK

The return of part of a system's output to change its input. Positive feedback increases the input, negative feedback decreases it. Hence if feedback is used (as it is in all regulatory systems) in comparing output with some standard to be approached, negative feedback is inherently stabilizing (because it decreases the error) while positive feedback is inherently destabilizing (and the error gains explosively in magnitude). The casual use of 'feedback' to mean 'response to a stimulus' is incorrect.

[S.B.]



FEEDBACK

Information about the results of a process which is used to change the process itself. [S.U.]



C of C – Glossary, Graphics

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FEEDBACK

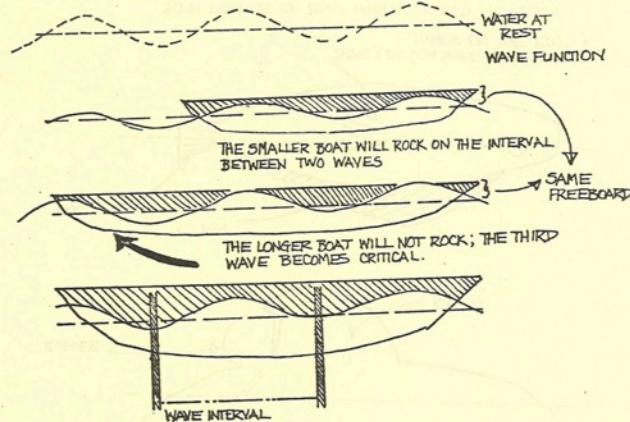
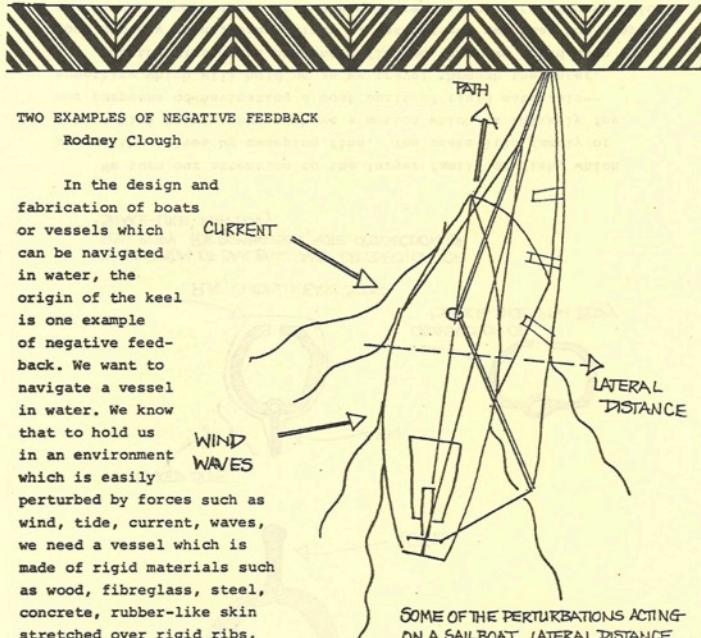
An unpoetic inexpressive word that shrieks for replacement. Correct use of the term would refer to eating your own vomit. 'Positive feedback' and 'negative feedback' would signify whether you like the vomit or not.

I'd prefer a term like 'circuit' to indicate any system or subsystem that responds to its own action - and something like 'convergent' or 'divergent' to indicate the nature of the response ('divergent' would cover the two unstable forms - anti-corrective 'positive feedback' and over-corrective hunting oscillation.)

[S.Br.]



C of C – Portfolio



THERE EXISTS A RATIO BETWEEN THE LENGTH OF A BOAT AND THE AREA OF THE EXPOSED HULL OR FREEBOARD, AND DRAFT

from top to bottom.

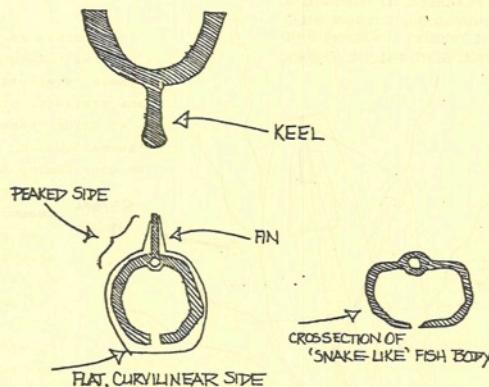
By navigating a boat--one which we have either built ourselves or which we have traveled on--we observe that the amount of lateral surface and freeboard retards the speed of a boat. Fast boats are associated with low profile, sleek shapes similar to the bodies of fish.

If we watch fish swimming, we observe that the faster fish are very thin and are able to pilot themselves by a very complicated act of twisting the body and fluttering a side appendage or fin. Some fish do not have any fins and navigate by twisting their bodies snake-like through the water. Other fish, which appear larger and more 'evolved', twist less and propel themselves by sweeping very large fins, very like a bird's wings. Their motion seems more effortless and smooth. We notice that they are equipped with two highly differentiated sides:

C of C – Portfolio

36

a top which is peaked, and a bottom which is curvilinear--nearly flat. These fish are very different from the snake-like cousins, whose bodies, if we were to cut them up, are circular.



We turn our attention to the larger family of fish, which propel themselves by sweeping fins. The snake-like family of fish, which twist, seem to have a motion which is unlikely for our purposes of navigating a boat built of rigid materials--something which will hold us as we travel through the water.

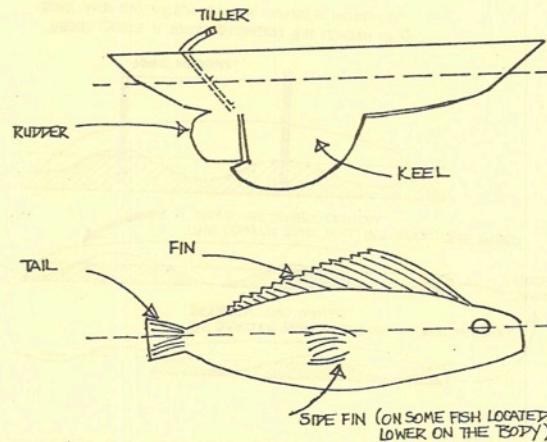
Looking closely at how these fish do this--we could also look closely at different kinds of vessels--we see that the shape of the fish body tapers at one end where the activity of propulsion

seems to be concentrated. More complicated movements and agility at performing different movements--swimming, darting, cruising, diving--are associated with this taper and how the peaked side of the fish follows this taper.

The larger the fish, proportionately, the larger the peaked side and the smoother the taper of the body shape.

Can there be a relationship between the length, freeboard, lateral surface of our vessel and the relationships we have observed between the peaked side, body taper and volume of the fish?

By experimenting with various representations or models of vessels--some which we borrow from ones that have been built, others which we build ourselves--we notice that this peaked side of a shape moving in water plays a large role. It keeps the fish 'up'; it keeps the fish straight on its path, without drifting from side to side; and it keeps the fish stable when it is not moving. In



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GOAL

GOAL

A goal is a description of the relation computed by a concept. Such descriptions are usually underspecific insofar as the majority of concepts have Fuzzy intensions (programs). Their existence is a prerequisite for the reproductive computations already discussed, (that is, at a microstructural level, a description is computed and a program is constructed to realise this description).

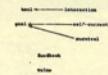
A participant may intend to achieve a goal if there is a concept for it in his repertoire; if not, he may intend to learn to achieve a goal, by building a concept that may achieve it. [G.P.]



GOAL

(1) An image deliberately held in front of an incompletely action to goad and direct its accomplishment. e.g. Orgasm.

(2) The convergent direction of any self-correcting process. e.g. Survival. Deliberation is not required. [S.Br.]



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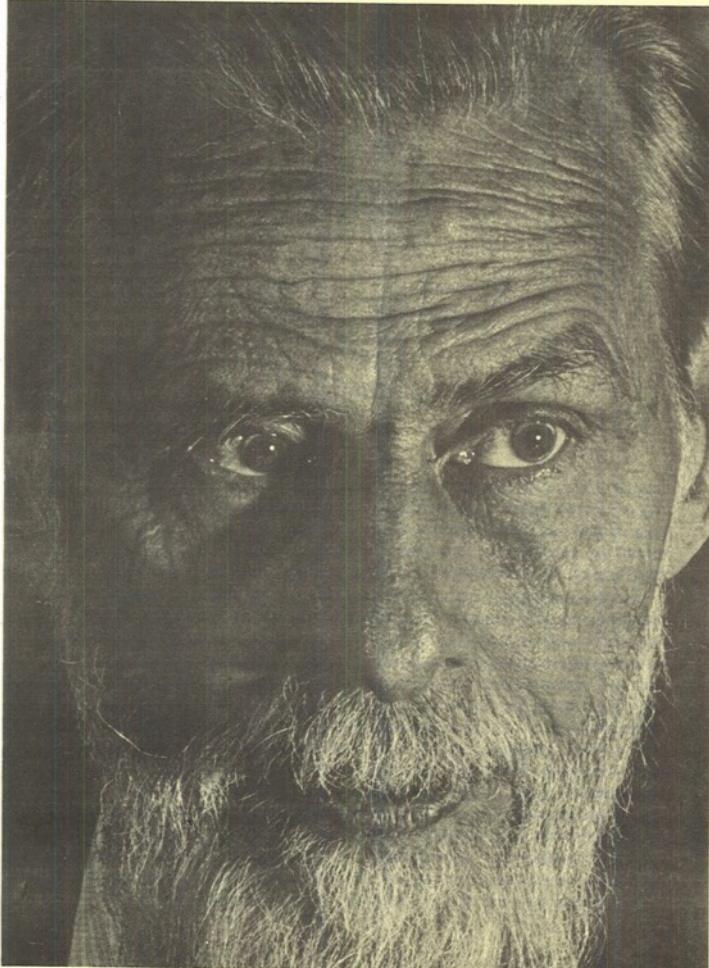
GOAL

A final condition or series of conditions in which the behaving object reaches a definite correlation in time or in space with respect to another object or event or series of events. [S.U.]





C of C – Anthology



A HIERARCHY OF VALUES DETERMINED BY THE
TOPOLOGY OF NERVOUS NETS

WARREN S. McCULLOCH

Because of the dromic character of purposive activities, the closed circuits sustaining them and their interaction can be treated topologically. It is found that to the value anomaly, when *A* is preferred to *B*, *B* to *C*, but *C* to *A*, there corresponds a diadrome, or circularity in the net which is not the path of any drome and which cannot be mapped without a diallel on a surface sufficient to map the dromes. Thus the apparent inconsistency of preference is shown to indicate consistency of an order too high to permit construction of a scale of values, but submitting to finite topological analysis based on the finite number of nervous cells and their possible connections.

The term "reflex" originally meant a disturbance which, initiated by an extra-nervous organ, returned by a nervous path to that same organ. The law of Bell-Magendie, that impulses enter the nervous system by dorsal and emerge by ventral roots, specified the direction of conduction of these circular disturbances. Circular propagation in this direction was called dromic, in the opposite, antidromic. With the possible exception of phenomena comparable to that described by Porter, no response of any effector has ever indicated an antidromic reflex although conduction in the reverse direction has been demonstrated in both the dorsal and ventral roots.

The term "reflex" has latterly been used of any activity in which one pylon was extra-neural regardless of whether or not it was somatic. Lack of anatomic continuity about the external pylon let after-comers ignore the essential circularity. All reflexes are dromes, activities of feed-back mechanisms, and consequently their function includes all purposive activity.

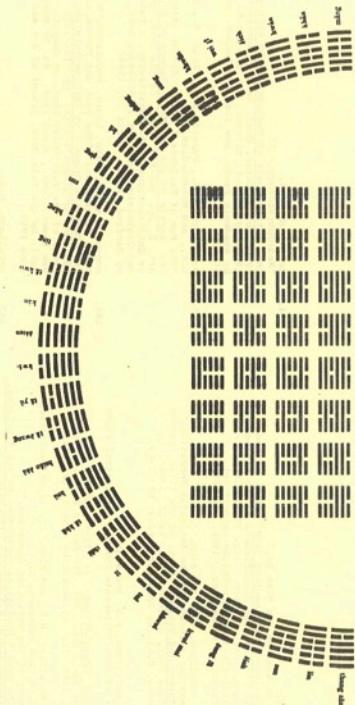
In addition to reflexes, there exist within the central nervous system reverberating circuits which for brevity are called endromes. Endromes are not in general so related to reflexes as to be uniquely syndromic or antidromic. Their temporal importance in determining the formal properties of nervous activity has been previously discussed (McCulloch and Pitts, 1943). Concerning endromes as well as reflexes, it is well to recall that a given feed-back circuit may be regenerative for one temporal combination of excitations and degenerative for another.



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HOLISM

Sometimes termed "anti-reductionism," holism contends that merely looking at a collection of parts and their interactions is not sufficient; the whole will not be understood if only a part is examined. The whole, in fact, is considered to encompass more than the sum of its parts—an "organizing principle" may sometimes be invoked. Holism seems a more useful attitude in connection with cybernetic thought.

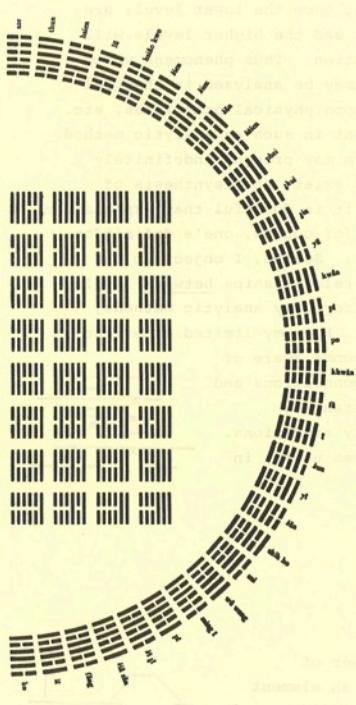
Holism too may have problems, based on its preoccupation with overall structural organization and form, if these are considered to the exclusion of analysis of the parts.

"the perception of the future
and the future of perception"

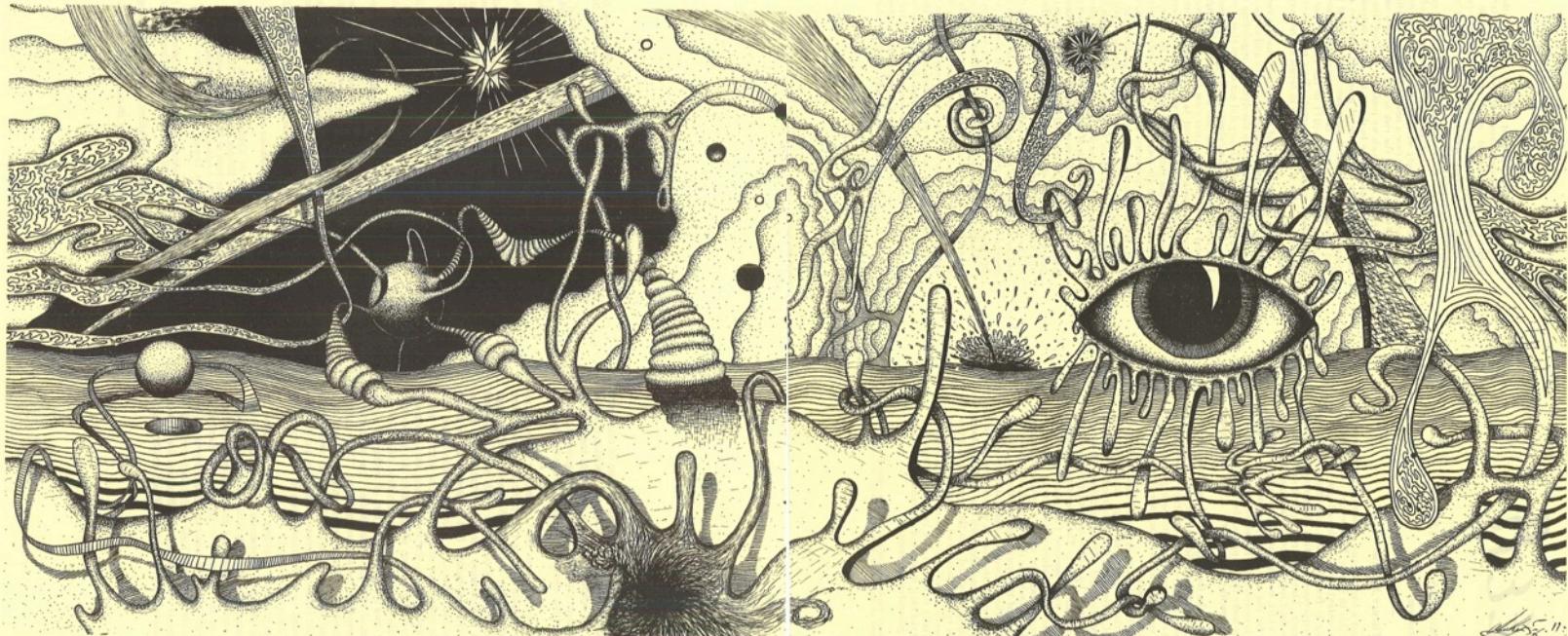
"the politics of learning
and the learning of politics"

"the phrasing of profundities
and the profundity of phrasing"

[S.H.]



C of C – Graphics





Cybernetics of Cybernetics

BEER

MANAGING MODERN COMPLEXITY

STAFFORD BEER¹

I. THREAT SYSTEMS

I speak to you today against a background of seemingly ungovernable crisis which it is impossible to ignore. We are met to discuss the future, but we must know the context from which we begin.

