WARREN BRODEY ANTHOLOGY

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Anthology

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FORWARD

The texts here compiled were written at the "watershed between ecological and non-ecological thinking."*

With Warren Brodey's permission, we share them in connection with the launch of a new digital interface to his book *Earthchild* from 1974, for which they may serve as a context (vandal.ist/earthchild).

Some of the ideas presented in these texts were received in interesting ways. Jack Burnham quoted from Brodey's article on human enhancement (written together with Nilo Lindgren) in the catalog for the landmark exhibition *Software – Information Technology: Its New Meaning for Art* in 1970; his notion of "soft architecture" was picked up by Nicholas Negroponte in *Soft Architecture Machines* (1975); and Gregory Bateson found use for his concept of the "time-grain" in *Steps to an Ecology of Mind* (1972).

Today, well into the paradigm of "general ecology" (Erich Hörl), Brodey's texts deserve renewed attention. Some of them have been hard to come by. It is time they are put back into circulation.

Hereby forwarded.

Karin Nygård and Ellef Prestsæter
Blaker, 2024

* Warren Brodey and Gregory Bateson, "The Treaty of Kealakekua Bay," unpublished transcript, May 1972.

of measuring order except in terms of the passage of time and these need not be closely related; thus we should always allow for a large range of uncertainty.

A good deal of our discussion of ideas about time seems not to have taken into account that the history of those ideas goes back far beyond Saint Augustine and Aristotle, who have been frequently mentioned here. The recent studies of Stonehenge (Hawkins, 1964) indicate that by about 2,000 or 1,500 B.C. ideas about the calendar were already quite sophisticated; and the alignments at Carnac, seemingly much cruder, suggest roots farther back. Recently, Marschak (1964) has marshalled evidence for a lunar calendric notation in the upper Paleolithic, say twenty or thirty thousand years ago. Evidence from prehistory is always somewhat uncertain, partly because it has to be evaluated in terms of present day concepts of time, which have themselves been built up over a long period of evolution. But there may be error too in regarding human knowledge as something that has been elaborated from an archetypal pattern already complete in outline about the time written history begins rather than being a pattern that has grown for a much longer time by accumulation of facets by "trial and error" selection. The latter I have tried to picture here with my "collective mnemotype" (see also Blum, 1963). Viewing our knowledge and its history in these terms may increase, I think, both our understanding and our humility.

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The Clock Manifesto

WARREN M. BRODEY (*Massachusetts Institute of Technology, Cambridge, Mass.*): The concept of Newtonian absolute time is more pervasive than we realize. It is implicit in the format of all our measuring systems. It is in our measuring units. There is as yet no other format commonly available. Though this absolute time—common clock time—provides an effective and coherent language of description, it is less adequate as a language of control. It is inadequate for describing in simple terms the relation of systems which continuously evolve each other, metabolizing what did not exist for them before into the process of actively becoming. Though traditionally poetic this is now a technical problem. A measurement language for timing our intervention into a system that is actively evolving is essential to the science of control.

The freedom to reconceptualize time is necessary if we are to have rules for selecting the clock whose time has a shape that optimizes the mapping of information from the phenomena into equivalences (units) which preserve it and reduce the opacity of the controllable phases. Such condensed information then is available as an effective base for entering the on-going control loop with intervention designed to a purpose.

We have heard from a historian how each different way of using absolute time units illuminates historical terrain so as to throw different information into shadow. Our skill in using the one common time format and its variations has led us through centuries of search for simplification without examining the implicit decision to continue following this convention—as one of many possible choices. Watching children being taught about time and knowing the variant shapes of time (like religions) in different cultures, professions, and over history as presented here, makes one aware that the clock format we commonly use is a convention. This clock convention is being examined in this meeting. Like all absolute conventions that constrain science, it is first broken informally into irreconcilable parts each fitted to a special purpose. When scientists of the different uses do speak, they know the Tower of Babel that develops until the different formats are specified. Only then can the novel facts, given existence by the more specified perspectives, by recombined into a new convention which will last until obsolescence again strikes it down.

But what are the constraints imposed by the old convention: The nonlinear phenomena of biologic and other control loops have defied simplification with a linear clock. I believe solution to this problem is obscured by the nature of common clock design: The time units that we commonly use are derived from one particular type of periodic relation—the relative periodicity of two systems in which at least one has little significant influence on the other. For example, man's biological clock had little influence on the earth's rotation. Given this constraint the way we must map the timing of two biological systems that have evolved a common control purpose, and a periodicity that optimizes their exchange of control information, is humorously awkward. Thus, ordinarily, biological clock A is mapped onto the mean solar standard time clock Y, the referent clock; biological clock B, which is to be joined to A in a control loop, is mapped similarly onto clock Y; then, these maps of A and B on Y are compared. If a relative A to B periodicity is noted which can be expressed *after being filtered through this system of notation*, a relation between A and B is said to exist. The filter may not be obvious, being implicit in the structural choice of units for representing equivalent periods of time. For example, changes of periodicity of heart rate and breathing are simply mapped onto the wrist watch, both being averaged over a period of a minute or less and their "relative" timing is obvious—provided one is not interested in how heart rate and respiratory rate evolve each others changings.

Those relations that, like respiration and pulse, easily fit the mapping of two variables onto a single third implicit in the unit of measure are called simple; and those that don't need further observation in order to be simplified.

Biological systems once squeezed through this time deriving procedure can be characterized in terms of present stationary levels and rates between levels. Phenomena then can be described in past time or in probabilistic future anchored in the past. But the rich dialogue at the growth edge of change—in the present available to control—which our technology now could assimilate and use for real-time control, appears overly complex within this traditional system of simplification: If living, growing, changing as-it-occurs cannot be simply displayed, we cannot actively and delicately join the rich control dialogue which resonating biological systems must use for maintaining ecological equilibrium. This dialogue we know among ourselves but deny to inferior systems where observer and observed likewise approximate closely.

Even if we accept the notion that all such anastomotically joined systems have a simple time relation for evolving each other as they move into the very tip of their moments, we have no formal language with which to describe this timing control over becoming. To illustrate this time control in human terms: The teacher who measures her information output to a child by the wall clock instead of carefully monitoring the time matching of her own capability to the opening and closing of the child's control moments, the moments when they communicate the most change choice, will not be an effective organizer of the child in terms of her intent.

If we wish to construct a control timing map to simplify and display the system of two adjacent cells, or of two people, changing in response to each other's changing as they join a mutual control dialogue, we need to explore new time formats. A time map that shapes differently, so as optimally to display territories of choice density where intervention is more likely to be effective, might allow us to formalize the science that is now preserved in hand wavings.

The hope that motivates these remarks comes from a belief in the potential simplicity of processes as basic to evolution as the relative periodicity and timing of information flow between individuals who approximate in sharing species structure and environment.

I gather from my biological and physicist friends that the wish to use one better known cell or particle to sense the changing of another even as they change each other is frustrated primarily by the lack of a way to quantify these kinds of relations. Let me again illustrate: Please think of how you would use the equivalences of a regular clock to get at the following simplicity of timing that even a child knows in his way of responding if not in awareness: Two people shake hands or look into each other's eyes, or two cells communicate enough to join in a communal self-organizing function. The ordinary clock will allow us to speak of these two people shaking each other's hands as if first A's shook B's, then B's shook A's, in infinitesimal moments. Using this kind of ping pong format, careful measurement does not give formal insight into the time language—the way the handshake actively evolves its transitions, although this is important control information.

The ping pong format allows one to gain the kind of information that can be obtained by a foreigner who can ask "where is the railway station?", but cannot engage in more complex conversation.

Imagine a creature of foreign species who, with our measuring tools, is seeking to identify the control exchange of a handshake or of two animals barking or rubbing as he might see it. He could only apprehend the sequences of behavior of each animal. He would not know the time language that we use in speaking through our handshake or our talking. Two people speaking to each other or solving problems together become components timed to their conversation in a way that is different from that in which each would speak alone. They are organized by their conversation as well as organizing it. The self-organizing process itself is a language which even a child knows. There is a simplicity here that would escape the observing super creature watching us with a traditional clock. We all know that the same energy or words or action applied in or out of phase with the other person's resonant timing has entirely different control significance. We use this time-control topology to add a delicateness to our communication that multiplies variability by many magnitudes without demanding changes in the timeless symbols we formally regard as our descriptors. It is our difficulty in instructing computers in the nuance of handwaving that requires us to rework our conception of time.

I believe that this rich dialogue of evolving control we know with each other is in the interaction of all closely approximated biological systems—each slight shift meets responsive shifts as the elements quicken to each other's changings. The weak shifts grow as they meet responsive changings and enter into feedback loops which periodically stabilize, and unstabilize, acting as organizers of other slight shifts. The information which grows as stability shifts toward instability enters into the closely woven edge of change in a design whose redundancy has yet to be captured. Yet redundancy must exist for a reliable control to be achieved. This growth edge of change enables a community of two or more similar elements to balance so that novel change organizes and triggers other growing variations into an evolving variety—that just allows this assembly to metabolize that which was just beyond the border of its organizing power—that which did not exist for it. This opening into the unknown is best handled by creatures who use weak variation to evolve control behavior, in the Darwinian tradition. It is this power to metabolize or evolve irrelevance into relevance, noise into signal available to choice, that characterizes the kind of system whose study most clearly requires going beyond absolute time.

There are those who will say that absolute time, the time of our ordinary clocks, makes our basic scientific structure more simple. As McCulloch makes clear: "If the base structure of an epistemological system is not rich enough, it can only distract us from the very conceptual parsimony that we in science seek to develop."

There is a chink in the wall. Once he sees through and then knows the wall is there, the scientist is captured by a new question, and turns to his powerful strategy of search—his expertness in groping. But groping is often slowed by failure to transfer among us that point of perspective which allows the new question: How do we go beyond absolute time? Partly out of my delight in whimsical formalism, and partly to bolster courage, let me now summarize these remarks in the form of a declaration:

The Clock Manifesto

1. We declare ourselves free of the constraint of the single clock.
2. We see the need to use well defined different clocks, which may not be coherently relatable to each other.
3. We expect that these clocks will be to some degree mappable into each other, but recognize that, for these clocks to be fundamentally different, there must be loss of information in this cross mapping process.
4. We suggest that these multiple clocks be chosen (designed) to meet the requirement of the problem space in question.
5. By attending to the topology implicit in the clock format being used, we hope it will be possible to develop a simplified notation for the timing natural to interactive systems that have the property of evolving each other.
6. We expect this relatively unconstrained approach to time will eventually provide a richer and less tautological multiclock perspective and will allow a more encompassing theory of time to develop.

MAN—LANGUAGE RELATIONSHIPS

O. D. WELLS (*Artorga Research Group, Beaulieu, Hants, England*): The language problem is probably far more important than has yet been visualized, and I would like to consider the possibility of treating "time" as a necessary artifact of our language structure. I put forth this simple thesis:

The folklore evolution of language is founded on a relation or mapping between *objects* in a common environment and *words* representing these objects in the language. Since objects in the environment *are not words*, we must sharply differentiate between the set G_1 of the *objects in the environment* and the set G_2 of the words into which these *objects* are mapped. Hence, whenever we refer to set G_1 we will underline the words used, indicating that we are using words to represent elements of a set that contains only not-words.

The words in the set G_2 represent objects in the common environment, but these words themselves can be considered as objects. For instance, the word „ʎƃuıɹʇs„ is an object. If we rotate it, it becomes a word "stringy" which we can say, besides being an object, has some meaning to an individual who has experience of English. Therefore, we have to invent a new set G_3,

The Design of Intelligent Environments

Soft Architecture

Warren M. Brodey

WALKING TO WORK this morning I remembered the white-gloved policeman who is now replaced by computer-timed, radio-controlled traffic lights. All lights used to be of equal duration, regardless of the hour or the traffic load. They were "stupid" in the days before actual flow was fed back to change stop light duration. Flow projections and intelligent guessing are necessary features of our newer computer-controlled traffic systems: necessary for the speed and density of flow now common, for example, in subways.

Nevertheless, this intelligence of the subway system and a multitude of other similar computer-controlled systems is still like the automated control of a well run insect colony whose program for behavior leads them to compute approximately the same course of action repetitively, with little creative effort on their part to evolve a purposeful behavior. When should this regulation which provides survival be called intelligence? I wonder if a man from the 17th Century looking at our present world would say that we had an intelligent environment. Would he be able to say that our environment was able to control itself more intelligently than his?

The concept of an intelligent environment softened by a gentle control which stands in place of steel bones and stone muscles is refreshing. A dam that senses impending flood and uses intelligence to prepare itself would not need be so ponderous. To date we have not endowed our environment with this creative flexibility; the intelligence we have commonly achieved is uncreative, stupid and in large measure hostile to human well-being. We have allowed hard shell machines to multiply and control us. Man is a captive of his increasingly automated mechanical environment. This process we have accepted ever since the early days of the industrial revolution, not imagining any other possibility. We have accepted the proposition that in order to use the power which machines deliver *economically,* we must restrict ourselves to the limited human behaviors that the machines can accept as meaningful control. One must steer by turning the steering wheel in the prescribed way regardless of one's body size, fatigue or personal style. Human behavior is mass produced by the power delivering tools man has learned to depend upon.

As we have created more and more power we have felt the iron gloves, which at first protected our hands from work, gradually thicken to protect us from touching the world around us. The teenagers search for a way back to "contact." But we cannot go forward by destroying the past. When man adapted for survival against a natural environment over which he had little control, he evolved; now men must evolve against the pollution of environment produced by our own progress.

What is the solution? Evolution now must include evolving environments which evolve man, so that he in turn can evolve more propitious environments in an ever quickening cycle. To stabilize the capacity we need to characterize this evolutionary dialogue. This characterization is increasingly being seen as the unsolved problem of our time. It is familiar to designers and architects in the student's question: "How do you design a house which will grow to meet the changes in the family that the house itself will produce?"

No man as yet knows the solution, but we can seek at least to clarify the question; a question well defined provides the beginning of its answer.

A DECADE AGO Rosenbleuth, Weiner and Bigelow wrote their historic paper, "Behavior, Purpose and Teleology." This ushered in cybernetic thinking. Their conception considered a thing and its environment in terms of their mutual relation. It defined behavior of the inanimate and animate within one frame of reference. The categories of behavior defined in that paper are a valuable start for developing a common notation for the design of intelligent environments.

Rosenbleuth, Weiner and Bigelow separated *active* behavior from passive behavior — behavior in which the object behaving is not a source of energy — as an object thrown. They subdivided active behavior into *purposeful* and *non-purposeful.* The latter is not directed to a goal, whereas the former is. If we decide, for example, to take a glass of water and carry it to our mouth we do not command certain muscles to contract to a certain degree and in a certain sequence; we merely trip the purpose and the reaction follows automatically. Although a gun may be used for a definite purpose, the attainment of a goal is not intrinsic to its performance. Some machines, on the other hand, are intrinsically purposeful. A torpedo with a target-seeking mechanism is an example.

In that historic paper the term "feedback" was first defined, and purposeful behavior was then separated into *feedback* or teleological and *nonfeedback* or nonteleological behavior. The word teleological was originally used to describe an innate or final divine purpose in all living things. The feedback control concept now allows us to define purpose without divinity: it is that goal from which deviation is corrected by feedback. The evolution of error correction procedures is used to define purpose; this brings us close to Darwin's concept of an evolutionary tree — a tree expanded in time by errors which escape correction and alter the feedbacks, but pruned by the death of those patterns which cannot survive when recontexted by the evolving environment. Survival and purpose intermingle.

Feedback, or purposeful behavior, is in turn subdivided. It can be *predictive* or *non-predictive.* "The amoeba merely follows the source to which it reacts. There is no evidence that it extrapolates the path of a moving source. . . . A cat starting to pursue a running mouse does not run directly toward the region where the mouse is at a given time, but moves toward an extrapolated future position." Predictive behavior may be subdivided into different orders. "Throwing a stone at a moving target requires a certain order of prediction. The paths of the target and the stone should be foreseen. Prediction will be more effective and flexible if the behaving object can respond to changes in more than one . . . coordinate. The sensory receptors of an organ or the corresponding elements of a machine may limit the predictive behavior."