The business of forecasting is fraught with many traps; it often seems ascientific. But the perspicuous detection of inexorable trends can be a matter of good science. There is a reality to observe and to measure, a reality in which a dead man is a corpse and not a statistic. There is a reality, too, with which to experiment; a reality that does not come in parcels labelled for the attention of appropriate officials. The very stuff of this reality is *complexity*. The elements of our society ever more richly interact: the more this happens, the more participation is invoked, the more the streams of data flow . . . the more complex does society become.

Handling complexity seems to be the major problem of the age, in the way that handling material substance offered challenge to our forefathers. Computers are the tools we have to use, and their effective use must be directed by a science competent to handle the organization of large, complex, probabilistic systems. This is the science of cybernetics, the science of communications and control.

The central thesis of cybernetics might be expressed thus: that there are natural laws governing the behaviour of large interactive systems—in the flesh, in the metal, in the social and economic fabric. These laws have to do with self-regulation and self-organization. They constitute the “management principle” by which systems grow and are stable, learn and adjust, adapt and evolve. These seemingly diverse systems are one, in cybernetic eyes, because they manifest viable behaviour—which is to say behaviour conducive to survival.

In my opinion, the most important fact which a quarter of a century’s worth of cybernetics has revealed is that this behaviour is governed by the dynamic structure of the system, rather than by special events occurring within it or by the particular values taken up by even its major variables. “Structure” means the way in which the parts of a whole are inter-related; and here it includes both the feedback loops by which systems regulate themselves and also the conditional probability mechanisms by which systems learn and organize themselves. “Dynamic” relates to the speeds at which communication is effected within the system, and especially to the relative lags with which messages are promulgated, overtake each other, and combine to form new patterns. Dynamic structure generates outcomes.

¹ Development Director, International Publishing Corporation, and visiting Professor of Cybernetics in the Business School of Manchester University, Great Britain.

Therefore I say that what will happen to mankind in its battle with complexity will be determined neither by particular innovation nor by isolated achievement at some unknown future date. Hence the attempted prediction of such things is not to the point. Outcomes are latent in the dynamic structure of the systems we have or may adopt: they will inexorably emerge.

At present, the most obtrusive outcome of the system we have is a gross instability of institutional relationships and of the economy. This cannot last. The society we have known will either collapse, or it will be overthrown. In either case a new kind of society will emerge, with new modes of control; and the risk is that it will be a society which no one actually chose, and which we probably will not like. I shall argue that we must use our science to detect the latent outcomes which will one day characterize the future of mankind. And let us so engineer our systems that their latent outcomes suit our social purpose. It is true that the outcomes cannot be fully determined, because there is noise (or shall we call it free will?) in the system. But a systemic design taking due account of cybernetic laws may be expected to produce behaviour which is predictable in terms of the overriding social need for stability.

Thanks to the growth of complexity, which is very much a function of the growth in data-handling capacity and of the information explosion, society has outgrown the dynamic regulating capacity of its own hallowed structure. History did not design that structure to cope with such complexity, and a cybernetically grotesque machinery is a result. It is from this standpoint that I ask you to look again at the environmental crises from which our view of the future must necessarily start.

The thermonuclear threat is a computable threat, and one which computably grows—although we act as if we were inured to it. The various pollution threats—by pesticides, by noise, by sewage, by carcinogenic urban air—were and remain systematically predictable. None of these things happened by chance, by accident, or by the wrath of God. We have run ourselves into these problems by failing to calculate the predictable consequences of the systems civilization has underwritten. The same seems to me to be true, though less obviously so, of the various forms of societary crisis which run alongside the environmental crises. Problems of race, problems of poverty, problems of overpopulation: all these are quantifiable aspects of computable systems. It has taken social upheaval and threatening violence to draw them to our proper attention; it has taken a major revolt of the young to motivate any kind of rethinking.

The risk which faces us today is the probability that society will yet refuse to study the systemic generators of human doom, and will disregard the cybernetic capability which already exists competent to bring these many but inter-related forms of crisis under governance.

There are two reasons for this fear. First of all, our culture does not take kindly to the notion that it nurtures the seeds of its own destruction. Instead of studying the systemic reality in which outcomes are latent, it prefers the technique of prognostication. Small wonder: by using such wholly non-systemic devices as the Delphi technique, we may predict a possible millennium for our comfort. But the Delphi technique is aptly named: its pronouncements are shrouded in ambiguity—because they take no account of the systemic context. Meanwhile, the systems we have already started, which we nourish and



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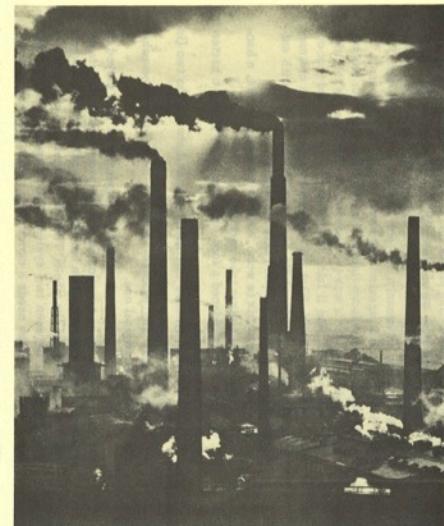
ALLOPOIETIC

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An allopoietic system is one in which the product of operation of the system is different from the system itself. In a man-made system such as a car, there is a concatenation of processes which specifies organization and yet does not produce the components of the car since the components of the car are produced by processes which are independent of the car and its operation. [K.L.W.]

ALLOPOIETIC

A class of organization. Allo/autopoietic descriptions can only apply when the system considered is defined by productions, i.e. when the relations between the components that integrate it, are productions. Whenever the productions are not productions of precisely the components which integrate the system (in whichever space) the system is allopoietic. The vast majority of systems commonly studied are allopoietic. [F.V.]

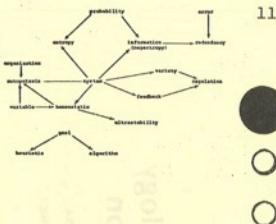




C of C – Glossary

AUTOPOIESIS

In cybernetics, this is a special case of homeostasis in which the critical variable of the system that is held constant is that system's own organization. The term is due to Humberto Maturana. [S.B.]



AUTOPOIESIS

A class of organization, characteristic of at least all living systems. In contradistinction with allopoietic systems, an autopoietic one is defined by productions of precisely those components which integrate it (in whichever space). Thus the phenomenology of autopoiesis is the phenomenology of autonomy insofar as the result of the system's dynamics is the system itself. [F.V.]

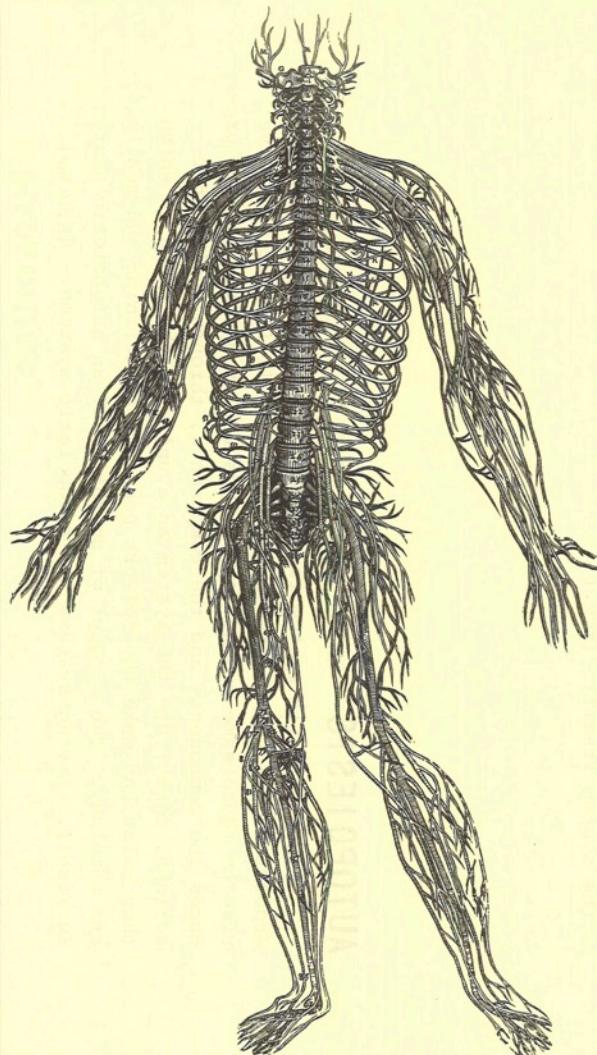


AUTOPOIESIS

An autopoietic system is defined as a unity by a network of productions of components which through their interactions give rise to these same productions. Thus the production network produces the components and the components, through their interactions, constitute the system as a unity in the space in which they exist and make the network possible by defining and realizing its topology. The product of operation of an autopoietic system is itself. Living systems are autopoietic systems. [K.L.W.]



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Neurophysiology of Cognition

HUMBERTO MATORANA
University of Chile, Santiago

Whether stated or not, the fundamental quest of neurophysiology is to understand the processes that determine the so-called higher functions in the brain. The present work is an explicit attempt in that direction. Whatever success I have in this endeavor I owe to the enriching discussions I had with my friend Heinz Von Foerster and my student Francisco Varela.

STATEMENT OF THE PROBLEM

PROPOSITIONS

Cognition is a biological phenomenon and can only be understood as such; any epistemological insight in the domain of knowledge requires this understanding.

If such an understanding is to be attained, two questions have to be considered:

- 1) What is cognition as a process?
- 2) How is it carried out?

I shall proceed accordingly.

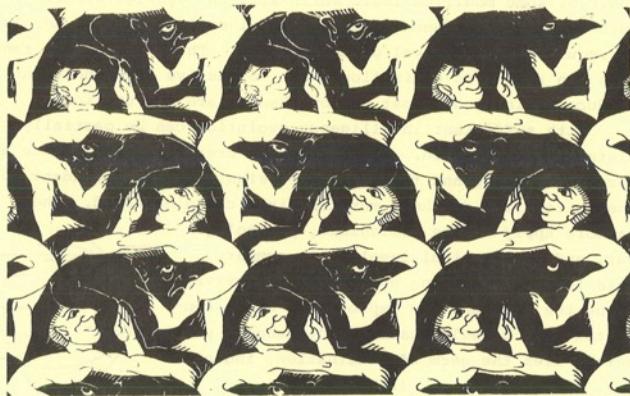
Work on this paper was done while the author was Visiting Miller Professor at the University of Illinois.
This paper grew out of work jointly sponsored by AFOSR Grant AF 49(638)-1680 and by AFOSR Grant 7-67.

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EVOLUTION

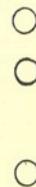
A history of change of a type of organization as embodied in a population of distinct systems. The systems must be related by sequential reproductive steps, in which the particular structure of each one is a modification of the structure of the preceding one, which is its historical predecessor. Sequential reproduction and change of structure in each reproductive step are the necessary and sufficient conditions for evolution. (Thus there is a history of the earth, but not an evolution of it; there is an evolution of the idea of space, not only a history of it). [F.V.]



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REPRODUCTION

In biology, "reproduction" makes reference to three distinct processes. Replication is the production of entities by a mechanism that is distinct from these entities. In replication there is a historical uncoupling of the entity produced from the mechanism that produces it. Copy refers to a process that is identical to a mapping operation where there is a mechanism for isomorphic transformation. Again, the mechanism for producing the entity is distinct from the entity produced. Self-division refers to a process that is peculiar to autopoietic systems. In this process, the unity produced is identical in its organization to the original unity, and it is a result of the maintenance of the original unity's autopoiesis. [K.L.W.]



EVOLUTION

The useful use of uncertainty through a process wherein some degree of randomness modifies the logic of behavior thus producing a mutation which is then tested for survival value against the embedding environment. Those logics which survive are in turn affected by randomness, and thus mutated and themselves tested for survival. The result yields either an extinction of the original logic or some modified logic which fits an "ecological niche." In a dynamic environment some continual modification of the logic is required for survival of the species. Thus, too little randomness can result in extinction. But, excessive randomness can also produce extinction. Most random changes are dysfunctional.

With sufficient intelligence evolution can be partially simulated and controlled. In this manner creatures become more and more specialized and therefore more significantly dependent upon the suitability of their mutation in a changing world. These same factors apply in the biological, psychological, and sociological levels. In summary this is a goal-seeking process with survival being the goal and the exploration being conducted in a grossly insufficient manner, yet herein lies the germ of imagination, ingenuity, and creativity. [L.F.]





C of C – Portfolio

Derek Schultz

Cognitive Systems: A Personal View

The entailment structure on the following pages is a schematic/diagrammatic of my personal intellectual interests, and the inter-relations I perceive among them. At the outset, it should be understood that all factors in the entailment structure are intellectual interests: this cognitive system does not extend beyond the intellectual domain.

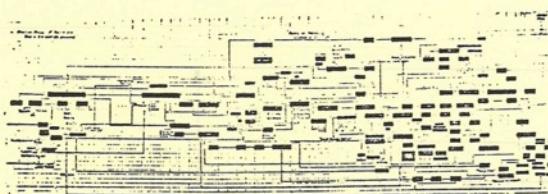
In this structure, factors encased in boxes are disciplines or topical areas, whereas those in quotes are books, papers, or general concepts. Any person associated in my mind with these factors is indicated without either boxes or quotes. The arrows roughly correspond to "leads me to" or "reminds me of",...that is FACTOR 1 "reminds me of" or "intellectually connects with" FACTOR 2.

Precisely, there are no dimensions in this structure upon which the factors are scaled: that is, the boxes are placed for convenience and aesthetic congeniality. Though spacing or distance on this structure has no particular significance, it is generally the case that the most important factors are centered between top and bottom, and a logical progression exists from left, ("Theistic Positions") to right ("Cybernetics; Systems Analysis"), on this horizontal axis.

It would, of course, be desirable to model this structure in three dimensions (say spherically) rather than merely in two... for one thing, "Cybernetics" would then be spatially proximal to "Theistic Positions" - an interesting relation!

Before actually explaining details of presentation, I would make two caveats: 1) I apologize for the handwritten presentation, and, at places, visual confusion - this structure began as a personal cognitive topology; 2) I would appreciate feedback regarding this presentation, and what is entailed therein. Until about 1977, I'll be at:

Department of Psychology
University of Illinois
Champaign, Illinois 61820



In presentation, we have taken the long diagram represented in Fig. 1, and broken it into two pages, with overlap in the adjacent margins (i.e., margins of pages x and $x+1$ are on opposite sides of the same sheet of paging). Though this procedure tends to destroy, or at least vitiate, the schematicism of the structure, the aforementioned logical progression on the horizontal axis lends unity. Finally, many abbreviations are employed in the structure, for which I present the following key:

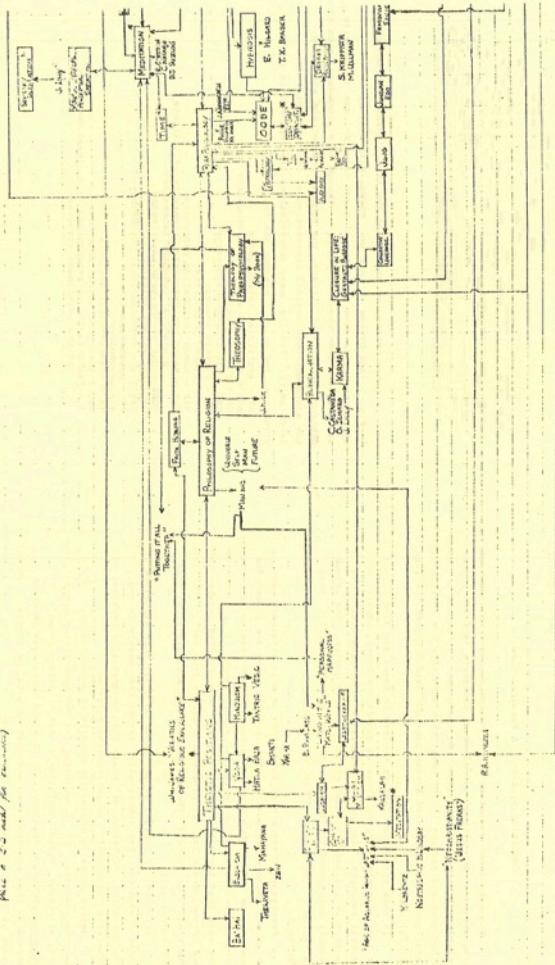
AI - artificial intelligence
ASC - altered states of consciousness
CS - computer science
EEG - electroencephalography
EL - eidetic imagery
EP - evoked potentials
HIP - human information processing
HVF - Heinz Von Foerster; University of Illinois,
Biological Computer Laboratory
OOBE - out-of-the-body experiences
OR - operations research
Org'l ψ - organizational psychology
PK - psychokinesis
ψ - psychology
TA - Transactional analysis
TSD - theory of signal detection
* - "this factor is represented in at least one place
in the entailment structure."



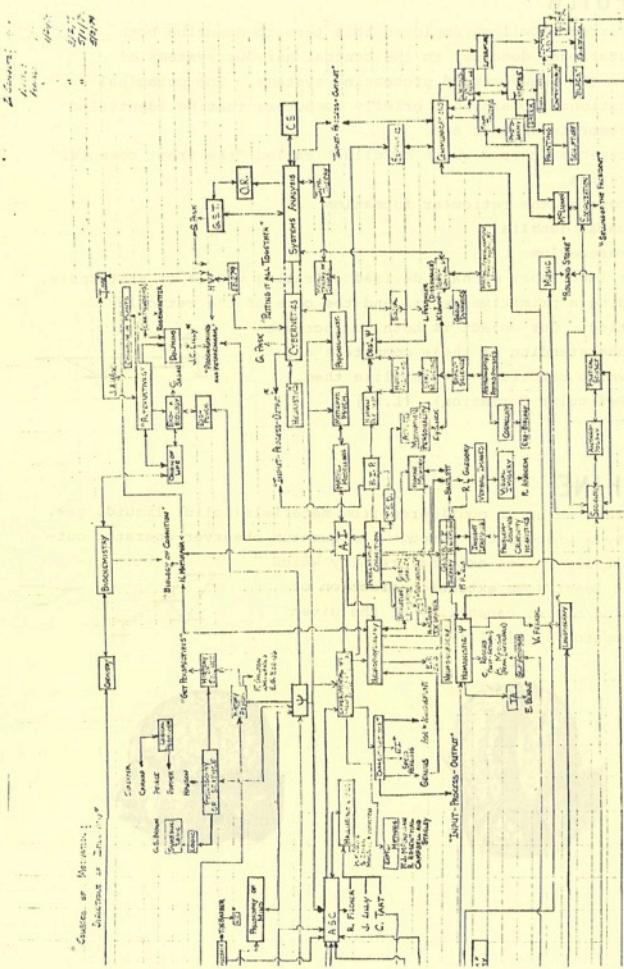


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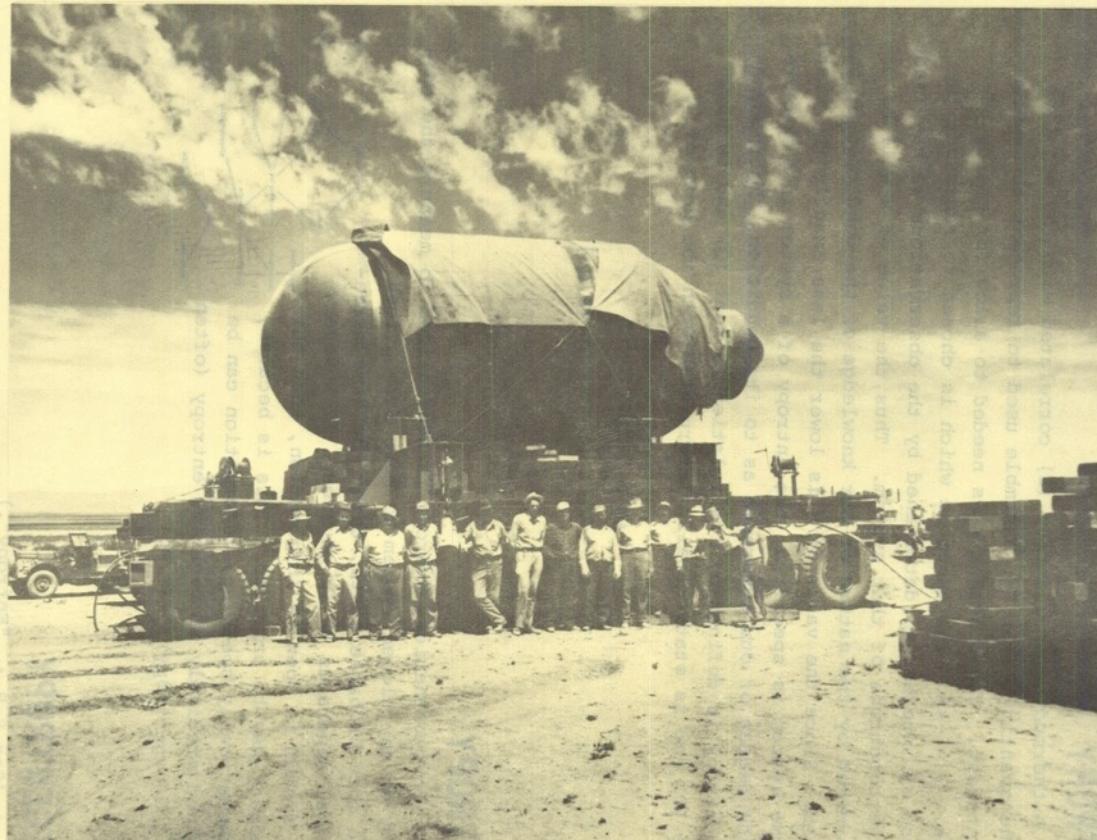


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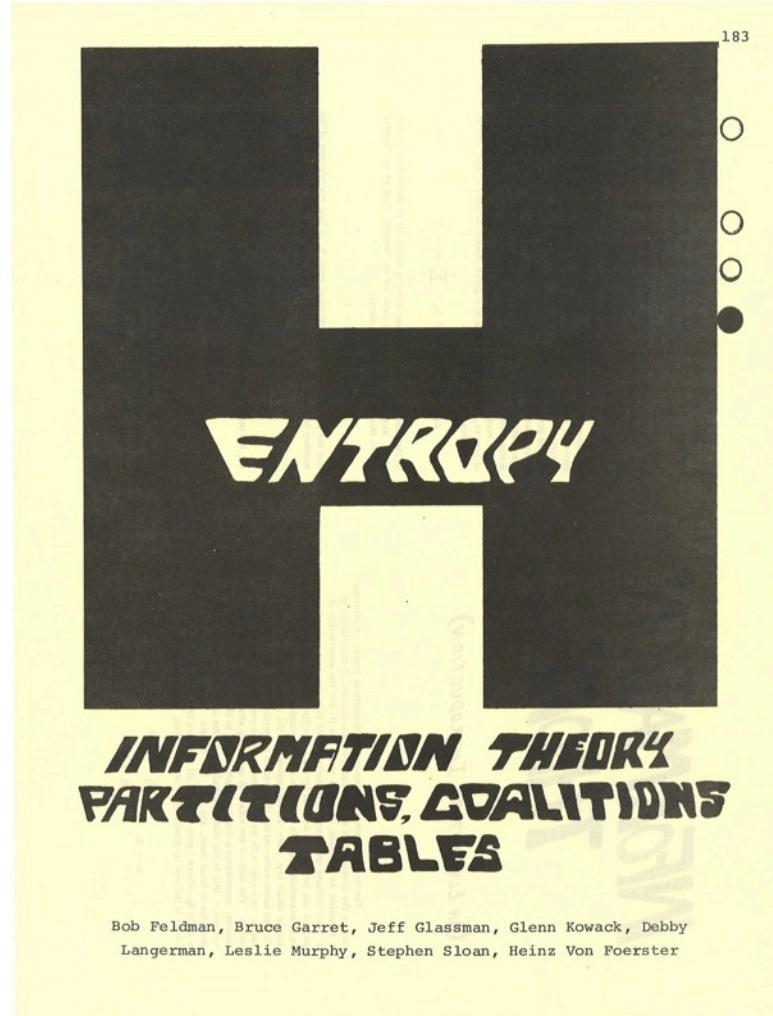
C of C – Glossary, Graphics



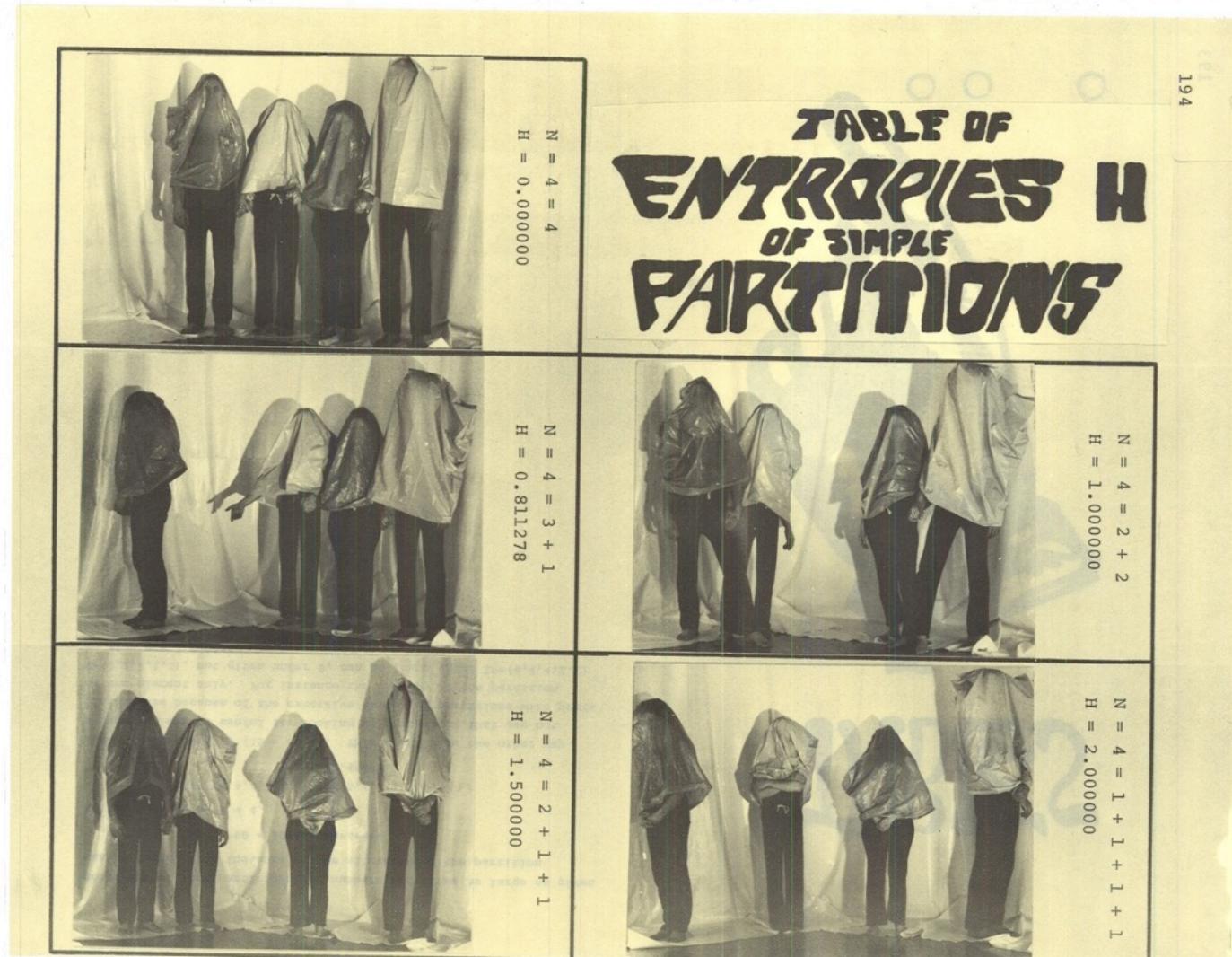
Packaged Entropy: Testing the A-Bomb, near Alamogordo, New Mexico, May 1945.



C of C – Technical Handbook, Graphics



C of C – Technical Handbook, Graphics





C of C – Technical Handbook

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220

ON SELF-ORGANIZING SYSTEMS AND THEIR ENVIRONMENTS*

H. von FOERSTER

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I AM somewhat hesitant to make the introductory remarks of my presentation, because I am afraid I may hurt the feelings of those who so generously sponsored this conference on self-organizing systems. On the other hand, I believe, I may have a suggestion on how to answer Dr. Weyl's question which he asked in his pertinent and thought-provoking introduction: "What makes a self-organizing system?" Thus, I hope you will forgive me if I open my paper by presenting the following thesis: "There are no such things as self-organizing systems!"

In the face of the title of this conference I have to give a rather strong proof of this thesis, a task which may not be at all too difficult, if there is not a secret purpose behind this meeting to promote a conspiracy to dispose of the Second Law of Thermodynamics. I shall now prove the non-existence of self-organizing systems by *reductio ad absurdum* of the assumption that there is such a thing as a self-organizing system.

Assume a finite universe, U_0 , as small or as large as you wish (see Fig. 1a), which is enclosed in an adiabatic shell which separates this finite universe from any "meta-universe" in which it may be immersed. Assume, furthermore, that in this universe, U_0 , there is a closed surface which divides this universe into two mutually exclusive parts: the one part is completely occupied with a self-organizing system S_0 , while the other part we may call the environment E_0 of this self-organizing system: $S_0 \& E_0 = U_0$.

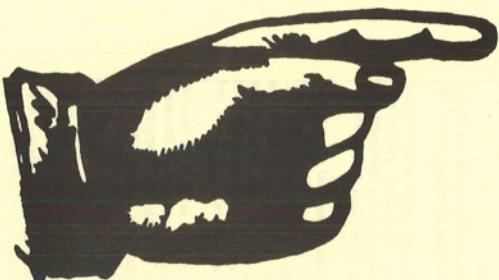
I may add that it is irrelevant whether we have our self-organizing system inside or outside the closed surface. However, in Fig. 1 the

* Supported by the Information Systems Branch of the Office of Naval Research under Contract Nonr. 1834 (21).



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ii.

AN INVITATION TO USE A COMPUTER-BASED COMMUNICATIONS SYSTEM

Members of the American Society for Cybernetics are invited to participate in a continuing nationwide discussion of cybernetics research using a computer-based communications medium. Remote terminals of the PLATO computer-based education systems are now located at the universities listed in the accompanying table.

In order to participate you will need to contact the person in charge of the PLATO terminal(s) on your campus to find out whom you can have access to it. Each person will have to negotiate access to the terminal in his city with the person in charge of the terminal. So far we have had no difficulty obtaining access to these terminals on a second priority basis. That is, the use for which the institution purchased the terminal comes first. Also, the PLATO laboratory does not dictate who may use the terminals at each site.

In order to use the terminal, you will need several codewords. When asked for your name, type "student." When asked for the course, type "com" (abbreviation for communications). When asked for the lesson, type "cobar" or "discuss." When in doubt, press the NEXT key. Once you are in the program, use your own name. Many questions might arise about using the system which would be cumbersome to answer here. The best thing to do is to ask one of the local users of the system to help you get into lesson other or lesson discussions the first time. Usually people are quite willing to help, so do not hesitate to ask questions.

Our purpose is to explore the use of computers-based communications media as a new kind of aid in conducting scientific research. If correspondence about current research is conducted through this medium, students and other scientists will be able to "audit" the ongoing professional discussions. As the computer storage becomes full, messages will be printed out and distributed through the mail to those who have participated in that part of the discussion.

This letter contains all the information you need to get on the system and participate in the conference. Similar discussions using this medium have been conducted since August 1973. If you have any questions, call or write Stuart A. Umpleby, 352 Engineering Research Laboratory, University of Illinois, Urbana, Illinois 61801, tel. 217/333-7451.

Stuart Umpleby

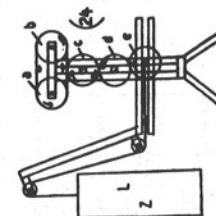


iii.

REMOTE PLATO SITES

Institution	Site Supervisor	Phone Number	
Agency for International Development Reslyn, Virginia	Michael Guido	705/527-9186	University of Arizona Tucson, Arizona
Chicago Skill Center Chicago Circle Campus of Univ. of Illinois Champaign, Illinois	Dick Wagner	312/326-7510	University of California Santa Barbara, Calif.
Educational Testing Service Princeton, N.J.	Sally Dronge	312/936-5157	University of Iowa Iowa City, Iowa
Florida State University Tallahassee, Florida	Jim Boyd	312/856-2800	University of Toronto Toronto, Ontario, Canada
Illinois State University Normal, Illinois	Bernie Anastasio	609/921-9000	University of Waterloo Waterloo, Ontario, Canada
Indiana University Bloomington, Indiana	John Merrill	904/599-2960	Villanova University Villanova, Pennsylvania
Iowa State University Ames, Iowa	Gary Clark	209/436-7661	Walton-Wright College Chicago, Illinois
Kennedy-King College Chicago, Illinois	Gary Cagle	812/327-9255	Chicago, Illinois
MacMurray College Champaign, Illinois	Silas Farmer	312/357-5672	Illinois Institute of Technology Chicago, Illinois
Medical Center of Illinois Chicago, Illinois	Bob Thomas	912/229-2219	Illinois Institute of Technology Chicago, Illinois
MIT Cambridge, Mass.	Barbara Johnson	312/768-5257	Illinois Institute of Technology Chicago, Illinois
Montgomery County Schools Kensington, Md.	Mits Yamaoka	312/394-2068	Illinois Institute of Technology Chicago, Illinois
Northeastern University Evanson, Illinois	Harlan McDonald	312/299-2526	Illinois Institute of Technology Chicago, Illinois
National Science Foundation Washington, D.C.	George Wallace	617/252-6768	Illinois Institute of Technology Chicago, Illinois
Parkland College Champaign, Illinois	Catherine Morgan	501/749-4900	Illinois Institute of Technology Chicago, Illinois
Purdue University West Lafayette, Indiana	Jim Schugler	312/492-2567	Illinois Institute of Technology Chicago, Illinois
State University of New York Albany, New York	Zirk McMillians	201/283-7755	Illinois Institute of Technology Chicago, Illinois

iii.



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iv

ZIELINSKI : BOOK PROPOSAL

ND(RICIS(AID#)) : AN ORGANIZATIONAL PROPOSAL

The following is a description of an evolution of a proposal for the organization of the book *Cybernetics of Cybernetics*. The basic underlying idea is the “Entailment Structure.” An excursion into the American Heritage Dictionary revealed that the Indo-European root of “entail” is “en-” which means “inner teaching,” inward learning, or fastenings within.” The construction of a definition of entailment structure is almost the same description of the proposal itself. Following this is a list of terms and possible definitions. Its purpose is to establish a working language we can use in order to talk about the different types of articles and presentations for the book *Cybernetics of Cybernetics*. Finally, an entailment structure is given which presents the hierarchy of organization for the terms discussed.