When the Rosenbleuth, Weiner, Bigelow paper was written, the existing automatic environments did not have the capacity to predict and extrapolate with sufficient complexity to be sensitive and responsive to self-organizing and evolutionary purposes. Given this capacity of our present machines, we can add to the list of behaviors defined in the paper. The category of the predictive machines can be further divided into *complex* and *simple.* An aggregation of simple machines grows only into a *complicated* machine decomposable into simple elements. The complex machine is more than an aggregate of its parts and their relations. It cannot be decomposed without destroying its capacity to maintain its organization. The complex machine can be further categorized as *self-organizing* (convergent) or *non-self-organizing.* In the latter kind of machine there may be sudden breakdowns, but in the former reliability is maintained by continuous breaking down and rebuilding. The system maintains its convergence by simplifying itself in terms of an internal purpose as defined by a complex net of intertwined feedbacks. If the self-organizing machine can maintain its purpose by responding to what was noise so as to evolve a new purpose, it can be called *evolutionary.* If it cannot, even though it is self-organizing, it is *non-evolutionary.*

GIVEN THIS HIERARCHY of behaviors of an object in relation to its environment, we can now redefine environment. Rosenbleuth *et al* defined it in these words: "Given any object relatively abstracted from its surrounding for study, the behavioristic approach consists in the examination of the output of the object and of the relations of this output to the input." When we speak of intelligent environments we traditionally define man as the object and the environment as the surrounding.

But we could also consider the surrounding as the object and man as the environment, or at least make them both object and environment to each other. Think of the effect of an infant's mattress or of his crib on the child. The balance of the mattress will affect the movement of the child — it will control him. It will teach him by subduing some movements and reinforcing others. The assemblage of rooms, walls and spaces in a home actively control the actions possible within it. An employee is trained by his work space and tools, a driver by his automobile. This concept of man as a passive unintelligent abstraction who does not create or evolve is a common simplification used by those concerned with environmental design. It is merely the reverse of considering the man as active and the environment as capable of only passive behavior. But much simplification is unwarranted. Imagine a time-lapse movie taken of a city and its inhabitants over the years. It would show an interaction involving purposeful, feedback, predictive, self-organizing and evolutionary behavior. With finer grained measurements one could see evolution at work in a day or an hour. Learning itself is an evolutionary process — in its best form. It prunes out the obsolescent and allows the unknown to be realized.

Attending the recent Conference on Intelligence and Intelligent Systems sponsored by the Air Force Office of Scientific Research, I was impressed with their problem of teaching computers how to ascend the hierarchy of behavior outlined in the Rosenbleuth paper. These scientists know that their teaching must go through the evolutionary stages we see in the phylogeny of the creatures we know best — human beings. They provide the environment for their machines and teach them just as we are taught by our buildings and books. They build feedback and prediction into their machines and they are struggling to build in complexity, self-organizing reliability and evolutionary capability. Some say that a machine is not intelligent unless it solves problems without the help of its environment, without the help of a dialogue. But without being taught, man too would be unintelligent! As Marvin Minski puts it, in the *Scientific American* issue on Computers, we too easily measure the machine against a non-existent superhuman man. Man must be continuously taught by his environment, both human and non-human. Man needs the novelty he metabolizes through his learning as much as he needs oxygen. To design intelligent environments we must know how to teach and are taught by our buildings, our work spaces, our transportation units. This process, being omnipresent, is easily unobserved. But we can caricature it back to our attention with our new control skills.

In the past the availability of energy was limited, and man's choices of what would be most pleasant to him as surroundings came after many compromises irrelevant to his creative survival and pleasure. Man has been a captive trained by the mediating devices with which he has controlled nature. But now intelligent environments capable of truly entering into dialogue are possible.

FOR THE SAKE of illustrating this trend and casting it into a form which reflects the new thinking, let me show a hierarchy of increasingly intelligent environments and the unsolved questions that prevent us from bridging the gap from complicated simple to truly complex, self-organizing and evolutionary designs.

An evolutionary environment maintains a hierarchy of long and short term purposes mediated by a complex network of feedbacks, each with its own dominant periodicities. These purposes themselves grow as the self-organizing system moves through levels of relative stabilization *vis à vis* its environment. The evolutionary environment is exemplified in the design of great art which grows in meaningful identity even though the perspective of the viewer is drastically changed by the impact of the changing information he draws from the art.

These respective levels of environmental intelligence are easily exemplified in practice, *until we seek to design-in the complex evolutionary dialogue.* As complexity increases, analytic logic undergoes what we might call graceful degradation — it slowly dies. We are then left with the relatively unformalized power of synthetic reasoning and simulation. We build crudely to find a way to think, and then we build again more exactly.

Some environments are *actively* intelligent, others passively so. A schoolroom that dampens the sounds of a creative surge of enthusiasm among its pupils in order to minimize noise transmission from room to room is *passively* intelligent. If it were actively intelligent, it would discriminate noise from nuances of speech, and it would have an active role in deciding what kinds of sounds were to be transmitted. It can be taught this intelligence by its designer. Active rooms may be purposeful or non-purposeful. The *purposeful* room, as a language laboratory — or a greenhouse — actively works to fulfill its purpose. It may have *feedback* — it may, for example, change its lighting and heat in terms of required plant growth. The sensors evaluate the plant growth as it takes place, and evaluate the resulting environmental changes. The motors modify heat and light in terms of this change. We are back now to the intelligence level of a computer-controlled subway, which senses passenger needs. Using the same model, let us consider the human teacher in the schoolroom who, like the traffic cop in his way, repeats the same window adjustment every time it rains or humidity increases. By the use of simple control devices, a factory or a schoolroom may be taught to change climate automatically. But such simple automatic devices have only the crudest feedback system. They do not actively sense worker efficiency, as a function of climatic change.

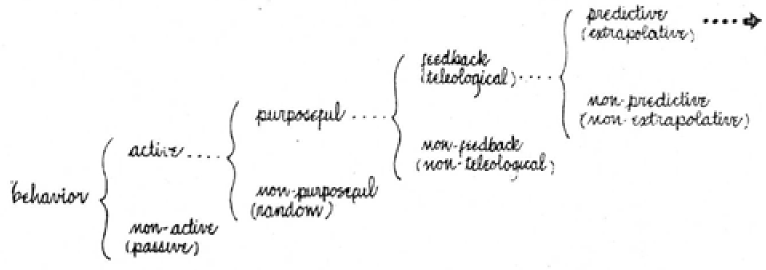
PRESENT CONTROLS are like those of an adding machine that pays attention to the user only through the commands it is given. It regulates the human being by making all but his simplest, most ritualistic commands meaningless. Environments that use more feedback related to user-machine designed purpose can be *predictive* of likely change, given the changes that have already taken place. It can be predictive in fewer or more dimensions depending on its elegance of communication with its context (one or more sensors).

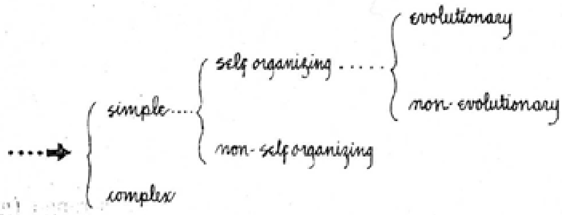
An environment may be simple or *complex.* If simple, it can still be made complicated, but multiplication of simple people or of simple devices does not create intelligence, unless they are organized onto the next level — a complex group.

I recently visited an expensively automated home where the gadgets were beginning to turn each other on and off by mistake. The ring of the telephone had the same frequencies as the T.V. channel changer — and changed the channels. In a complicated "deluxe" automobile of a friend, the gadgets all interfere with one another and will occasionally go on a rampage, wildly clicking each other on and off. The doors are designed to lock automatically at 8 miles per hour, the lights to dim at an approaching light, the heater to air-condition, and on on. Now the approach of lights locks the doors — the driver swears that the gadgets are trying to build feedbacks between them.

If the simple gadgets were actually to build a network of self-reinforcing feedbacks between them they could then be controlled, not only by changing individual readings but by shaping their beginning *self-organization.* What do I mean by self-organization? How does one help a number of individuals form a group? By discovering a purpose where three elements at least cannot be simply divided into two without loss of function. We wish to use, for characterizing the process, those aspects of complexity which evolve as the simple system made too complicated goes wild beyond simple control and starts to organize itself.

Why try to design a complex environment? Present control sophistication allows us to construct a learning environment in which lighting, heating and information display can all be usefully controlled in an intelligently interconnected way and corrected by pupil preference expressed in voted nods of "please open the window — let in more air." The teacher who respects individual variation and children's creativity can develop a more evolutionary style.





But she often falls victim to fatigue. The non-human system does not allow her to simplify control or to predict. There may be no windows; the thermostat is set for the ideal child. All children must accommodate to averaged environments built primarily to reduce upkeep and to last for many generations. Children are soon taught by the school environment that learning means disregarding personal variations; the captured child must adjust. He is forced to adjust *not* by the school or the teacher's making a decision, but because his individual variations are meaningless within the range of values allowed by the environment. Children cannot be creative in an environment of paper forms, bricks, mortar and air-conditioned hums whose unintentional purpose is to reduce all to an average which stifles the drive for discovery and change. Those who have tried to deal intelligently with true-false questionnaires constructed for simplified data processing know the "stupidification" that results. The teachers and the school system, as well as the child, are made stupid by the complex media and controls at present used. An environment that did not need to simplify children into square feet of space per child would allow them more aliveness. An environment that would learn from each child his style and help him to evolve it would be a true learning environment. It would not be just a caretaker — it would take part in his evolution.

MORE INTELLIGENT environments are now being developed — the Apollo space ship system is one example. But though the space ship environment is a masterpiece of technical achievement, it is still only a *complicated* environment: it is neither complex, nor self-organizing, nor evolutionary. It survives the loss of a component only through a reserve of back-up components that must be themselves reliable and that must be switched into place by equally reliable redundant links. As such essentially stupid environments become more complicated, dials and toggles soon stand in massive array. All the skill of human engineering is required to avoid the mistakenly flipped switch that at supersonic speeds spells sure disaster.

The bottleneck is now the lack of an intelligence match between man and computer, for man cannot use his evolutionary skill when the environment has none. The ideal environment would replace toggles and switches by a skillful mutual man-machine sensing of the advantages and disadvantages of a particular cooperative behavior. The environment system would itself grow with the user.

ARE SUCH COMPUTER BASED intelligent environments possible? We have developed our environment through the stages of being active, to having purpose, to using feedback, to extrapolating, to being complicated. Can we now teach our machines or environments first *complex,* then *self-organizing* intelligence which we can ultimately refine into being *evolutionary?* The first answer to this question is that we do not know how.

But if we do not know how to create a complex self-organizing evolutionary environment, we can at least begin assembling the ingredients and concepts that can, by trial and error, produce better tools. If the task is impossible we shall at least learn why.

A *complex* system will include a complex network of interconnected feedback loops. What example could we use to start with? I would choose to place a man and his computer-controlled environment in close connection, so that the man who is *in* the evolutionary exploration process can tell us how to sharpen our exploration. Let us put the man in a room in which the air flow, temperature, lighting intensity and color, the acoustical reflection and conductivity, the floor vibration and as many other known parameters as possible will all be computer controlled and measured. This has been done, to some degree, but not all in one place or at one time. The man will also be instrumented so that his behavior can be monitored. We will use as many ways as we can of measuring the man's outputs — both physiological and behavioral: heart rate, electroencephalogram, surface heat, core heat, head movement, hand movement, etc. These data were used in the past to describe what man is like; we will be satisfied if we can help one man to evolve a meaningful learning dialogue with his personally designed environment. Now, remembering that our purpose is to develop a truly interconnected network of feedbacks, let us connect the man's output behaviors — heart pulse accelerations, for example — so that they become data which the computer uses to adjust environmental parameters. Let us make these connections so that each is connected to all the others. Now we have a complex network of feedbacks — we can no longer tell, in traditional terms, which is man and which is machine. But our purpose is to simulate a complex system — or at least to build a caricature of it that will help us to learn whether such a system can be built.

Our next task is to see if this complex system can become *self-organizing*. We have put a man in the loop. The information of the system flows through him as a part of the organizing network. If his heart beat accelerates, the room becomes redder (for example); if his breathing deepens, the room takes on a richer hue. As the hue intensifies his heart may beat faster in response to the stimulus (the strength of color which changes with his feeling). This personalized total environment will be capable of producing a profound experience without brain damage. If the eyes move to the left the display may adjust to the right, or become dimmer because his heart has "reddened" the room. The computer will be taught to use these extrapolations of its data most suitable for providing an experience and pattern that man and machine can organize.

Let us ask the man if he can discover any patterns in the system, patterns which he can try to organize. As he learns he will expand what he has already begun to know. Perhaps in the accelerating dialogue he senses a sudden rhythmic beat reminiscent of a jazz band. Let us help him recreate and measure that beat. We will shape the system by changing its sensitivity (the amount of change necessary to get a message through the net) or the time delay (the time it takes to get a message through) or other overall system features. We can link the machine inputs and controls to the computer's memory of the system's state when the jazzlike occurrence happened. Can the man recreate the old stability? If he can learn to use his many outputs, now computer inputs, to stabilize the complex environment — if he can change the computer program so that it learns to join him in this effort to find an easily recognizable pattern — then we will have begun to study the process of self-organization. We will have begun to understand that convergence of data necessary for maintaining a complex organism so that it changes noise into information which allows the system to stabilize even as it changes. Human beings organize their human environments this way with ease — a child and mother must do it or a household will never settle down. We are trying only to simulate a common occurrence.

Having created such an artificial man-machine system — a soft environment — let us now confront the man with the task of *evolving* a time phrased purpose with many kinds of goals, interrelated in time with the others. This is not essentially different from the problems facing a woman who prepares dinner while looking after children, paying bills and answering the phone — with only a small amount of the information processed ever being thought through consciously. If asked she cannot analyze her intelligent procedures. She corrects for error, she pays attention only to what needs attention. She knows when the family has organized itself and found a purpose for the day. She groups data and tasks, constantly changing the code to help the job organize itself. If you have to ask a question unrelated to her state there can be no answer. She is aware of her evolving behavior only when her rhythm is broken.

ALL HUMAN BEINGS depend on their self-organizing and evolutionary relationship with their environment. A man automatically changes his voice when he enters a new room so that it will still sound like him. But can there be an evolutionary stage of the postulated system? The evolutionary stage of the self-organizing complex man-environment system can only grow out of its antecedents. Even human beings as evolutionary creatures can only develop each new refinement of being out of the last. We cannot do better.

WHAT WILL WE ACHIEVE if we can build the kind of intelligent, complex, self-organizing and evolutionary system that I propose? We have new tools to try out. We have real time computation available. A computer can predict from the trajectory of a man's hand where it can go next, and within this range (given the man's purpose as demonstrated by his last movements) where it is likely to go next. It can use this prediction to make available to the hand the implements or the light it may need. The computer can discover that a child has not been paying attention because he is bored, once it is taught the particular behavior patterns that indicate boredom. The teacher and the student would both teach it intentionally and perhaps unintentionally once they decided that this was their wish. The computer could change the fresh air in the room, or the lighting or the lesson, or the size of letters, the mix of spoken words, pictures and alphanumerics, or color, or two or three dimensional display. It could request that the teacher appear when the child-computer system encounters difficulties. Another analogy would be the dynamic transit system which maintains its purpose in relation to the town it serves even as it and the town change through their efforts to maintain equilibrium.

This design of intelligent environments, this idea I call *soft architecture,* as yet seems to interest few professionals. But the increasing capacity and lessening cost of new computers offer us the tools now. With the flux produced by our explosive progress, if we can begin only by modifying the school environment so that it actively teaches children, we will at least see the next generation taking highly intelligent environments for granted. Our progress will depend on those few who are willing to accept and apply these new concepts. Limitless opportunities for applying the new control sophistication will appear, once we recognize as obsolescent the old economic pressures which reduce people to that average required by a rigid external environment — once hard architecture begins to be replaced by soft.