The idea was brought up that we would like the book itself to be a cybernetic event and organized in a cybernetic way. To see this meant that I could see, all at once, what the book was about and how it was organized, and, if I were to open the book to any one page, I could see where I was in relation to everything else.

An entailment structure could be used to meet the first need, that is, a display of everything in one place and an indication of connections. On each node of the structure would be a pointer to the location in the book where the article or presentation is located. To meet the second need, opening to any page and knowing where I was in relationship to everything else, caused more of a problem. But it would have to be on each page. The idea occurred to have a pointer on each page giving a location on the entailment structure. For example, I want to locate Champaign on a map of Illinois. I go to the list of cities and find “Champaign (Illi.).” Then I go down the vertical edge to “I” and across to “9” and look in the area indicated and find Champaign.

In short, then, the proposal includes two implementations: an entailment structure “map” within a coordinate system and an indexing function on each page which points back to the entailment structure.

EVALUATION STRUCTURE

Word	dn	Indo-Euro Root	Meaning
entail	to have as a (necessary) accompaniment or consequence	endek	(Latini: intro) inward used to form verbs from nouns to indicate , or resemble
en	from	en	(Latini: intro) within, inner.
tail	Something that follows or takes place last	dak	(Latini: docere) to teach (* : docere) to teach

EVALUATION:

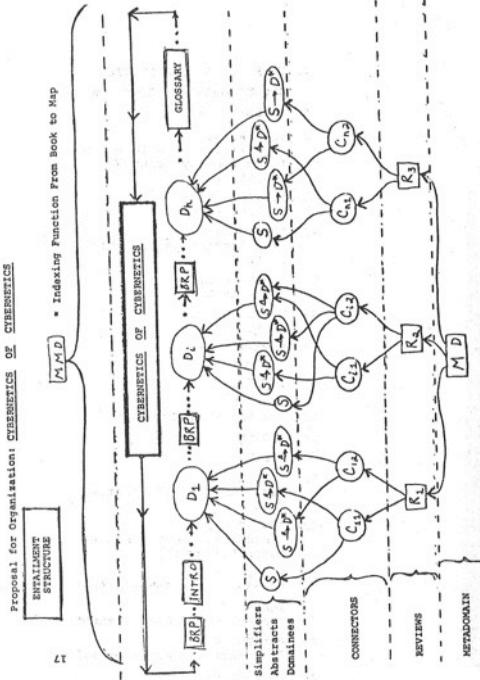
Indo-European:	Indo-Euro:
English Connotation [email]	[=Informed Learning] [Inner teachings, -ability to follow] [A resembles B]
English:	[email]

DEFINITION OF TERMS

TERM	Symbol	Definition
Domain	D	A target book, article or paper
Abstract	A	Sums up and presents conclusions A can produce any P, Q, R
Simplifier	S or Q	Purposes is to make simple the ideas and can proceed A, Q, R, D
NETDOMAIN	MD	What is needed to understand what follows

Proposal for Organization: CYBERNETICS OF CYBERNETICS

L1 $\vdash A \wedge D \vdash$ * Indexing Function From Book to Map



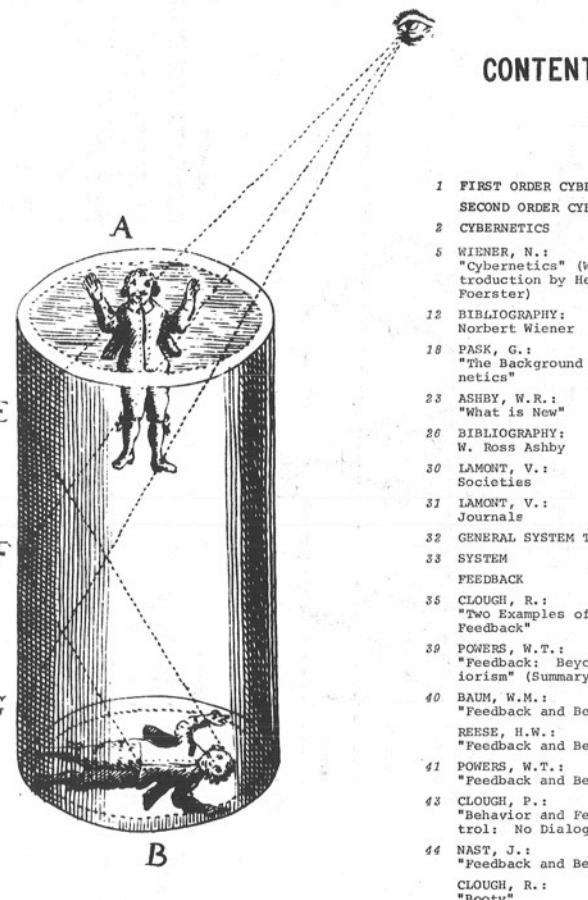
TERM	Symbol	Definition
Connector	C	Relates each * to the other *'s in one particular domain (Target of C is A P)
Review	R	Current State of the Art
Meta-domain	MD	Display relationships among domains of Cybernetics in applications of Cybernetics to individual domains
Metadmeta-domain	MD2	An indexing function on each page showing where you are in relation to everything else (a point on E.S.)

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○ ○ ○



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PRODUCTION CREDITS

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(ii) the splendid cooperation of the Publications Office of our Department of Electrical Engineering; of the staff of the Engineering Publications Office; and of the staff of the Production Department, University of Illinois Press, who printed the cover and bound this collection.

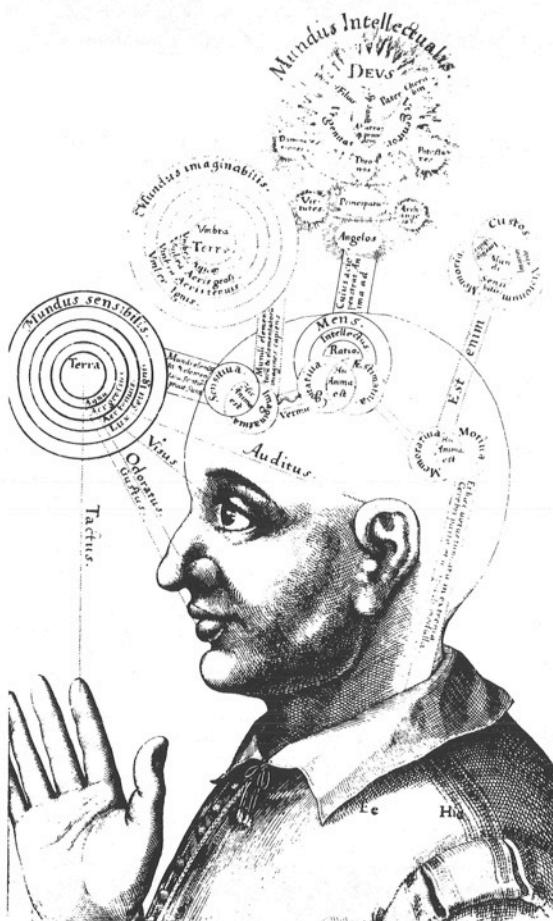
Moreover, my thanks go to all of the "glossarists" who so kindly responded to our invitation to participate in this venture, and to the United Mime Workers whose understanding of combinatorial matters made partitions and coalitions for everyone to see.

H.V.F.



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COURSE DESCRIPTION

CYBERNETICS OF CYBERNETICS

Instructor: Heinz Von Foerster

EE 272 Bph 199
EE 490 Bph 491

Fall Semester 1973, continued through
Spring Semester 1974.
3 hours (1 unit)/ semester

Prerequisite: Consent of Instructor.

Course Description

This is a project oriented course. Its principal aim is to arrive at a format (model) for publication (monograph, anthology, reader, source book, handbook, catalogue, primer, or whatever) that, when published, shall serve as a nucleus for a comprehensive presentation of the full range of methods and concepts in cybernetics as they are available today with regard to cognitive, social and cultural processes. However, a knowledge of cybernetics is not required as a prerequisite in this course.

"First-Order Cybernetics" developed the epistemology for comprehending and simulating biological processes as, e.g., homeostasis, habituation, adaptation, and other first-order regulatory processes. "Second-Order Cybernetics" provides a conceptual framework with sufficient richness to attack successfully such second-order processes as, e.g., cognition, dialogue, socio-cultural interactions, etc.

It is the purpose of this course to make this conceptual framework accessible to a large and diversified audience (from high school students to university professors, from local organizers of voluntary action programs to administrators of large civic systems), by a publication whose design should be accomplished on or about midterm of the Spring Semester, 1974. The book to be designed will be a thousand (1000) page volume, 8 1/2" by 11", to be run off on rotary presses. Moreover, besides its internally fully interacting organization by means of cross-referencing, concordance, glossary, and newly to be developed graphic means, this volume is to be abundantly illustrated, comparable to McLuhan-Fiore's The Medium is the Message or the Whole Earth Catalog, so that going through this volume should be an intellectual as well as a visual feast.

Students who wish to participate in this course should be prepared to meet exacting production schedules and a considerable work load. Last day for dropping this course will be the date as posted in the University Calendar. Only those students should apply who believe in learning by doing.



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SESSION ABSTRACTS

29 Aug 74 Orientation. FOAR Proposal distributed and discussed. Population and oil use projections given; basic concepts of the subject matter are sketched; trivial and non-trivial machines, second-order cybernetics, limitations of logic, non-linearity, hierarchy, and heterarchy.

Theorem One: The logic of the world is the logic of the description of the world. All our experiences, perceptual, intellectual, emotional are states of nervous activity.

5 Sep 73

Dyadic explanatory paradigms and the nature of Explanation. Monadic, dyadic, triadic, no relations. Symmetries of paradoxes are rearrangements/Deconstruction. Two conditions for a paradox are that the length of a subject's description of the arrangement is longer than the description of that arrangement for which this is the more direct description. These descriptions are causation. Explanation is a lifting from a plane enabling two dimensions into three. Paradigms of causation are discussed. Lexical and ostensive definitions are defined.

10 Sep 73

PLATO Session—Valerie LaMont and Stuart Umpleby. Functions of human participation and information exchange described, also the history of hardware of PLATO. Demonstration of terminal use. Bileansman program for class planned.

13 Sep 73

Work on PLATO terminal.

17 Sep 73

Recursive nature of relations. Order is a relation of the descriptive, aspherical, arrangements, descriptions, lengths of descriptions, i.e., the length of a subject's description. Proportionality of functions is clarified. Length of description of the arrangement did not know logarithm was harder for some people to accept people trop—everyone had heard of it, no one could use it quickly. Interactions and causation are relations, thus causation is a form of genesis and causation. A model of causation, the law-breaker goes to jail. In scientific law, when the law is broken, the lawbreaker goes to jail.

19 Sep 73

19 Sep 73 is of the observer, not the world. Language is a result, but usually we think what we say. We who are thinking terms, but usually we think what we say. Principle of Variation. History of Cybernetics is told, organised around the individual scientists and their contributions.

24 Sep 73

History of Cybernetics continued into current generation. Difficulty to second-order concepts noted. A model of sensation, perception, cognition and affective action is described. Memory is essential to such a system. The quantum theory of memory is described.

Gordon

park, who showed that purpose is necessary for the interpretation of a model requiring purpose. Every complex system has a language. A model can be used to reflect one language, one culture, one tradition, one society, one language. Originals and others; interwoven languages of semantics.

26 Sep 73

General discussion of needs, goals, and organization. Bi-monthly internal publication proposed, to be called Cybernetician or Cyberneticist.

1 Oct 73

Establishment of Conventions*, as assignment by Herbert Brin is given and discussed. Trial of the human mind in making connections where none exist. "I am my major field of interest." *SFV. Next a sentence—ask, why that said to me? "These two things are not connected" is a relationship.

2 Oct 73

Tremo's meeting. Class members introduce themselves by interest and intent. "What we would like to see is a group spirit existing through the processes of the class with the 'C' of Cybernetics." "What we would like to see is a group spirit existing through the processes of the class with the 'C' of Cybernetics." "What we would like to see is a group spirit existing through the processes of the class with the 'C' of Cybernetics." "What we would like to see is a group spirit existing through the processes of the class with the 'C' of Cybernetics." "What we would like to see is a group spirit existing through the processes of the class with the 'C' of Cybernetics."

26 Sep 73

Assignment is given to comment on "Feedback: Beyond Behaviorism" by W.T. Rossen. Approaches to cybernetic material are requested. Self-study, pick-up and read articles in Biological Computer Laboratory Library. They will lecture and provide integrated feedback. It will work out if we are interested in general interest areas so as that these processes might be used in a book--"On Man and Machine". Discussion on growth and organizational group structure.

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8 Oct 73 Resources for the Cybernetician and its content are discussed.

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10 Oct 73 Behaviorists react violently when the issue is learning or social change.*—Patricia Clough. Discussion of Powers, article and responses. Resistance to information is an indication of feeding flaws.*—Robert Brin.

22 Oct 73 Discussion of organization. Group spirit, Legal and financial parameters of final project. Domains vs. Production groups. What is wrong, what to do, discussion.

24 Oct 73 Distinction is drawn between a cell and its environment. When a distinction is made, entities are created and a relation established. Environment = Organism + Environment. Thus an evolution of environment exists just as does evolution of the organism. Reality is the component of the organism thinking about itself. The number of cells in a population total is less than the number of nerve cells, structure, function, description, definition of action potential. Principle of Undifferentiated Encoding: The electrical activity of a nerve cell encodes only the magnitude of perturbation agent (like heat, light, touch, etc.). The nature of the perturbation experiment in transbrace.—the weaker after a tap one could see through them as he did before until it annoyed—up!

5 Nov 73 Interview group reported that people do feel that they know about cybernetics—group had assumed not. But they don't use cybernetics—group had assumed not. Organization Groups proposed; Domains—collect glossary, to use and find experts in one's domain, review books, find connections between domains and Mathematics, Group Connections between the connections. Story of how music was invented—Herbert Brin.

7 Nov 73 Metaphors are the topic of a class discussion led by Mike Holloway. Metaphors bring out or transfer characteristics from one domain to another, see original characteristics and analogies. Metaphor—group had assumed not. Models—group had assumed not. Domains—group had assumed not. Domains—collect glossary, to use and find experts in one's domain, review books, find connections between domains and Mathematics, Group Connections between the connections. Story of how music was invented—Herbert Brin.

12 Nov 73 Format discussion. Varying attitudes toward the book are expressed. Satisfaction, satisfaction by reading, by reading it again, by reading it again, by reading it again. Why has it been mentioned by Steve Umpleby? He wants a book that will really shake people up. Who is this audience? Why has Mannheim's work on 1936? Bob Bobbister proposes a graduate course on the sociology of knowledge. There could be a complete linguistic universe without metaphor. Analogies reproduce structure in one context by mapping structures from another structure. Models map properties, and new or other, is a better fit. Symbols are used to represent properties, and new or other, and "Mild as a map" is strongly objected to by Patricia Clough. Some difficulties in dialogue and context. "The alternatives in the sicker and answer must be the same; there must be a common truth table whose values are sought by the asker."—Mike Holloway.

14 Nov 73 Danger of specialization. An experiment with slides shown to two audiences, a set of art slides in the style of... mixed slides. Original art work. Art people failed to see the differences. Art people saw the same connection as devotees. A traditional approach is justified on the grounds that books have gone through "natural selection" and people have well defined notions of how to receive information. We are designing a book for course who is the target audience. The book should be simple and accessible. On the one hand, it is a book that can be used as a reference. On the other hand, it is a book that can be used as a guide. Family—genetic to its language and which is peculiar to it. Familiarity with these may rob us of the ability to experience freshly. A statement of need is a work of art.

26 Nov 73 Assignment to envision the book to be. "This is what I would contribute." "What is to envision the book to be?" "This is what I would contribute."

26 Nov 73 Trial, non-trivial, machines. An ultra-trivial machine, * (denoted state) remains constant. Operators and elements as system constants. Operators and Operands. EXPLANATIONS link descriptions. Five types of causation: Aristotle. Transitivity of causation generates time. Announcing original claims, name, date, time. A statement of need is defined when all of its elements and operators are defined. Principle of closure.

3 Dec 73 Notation for operators and elements. Closure. Operators as numbers. Operators and Operands.

5 Dec 73 Elizabeth Park. A distinction. Psychological individuals and Mechanical individuals. P-individual capable of explaining a concept. Distinction between concept and name drawn. Process One-Concept of basic role. Process Two-Concept of a concept. Process Three-Concept of Process Two as P-individual.

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The limits of the P-individual are the limits of the physical domain in which the conversation takes place. People like to play construct and reconstruct their mind's world. A pyramidal structure of Complexity, Self-awareness and Use of symbols. Unfolding his personal system of meaning, he discloses a wide discussion. Impossibility of not imagining himself as a whole. Chance and the principle of indeterminism are needed to grow symbols: a recognition of the existence of the undesirable. Need for new use of language for symbols. That which is now revealed will be hidden again. Matuzawa's use of Political and Patricia Clough's use of 'moral' are seen as similar.

12 Dec 73
Meeting on a Sunday evening at H.V.P.'s house. Discussion of communication obstacles are discussed. H.V.P. gives a notion of what he desires, a took box of concepts.

Linguistics is anatomical. "Start people thinking in circles." One is raised when one takes things for granted; everything happens. Needs to be done. Social Science? It is done by people who do not understand. Purpose of Social Science is described in this framework.

10 Dec 73
Social Science discussion starts with definition of living system. What can be done with Social Science? It is done by people who do not understand. Purpose of Social Science is described in this framework. How to construct an interview.