Human enhancement through evolutionary technology

The coming widespread availability of computational power or "distributed intelligence" could open the door to a new kind of "interfacing in depth" between men and machines. Engineers might begin designing evolutionary artifacts aimed at an enhancement of man's control skills and perceptions

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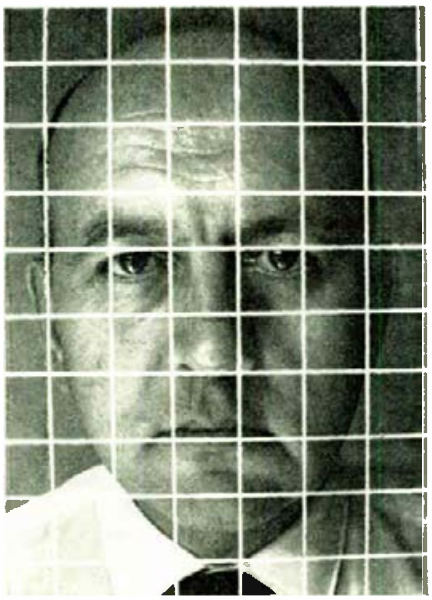
The thrust of this article is this: There is a need now, more than ever before, for men to stretch their capacities in what we shall call evolutionary skills. Moreover, it is at last becoming possible technologically to enhance these skills in man by incorporating somewhat similar evolutionary skills in the machines which we design and build. However, if engineers are to develop machines with evolutionary capabilities, they will need to restructure their own way of thinking, throw out traditional ways of thinking, and find their way, through playing with evolutionary design techniques, into an ever-deepening understanding of the significance of such techniques. They must bootstrap themselves into a new kind of "think," into a new climate of man–machine interaction, in which men evolve intelligent machines and intelligent machines evolve men. This new kind of think is what this article tries to unfold in an effort to spur lively support for the evolutionary direction.



It should be clear from the outset that a widespread technology of artificial intelligence, upon which the argument of this article depends, does not yet exist. Some readers will hold that it is wrong or premature to extend new promises and proffer new uses of intelligent machines when the field is still littered with the disappointments and the disparities of past promises and present performances. But if intelligent machines and an evolutionary technology are to come into widespread use, there must also arise a widespread realization of how that technology might profitably be used. To reinforce the demand for the technology, we need a spirited and practical image of the ways in which it is needed.

"Human enhancement," as we argue in this article, is *one* way. It is a way of involving the human in the evolving technology. It is a way of breaking the paradox: "You don't get the technology until you have the demand; and you don't get the demand until you have the technology." Both the demand and the technology must evolve hand in hand, through a real-life dialogue. One way to get this dialogue going in an evolutionary direction is to do a bit of skating on thin ice. That we shall do.

The context

Times change, and the works that men do change. Through invention, and the evolution of inventions, man has continually modified and worked shifts in his environment. Each generation adds its creations to what came before. Field becomes farm, logs become wheels, rocks become buildings, the shortening and lengthening shadows cast by the sun become time. Each of these transformations dawns in the mind of man in the form of concepts, ideas clenched in the mind "like a fist in your hand."[1] Man envisions his world in the light of his own works . . . "the pastures of heaven," the great "wheel of the universe," the "house of the soul," the "desire for immortality." And as man's invented artifacts give way to new inventions, his conceptions of the world give way to new concepts. Yesterday's truths become today's clichés, the mental junk and obsolescent concepts that need to be continually cleaned out to make way for new truths and new concepts. In the Western World, science is born, and psychology springs from Aristotelian analyses. As Eilhard von Domarus tells us in "The Logical Structure of Mind,"[2] it was Aristotle "who made possible the distinction between the sciences of mind and of matter"—two branches of science that have been separated ever since. In our own epoch, man conceptualizes *evolution*, and begins to examine the deep laws of life whereby the past has passed into the present. The farms have become highways, the wheels have become automobiles, the buildings have become laboratories, and time has become relative. And only in our day do the scientists of matter and of mind attempt to

bring the two houses of science together again, to crown these fantastic edifices of knowledge that have been two thousand years in the making.

But with what success? It begins to appear that the logic that applies to the analysis of inanimate matter, a two-valued logic of true-and-false, and the chains of cause-and-effect, do not aptly model the operations of living beings. The description of life requires more than a logic that can be derived from "truth tables."

Unlearning

It appears, too, that inadequate attention to the process of cleaning out mental junk, of unlearning obsolescent concepts, hinders the evolution of new concepts. Yet, we don't even know how to think our way into the problem of how we "unlearn." Our newest computational tools, however, invite us to reconsider basic premises about how we learn to learn.

In tracing the evolution of man's inventions in his book for Everyman,[3] Norbert Wiener, the creator of our legacy of cybernetics, notes that "the art of invention is conditioned by the existing means." Today, as we well know, the "existing means" have changed radically from the means of just a generation ago. The dreams of our predecessors, and their purposes, have become *our facts*. Many of the potentials that Norbert Wiener put forward only speculatively are already here. Many of his conceptions exist as our hardware, and these new tools are getting better at a *rate* he more or less predicted. His book, published in 1950, although it already reads like a "period piece," can now be profitably re-evaluated by the community of engineers as a source book of ideas of how to make practical use of our new computational and technical skills. The title of his book, *The Human Use of Human Beings*, still lingers as a call to action rather than denoting an accomplished fact.

The new means

To do what? To create, through the emerging means, through distributed "artificial intelligence," an environment more consonant with the real needs of man. There will soon be a computer available at the end of each telephone circuit that could be used to help prevent us from being carried beyond our human powers to manage an environment increasingly dominated by unintelligent machines governed by essentially nonhuman principles. We need an environment, which is more and more made by us, to have more of our kind of intelligence and our kind of behavior. But how can that be done, and why should it be done?

In his inaugural address as President of M.I.T. this past October, Howard W. Johnson affirmed that Institute's concern with the vigorous current of change that modern technology is producing. We cannot produce students who are, as in Kafka's words, like "couriers who hurry about the world, shouting to each other messages that have become meaningless." It is difficult to see, he stressed, how the evolving professional community can be without an "understanding of [both] the physical and biological world."[4] Furthermore, he quoted President Kennedy in stressing that "the real problem of our century is the management of an industrial society." Can engineers use their technological skill to refine what has been seat-of-the-pants intuition? How can they assist in and clarify the tasks of managing an industrial society?

From another quarter of our social organization come similar sentiments: "Developing our human capabilities to the fullest is what ultimately matters most. Call it humanism—or whatever—but that is clearly what education in the final analysis is all about."[5] The speaker is Secretary of Defense, Robert S. McNamara. Again, there is the practical question: how?

Perhaps, as we have already suggested, our present technology already contains within it the kernel of the answer to all these questions. Some engineers and others believe that technology cannot find solutions to the social displacements caused by technology. However, the reverse might actually be the case. The solution might come only through the technology.

Accelerating ecological imbalance

Our argument is relatively straightforward. It revolves around the historical fact that man has tampered with natural evolution to a spectacular degree. Man has been so successful in his efforts to control his physical environment that he has usurped nature's role in maintaining a kind of balance among all its parts. Humankind has altered the natural ecology and has started to organize things in its own way. Man, instead of being a subsidiary animal in the grand design, has become, for all apparent purposes, the driving element in the natural system. But the trouble is that man has not yet become such an accomplished systems engineer that he can master and maintain a more or less stable planetary ecology on his own terms. There are insistent signs that man, through his great engineering works and his technology, threatens to throw the naturally balanced system into a violent instability. The air and waters of the planet are being rapidly poisoned, many resources are being depleted, the available space is rapidly being occupied by man and his inventions, many unfortunate men are at wit's end, and so on. Thus, there is a pressing need, not just for conservation, but for a new level of stability and control in this dangerous evolutionary trend.

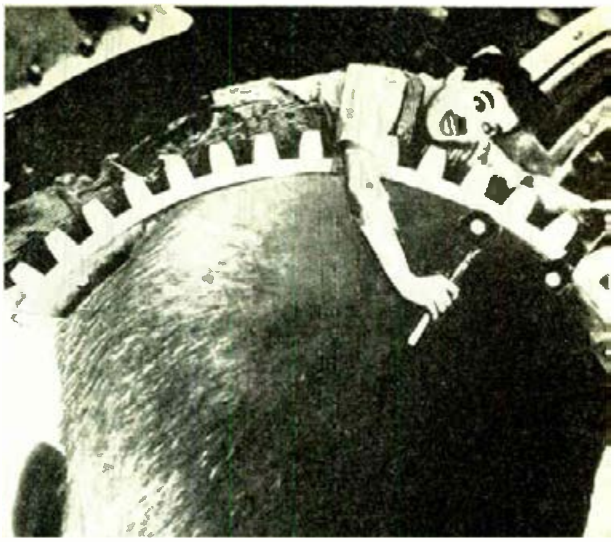
The automation of industrial man

On the other side of this issue is the fact of man's own existence, and whether or not he has liberated himself through his efforts at control over his environment. There is the question of whether, in his increasing development of automatic machines, man has not also automated himself, and seriously reduced the potential variety and richness in his own life endowed to him through his biology, through the gifts of millennial evolution.

Evolutionary technology

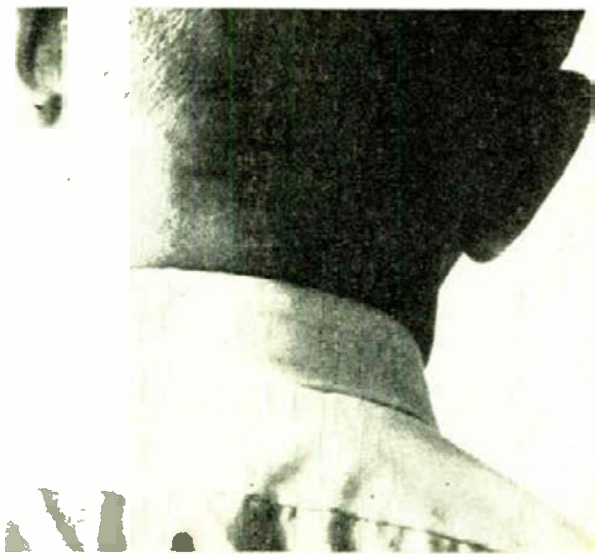
It is our assumption that all of the suspicions put forward in the foregoing paragraphs are manifestly true. Our massively successful technology, which was supposed to have provided our salvation, has brought us into deep trouble. We postulate that this technology must be modified in a dramatic fashion, that our machines must be provided with evolutionary powers, with some intelligence more like our own.

We shall have some fairly specific strategies to put forward that touch on many levels of the same problem. Moreover, our ideas are aimed at engineers, for they are as cognizant as anyone about how much machines now control our environment. Furthermore, through their excellent work in the past, and through the work they are doing at present, engineers have brought within reach the possibility of endowing machines with evolutionary skills, which should not only bring about an enhanced technological effectiveness but human enhancement as well.



However, despite their awareness of their machines and the nature of physical control, there is a serious question as to whether or not engineers have properly conceptualized the breadth of the effects that machines have had on human life. Machines could be set up and designed so as to teach their users how to use them more expertly, so as to enhance both the control and conceptualizing skills of their users, so as to satisfy the user's own personal needs and his own personal style, rather than, as it is now, so as to reduce individuals to a stupefied norm. What we are after, in engineers, is a new respect for the capacity of our new control technology to serve the individual and his individual variations. A regard for individual variations, in the designing of new machines, is necessary for the evolutionary process.

The notion of evolutionary skill has many ramifications. Both man's control and conceptualizing skills are more culturally determined than we ordinarily realize, and are



not being used to their fullest potential. Furthermore, these skills, controlling and conceiving, are less separable from one another in an individual than the separate terms suggest. One begins to gain control as he conceives that the possibility of control exists. We are only now becoming aware of the need for personalized environmental management. This brings a new perspective: a man is constantly changing, either growing or decaying, just as his environment is constantly changing. Exactly how a man grows and changes, how he evolves in his powers of control and communication in relation to a changing environment, must be analyzed and described through some formal means. As yet, no such formal or scientific description exists, but it now appears possible, through the use of modern tools such as the computer, to begin to develop such a formal description, and to begin to explore man's potential for the enrichment of his control and conceptualizing skills.

But we won't know exactly how to approach this new description of man until we perceive how man has learned over the generations to solve real survival questions, often without awareness. Our methodology, our approach to the restoration of natural-like ecological controls, must grow out of data from evolutionary real-life situations. Such data must emerge from a "dialogue," a kind of interfacing in depth, between man and his new machines.

Complexity and measure

With physical systems of the order of complexity of a man, or with large systems made up of many men, with systems as large as our human society, which are now composed of complex aggregates of men and machines, it appears no longer possible to analyze or simulate the behavior and systematic requirements through traditional modes. Their operations and functions, involving multifoliate nonlinear feedbacks and interactions, are far too rich for the usual descriptions we apply to physical systems. Units of measure for functional controls relevant to a particular purpose are fundamentally different from the units of measure ordinarily used for describing the actual construction of a system. With truly complex systems, one seeks out simplicities of behavior rather than simplicities of construction, because such systems have complex choice patterns with which to stabilize themselves in relation to dynamic environments. The problem is to find those measures that allow one to simplify the necessary control behaviors.

But up until now we have not sought a formal methodology for finding such measures. Thus, to begin the construction of evolutionary systems, it may be necessary for us to try them out, to build the physical systems so that they can "evolve" through real time in real-life situations. It is quite possible that through such evolutionary designs, new types of systemic "simplicities" will be discovered that ordinary analysis would not make evident, or that are not apparent in the complicated aggregates of smaller systems of the kind that engineers have been studying up till now.

Planning for unexpected applications

The introduction of an evolutionary system into a real-user situation is colored by a difficult question that will affect any organization's deliberate decision to move toward the incorporation of such systems into real-time operations in which the usual daily activities continue. The question is how to justify the cost of an apparatus or procedure whose functions and virtues in terms of the purposes of the organization cannot be wholly defined in advance, but where it is a reasonable gamble that the "unexpected" will be profitable. For instance, many organizations have been using conventional computers, but they have no way of knowing whether or not they need or could use the more expensive on-line time-sharing systems now being evolved, since they have had no experience with such systems. The problem then for the person who believes in the real value of such a system is to get the potential users involved in it, to get them to grow with it as the machine–software combination is evolved to their purposes and style. If the users become involved in a prototype scheme of the system that is capable of being evolved in its usages, then the procedures of the humans change along with changes in the procedures of the machine. But the allocation of many of the costs in such an evolving system, in which the user and software procedures are undergoing "tuning" to one another, cannot be stipulated in advance. Despite the difficulties of incorporating evolutionary systems in real-life situations, it should be evident that this is the only way their true worth can be discovered. A prototype must have sufficient complexity to begin the evolutionary process and sufficient flexibility so as not to preclude unexpected possibilities or benefits. Much of the physical system can be specified in advance, of course, as can be the system software (the available programs), but the users will not know beforehand, in depth, *all* the things that they will be able to do with it.

Also, with very complex machines, if the machine does not help the user by evolving and enhancing his initial capacity to control it, he may simply reject it as being useless; and he may continue to use, at great cost, obsolescent and perhaps even dangerous machinery with which he is familiar.

Control of complexity requires machine intelligence

From an engineering point of view, it is rational to ask at what point systems become so complex that traditional methods of attack become inadequate. It is said that the dividing line, where the capacity either to analyze or simulate a system breaks down, is somewhere between the complexity of a supersonic transport and a huge computer network. The flight dynamics of the SST can still be simulated, but when you go to an information network with many users, the simulation becomes meaningless. Somewhere between these orders of complexity, traditional methods will break down completely. Perhaps with telephone systems, certainly with large time-sharing computer systems, on out to large sociological units, you have passed a break point after which you must go to a new methodology, to an evolutionary method of attacking the system problems.

However, our interest and emphasis in evolutionary design, although it has something to do with the "practical problems" of gigantic systems, is not focused on such questions. Our interest in evolutionary machines is based on a concern for what has been happening to the human users of machines, what is now happening to them, and what is likely to happen. We see evolutionary machines of all kinds, large and small, as large as time-shared computer systems or as small as chairs, as a prerequisite for what we shall call "human enhancement."

It is precisely this quality, built in advance into a system, of man and machine being able to evolve each other, that we consider vital to solving the problems of technical pollution discussed earlier.

The need for new concepts

In effect, we are saying that our present tradition of science and technology, the physical science built up so manifoldly of sequential cause, then effect, relationships, has brought us to a kind of dead end. Something radically new is wanted. More refinements of cause-and-effect, stimulus-response models, or more aggregates of such models in complicated systems, are not likely to lead to any real amelioration of the technological pollution.