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Meeting on a Sunday evening at H.V.P.'s house. Discussion of communication obstacles are discussed. H.V.P. gives a notion of what he desires, a took box of concepts.

One is raised when one takes things for granted; everything happens. Needs to be done. Social Science? It is done by people who do not understand. Purpose of Social Science is described in this framework.

21 Jan 74
Ken Wilson starts as chairperson. Open-microphone organisation group created to demonstrate. Reports of glass groups necessary. Rodney Clough forms group to do exhibition of formats for book. Other organizational matters.

Blue: Two-slit experiment as metaphorical point of view; on providing links.

Black: Space excited by electro-magnetic radiation from two sources. Products of light; photo effect.

18 Feb 74
Discussion of C of C. 18 of Cybernetic class vs. conventional. Class in consciousness; role of short term history in a small organization, strategy for printing Cybernetic 45.

20 Feb 74
Earl Jordan, Chairman of EE Department visits the class.

25 Feb 74
Announcements, organization, assignments, mixed discussion.

27 Feb 74
Presentation on Symmetry by Jim Wise. "Perceptual processes are mediated by symmetrical operations. Symmetry operates in visual systems. Paramount objective is a stability, unstable system is useful; feedback is simply a regulating feature." Linear and non-linear systems. Sensitivity = Noise Reduction.

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4 Mar 74
Professor Kuo gives mathematical description of feedback system. "Paramount objective is a stability, unstable system is useful; feedback is simply a regulating feature." Linear and non-linear systems. Sensitivity = Noise Reduction.

13 Mar 74
Richard Herbert presents on the Concept of Causality and the Causality of Concepts." History of problem of color shadows. Umpleby's model of self-interest, theories and social systems. Discussion structured by organizational group with five tickets to speak, issued each member.

24 Mar 74
A label is introduced to explicate a relation. Confused with the word 'label' as it is the label explanation, then the label is reified. What is left is the label.

Reform-Yr fiddle within a given feedback model. Revolutionize change the sign of the feedback. Economic sys tems feedback systems.

28 Jan 74
Steve Sloan chairs the first meeting run by the organization group. Class starts on time, following an agenda, which is accomplished with difficulty. Sherwin Gooch stirs discussion of possible and negative feedback.

30 Jan 74
Proposal: Experiencing Brightness. 1) Systems of learning about bright objects. 2) Learning by looking outside. 3) Learning outside the limbic structures of the brain. Representation for experiencing outside group dynamics. People to come and be learned from is not set up. HVV gives no explicit evaluation scheme for judging whether one is or is not learning in a dialogue--underspecification.

5 Feb 74
Goethard Günther. Multi-valued logic. Subject-object relationship--critique in modern science. Plato's number theory and康德ian noumenal and dialectical materialists. "I still think in two-valued logic, in spite of thirty years of study of multi-valued logic." An assignment (with stipulations) for Cybernetic 45. Formulation of assignment of dialogues with C of C, Ken all descriptions of askon, else or anyone you can think off--Reinhard Wilson and Herbert Brönn.

6 Feb 74
Stu Umpleby asks questions of the application of Cybernetic to social systems. The nature of the scientific method is clarified. Difficulties in applying scientific method to social systems discussed; two approaches in cybernetics are mentioned: Class discuss is independent of both instructor and the material.

The proceeding is Yellow. In Blue a theorem, choice of topic. In Black: The Interaction Process

Hypothesis Two : Understanding is independent of both instructor and the material.

In Black: Long-term cognition, photo effect. Dialogue blossoms in the context of the discussion. Contradiction of class is very great; notes are accurate and copious.

13 Feb 74
Yellow: "...always be aware that what we are studying in this interaction is interaction. Languages are defined in the context of the discussion. Contradiction of class is very great; notes are accurate and copious. value in the group." those who do not understand are the most

Blue: Two-slit experiment as metaphorical point of view; on providing links.

Black: Space excited by electro-magnetic radiation from two sources. Products of light; photo effect.

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27 Mar 74
Electro-magnetic fields. Mathematics of Photo-electric experiments. Quantum Mechanics contrasted with Wave Mechanics. Two-to-one mappings. Relation of Stability and size. Metaphysical images.

1 Apr 74
Mapping in the Eye. Can sensors perform decomposition? A: You have a transformation of what is coming in. C: You have a transformation of what is coming in. Composition: An overlay of several agents at one point. Decomposition: Regaining the sources of the activity.

8 Apr 74
Model of dialogue--Richard Howe and Steve Sloan. Model access to interiors of others, but conjectures are made directed toward that mode of participant is made by others, remarks --HIVV. Cohesiveness is mapped incoherence.

16 Apr 74
Global phenomena of image mapping--sensory reality. Lens, retina, image, photos, receptors.

15 Apr 74
Coalition and Partitions Function of eye in higher and lower mammals. "HOW WE BEGIN TO ENTER CYBERNETIC Cortex cells; sensory organization does not mean functions. Prinzipien of unterschiedlich encoding.

17 Apr 74
Generalized model of dialogical process is presented by Howe and Sloan.

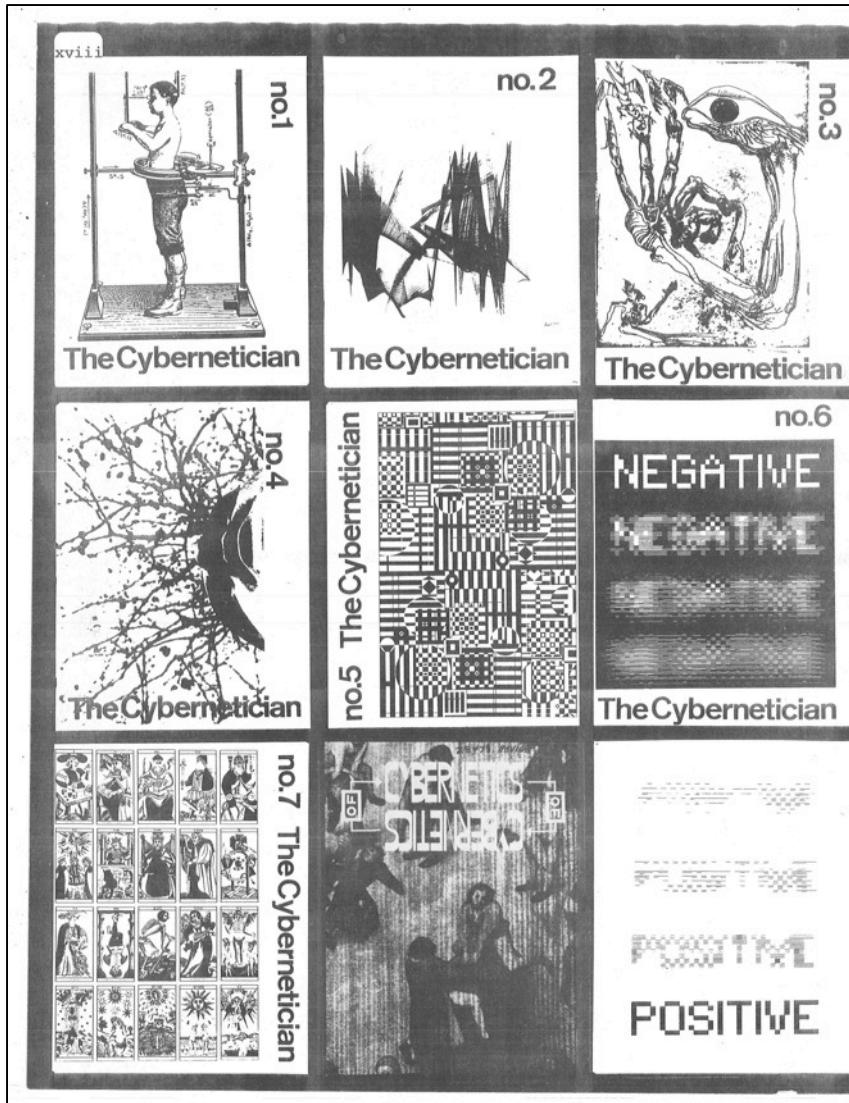
22 Apr 74
Implied Implication: Agent does not imply sensory response; response implies existence of agent. Composition subs. Computer Transformation according to other kinds (Aristotle) binary operations.

24 Apr 74
Dilthey's conception of dialogue. Forays (plan) for Cybernetics. Semantic-Inter-

action, Reader, connections, execution, State of Affairs of book reviewed.



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ACKNOWLEDGEMENTS : GRAPHICS

ANONYMOUS + 46; ARBUS + 342; ARNOLD + 54; BALDUNG-GREEN + 399; BRACELLI + 96; BRODATZ + 102; BRÜN + 365-370, 383-385, 472; CALLOT + 417; CEZANNE + 333; CLOUGH, R. + 151, 171, 333, 386, ii, iii; CODEX MARCIANUS + 1; COMMUNICATION + 140; DORE + Metabook; DÜRER + 173; ELEAZAR + 122, 456; EDM + 281; ERNST + 849; ESCHER + 124; FARBMAN + 373; FAHRAEUS + 64; FLUDD + xii; FRASNEY + 258; FU-HSI + 79; GLUSKE + 105; GOURMELIN + 340; GOVINDA + 33; GOYA + 300, 311, 418; GRIMAUD + 357, 358, 449; GROSZ + 255, 335, 363; GURBERG + 457; HACKMANN, B. + 336, ii, iii; HACKMANN, J. + ii, iii; HOFFMAN + 38; JAHNKE + 281; JUSTE DE JUSTE + 345; KIRCHER + vi; KLEE + 219, 477; KLINGER + 446; KOLLWITZ + 360; KOWACK + 34, 194, 207-211; LINDGREN + 65; LORAN + 333; MAIER + 62; MARZULLO + 26; MUTTER + 265, 287, 375, 489; MUY-BRIDGE + 189, 170; L'OEIL + 467; OROZCO + 425; PASK + 222, 228, 305; PATINKIN + 269, 352, 454; PREISLER + xi; RAY-JONES + 452; RICHTER + 179; RICHTER, F. + xiv; RIMMER + 52; ROMBERCH DE KYRSPÉ + 314; ROTA + 261; SCHEERBART + 151, iii; SCHLOSSBERG + 18; SCHÖN + 220; STEINBERG + 130, 247, 282, 426; SULZER-KLEINEMEIER + 296; TITIAN + 447; TOKURIKI + 287; UNIDENTIFIED + 128, 256; U.P.I. + 181; VESALIUS + 112, 141, 150, 281, 284; WIENER, M. + 12.





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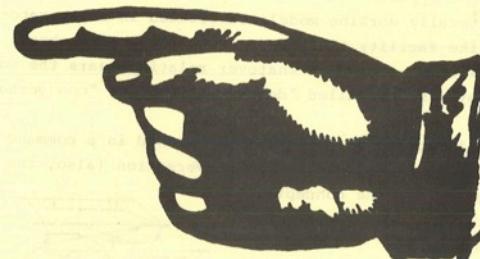
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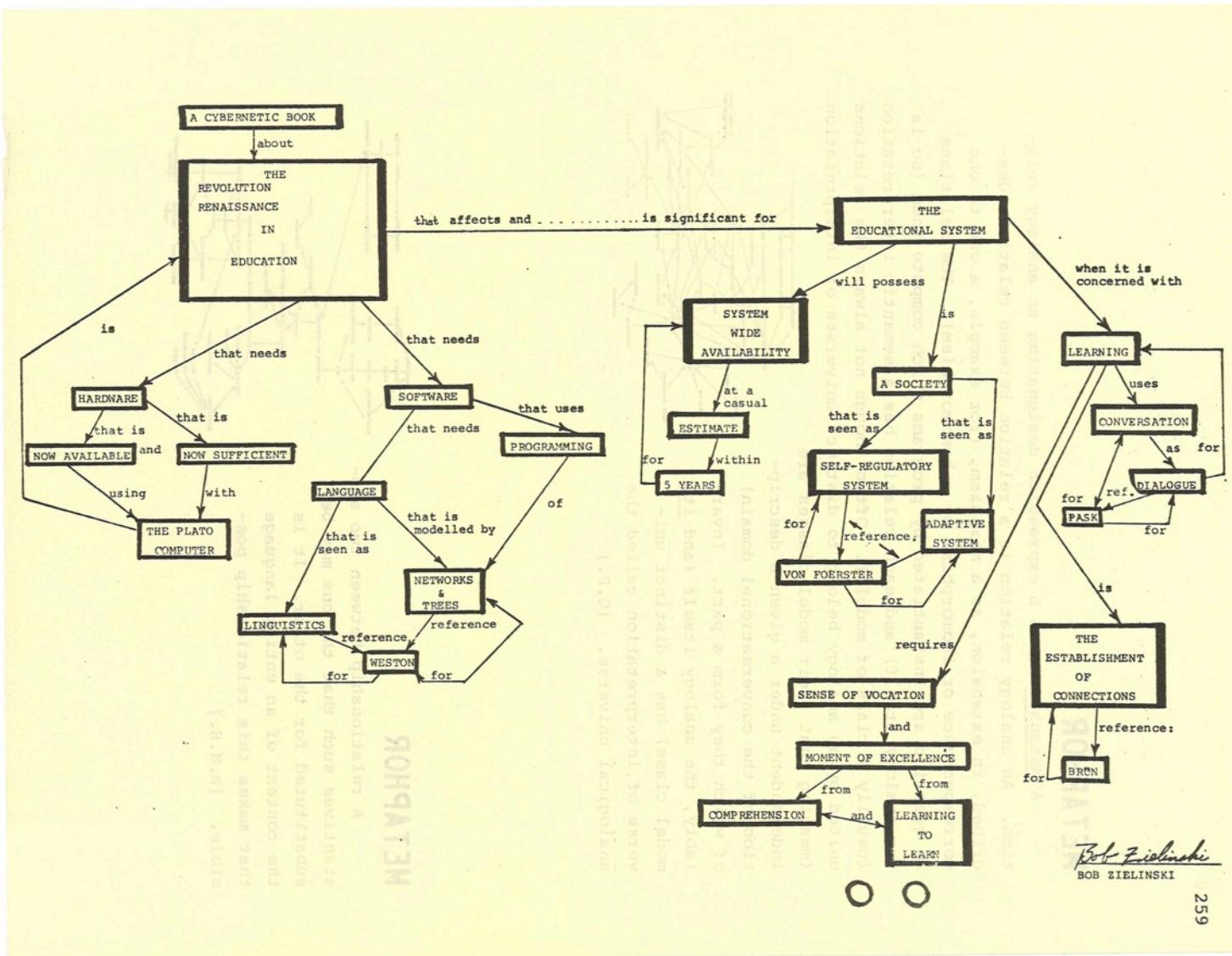
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PARABOOK



Cybernetics of Cybernetics





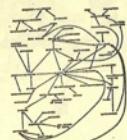
C of C – Glossary, Record

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PARADOX

Paradox is the result of insufficient clarity of thought. Some paradoxes depend on time. Thus, if all Cretans lie and one says "I am lying" though grammatically apparently complete is in fact meaningless. One must say: "I am lying when I said (or say) such-and-such was (or is) so." Then if such-and-such was (or is) in fact true when he said the sentence, the Cretan lived up to his reputation and lied. If, however, it was (or is) false, then this Cretan was the exception that proves the rule. This paradox (as all paradoxes when carefully enough analyzed) is pseudo, depending on the omission of the semantically crucial part of the sentence, in this case the part answering the question, "You lie when you say what?" The empty phrase, "I am lying" says nothing until the statement to which "am lying" refers is given. If the tense were shifted and the Cretan made to say "I was lying," everyone would see the word-juggling and ask "About what?" And then the pseudo nature of the situation would be speedily revealed by this shift of time reference or tense.

Some paradoxes depend on using the same word in two senses that are incompatible within the framework of the proposed situations. Take the well-known but ill-understood chestnut: "Is the class of all classes a member of itself?" Now a class means a selection of items on the basis of certain definable criteria. Hence the first appearance of the word "class" in the quoted question is illegitimate. For "all classes" is a euphemism for "all possible things," and "all possible things" means just what it says and hence cannot denote any class whatsoever because it is not a selection since there can be nothing larger to select from. One can validly speak of "all classes," but this "everything" in itself is not a class; and since there is nothing outside of "all classes," they cannot constitute a member any more than they constitute a class. Thus the entire quoted question is meaningless and misconceived. Again careful thinking unmasks the paradox for the linguistic legerdemain it always is. [C.M.]



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ELECTRICAL ENGINEERING DEPARTMENT

Interoffice Memorandum

Date 5/3/74TO CY #8 4VE

FROM

PARADOX

Thou shall not
contemplate "para-
dox"



C of C – Anthology



336

THE NEED OF COGNITION FOR THE COGNITION OF NEEDS

Herbert Brün

I. Cognitive Processes and Societal Problems

We know enough, today, about social problems and cognitive processes to make statements:

Social problems are interconnected with cognitive processes. Anyone who attempts to study and to answer the questions posed by one, sooner or later finds himself involved with the study of questions raised by the other.

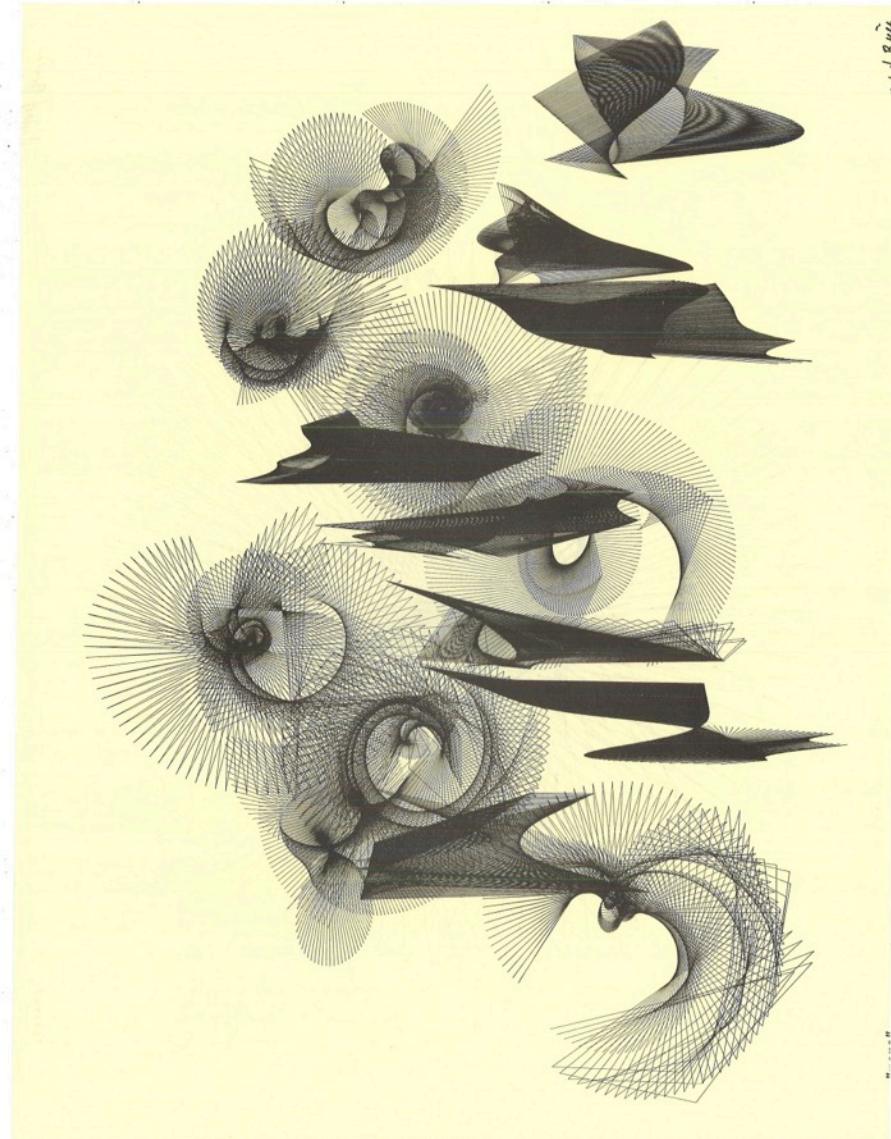
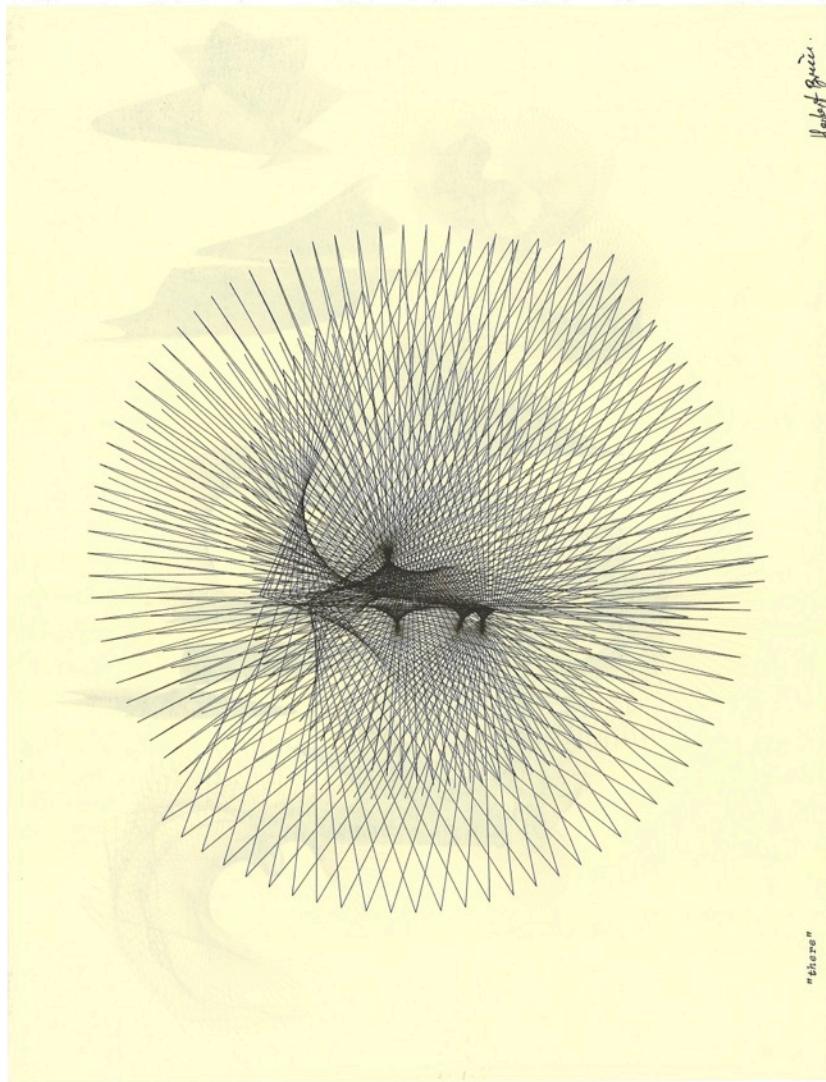
Answers to so involved a system of interlocked networks of questions will be found only if it is made possible to complement existing theories and conjectures with concrete opportunities for the examination of both, processes and problems, for the observation of their real-time manifestations, and with the still outstanding step from sophisticated documentation toward effective and problem-solving explanation.

It is necessary to recognize that he who sets out to study and to act upon cognitive processes and social problems is himself a member of the set of his objectives. The time-honored distinctions, therefore, between theory, practice, fundamental and applicable research, development etc. no longer hold, when the subjects are cognitive processes and social problems. In fact, all active attitudes, scientific and creative must move simultaneously and together, none emphasized at the expense of the other, each emphatically appropriate at a given moment to a given observation or purpose.

The objective is the understanding of cognitive processes and the solution of social problems. We agree that each one of us approaches the objective differently. We wish to pool our capabilities without having to sacrifice this diversity.

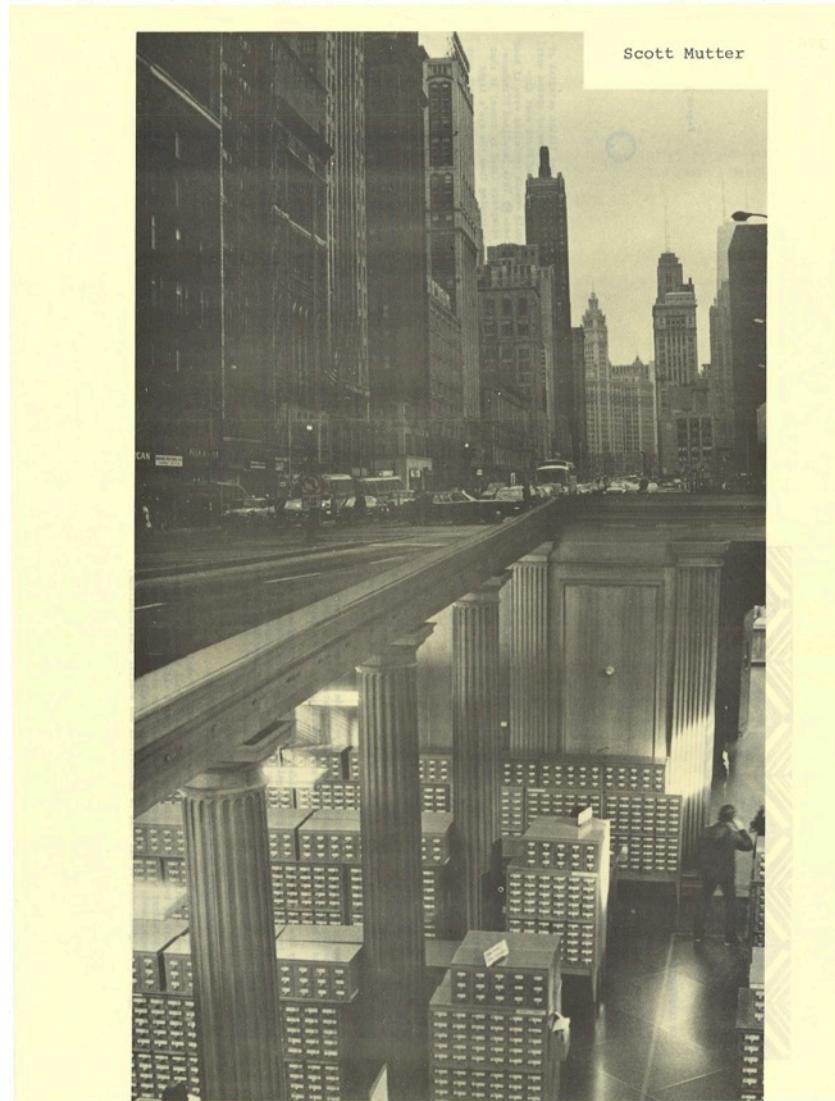


C of C – Graphics

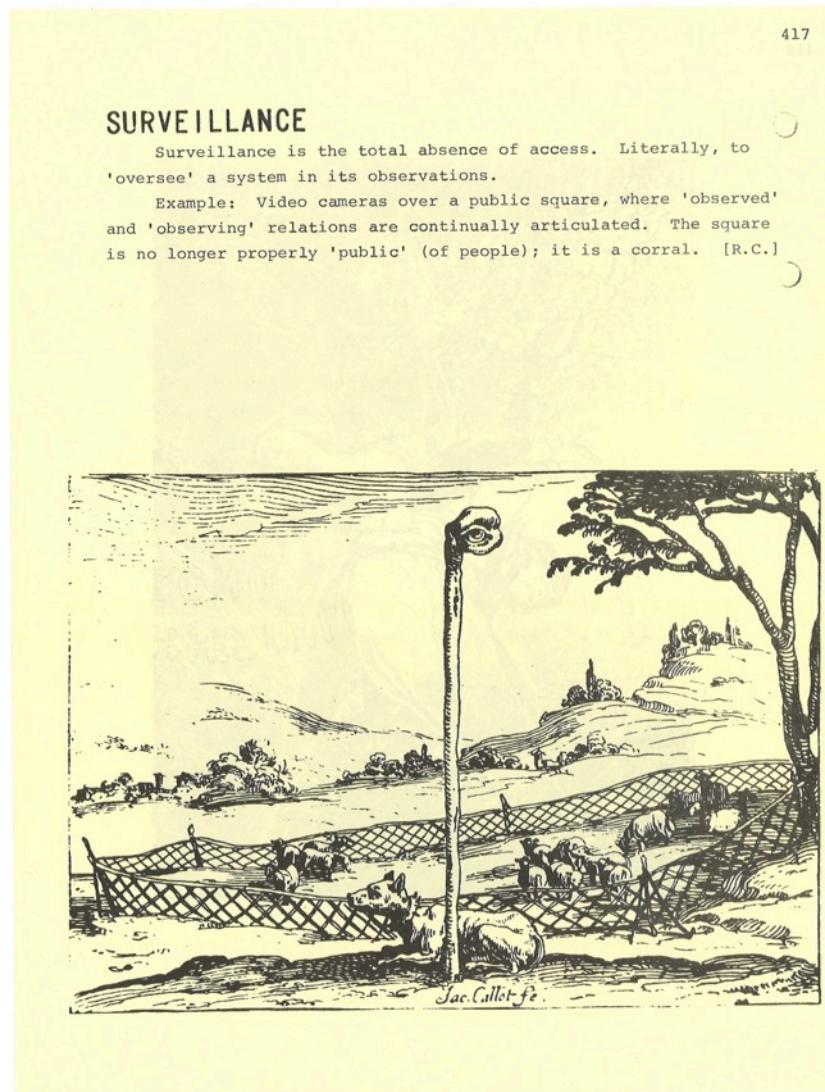




C of C – Graphics



C of C – Glossary, Graphics





C of C – Portfolio

The Establishment of Connections

Since the assignment is the establishment of connections, the establishment of connections is the assignment.
Herbert Brun

Kenneth Wilson

The Establishment of Connections.

Part One:

There are established and establishable connections

Connections are established causal links between events, objects, subjects, and ideas

Established connections are established

The U.S. government is an establishment with many connections

The connections established by the U.S. government are said to be established

These connections are established as present day reality and facts

establish the connections

There are no established connections
Connections are to be established

The invitation is to establish connections
The postulate is that we may establish connections

between any two things: All things are connected

Wilson -2

Part Two:

List all of the words that you would use to state or to imply connections

Language is connections made whether intended or not

In a closed contextual situation we can model language in the following form



where the "A"s refer to things that are connected and the "C"s refer to the connectives

To establish one set as objects and another set as connectives is arbitrary

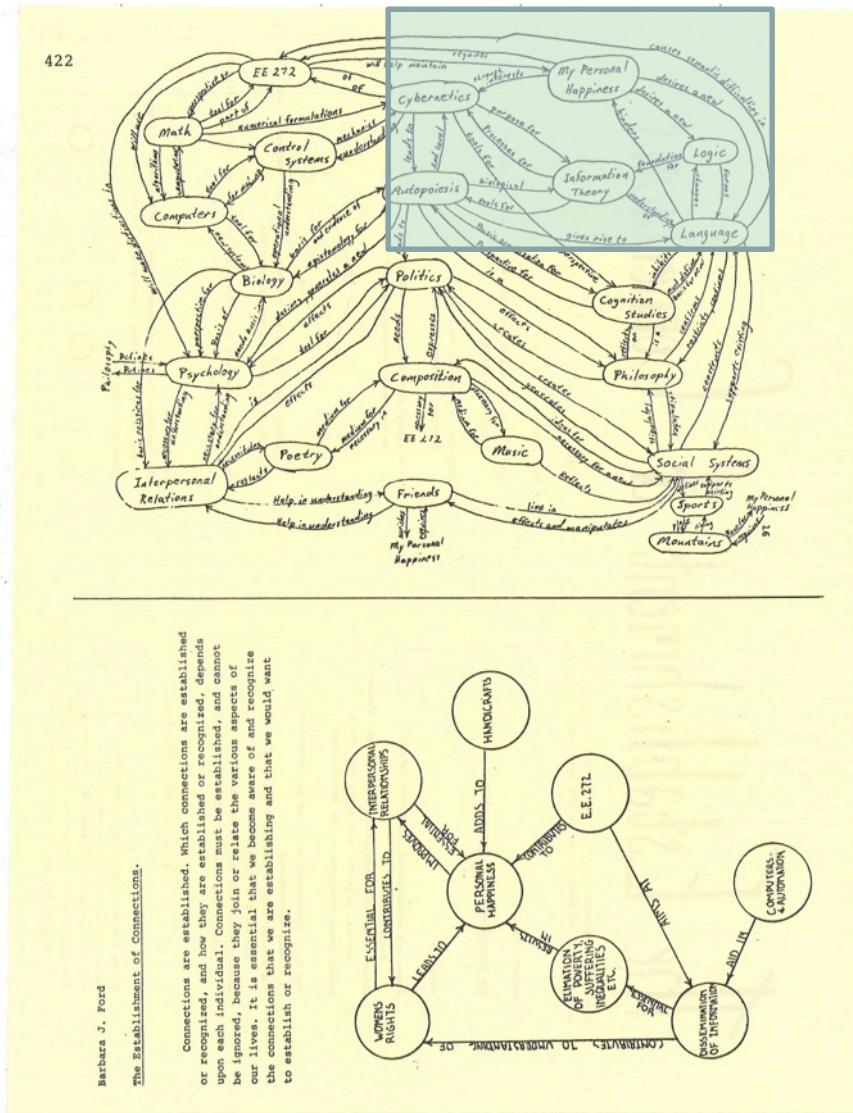
Part Three:

The following graph represents the establishment of some of the connections that I would like to make between my areas of interest.