For instance, highway engineers design and build big new highways to alleviate existing patterns of traffic congestion. They pinpoint the bottlenecks existing before the new highway and attempt to bypass them. But the construction of the new highways and bypasses, causing displacements and disruption to humans and animals through the leveling of trees, individual dwellings, farms —all this destruction and construction is barely complete before the new highway itself becomes obsolete. Change evolves change– even if we blithely deny the need to research the process.

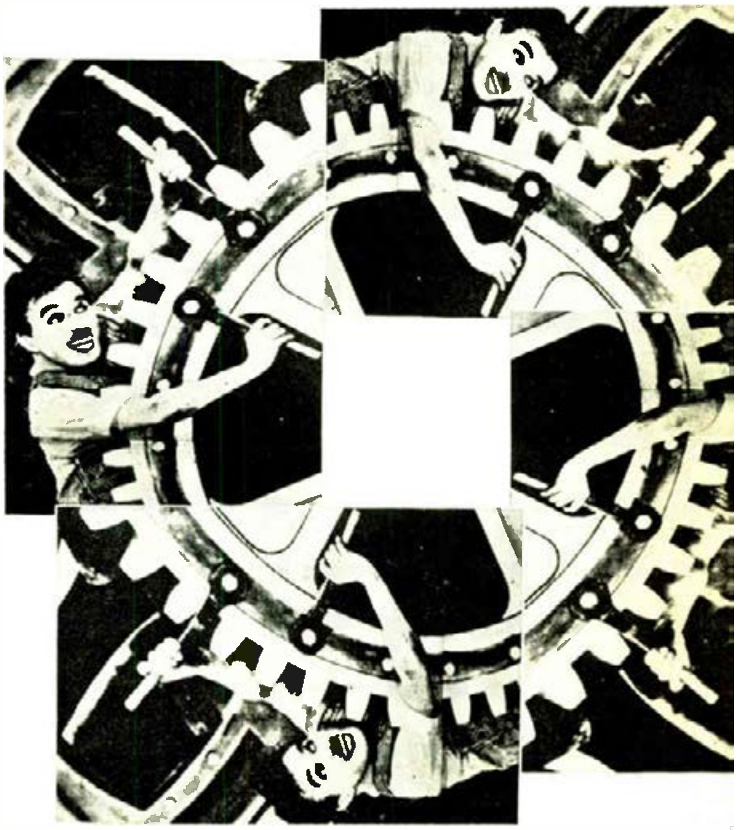
If, as Oliver Selfridge of the M.I.T. Lincoln Laboratory suggests, these problems cannot be left in the hands of traffic engineers alone, then who are the people with a broader grasp? The governors of the states? They too are hampered by legal codes and political structures that are also obsolete with respect to their capacity to respond appropriately to the massive social effects of technology. The tendency in the highly developed countries, such as the United States, is to look to the highest levels of the government for solutions to the problems manifested at apparently local levels. But even at the highest levels of government, there exists an uncertainty. We do not know where to allocate decision skills that can effectively increase our responsiveness to the social ills caused by technology. Something new is needed.

Irrelevant truth

To get moving toward this "something new," we must begin to shake ourselves out of the old. This is not easy. It is not even possible to gauge how deeply our classical concepts *are* rooted, until *after* we have adopted the evolutionary viewpoint that regards information as continuously being evolved from the unknown, metabolized into meaning, and finally recontexted into noise. Truths, while still true, become irrelevant. Man survives as a creature who continually changes and evolves, a creature who feeds on novelty, who reorganizes himself as he reorganizes his physical world and maintains stability by this process of change. It is not easy to adopt the evolutionary viewpoint, or to bring it to bear relevantly in engineering work. The old Greek way of simplifying the physical world into timeless true–false statements is what we have cut our conceptual teeth on. New information or insights we receive, any novelty we detect, we will automatically try to structure and fit into our present conceptual framework, so that we must suffer the frustrating effort of trying to "see" something outside the framework as though it existed within the framework. When we cannot make the fit, the world seems out of control and absurd, but it is our old Greek concepts that are absurd. We have informal ways of getting around these absurdities; but they are not codified for ready use or teaching.

Points of view

Man's irrepressible need to explain away or to fit new experiences into his existing conceptual framework often enough leads him into making comic connections, one of the most delightful of which is mentioned by Freud: "On one occasion during a sitting of the French Chamber a bomb thrown by an anarchist exploded in the Chamber itself and Dupuy subdued the consequent panic with the courageous words: '*La séance continue.*' The visitors in the gallery were asked to give their impressions as witnesses of the outrage. Among them were two men from the provinces. One of these said that it was true that he had heard a detonation at the close of one of the speeches but had assumed that it was a parliamentary usage to fire a shot each time a speaker sat down. The second one, who had probably already heard *several* speeches, had come to



the same conclusion, except that he supposed that a shot was only fired as a tribute to a particularly successful speech."[6]

Somewhat less amusing, but revealing nonetheless, are the kinds of "in" jokes perpetrated by students of engineering and science, who find it funny to talk about the "real" world in terms of the equations and physical laws they are learning in their academic courses. The humor lies in the fact that "everyone knows" that these formulas are absurdly far from explaining the real world as they already know it from their experience. But give these engineering students a few more years of exposure to these technical formulations, and the constrained world technology, demands an ever-higher responsiveness on the part of those who attempt to manage the change as well as those who merely try to adapt to it as best they can. The slowing of children's learning to an adult teacher's polite pace is no longer advantageous. The manual workers, who acquired a fairly narrow repertory of skills, were the first ones to be threatened with obsolescence, but now even the clerical and conceptual workers are being overtaken by their technology. The refreshing creativeness of children must be allowed to reap its fruit in enriched variety of styles and interests and ways of knowing. The old kind of standardization has lost its utility.

Man-machine dialogue

What has all that to do with dialogue? Imagine, if you can or will, a machine that is as responsive to you as our postulated tennis teacher—a machine that tracks your behavior, that attempts to teach you a new control skill or a new conceptual skill and gives you cues as to what you are doing wrong. Furthermore, the machine gauges how far off your actions are from the program you are trying to learn, and "knows" the state of your perception; it is able to "drive" your perception gradually and

sensitively, pushing you into unknown territory, into making you feel somewhat absurd and awkward just as you do when you are learning those new tennis movements. Suppose, in fact, this machine could sense factors about you that even a human instructor would miss—how your heart rate was changing its acceleration, how your temperature was rising or falling, how the acid production of your stomach was beginning to increase, or how your eyes were actually tracking during certain tasks. If the machine could use these "sensory" inputs in an intelligent fashion, it could be even more responsive to our needs and problems than the tennis instructor. In other words, this supposed machine would functionally be what we call a "gifted teacher." This machine would be behaving, in fact, like a deeply perceptive wise man who can behave in such a manner as to drive us out of our resistances to learning new patterns of behavior. He would be "tracking" us in the complex of our physiological and mental behavior. And he would not only be tracking, but he would also be deftly pushing, rhythmizing his interventions to our "natural" time scale so as not to push us over into radical instability. This wise friend would not be reading out to us archaic laws, set in a language that is irrelevent to our needs and purposes (that would be just a smart friend). He would be sensitively following our natural responses, building them by gentling their cadence just beyond the pace on which they evolved a moment before, and through this guidance, he would enhance what we could see and feel and do. What was mere noise or disorder or distraction before becomes pattern and sense, information has been metabolized out of noise, and obsolete patterns have been discarded. The man who helps us sense *our* wisdom we call wise.

Nondialogue interfacing

Granted, such a remarkable machine does not exist (except as a twinkle in the imaginative eye of a father who is trying to conceive of his infant son's world). By contrast, consider our actual machines, the ones we have been building since great-grandfather's time. What is the character of our dialogue with such machines, and what has this dialogue done? As ingenious as our machines have become, our dialogue with them is essentially unidimensional. We read meters, push buttons, throw switches, or maneuver a control stick. In a car, we sit relatively immobile while we turn a wheel either clockwise or counterclockwise. And so on. Some of the photographs on these pages suggest how narrow our contact is with our present machines, and others suggest a new depth of contact. The significance of our present machines for us is that these machines also condition us to certain limited behaviors. They do a lot of the dirty work for us, but they make us pay a price in their management. Our machines are "stupid"; we cannot engage in a rich dialogue with them. Their management stupefies us, for we must adjust ourselves and behave in a more automatic fashion. We have learned to live by the fixed machine-time —three shifts a day of tending machines—rather than following our natural time. The machines follow fixed laws and, in managing them, *we* follow fixed laws. Not only that, but all men who manage machines must manage them in more or less the same way; all men are constrained to be "average" men vis-à-vis the machines.

Moreover, as our machine systems grow more complex, stretching their wires and tentacles throughout the fabric of our human society, the danger of their carrying us out of control becomes more magnified. Regional power failures make us aware of our dependence on machines and, according to the news, of our joy at their embarrassment. The danger of machine-like decisions being made by the aggregates of existing machines, made through a modal logic which is not *our* logic, persists. For instance, the Internal Revenue Service simplifies *our* affairs to meet *its* programmer's problems. We require large systems with which we can engage in humanlike dialogue, of the rich kind that occurs between people. Our entire machine environment needs to be given a self-organizing capability that is similar to the self-organizing capability of men,[8] so that both kinds of systems can evolve and survive over the long run. Coexistence is better than the slavery to the stupid machines that is accepted now.

But can sensitive capabilities be given to machines? Will it be possible to create a more intelligent and more responsive environment? Or are these merely fanciful and empty wishes? No. Work is already beginning, and we shall cite some examples in a subsequent article.

Dialogue specifications

We should summarize in a little more technical fashion some of the characteristics of dialogue systems: (1) A dialogue has the capacity to draw its participants beyond the sum of their action or intent. It evolves them. (2) The dialogue occurs when the two or more systems (e.g., persons) begin playing each other's transitional states simultaneously. They predict and hold a high level of what will be novel, given these predictions. Imagine yourself with a well-matched friend. You will also try to keep fresh and unexpected information building if you are close. You will drive the dialogue almost to the point where you are not sure that there is understanding until you test. Both parties push their individual codes just to the edge where there is just enough common coding to comprehend one another if their "prediction" is right. (3) Each participant uses less ambiguity when he perceives that such a reduction is needed (either because the other person is obviously not understanding or because there are environmental distractions—the time delay before such correcting is itself a code). (4) Error correction and an evolving purpose are used to control the conversation and allow the conversation to develop. (5) As the dialogue drives its participants, the self-regenerating power organizes its components even as the whole system changes, and some components waver on the limits of instability where the lack of prediction and the delicacy of balance allow what has been noise to become organized as a controller. Noise acts on the system when it is easily perturbed and the resultant shift reflects this effect, and what happens becomes information (thus, for instance, when a person is irritated or abnormally disturbed, he does things that do not follow his "normal pattern," and gives the other person an insight into his underlying operating codes). The system must be time-phased. It adapts to environmental change in shorter and longer intervals, the variance in inertia preventing fragmentation. (6) Automatic error correction allows the system to remain within required limits for smoothly evolving, giving dialogue a purpose. The dialogue of seminar learning has a different purpose than, for example, lecture teaching. The power of dialogue is commonly used to create data out of noise, to create information out of what was so unknown (and perhaps unsuspected) as to be beyond that which was perceived. It is used to give fresh conceptual hooks without which data would be so meaningless as to be beyond perception. During dialogue, a pattern emerges from what was meaningless and random. This is what real learning and unlearning (destructuring the obsolescent concepts) is about.[9] Thus, (7) in dialogue, the changing in entrainment of many levels of synchrony and isomorphism allows significance to grow out of the slightest variations that happen at a control point—a point where a small change makes a large difference in the way the total organization goes. In dialogue, there is continuous identification of those points where slight change will induce significant new recognition of pattern. That is why the amount of information that can be exchanged is of a higher order than in nondialogue systems—a considerably higher order.

In sum, the most delicate matchings of stages so that two systems (either man-and-man or man-and-machine) communicate optimally for the purpose of unlearning conceptual and control obsolescence will occur during the dialogue.

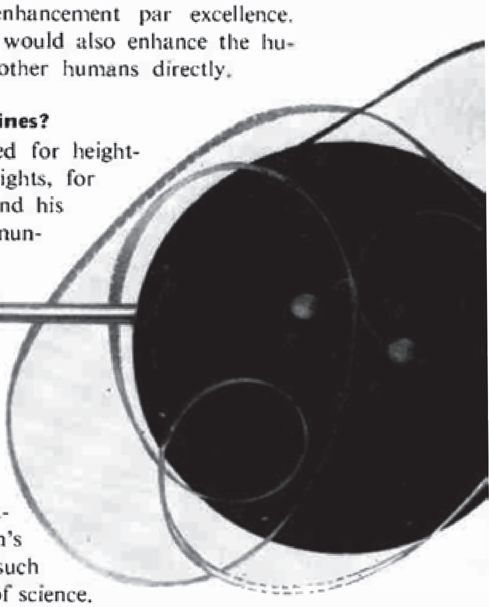
As McCulloch and Brodey phrase it, "dialogue is not a simple alternation of active speaking and passive listening turn by turn. Both partners are continuously observing and sending many cues. It is a closed loop of many anastomotic branches through which there runs at a split-second pace an ever-changing symphony and pageant relating man to man ever more richly."[1]

Dialogue: formally obscure, operationally familiar

Thus, if men are to use machines for learning, they must see that these machines incorporate the capabilities of evolutionary dialogue in order to enhance the possibilities of enriched information exchange. It is even conceivable that in dialogue with machines, man may discover prejudgments and preconceptions that are so omnipresent with men as to render them utterly automatic. If this is indeed the case, the way could be opened to modeling and discovering the deepest laws of man's learning behavior, thus also opening the door to making teaching a science rather than an art presently enjoyed only by the gifted few. If education's purpose is indeed human enhancement, then such man–machine education would be human enhancement par excellence. Such heightened teaching would also enhance the human's capacity to teach other humans directly.

Why dialogue with machines?

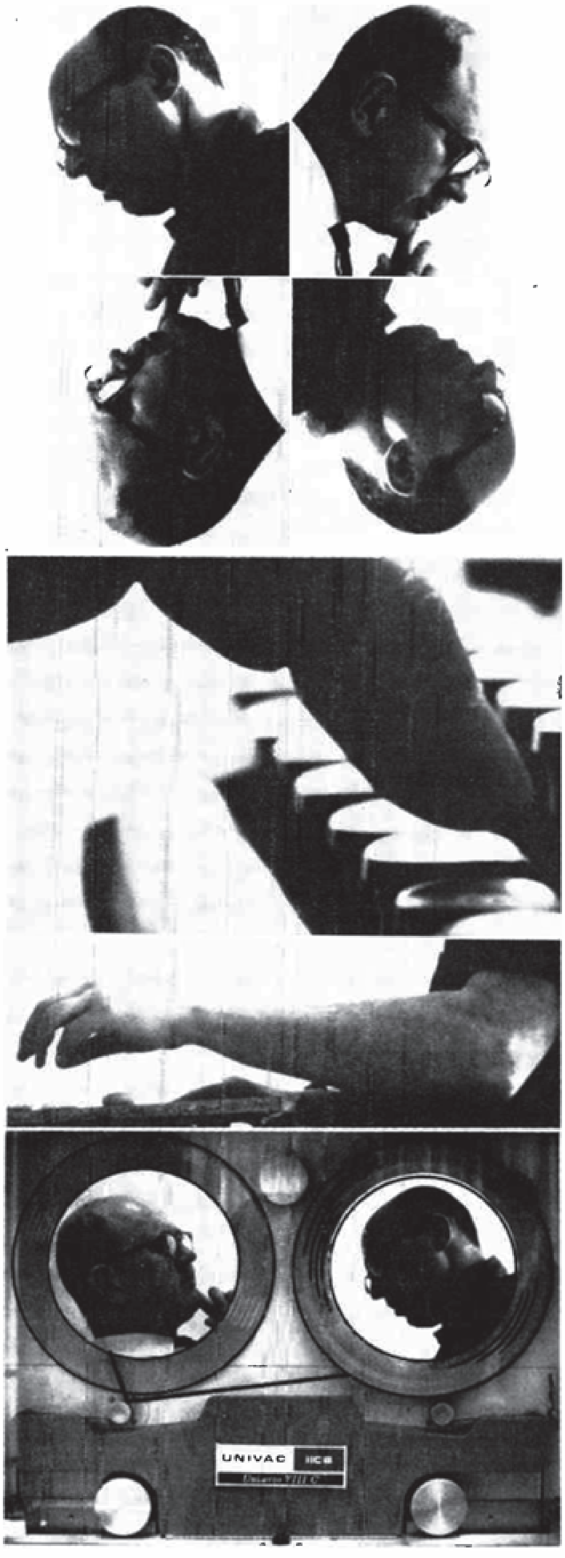
Man has always yearned for heightened perceptions and insights, for the truth about himself and his world, and for deeper communion with his fellow men. The drive for man to model or map in his own mind the nature of life and of the physical world is virtually automatic, and seems related to man's survival. The drive for such knowledge is at the heart of science.



In some periods, men have sought heightened perceptions through starving themselves, through living alone in desert wastes, through self-tortures of all kinds, through good foods, through love, through vigorous athletics. There have always been, so far as we know, natural drugs and alcoholic beverages, and today there are a great variety of these, of which LSD is probably the most spectacularly publicized. Each epoch has practiced its own rituals and utilized its available media. Now, you might say, we are proposing to employ machines for similar purposes.

But the reader is misunderstanding us if he thinks this is all we mean. We are not urging merely a new kind of calisthenics, although it is not hard to imagine that intelligent evolutionary devices would be used for such purposes (especially when such devices become cheap enough and easily available). What we are urging is that engineers become aware of the new tools of artificial intelligence that are now falling into their hands. Machine intelligence—logic boxes, if you will—could give machines a capacity to interact with the human at a level of detail that isn't restricted to a simplistic game. We are urging them to set themselves up to explore the evolutionary capabilities of man and to investigate the various aspects of the phenomenon of dialogue. We are saying that the situation now vis-à-vis intelligent machines is analogous to the situation of man at the beginning of the industrial revolution. At that time, men must generally have held the concept (rapidly becoming obsolete) that work was for the muscles of men and for animals. But along came the engineers finding ways of distributing muscle work among machines. At first, the machines were expensive, and men had to be brought together in work pools, in factories, near the machines and their sources of power. Then engineers found ways of distributing energy more simply and economically, so that now wherever you have electric plugs, you have muscle power to run dishwashers, air conditioners, etc.

In this new epoch, which Wiener called the Second Industrial Revolution, we are beginning to see the evolution of distributed intelligence, and men may begin to discover ways in which certain tasks of intellect and control, which we have long considered innate to man and as part of his privileged domain, may be delegated more economically and more satisfactorily to his environment. But to do this, the engineer must throw over old habits of thought, which are certainly relevant to the purely physical environment, and he must discover how to conceptualize man. He must learn the laws for observing in the situation where observer and observed are of the same species and influenced by each other's acts even as they occur. These laws of operation are manifestly different from physical nature. The engineer, we believe, must go about discovering the evolutionary character of man through essentially evolutionary processes. He cannot start out measuring and specifying man with set physical parameters brought over by main force from the world of physics, from mainly cause-and-effect models. For this purpose, man must be measured as an evolutionary creature. The new tools of artificial intelligence make it possible to synthesize and model evolutionary processes in man, because these new tools can also be given evolutionary powers and can enter into dialogue. Nor are we talking here about some form of "average" evolutionary process. Plainly, some men are geniuses, with mighty capabilities of conceptualizing, and other men are dolts, who nonetheless yearn for satisfactions they should not be denied. And some men may *seem* like dolts, but may well harbor perceptual powers and views that they have been unable to express or formalize within the available means and that society has not learned to appreciate or tap for its benefit. Through new intelligent media and tools, such men might well "come to life." But we will never know for sure until we have tested and tried the limitations and the possibilities of the new media.



Evolving vs. the old conditioning

Thus, the new evolutionary tools, in their "nature," should be shaped with a "requisite flexibility and variety" to satisfy individual users. Certainly, in the beginning (*now!*), the efforts at bringing evolutionary powers to our machines, and the enhancement of human capabilities, must be modest, but the evolutionary process itself is bound to proliferate into steadily deepening possibilities.

Not least of all, we must consider the incalculable benefits that could be brought to the young, the next generation. In point of fact, we should remember that engineers today are largely designing the environment for the next generation. The new generation, the young kids, who are open and alive and curious and experimental, who are learning the new science, who are learning new concepts, won't, through the new evolutionary tools, be restricted by the relatively simple formal means of our generation (e.g., the workbooks with blanks that the child or man must service). The simple linear and Aristotelian conceptualization that has governed the learning process up to the present has, on the whole, been more stultifying than enlivening. It shut out, rather than permitted, the metabolism of novelty on which the human spirit feeds. Nor did this older formal means allow the control finesse necessary to drive a student safely beyond his conditioned fears, to disorganize his conventions of what is humanly possible, to drive him just far enough into ambiguity, confusion, and absurdity where he could reorganize his mental patterns in accord with a deeper reality. Such evolutionary tools could make better scientists of the young, or better doctors, or better psychologists, or whatever. Young children are the world's "natural" scientists. Through new media of modeling and conceptualizing, their whole conceptual training could evolve faster and more richly, their curiosities and capabilities could be enhanced rather than quashed by the machinery of education. Education would be made relevant to them and their personal lives; it would be more than just something out of a book. Again, we won't know the possibilities in this direction until we have tried.

The devices of entertainment that could grow out of intelligent machines could be enormous. We won't even bother trying to specify what such devices might be like. Suffice it to say that any device can be treated as a toy; we are safe in assuming, we believe, that there will always be entrepreneur types who will find novel ways of exploiting such devices. Not that we have anything against toys; we ask only that they be lively enough to help us enjoy our own aliveness.

Using the lead time

The reader who has come this far with us must sense the open-ended, rather "soft," unfinished character of the ideas we have put forward. Perhaps, he might say, it is far too early to attempt to crystallize ideas that are still unfolding. But—and this is a matter of judgment—we believe that the accelerating effects of our technological pollution give us very little "lead time" in bringing these effects under human control. We do not think of evolutionary technology as utopian, but necessary; and we think the time for engineers to join in the necessary dialogue is now. The decisions about the deployment of government resources to answer the problems of technological pollution are being made now, and these decisions could have positive effects on the life we enjoy in the future, or they could lead to waste and irrelevancy in that life.

There will be those who will object that the computer construction art, and the science of artificial intelligence, is too little advanced to undertake the kinds of evolutionary tasks we have talked about. But we must be careful not to misjudge the breathtaking swiftness with which the computer art is exploding within our social organization. The scientists of artificial intelligence—Minsky, McCarthy, Simon, Newell, Samuel, Papert, and many others—are busy evolving their machines; the cost of on-line computational capacities is dropping at a remarkable rate; and time-shared computer systems, regarded as the necessary take-off stage for widespread on-line intelligence, have been pushed hard in the past few years by Licklider, Corbató, Fano, Shaw, Selfridge, and many others.

Our computers are still young, and despite all the bluster about their powers, are still more like insects than mammals—hard-shelled, quick, busy, rigidly constrained in their maneuvers, persistent and exacting in their repetitive tasks, and rapidly multiplying. If we manage them in the way we have managed our earlier machines, and give them anarchic powers within the human community, we too shall behave in a more insectlike way.

But our computers are growing in influence, as well as intelligence, so there should be support for evolving their "sensitivities" in using humanlike intelligence.

Properly managed, these new computational powers could bring a new beauty and true functionalism to engineering, could mediate between us and the harsh automating effects of our present technology, could bring new satisfactions to the human users of technology, and could perhaps stabilize the rapid change of our environment. Although the work has begun, it needs the momentum of the whole community of engineers. The lead time is short.

A subsequent article will discuss practical examples of evolutionary design that are now under way or being contemplated; it will aim at concretizing the questions that have been treated here in a philosophical vein.

A word about this coauthorship. The ideas and the philosophical outlook are Brodey's. In order to elucidate the evolutionary idea, we have engaged in the kind of dialogue described in the article. Original photos are by courtesy of George DeVincent.

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Experiments in Evolutionary Environmental Ecology

There is a peculiar thing about talking about evolutionary development. You don't know where you're going. You know, perhaps, where you've been. You may know where you don't want to go, but you don't know where you're going next.

I recently overheard two architects talking rather intensely and one was saying to the other, "I think I have become obsolete." And the other one said with a sigh, "Well, anyway, I guess I can make enough money to put my kid into a college, and there he'll learn to press buttons like the people at all the schools seem to be doing."

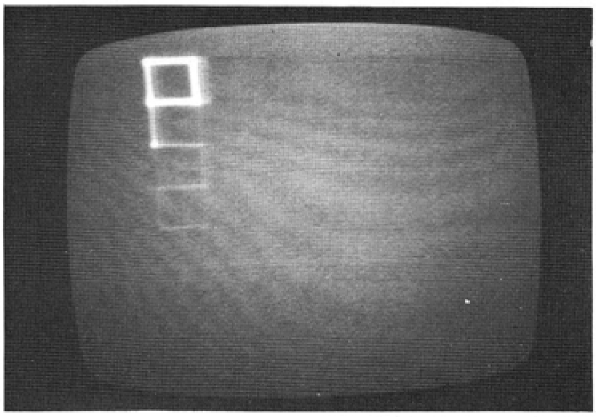
Somehow or other I didn't think he was particularly satisfied with this view of life, but I know he was terribly concerned about where the course that we are now taking is leading us. We don't know where we go from here.

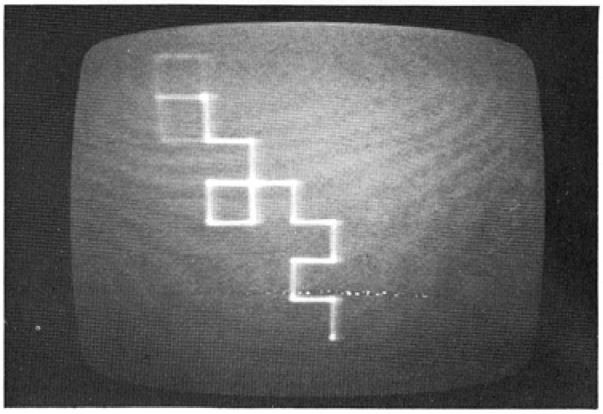
Now is the time when we are all in the process of trying to break out, of trying to do something different, and trying to be somewhat more alive than we've been—in our architecture, in our work, in everything we do. The language of aliveness is within us, but so far it hasn't really come out.

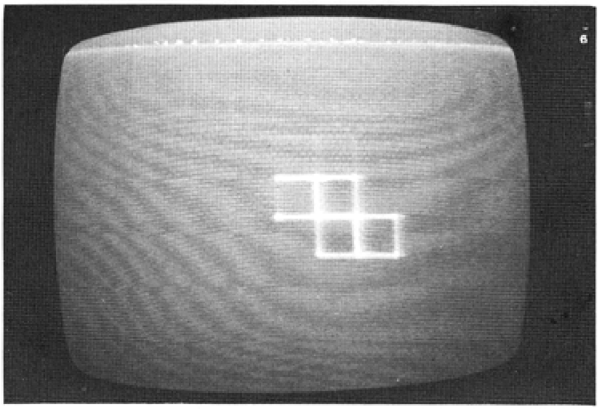
In building this machine world we have in fact recapitulated. We have brought ourselves into a metaphor which is a statement of where we have been, and of what science has given us to date. It has given us a way of capturing ourselves so that we become deadened.

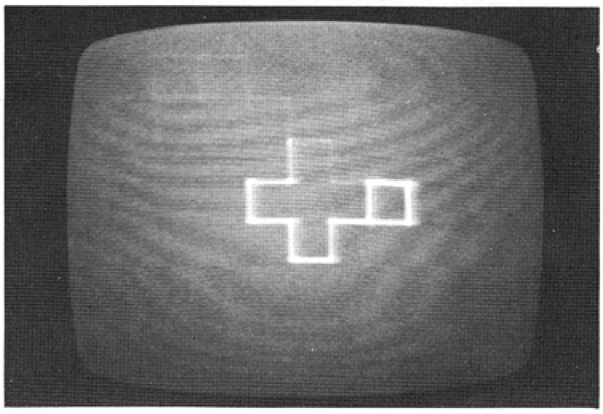
What do I mean by that? Let me start the TV monitors. Don't expect anything very fancy, I am only going to present something metaphorical.

Today we are at the end of the road for modern cubes. For the world of cubes is a world without relation. It is a world of matrices where you draw in the right, the left, and you put straight lines between them. Then you do all sorts of permutations and combinations and think that you have come up with relationships. But there is no language of relationships yet.

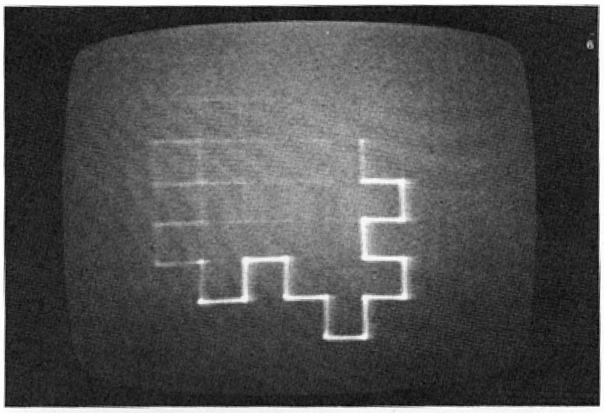








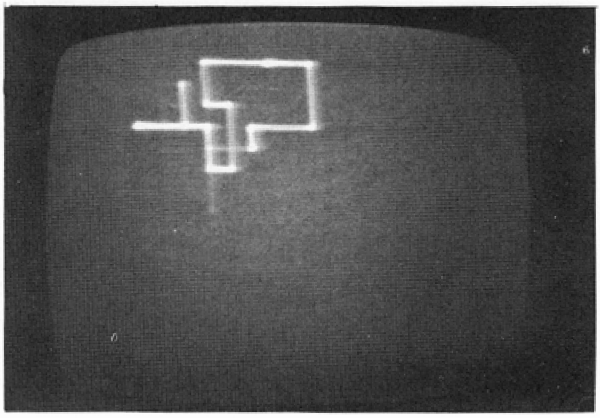
Dr. Brodey is a Psychiatrist teaching at Harvard and M.I.T.
and heads the Environmental Ecology Laboratory

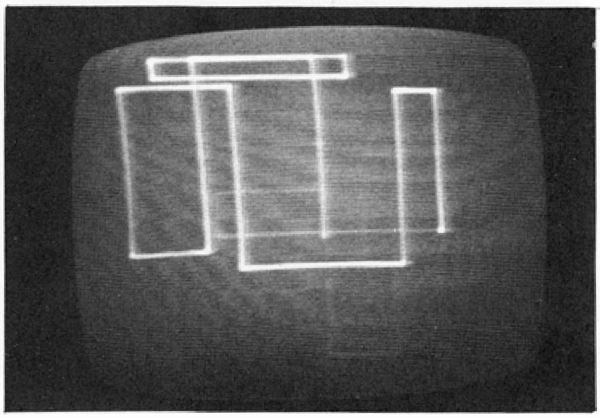


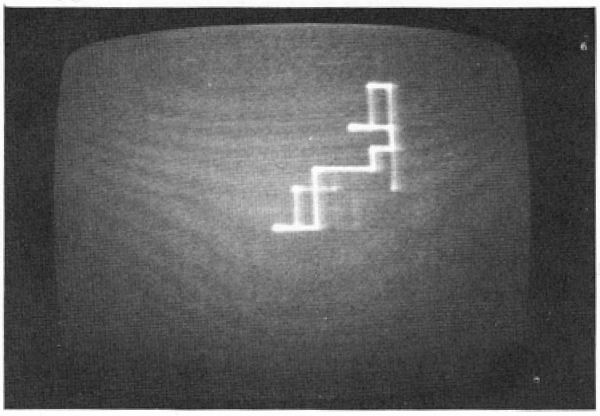
Now I must cut my tone back in order to reduce myself to the world of squares; you know, the waspish world. The world of sort of being exactly right in every sentence after the next and with as little ambiguity as possible. Now I put myself back in the world of squares where I hardly move my body and where when I say hello to somebody my lips move, but my arms don't. My eyes don't flash, and I am part of the system that controls us except when we're drunk or excited or when the young people, perhaps, are feeing their oats.