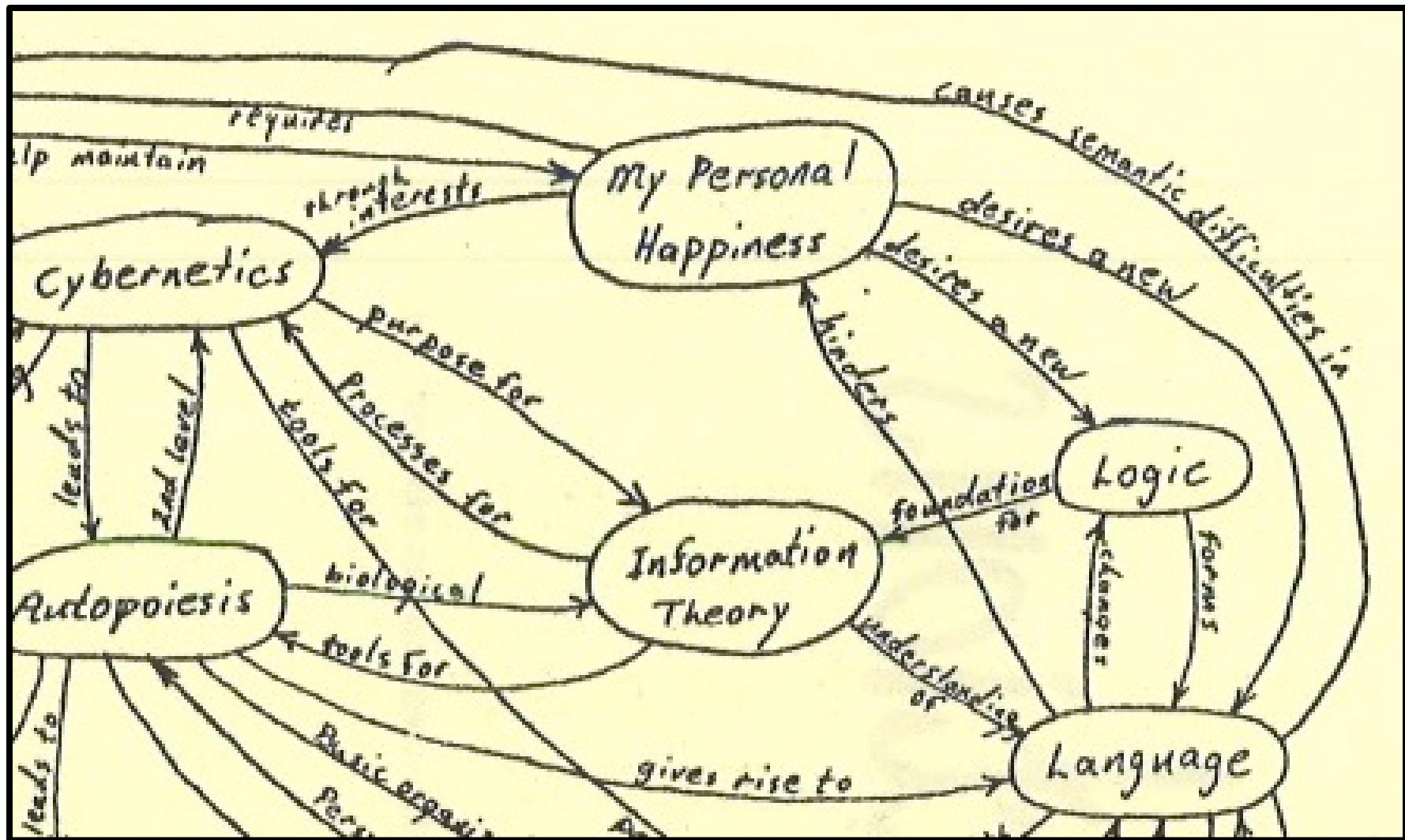




C of C – Portfolio



C of C – Portfolio (detail)





C of C – Portfolio

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EXTHOS

"Distinction is a Perfect Continence"
(G. Spencer Brown - Laws of Form)

An environment is anything not seen to be contained within a distinction.

When a distinction is made an environment is seen.

A context is a set of observed relations between an environment and that which appears to be contained within a distinction seen to be embedded in that environment.

Observers are, for our purposes, human beings. Observers can observe themselves and observe themselves observing themselves in an infinite recursive process.

All distinctions are made by an observer. The first distinction he or she must make is to distinguish his/her self from everything else.

When an observer distinguishes his/her self, he or she creates a context.

A frame of reference is a set of relations between (A) and (B). (A) is the observer's view of his/her inner state and position in the environment with respect to a distinction which appears to be outside him/her self. (B) is this other distinction and its observed context.

When an observer makes a distinction which appears to be outside him/her self, a frame of reference is created and a context is seen.

The type of distinctions made, and the nature of the observer's context and frame of reference, are determined by the purpose that the observer chooses for his/her self.

All distinctions, environments, contexts and frames of references, are always generated by an observer and are represented only in the relative states of activity of his/her nervous system.

Statements imply distinctions.

If the observer's purpose is to understand a statement then he or she must generate a frame of reference. From this frame of reference he or she will observe a context in which the distinctions and the relationships implied by the statement appear to be true.

ASSIGNMENT:

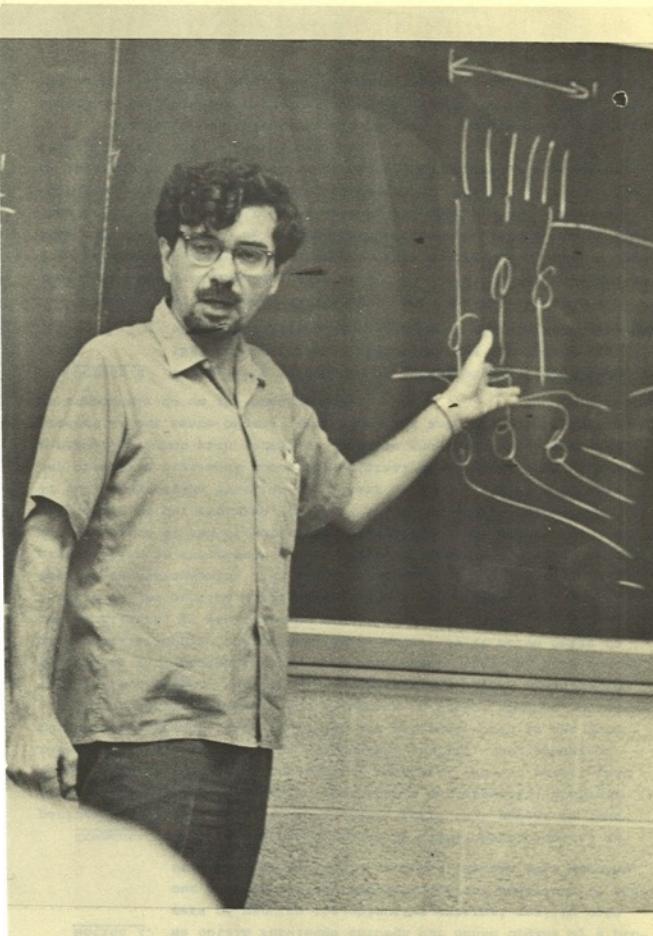
In light of the above statements make a composition which can (or cannot) be understood only in ways you intend it to be. Ideally, the parts of this composition can either not be understood when taken out of the context of the whole composition, or can be understood only in ways you intend them to be.

Disagreement with the arguments presented here is no ground for rejecting the assignment. Neither is failure.

Bob and Jim Rebitzer
3/13/74
BioPhys. 199



C of C – Anthology



any one confluence of a developed science and culture and its corresponding

COGNITIVE STRATEGIES

by

Humberto R. Maturana

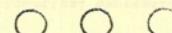
My purpose in this article is to discuss cognition in relation to man and the unity of man, in an attempt to show that any notion that we may have about the unity of man is bound to our views about knowledge and reality. Since everything that I say is said as an observer addressing other observers, I shall consider the statement that "any human action implies knowledge" as a sufficient experiential characterization of cognition, and let any additional connotation arise in the course of the article.

A. The objectivity of knowledge.

Present views about cognition as they are generally held by scientists, both explicitly and implicitly, are founded in the following epistemological notions.

Notion 1. We exist in an objective world that can be known and about which we can make cognitive statements that reveal it as an independent reality whose validity is, therefore, independent from us as observers.

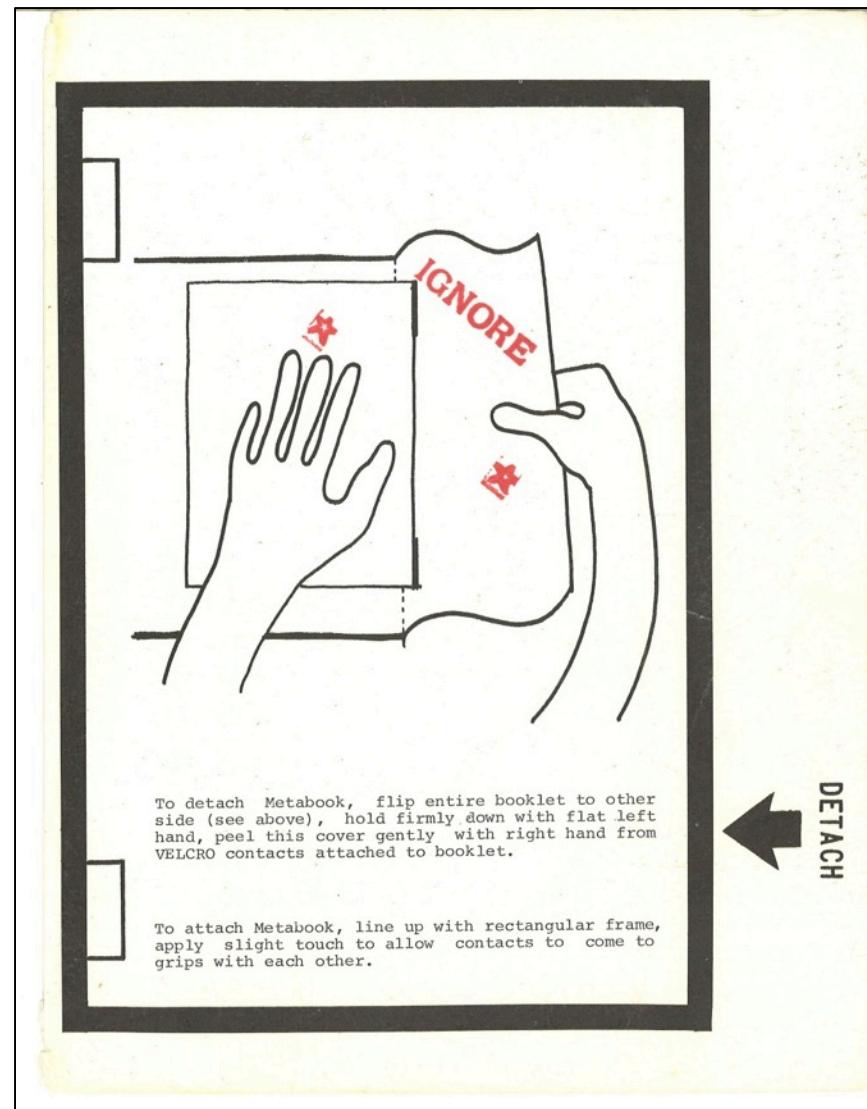
Comment: Although experientially this notion seems proven by the very circumstances that generate it, namely by our day to day manipulative experience and the predictive success of our operation as physical entities, it is an a priori notion because a successful prediction does not prove that the operation through which we make it reflects an objective reality, or constitutes an expression of our cognitive access to this reality. A prediction is a statement of what is the case within a relational matrix. Accordingly, if by some observational procedure the phenomenon considered is revealed through a projection onto a relational matrix, any statement of what is the case in that relational matrix will necessarily be observed as a state of the matrix onto which the phenomenon considered can be projected in the act of observation. Therefore, the success of a prediction only proves that a certain mapping or projection operation can be made, but does not reveal the nature of what it is that is mapped or projected.



C of C – Inside back cover

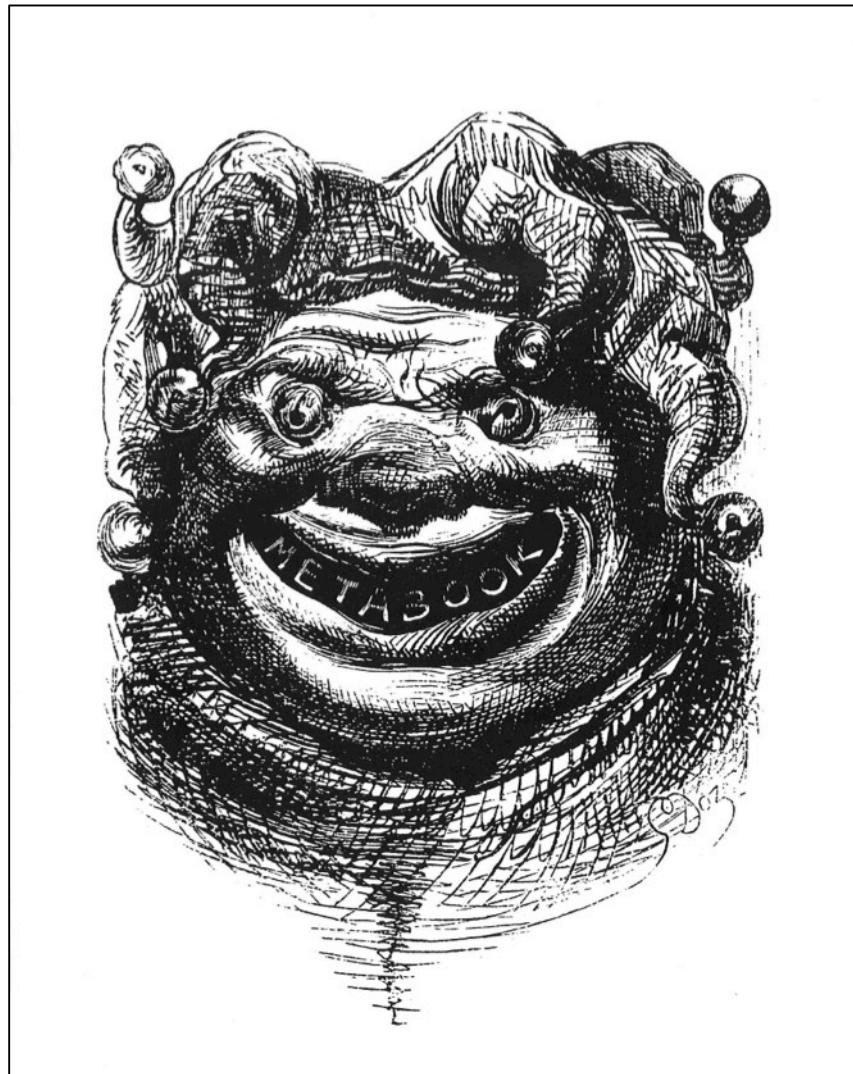
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A IS BETTER OFF WHEN B IS BETTER OFF.





C of C – Metabook





C of C – Metabook

HOW PANTAGRUEL, BEING AT SEA, HEARD VARIOUS UNFROZEN WORDS.

WHEN we were at sea, junketting, tippling, discoursing, and telling stories, Pantagruel rose and stood up to look out: then asked us, "Do you hear nothing, gentlemen? Methink I hear some people talking in the air, yet I can see nobody. Hark!" According to his command we listened, and with full ears sucked in the air, as some of you suck oysters, to find if we could hear some sound scattered through the sky; and to lose none of it, like the emperor Antoninus, some of us laid their hands hollow next to their ears; but all this would not do, nor could we hear any voice. Yet Pantagruel continued to assure us he heard various voices in the air, some of men and some of women.

At last we began to fancy that we also heard something, or at least that our ears tingled; and the more we listened, the plainer we discerned the voices, so as to distinguish articulate sounds. This mightily frightened us, and not without cause; since we could see nothing, yet heard such various sounds and voices of men, women, children, horses, &c., insomuch that Panurge cried out, "Cods belly, there's no fooling with the dévil; we are all beshit, let's fly."

Pantagruel, hearing the sad outcry which Panurge made, said, "Who talks of flying? Let's first see who they are; perhaps they may be friends: I can discover nobody yet, tho' I can see a hundred miles round me. But let's consider a little: I have read that a philosopher, named Perron, was of opinion that there were several worlds that touched each other in an equilateral triangle; in whose centre, he said, was the dwelling of truth: and that the words, ideas, copies, and images of all things past, and to come, resided there; round which was the age; and that with success of time part of them used to fall on mankind, like rheums and mildews; just as the dew fell on Gideon's fleece, till the age was fulfilled.

"I also remember," continued he, "that Aristotle affirms Homer's words to be flying, moving, and consequently animated. Besides, Antiphanes said, that Plato's philosophy was like words, which, being spoken in some country during a hard winter, are immediately congealed, frozen up, and not heard; for what Plato taught young lads could hardly be understood by them when they were grown old. Now," continued he, "we should philosophize and search whether this be not the place where those words are thawed."

METABOOK

The Metabook was prepared by

RICHARD HERBERT HOWE & STEPHEN SLOAN

with the help of

Doug Petty, Kathy Richardson, Catherine Sloan,
Heinz von Foerster, and Bob Zielinski

and the gracious and tireless efforts of
our secretary,

Adena Kershner



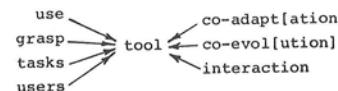
C of C – Metabook

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INTRODUCTION: Use of the Metabook.

The Metabook is to help the reader discover and invent connections between the concepts, and the authors, of *Cybernetics of Cybernetics*. For this purpose, the Metabook presents sketches of conceptual entailment structures for the authors of Glossary entries, and a minimum of data derived from those structures.

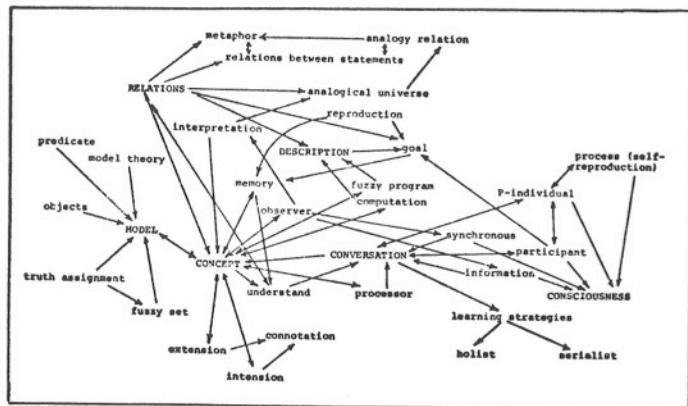
"Conceptual entailment structure" may be explained as follows. A concept is defined by other concepts. The concept defined may then be substituted for the concepts defining it. One may say that the concept defined thus "entails" the concepts defining it. The structure of the defining concepts is called a "conceptual entailment structure". So, for example, Steward Brand has given the following definition: "A tool consists of a use at one end and a grasp at the other. Tools, tasks, and users co-adapt and co-evolve in rich interaction." Brand's definition of "tool" entails the concepts "use", "grasp", "tasks", "users", "co-adapt[ation]", "co-evol[ution]", and "interaction". This entailment structure may be presented graphically as follows:



Arrow tails are concept entailed; arrow heads are concept entailing.