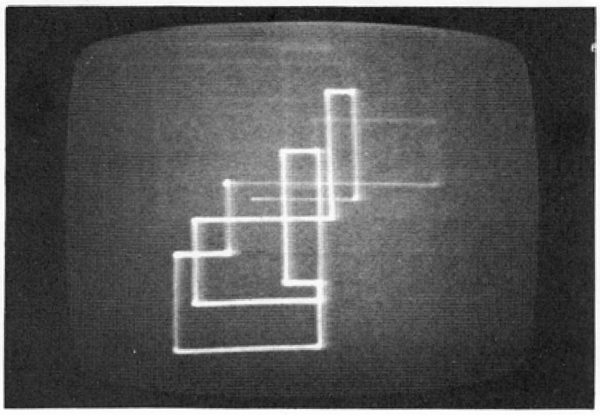
The squares you are looking at were generated by our computer which cost a good deal of money. . . but it makes beautiful squares. Look at the squares and you will see the architecture that lives around us. The computer made these squares. The squares move. You could build buildings out of these squares. You could make them into cubes. You could make all sorts of shapes with them.

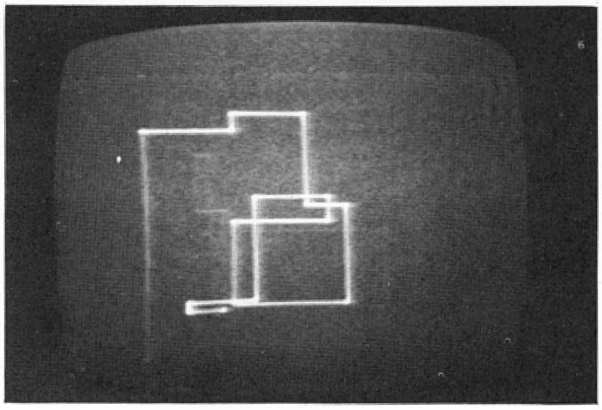
They're random, the squares. That is there's a question at each point. You see we've allowed now a sort of a school system, the child can have a choice. He can go to the right of the square. He can go to the left. He can even go backwards. He has choices, not many choices, but he can stay within the system if he's willing to follow the squares and the cubes. The architectural student soon learns how to avoid those kinds of choices that he can't deal with on drafting paper. This makes his life less complicated when it comes to pleasing his teachers and following the tradition.



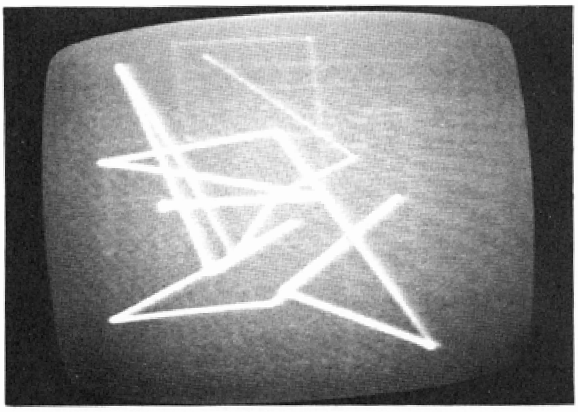


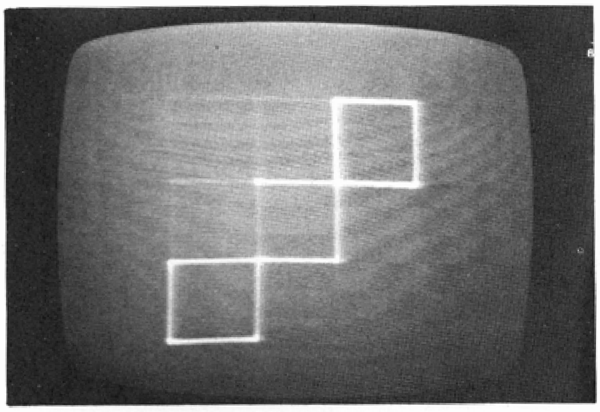


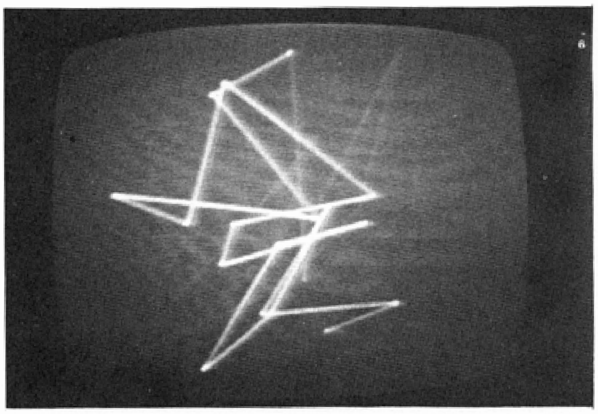


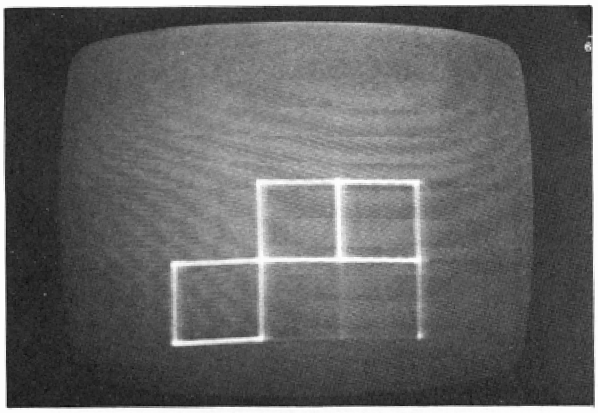


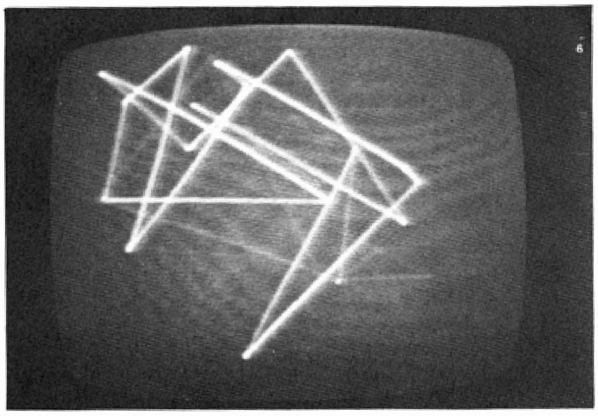
Now we've made the system more complicated. We have larger squares with random kinds of distances between the points at which there are right angle turns. The video system allows us to "draw" a moving picture. If I were doing it on paper you couldn't see the movement because you would only see the page after the squares, rectangles, and other shapes had been drawn. Here with our new media, the television and the computer, we are now able to see action in process.







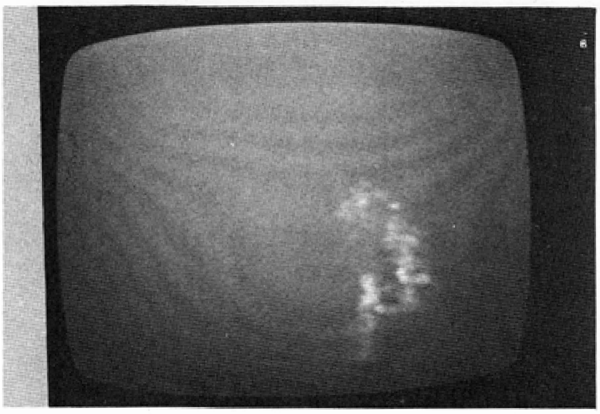




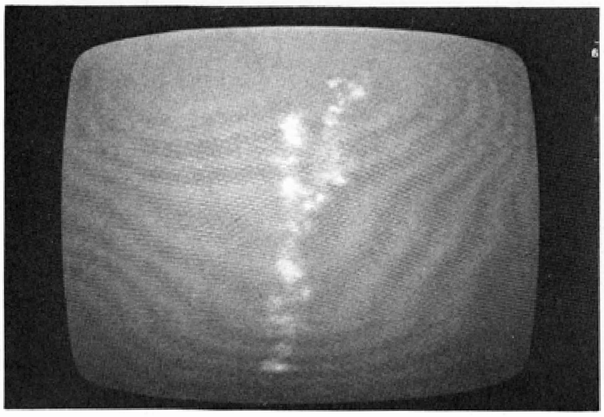
Now, the squares have changed. We have allowed all sorts of angles to occur randomly and distances to occur randomly. The computer is generating these designs given a random program. Think that perhaps you might be able to stop the action and choose a particular shape that pleases you and use that shape for whatever purpose you may have in mind. It's not easy to get that wide a choice, so the computer is useful there.

They stop and we go back again to the familiar. Everybody's willing to buy squares. You have an open market. You can build them on top of each other as little pigeon holes and you can put all sorts of people and things in the pigeon holes. And you have modern housing, the kind that we are trying to sell to poor people. The poor people somehow are not satisfied with that or perhaps they haven't learned yet the elegance of living in the style that we're accustomed to. I don't know whether they're more intelligent or less.

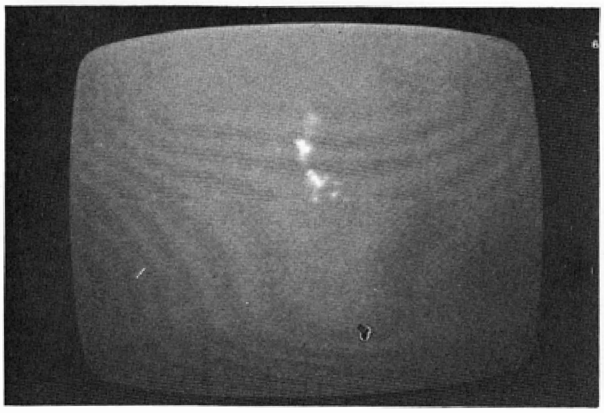
There is another world, a world that many of our young people live in. We are building for younger people, constructing environments for those who are to come. They should have some influence over what we do to their world. The relationships that you hear in their music, for instance, are of a complex nature that can't easily be simplified by the computer. Computers have developed out of the discipline of science; the discipline of science so far has not been able to handle these kinds of relationships.



By relationships, I mean the kind of communication that occurs between two people as they are grasping each other's hand in a handclasp. This relationship exists when one person is speaking to another in such a way as to express much more than is in his words, speaking with his face, with his body movement, with his whole demeanor.



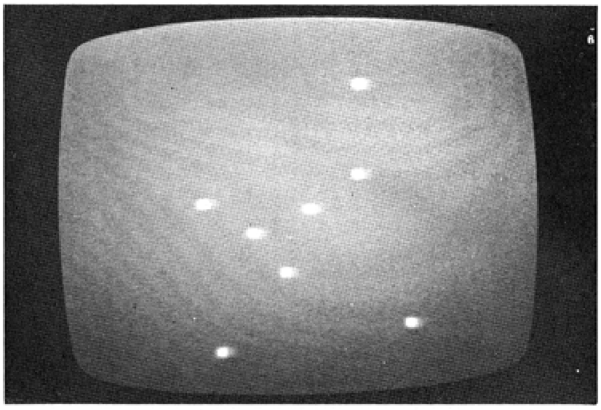
Now, here is the obvious problem, or at least it seems obvious to me, namely that science has not provided us with a language of relation, a way of talking about complex systems, a way of dealing with complex systems. We can add simple systems to make complicated systems but we don't know how to deal with complex systems. Complication we have, but complexity is a problem that yet we do not know how to deal with.



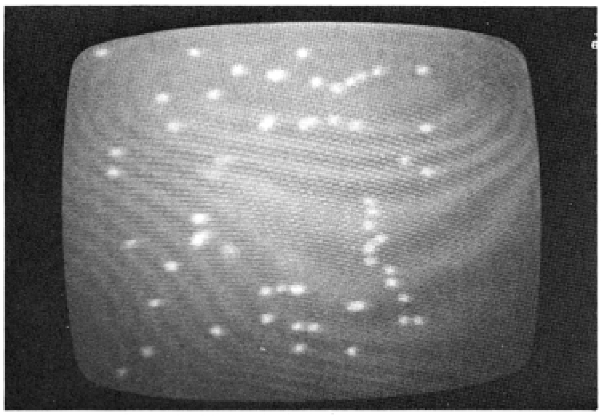
The architect is a man who works with complexity. He is forced to deal with it in his artistic maneuvers. The group at my laboratory is also trying to deal with such complex systems. You might find one of our earliest exercises interesting.

Imagine a light moving around on a scope at random. It's going whatever direction it wants, with whatever kind of movement it wants. Notice that I'm anthropomorphizing it on purpose. This blob of light is sort of like a human creature.

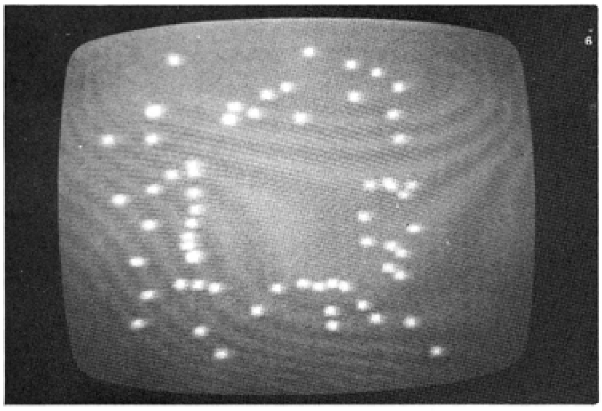
You know, we don't know how to talk about human creatures. We can't talk sensibly about how they behave. We can't even talk about the real relationships between them with any kind of precision. But on the other hand, we operate in the context of these relationships all the time, so we must know a great deal about them. We use them every day. We have within us an informal language of relationships that is with us all the time. It's so close to us that we have no way of conceptualizing it.



Now here's a small group of eight of those creatures on the screen. They're all standing still—just dots, people, snapshots. What kind of relationships are there between them? With a snapshot of these people you couldn't tell, but once they start to move it appears that there is some kind of organization among these creatures. If you're like the rest of us you'll read an organization in. As far as the computer is concerned, these are just randomly moving dots of light. We carefully programmed the computer not to put in any relationship other than that each creature should walk in its own way, a limited distance in any direction that it wanted. The only control we've put on this system is the distance that each creature can travel in a particular time.



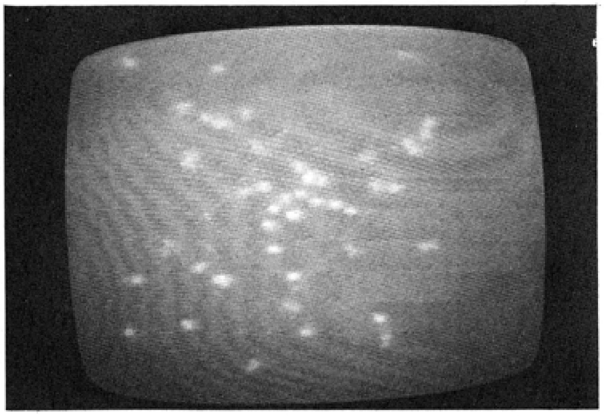
When I look at the scope, these creatures seem very much like bacteria, or like the little animals that live in water. They are really just simply random moving globs of light. I should waste your time with globs that move around at random.



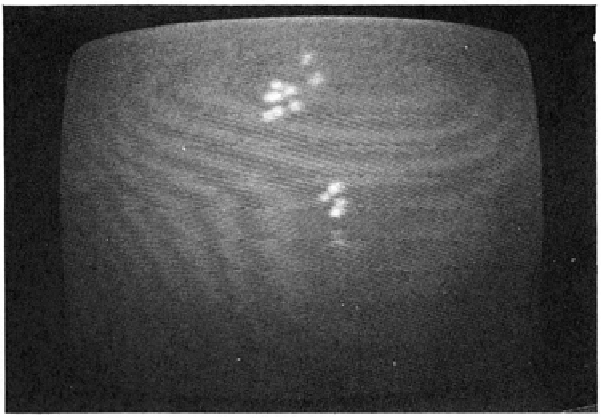
The question we asked ourselves is what are the minimal controls that we could put on these globs that would organize them in some way that was recognizable to us. We assumed that these are free kinds of creatures like people when they're not constrained. We put in a game for them to play. We said to the globs, as you get closer to the center you will have to move more quickly. That's all.