--In the case of more elaborate definitions, sub-definitions may enter into the entailment structure, as well as cycles of entailment. The latter become more evident if the entailment structure represents not just one definition by an author but many definitions by the same author. The latter can become quite rich, as in the case of Gordon Pask:

G.P. [Gordon Pask]



analogy relation, analogical universe, connotation, fuzzy program, fuzzy set, P-individual, predicate, processor, serialist, synchronous.

18, 51, 81, 231, 244, 247, 260, 271, 301, 312, 353, 402, 424

This figure displays an entailment structure exactly as it is to be found in the Metabook. The words listed just below the entailment structure are the concepts that are unique to this author's entries; the numbers given just below these concepts show the pages on which this author's entries (and articles) are to be found.

C of C – Metabook

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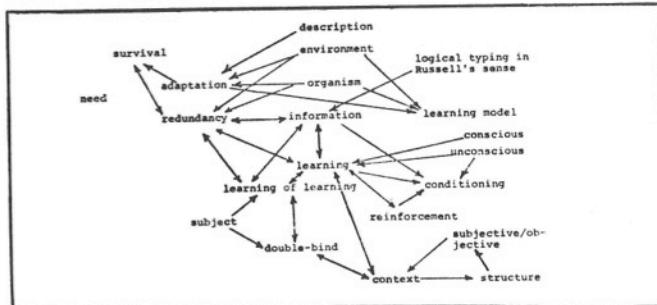
Pending the implementation of Third-Order Cybernetics, the making of such Second-Order Cybernetic connections necessarily reflects the orientations and desires of the makers. Although we could not treat our authors objectively, we hope that we have treated them fairly, and we encourage the reader of Cybernetics of Cybernetics to alter and amplify the sketches that we have presented here.

We were able to include in the Metabook only those authors whose entries were received before May 15, 1974. To help identify those author's entries, a miniature of their entailment structure is placed at the lower right of each of their entries in *Cybernetics of Cybernetics*.

Such entailment structures show intra-author connections. With such structures in hand, inter-author connections may also be found. So, for example, what concepts are unique to each author (as shown above); what concepts connect an author to another author or authors, and how many and who. This information is to be found in the tables, pp. 518 to 521. Some information-theoretical statistics about the entire Glossary set have been computed. These may be found on pages 522 & 523.

G. B.

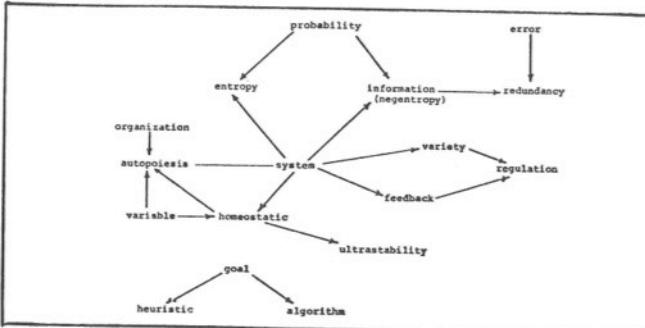
[Gregory Bateson]



conditioning, double bind, reinforcement, unconscious.

97, 98, 299, 419

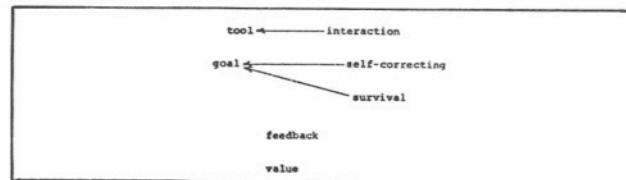
S.B. [Stafford Beer]



homeostatic, regulation, variety, ultrastability.

², 32, 33, 46, 53, 80, 86, 102, 111, 134, 182, 219, 449

S.Br. [Steward Brand]



S. Br. 34, 51, 53, 141, 371



C of C – Feedback



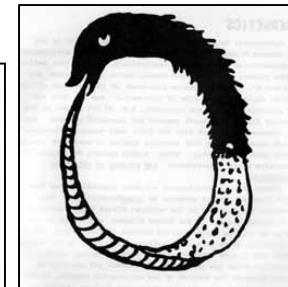
PROF. STAFFORD BEER
FIRKINS
OLD AVENUE
WEST BYFLEET
SURREY KT14 6AD
ENGLAND

FEEDBACK:

*Congratulations — you
obviously had a whale of
a time! Your image of me
is not my self-image at all: I don't know if
that's merely not surprising, or whether it matters
(to you or to me). It's a pity that you didn't carry through
the punched-hole cross-reference scheme yourselves, but
doubtless too expensive. Very
affectionate good wishes to you all.*

DATE
8th September 1974

SIGNATURE
Stafford Beer.



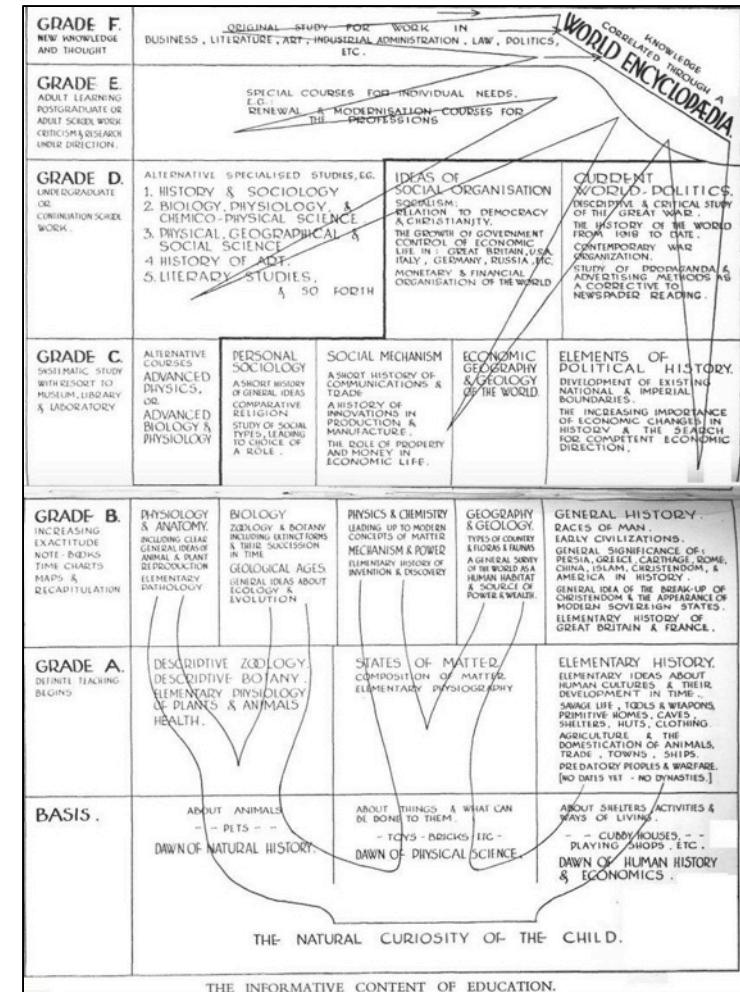


BCL, spring or summer 1974

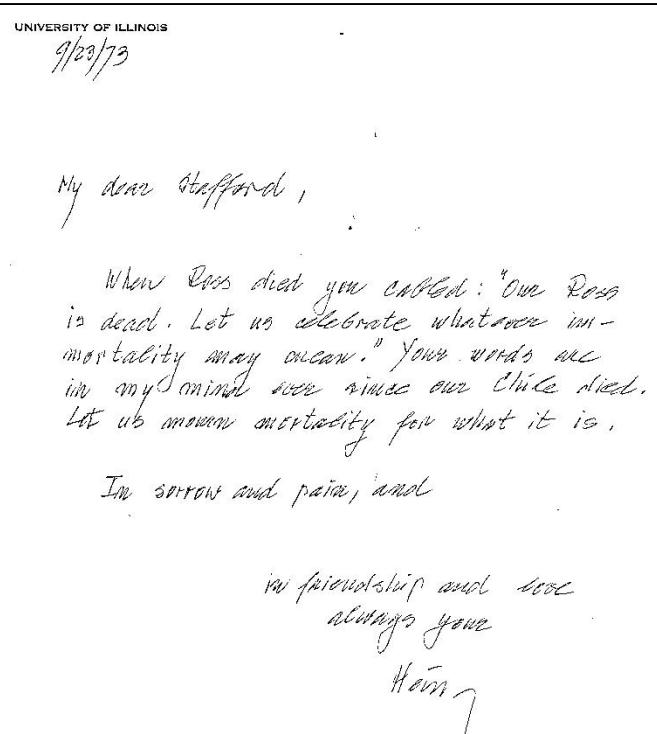
“World Brain”: Organic, Encyclopedic, Emergent (F. Heylighen)

- H. G. Wells
- Pierre Teilhard de Chardin
- Buckminster Fuller
- Marshal McLuhan
- Stewart Brand
- Stafford Beer

–Emphasis on peace



Cybersyn, Chile 1973

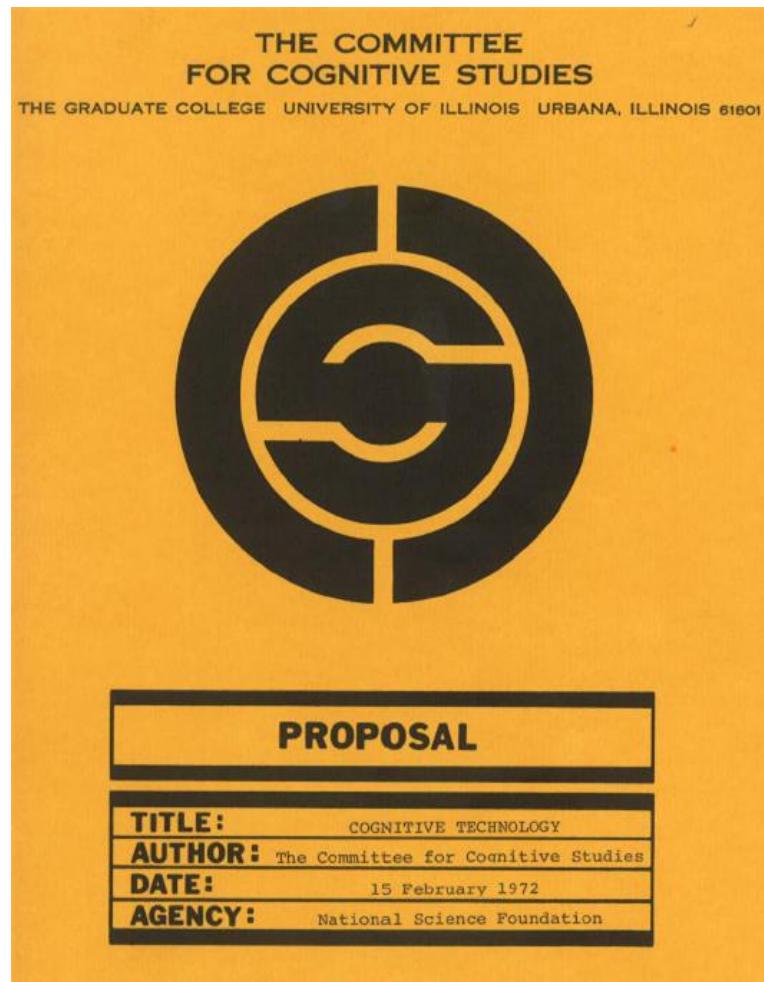


Von Foerster to Beer:
"Your words are in my mind
ever since our Chile died."
23 Sept. 1973

Stafford Beer

- Also:
- Maturana
 - Varela
 - Uribe

Cognitive Technology, 1972



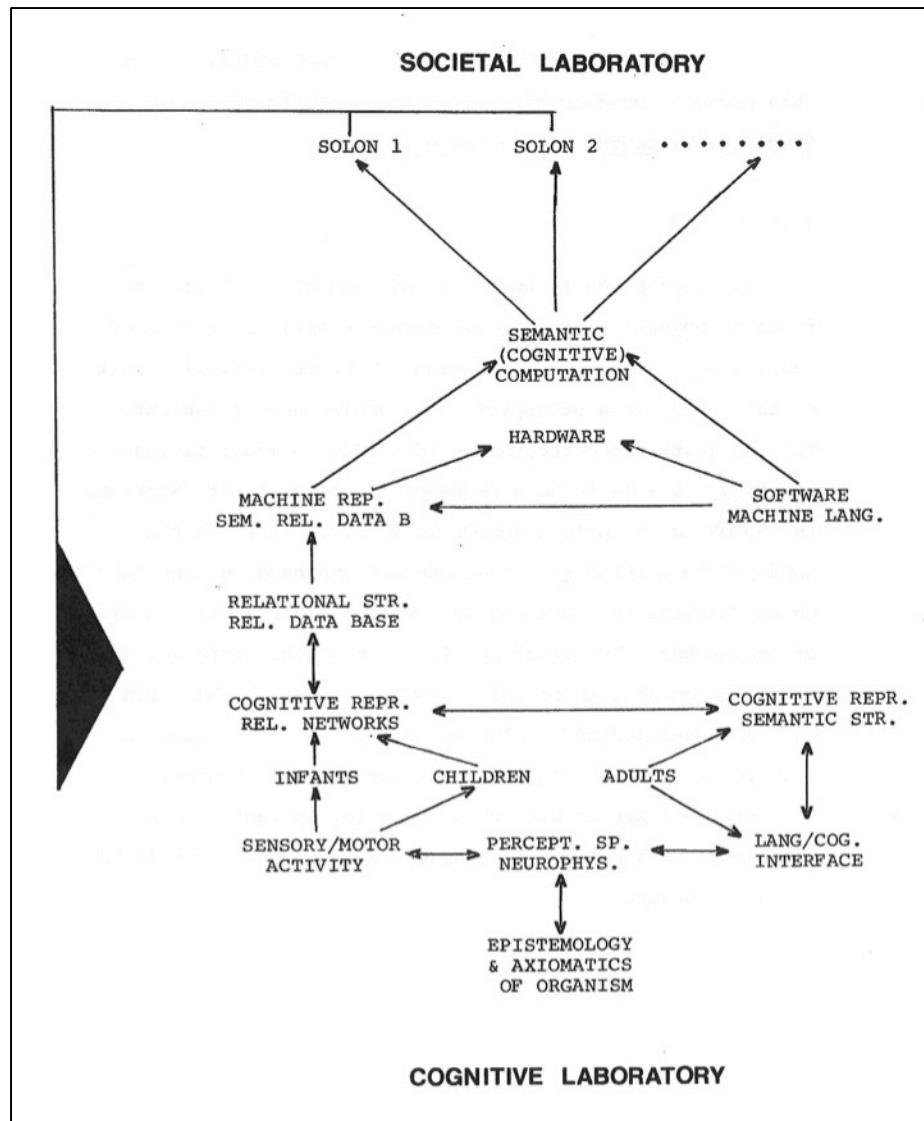
“Cognitive Technology: A Citizen-Society Problem Solving Network” (HvF, Brün, Easley, Lehman, Weston, Witz)

- 6 versions, 99 pages, \$1 million
- COGLAB: “Provides the organization for interdisciplinary, theoretical investigation of relational structures, and computations within these structures, which underly [sic] language and cognition.”
- SOLON: “Installations … that permit members of a specified segment of society to interact … [These interactions] form the data for further research (COGLAB).”

–Cybersyn for education, politics

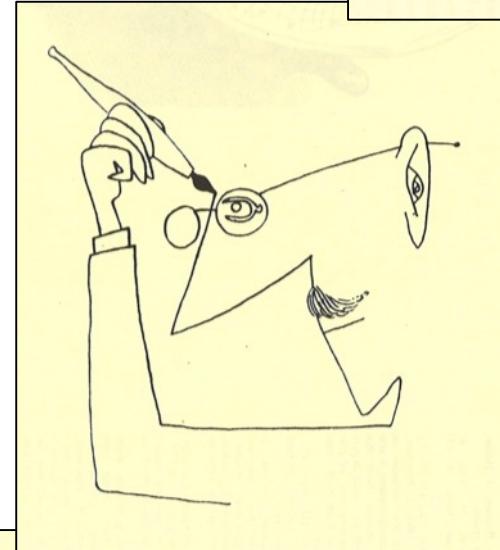
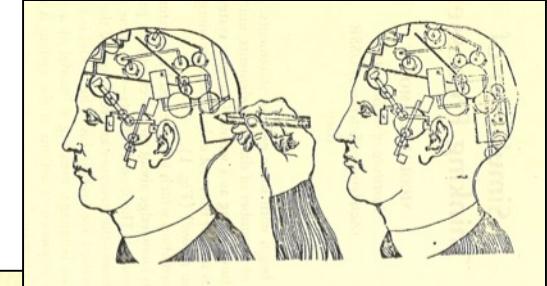


Cognitive Technology Flowchart



Cybernetics of Cybernetics

- Material Brain
 - Black-boxed
 - Treated as node
- C of C Functions As:
 - Connector
 - Architecture
 - Model
 - *Stimulus*



The End



“The biological computer
in the Biological Computer Laboratory
was Heinz von Foerster’s brain.”
—Poet Michael Holloway