We watched them moving and sure enough, as they get in the center they go zooming across the screen, and they leave a big space in the middle. So this means that they did organize in a way.

Now there's nothing so unusual about this organization except that when you think about it, it's fairly complicated. It's easier when you have a media that allows you to express this kind of activity outside yourself on a screen. Complex relationships of this kind are not easy to fathom unless you're fairly expert at mathematics and even that won't help much.



Now in the next game we looked at another kind of environmental influence. We said that as soon as the globs of light moved inside a diamond shaped space they would slow down their speed. We defined the environment in terms of a rule as to whether they move fast or slow, that's all.



Some people think this is sort of like a fair. Once the globs get into the fair, they slow down in their pace. They start getting interested and they start to pile up inside. Some people could make all sorts of complicated, wonderful explanations of this behavior. One could say that they are all trying to get into the sapce, but this just isn't true. The globs of light are not trying to do anything. They just randomly move about.

With these experiments, we're trying to control in the most minimal way a variety of possible behaviors. In other words, we're using the computer to study how to minimize this control. If everybody could be allowed to vary in their own particular way, then how would you handle such a situation? Is there a way of thinking in terms of random variation, in terms of using things that aren't organized in the old way?

In this next experiment the only organizing rule was that the more globs of light within a short radius of each other, the slower the globs will move. We didn't set in any grouping behavior intentionally. In fact, we didn't know quite what would happen. Although this rule makes them tend to form groups, we don't know how they are going to group because there is no regularity about it. They get into colonies of globs and then they get out of the colony. They'll escape.

The computer allows us to see these relations in real time. By that I mean that you can program the computer so that these globs will follow a particular set of rules but then you can change the rules even while the action is in progress.

It would not be possible to do this kind of exploration without a computer. There's no way to do it by hand. One could do it in terms of building a mathematical model and then "seeing" it in your head if you happen to be that kind of a person. Most of us would find it difficult.

We are approaching a different kind of problem than we've ever approached before. We are using the computer to do things that you couldn't do otherwise.

The essence of all I've been saying is that we, ourselves, have become programmed. We have become programmed to a way of life, to a way of thinking, that has been organized by the media for representation that we have available to us, the media of computation, the media of drafting boards, and the media of tracing paper and the like. We have been programmed to particular ways of perceiving and recording the world through these symbols.

This programming essentially is only skin deep—if you consider the skin to be quite thick. By that I mean that within ourselves, in our intimacies with each other, and with the world, there are beautiful and complex relationships. We deal with them every moment. We couldn't live without being able to deal with them. But we also have a formal structure, a formal wording, a formal kind of representation that we use for communicating with each other.

That formal structure is highly constrained by a kind of Aristotelian way of organizing. Some messages do not fit on this kind of box structure, this matrix structure. Some messages will never fit, no matter how small those boxes are made. Thus they cut off certain kinds of relationships we can establish with others.

At this time we must begin looking for new simplicities which will help us find our way into the language of relation and into the kind of evolutionary thinking which we can only approach through understanding the language of relations. ■

reason-able rules for reason are obsolete

SPRING 1970

Conference on HABIT FATIGUE

This is what we do.

The description of what we think and what we do are is relevant only as it is expressed in what we do.

What we were, our titles, our tenures, our habits no longer tells you what we do.

We make ecological tools and toys.

We do our thing inside ourselves, outside and among our network.

If you are among our network identify yourself to us, that we may do together.

E.E.L., Inc.
ENVIRONMENTAL Ecology LAB.
might best be characterized
as a "post-industrial" laboratory.

to making ... of what ... denald ... existence ... these habits

It is dedicated to challenging
many of the precepts upon which the industrial
and scientific revolutions of the 19th and
early 20th centuries were based.

The challenge
is not one taken up simply for its own sake,
but rather has become inevitable and obligatory eg. T.V., IBM.
as a result of the advance of the "information sciences".

children are not slaves of the industrial habits, they laugh

Prior to the technological development of
"self-organizing systems" the benchmark of scientific
validity was the demonstration that a measurement could
be repeated or that a process could be performed ---
quite irrespective of the purposes "ecology" is intention, in Tension, with complex con(together, simultaneous) Sequences.
to which the measurement
or the process
might be put. THE WORLD OF BUILDING CODES ETC. ecology is contextual.
captures even its "controllers"

...ll discuss this the meeting. ...ou are self organizing in moments you are not being enslaved by the SKINNERIAN ...ROGRAM which corporate ... THE PRESIDENT ...ES NOT HAVE ...NTROL. HE IS ...NTROLLED BY ...APER ... IF YOU HEAR WHAT ...

Truth was thought something to be established
and it existed in some "holy, high, eternal noon".
Searchable. Contextless
But somehow irrefutable. MAN is an environment to other creatures

there is no eye of god divorced from his surround as if the habits' game provided "truth" in winning, while (only) holding to rules

Analysis became enshrined as the first step to anywhere
and when a research effort failed it was assumed that the
analysis had been inadequate.

Upon this rock the social
sciences almost foundered until statistics were brought
to bear so that results could fit the ordained mold. into able that which average man
But
even there dissatisfaction lurked because the individual
was asked to fit his purposes to the average or pay the
price of custom tailoring.

PERT is backwards looking — forward

manufacturers identify as MARKET users, forcing ladies into icebox, frigid, rigid aisles. Sunday roles of Christian etc.

The little boy said "I want a pocket full of peanuts" The lady said "a half pound" The boy said "no! a pocket full" She replied "I have no ways, you must learn about measure!" He became poor at mathematics captive

The price was high. 40 year mortgage 6% (ends 2010 A.D.)
Because the machines
Which science had so lovingly invented
Were unable to adapt
Their products to the individual.
Mass production was good!
Wasn't it? HE DID NOT HATE People, But at their habits

he laughed — they are obsolescent he argued by his way, his style, by being un-roll-able role

Not for its own sake it isn't, although it was for people
who had need of things --- for people who hungered.
IN AFRICA INDUSTRY IS CANCER, Something loving is needed.
We are
not hungry now but we have appetites, and appetites arise in
wanting something that responds to us. Appetite comes after hungers RAPE; it is the delicious Taste of loving calmly in a sea of waves of feeling strongly surging and subsiding in beauty.

THE PRINCIPAL ACTIVITY AT E.E.L. IS THE SEARCH
FOR RELEVANCE.

No Role as STUDENT habit Training IN A UNIVERSITY M.A. PhD

...ANK REQUIRES ...CODE TO ...LAST. Do NOT BUILD HABITS THAT ARE COSTLY BEYOND THEIR VALUE INTO HABITATIONS ... you!

Consider for yourself:
what kind of clothes you buy
what kind of transportation
what kind of office do you work in?
what foods do you consume?

How much of your daily time and effort is involved
either in adapting the above to your purposes
or in tolerating their unrelenting permanence?

COMMUTE
"Do cars have children", then why do they have a population explosion"

Consider transportation. Please commute
Oh sure, you can select the car you want from among 200 models!
Then get behind the wheel.
Where can you go in backed-up traffic?
You may be waiting for the highway department to widen
and lengthen
and make safer
and cleaner
the roads you drive on.

Population of cars; no there is no room for people.

Do you DRIVE? DEATH SMOG

But let us be quite clear on this:
Every step which makes driving more convenient proliferates
the future use of more automobiles than it will serve.
This foregoing concern illustrates our attitudes
as ecologists.
Consider, though, another aspect of our cars.
One great advantage of the horse was that he learned your
most accustomed route , and could proceed along it without
further attention on your part.
The automobile, however......

If a car where like a horse in intelligence as well as power would it want to fart and fart until it suffocates its rider's children D.E.D.

What E.E.L. can demonstrate is that self-organizing systems
can take over redundant, repetitious matters
and let you operate
in a manner more suited to your talents.
It is not our goal to isolate the operator from
his performance. IMAGINE HYDROMATIC STEARING of a horse;
Far from it.
We want instead to allow him the freedom
to remain in touch Thighs and flanks Together
with those parts of the process
where the maximum of information lies that is
of relevance to him.

Taos

IT is a love world we prosper

I like To see but cannot only see what I am shown

We don't want to throw out TV.
We would rather make it more relevant to the viewer
by changing itself in a manner that depends upon
where he is looking.

"My eyes have been de-balled" he proclaimed. " Gutenberg's T.V. is living up a Key hole, Nixon face peerin out the box, mad donna like!

We don't want to eliminate telephones.
We merely have come to distrust the reliance of western man's
on totally verbal communication.
And adding a TV picture to the process does not improve
communications all that much. It is simply the western way.
E.E.L. is ready to develop a system which would allow you
to hold hands at a distance. We call it Telegrasp.
Or Communicouch.

EEL is not us alone it is our network. Join if you are ready

E.E.L.'S INTEREST IN COMMUNICATION IS THAT OF THE
TOTAL ECOLOGY OF HUMAN DIALOGUE.

We will one day know you better, our roots share their nurture with you among many

How did E.E.L. come to where it is at present?
Was it planned?
Did it follow a program?
Where did the money come from?
What return on the investment was promised or expected?

CHILDREN MUST be freed from idiotic schools.

The roots of E.E.L. go back in time a few years but can best be summarized as arising from the ideas and personal associations of a common mentor: Dr. Warren S. McCulloch, one of the fathers of the field of Cybernetics. It was he, directly or indirectly, who introduced most of us to each other, and who gave us the confidence that the ideas we wanted to work out in some form of embodiment had the timeliness we hoped for, and had the momentum of history behind them.

Another individual, who must remain anonymous by his own request, saw the potential for the ideas that were on their way to becoming concrete and provided the capital for a one-and-one-half year "all out" effort of a half dozen people to commit themselves solely to the project.

No return commitment was demanded although if the "next round" of E.E.L. is successful, there is a built-in return to the original investor which would hardly allow more than a break-even.

Beautifull industryial place of SAILMAKERS.

The loft space at 33 Lewis Wharf was obtained in late 1967 and two computers and an avalanche of tools and materials were brought together there. The initial effort was not so much terminated as interrupted in July of 1969 and a period of metamorphosis was entered upon to promote a reassessment of the intrinsic and extrinsic value of the various projects which had been pursued and to look outward toward industry and other sources of funds for a continuation of the laboratory.

During the active period of the laboratory's operation a considerable amount of film footage was exposed showing laboratory people and projects in process --- both in "real time" and in speeded-up "time-lapse" photography --- and a 20-minute digest with sound track was edited from it. Some days

The results do not necessarily yet speak for themselves. we feel we have so far to go we got nowhere

One of our big problems to date is the essential difficulty of setting into verbal or visual form what we consider to be expressible only in some as-yet-to-be-invented direct language of experience. It is, in fact, toward an implementation of such a language that we have been working.

NEW MOVING FLAGS. That grow! If we had at hand working prototypes of the devices about which we talk so much, we would not have to talk. The ability to connect another person in to a complex, interactive, responsive system would convey the message. He would walk away perhaps also unable to name it; but now he would "know". He would truly have "grasped" rather than merely having been touched.

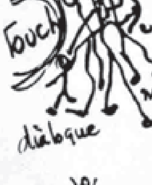
Seagulls ocean granite

we reassesed we found we needed friends who cared and saw and felt the value of the struggle to make tools and toys To support the Revolution in The CHILDREN so they will not be alien to their habits.

plants are growing, roots rooting flowers bloom

technology human HUMAN PEOPLE technology PEOPLE TECHNOLOGY PEOPLE got BUCKS work at creating people technology we want the AEROSPACE INDUSTRY TO BE CONVERTED not religious conversion just for survival of post industrial world has practicable spiritual values.

WORDS UCK.



touch appearance widening network dialogue

People

sometimes the acts of man are simple and ...ous

The mind of man boggles his words

what do you know about ...AVITY. IT IS EVERYWHERE IS IT.

oh me! I wish I wish and wish for more than my hands can make and we need a working network

Many of the devices we talk about have worked in some prototype form at one time, only to have been torn down immediately for the process of evolving into the next device. Some were so complex or tenuous in their initial embodiments that they "worked" only briefly and only recognizably to the inventor.

People Technology People METATECHNOLOGY ECOLOGICAL uses ECOLOGY uses TECHNOLOGY USES COMPLEXITY, NOISE; THINKS BIOLOGICALLY

We do not apologize for that.
The devices and their erstwhile working have
become our "words" for describing the
processes of exploration
and evolution.
Those that are relevant can be made to work again,
and work better than before.

The range of applications to which we would like to put our emergent technology is vast and touches everywhere that man would like to have a closer communication with his world.

Love relation with intimacy with years of Experience passed among them as TFy touched the tree and its man stood back to know each other.

We want to put him into control of
responsive dialogue with
perceptual grasping of
communication about
himself inside and outside and in time and space "grains"
larger and smaller than he has had access to formerly.

plankton seaweed fish water

LOVES LOVING AS A TECHNICAL as well as biological Tool To enhance us as environments to other plants animals

his ~~living spaces~~: on earth and in houses
under the water
in his clothes
at his job
outdoors

TOOLS AND TOYS

his communication with others
his ~~understanding~~ of cultural flow and change
his transportation systems
his reuse and recycling of waste materials
his potential for communication with other species
his potential for high-information exchange: verbal
non-verbal
physical
metaphysical
with technology
without technology

DID Jonah Know the whale? Did Jonah love the whale so he could include the whale in his network and be included by the whale who would then teach their children

ECOLOGY IS ~~MAKING~~ TOOLS AND TOYS

are whales polluting shrimp beds

OLOGY TOOL TOY NERS UNITE

his understanding of how complex systems work by being able to plunge his hands or ~~himself~~ into a facsimile or computer-based model and thereby become part of that system; such embodiments require on-line, real-time application of a "dedicated" computer. We finally have thrown out our "real time dedicated computer"; it does not provide the change in values and in fact prevents THIS! But we have not thrown out the [illegible] ions the computer taught us to create!

computer behaviour's have been like automobile behaviours, useful to make us realize where we want to go and can go. Way are not the way to get there — reducing exhaust does not make the gas engine right. New forms of lively behaviours from non living materials are possible.

We at E.E.L. claim that the realization of the above-mentioned projects in workable form is well within the current state-of-the-art ~~and that in fact we~~ already have the necessary components developed.

← relative to WARREN BRODEY, AVERY JOHNSON

We invite inquiry: ENVIRONMENTAL ECOLOGY LABORATORY
3 Lewis Wharf
Boston, Massachusetts 02110
(617)-523-6167

Solar arcology

A living Room in your home or more living be WARREN and AVERY. What is ecology ... Ecology is

THE WORD WEAVE

Do NOT Build old habits which you would like to leave into your HABITATIONS

unlearning the obsolescent hurts

DEHABITATE TO SURVIVE

WEAVE IN DROP OUT HABITS and see your habits CALLED VALUES

filters

TEXTURE TOUCH

Textures

IF! IS IT WRONG TO AVOID THE OLD GRAMMAR FOR PRINT. JUST READ your associations

networks are points between

executive programs

HE CARES

EVOLUTIONARY CHANGES ARE AT FIRST ABSURD

PRUNING by evolution which habits and by unusually

Communication energy goods & service

not merely lines of transport

visual projections

can be thought of

they are energy fields

they become money

hot

dollars Telegrams

sensing in behaving

that materialize flows

at STATIONS, in STORES at AIRPORTS when RESERVATIONS become the actual person.

radio t.v.

kinesthetic action movement

information metabolizes

regenerate

NEW MIX of DATA. COMES OUT OF THE DATA BANK, NEW COMPOUND NEW PROPERTIES

condense

RESPOND TO

together

harden

hard facts with impressions

ABSTRACT children in schools

schools

HOMES THAT ARE ABLE TO

Bring Come

HUMAN BEHAVIOURS

HUMANS AS ENVIRONMENTS TO PLANETARY GROWING

FREIGHT TERMINALS COMPUTERS PEOPLE

MIX

values

BABIES

joy

BUDGET

soil

grow

P.P.B.

MISERY

FUN

BODY HEALTH

MEDICAL CARE

SURPLUS

spiritualogy

evolve

EDUCATION

SEWAGE

abstract

Soul

structured

BUILD

BUILD

DO

EXPLORE

The New Year, 1971

ECOLOGY TOOL & TOY

A NEW TECHNOLOGY FOR THE '70's AND BEYOND

ECOLOGY TOOL & TOY has evolved from a group which began in 1967 to explore a great diversity of avenues by which the available technologies might be brought to bear upon the problem of creating truly responsive, courteous environments. We had at our disposal from the outset sufficient funding to place in our hands the most sophisticated tools and materials we might wish to try; and a time limit was set, at the end of which the results should be able to support themselves.

That time ran out in late 1969 and by then we knew we had pushed forward into a territory more incredibly valuable than we had hoped to attain. We found ourselves to be the authors of a set of concepts and approaches to the realization of tools, toys, structures, environments, furniture, clothing, and containers that was so entirely new that we did not even have at our command a language adequate to describe them. The best luck we have had in communicating these ideas has resulted from our occasional opportunities to give someone else the experience of interacting with our environment and of laying hands on to the crude prototypes we have been able to put together, and then to have him tell us about his experience. Once he is fully into the self-referent process of teaching, he suddenly grasps the central core of our purpose.

Initially we played the games that so many other people have played and which so many are still playing. We knew we wanted our environments to be interactive with us and we made the mistake of thinking that "environment" consisted of things one could see or hear, point to, and name. The correction of our mistake was not simply the substitution of other senses for sight and hearing, but was rather a move toward a more fundamental understanding of the processes of perception.

A. We learned that perceptual experience is not acquired "through the senses" by a passive observer: he must be involved as a participant.

B. We learned that his participation must be more than symbolic, and it must involve him in a way more directly related to the experience itself than the pushing of buttons or the reading of words or the learning of ritual can ever involve him. Stated very simply: the environment must push back at him <u>at least</u> in the same way in which he pushes on it.

ARMORY ROAD, MILFORD, N.H. 03055 (603) 673-4354

C. We learned that the kinds of participation that people enjoy the most are not acts of conscious will in which one attends to the details sequentially. Rather, one sets into motion a continually evolving stream of exploratory interactions with an eventful environment and then "observes" the <u>behavior</u> which results, thereupon to form the percept. Thus, perception is a truly self-referent process.

D. We learned that what our daily environments lack the most seriously is <u>playfulness</u>. In order to afford them this quality, they must be made sufficiently self-organizing to have behaviors of their own which are sensitive to your interaction with them as if <u>you</u> were environment to them.

.........but playfulness involves much more.........

The flow of interactions must present you with occasional unexpected shifts of context: changes, that is, in the ways you are allowed to engage and explore them.

Some behavior must originate in the playful organism and some must arise from your interaction with each other. If all of it comes from you, the organism is dead; if all of it is imposed upon you, the sense of being programmed by the environment becomes unbearable.

The interactions of interest are to be found in many time-frames, and in a variety of size-grains. Contextual shifts may occur within or across these categories. In the simplest of the systems we have played with, local responsive computation within the system subcomponents and between near neighbors is sufficient; when the referent of the play is not the immediate exchange between the players (e.g., mother and infant are involved in an immediate interaction; while tennis players are relating to a goal more distant in time and symbolic in form) then the artificial organism requires more complex control systems to integrate the behavior of the whole.

There appears to be no upper bound on the complexity of play of which a human participant is capable. A lower limit (for play even to exist) seems to be the involvement either of two sense modalities and one "motor" process, or two motor and one sense. In either case, the lone element must be affected directly by one of the other two. In any case, we do not try to approach this lower bound.

There must be a random element to the play so that new combinations will eventually be explored and a virtually infinite recontexting of one's informal skills becomes possible. The purposive nature of the play in the longer time-frames arises from a biassing of the statistics of that randomness and from gradual and accumulated changes of that bias --- a simple form of learning.

However, randomness by itself serves to maximize ambiguity and to minimize the opportunity for the participant to explore the contexts of play. Much of the energy of play must fall into the sink of redundant pattern or melody, but not so much as to become habitual. Most of the "entertainment" available in our daily world is either so redundant as to produce boredom, or so random as to produce anxiety. "Courteous" and playful environments move softly over a wide range but stay well within those bounds.

Playful environments must always offer the courtesy of allowing play to subside for a time when it is apparent that the other player(s) are disengaging. This is not to say that the environment should "go dead", but rather that the sources of its behavior should become internalized for a time and the outward evidence should be rhythmic and somewhat insensitive to changes imposed upon its exterior.

At the opposite extreme, occasional "hysterical" behavior on the part of the environment is permissible and is in fact advantageous when the complexity of <u>its</u> environment (<u>you</u>, however many you are) has changed <u>enough</u> to imply <u>that</u> the game in process is obsolete.

There are other aspects to playfulness, but they become more complicated. In any event, the latter kinds of contextual sensitivity mentioned above are only feasible when the environment is under the organizing control of a complex data-processor. State-of-the-art computers can be programmed to provide the necessary complexities of relationship, but our state-of-the-art peripherals are not adequate to adapt such computers to the purpose within the next year or two. Sufficient complexity of behavior may be achieved through adequate provision for structural, local, and proximal computations for environments to enthrall anyone with an appetite for participation, but who has neither the time nor the sustained privacy to develop commensurate skill of his own. Let us return to our story.

E. We learned that in order to involve people fully we had to make their "large muscle" behaviors meaningful. That is: to communicate with the whole man you must literally elicit responsiveness from his whole body. This task in turn requires that he discover the relevance of whole-body movements by moving in an environment which changes in some way that is correlated with and directly responsive to those movements. It is not enough that some lights flash when his feet step in switches as he walks. In addition, <u>something</u> must react physically back upon his foot or leg. <u>Better still</u>, let him push against a wall that may either push back or move with him; let him walk upon a surface that heaves up around him; let him lie on a bed or sit upon a chair that interacts complexlv in touch and movement with his changes of posture and with the rate of change of those changes.

F. We learned <u>above all else</u> that it is unnecessary to make any measurement <u>directly</u> upon the participants within the environment (i.e., Big Brother should not watch, for he will be unable to decipher his observations; rather, he should enjoy himself). All measurements are for self-referent use only in the organization of the responsiveness that is to be presented.

In the process of acquiring these understandings, we will admit, we fumbled along for a while in the now-familiar manner of other entrepreneurs. We made light-shows and tore them down; we tried computer-aiding our videotaping processes; we tried simulations of this and that; and we tried extremes of perceptual overload or of perceptual deprivation. The only elements of our endeavors that were satisfying or showed any promise were those which responded in the manners enumerated above --- and the most delightful of these were "soft" not only in their responsiveness to change but also soft to the touch, molding themselves in an interesting way to the body member impinging upon them. Our time and funds were more than half gone when we began to recognize the value of our new-found tools and toys and we turned to an intensive effort to elaborate upon what we were learning. When the clock ran out we discovered that we had progressed so far into a completely new territory --- new, that is, to the technology of the artificial, but familiar to the physiologists among us --- that we were without an adequate language with which to relate our product to the industries which might take it and make it valuable to a broad market, thereby to return to us the access to our next stage of evolution. We could not talk to the Research Directors, Product Managers, and Marketing Representatives who wanted to know what we were offering. We could not explain to them the complexities of loop-processes nor the technology of playfulness when what they wanted to hear was: What'll it do? Who wants it? How can we market it with our other products? Cybernetics is a good word these days, but how do you sell it?

They will have to be shown and we intend to show them.

We do not care <u>who</u> it is that helps us to make our inventions valuable so much as we care <u>how</u> that value is returned to us. We are looking for innovative industries that can provide us not only a financial royalty to sustain us in our laboratory but also the tools and toys (toys are tools-to-think-with) that will allow us to invent ourselves and them into the next stage of development. Above all we require that those industries have enough control over their own processes of change that they can allow themselves and us to be playful. Together we will explore new contexts, new applications, new markets, and new ways of living and working together so that the relationship can enrich itself without bound.

The products themselves will range in size from toys for children --- through furniture and beds for adults --- to large architectural components that can change in many parameters with the demands of weather, of occupancy, or of context of use. They will range in complexity of behavior from simple beds that can enhance your restfulness or conjugation --- through automobile furniture that not only attends to your comfort and state of alertness but also provides you with a low-resolution awareness of the condition of the car or of the highway --- to systems that can teach highly complex skills to an individual by adapting first to his own informal style of approaching the task.

The materials necessary for these products are already familiar to us, and we have access to the presently available tools for handling them. We are also prepared to specify the parameters necessary for incorporation into far better tools that would allow a wider range of play --- for the tools themselves must eventually embody playfulness.

The control systems necessary for the early stages of development: self-organizing controllers, decision systems, and learning algorisms, are to some extent off-the-shelf items currently in use in space programs and military systems, if not actually already adapted by industry. We are constantly in touch with the advances in methods of data-gathering, processing, and transfer.

In short, we are ready now to undertake a full-scale development program that will lead directly to production designs and highly marketable forms of the systems and devices described herein.

Directors	Associates	Consultants
Avery R. Johnson, Ph.D.	Francette Cerulli	Irving Malick
Warren M. Brodey, M.D.	Ann Capper	William Harb
Associate Director	Craig Cassarino	George A. Curtis
William M. Carrigan	Robert A. Pozar	Joseph B. Seale
	Paul Ryan	Thomas S. Wilson
		Edward Pascal

* * * * *

The available bibliography on this new technology is meager, but the following articles and papers of recent vintage may provide some useful background for those who want it.

by Avery R. Johnson:

"Information Tools That Decision-Makers Can Really Talk With", Innovation, Issue No. 10, March 1970

"The Three Little Pigs Revisited", Student Publications of the School of Design, Vol. 20-1, N.C. State Univ., Raleigh, 1971

"Dialogue and the Exploration of Context: Properties of an Adequate Interface", Proc. 4th Ann. Symp. Am. Soc. Cybernetics, October 1970 (in press)

by Warren M. Brodey:

"If You Can't Support The Revolution, Let The Revolution Support You", Innovation, Issue No. 15, October 1970

with N. Lindgren: "Human Enhancement: Beyond the Machine Age", (two articles) IEEE Spectrum, September 1967 and February 1968

"Information Exchange in the Time Domain", In: Gray, Duhl, and Rizzo (eds.) General Systems Theory and Psychiatry, Boston, Little Brown, 1969

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Biotopology 1972

by Warren Brodey

The following are excerpts from 1) a manuscript/letter recently received from Warren Brodey on the topology of klein form systems and 2) a transcription of the audio portion of a twohour video tape made by Andy Mann and Darcy Umstedter in which Warren relates klein form systems to bioptemes (biological optimizing systems) and contrasts these with mechy max (mechanical maximizing systems) which he thinks predominates in the mismanagement of the earth's ecology in ignorance or disregard of context [the extent to which all things (systems) are related].

TOPOLOGY is a non-metric elastic geometry. It is concerned with transformation of shapes and properties such as nearness, inside and outside. (Paul Ryan, *Radical Software* 3).

Compare the kind of space people are in who ask "Do you follow my line of reasoning?" and the space of those who ask, "Can you get into the space I am in?"

"Can you get into the space I am in" means asking the other people to loop through your style, your information arrangements, your habits, your epistemology, your language, and how you deal with the unanticipated.

Infolding: Imagine working through into depths with the help of a media that provides instantaneous feedback and thereby allows infolding with time, memory, energy, relation, no longer in the image of print. "Do you follow my line of reasoning?"

I am not a TV freak. I am a person engaged with a group in synthesizing actual plastic materials that use the *ecothink* in their working. The going is slow but the space is now clear in my head. We taped a discussion—each of us trying to catch what we thought had meaning. I might catch your face when you registered surprise at what your hands had just built. On the next infolding we would discuss what you expected and your surprise. We would use the TV to penetrate in depth the experience even as it happened and to penetrate the experience of the experience—the meta experience.

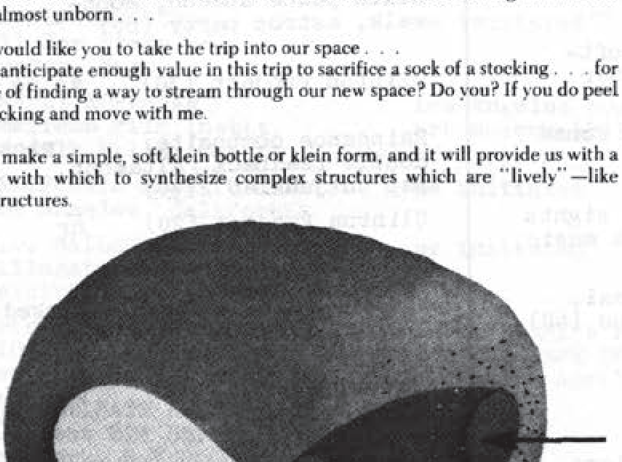
Paul talked about this in the last issue of *Radical Software:*

> Taping something new with yourself is a part uncontained
> To replay the tape for yourself is to contain it in your perceptual system
> Taping yourself playing with the replay is to contain both on a new tape
> To replay for oneself tape of self with tape of self is to contain that process in a new dimension
> Parts left out of that process are parts uncontained
> All of this is mapable on computer graphic terminals!

Infolding as it is described by many creators of *Radical Software* is really a radical, a powerful, a timely, and a materially significant happening. It takes us into a new space. Some of the readers, particularly Paul, would look at the tape we were making if this were an infolding session and show me my stubbornness in not seeing what they were telling me a year ago or more. But our group has been working in the same space with different media in hand—a responsive touch media instead of a visual one. Our child has asked for its launching. It is a frail being, almost unborn . . .

Now I would like you to take the trip into our space . . .
Do you anticipate enough value in this trip to sacrifice a sock of a stocking . . . for the sake of finding a way to stream through our new space? Do you? If you do peel off a stocking and move with me.

We can make a simple, soft klein bottle or klein form, and it will provide us with a simplex with which to synthesize complex structures which are "lively"—like living structures.



Klein form: no inside, no outside

First, cut the toe out of a stocking, stretch hose is better. Cut a slit near the knee; make it about the diameter of the toe. Fold the stocking over back on itself; put the toe in through the slit. Pull the toe free edge through (but not all the way through) til the free edge at the toe and thigh are adjacent. Now get a needle and thread. Sew the slit to the stocking coming through it. Sew the toe free edge to the thigh free edge. (See diagram of klein form)

Reach down the double tube. Your hand will go down the contained tube (what was the toe) through the slit to where it is uncontained and then around into the containing space between the toe and the thigh of the garment.

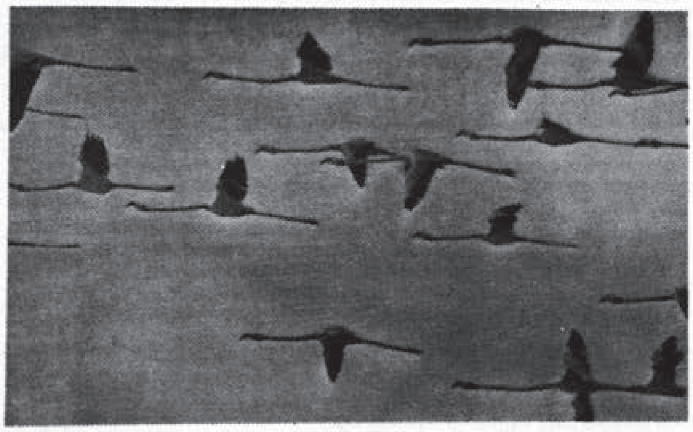
We are in very different territory.

In the past you started out with points; points went to lines; lines swept a surface in two dimensional forms. When you went to three dimensional forms the first form was a sphere, because that's the simplest; then from a sphere [you can make a hole in a sphere and stretch the sphere out (as far as topology is concerned, you're allowed to stretch everything)] you went to a donut; a donut to be a donut had to have a hole in the middle, and you could stretch it as much as you wanted but it still had a hole in it.

The klein form is different. There's no inside; there's no outside. Instead you have a contained tube and an uncontained tube, a contained hole and an uncontained hole from which you can make interlocking klein forms in a chain . . . Any part of the form can touch, contact, communicate with, flow with any other part, and the parts, the whole, in time flow through each other in a way the donut and sphere cannot. We have a quality of continuousness in the form and at the same time intracontainment or infolding; we have intrinsic to the form identifiable relationships that are not diadic (inside, outside) but are always at least triadic (context). There is no central governance or cooperative communication. There is enormous variation—the basic structure is so informationally rich that no two systems are sufficiently similar to value a same "thing" at the same time—indeed there are no "things" except as special cases.

The beauty about the klein form is that for the first time you are not captured by spheres or donuts. You can talk about a jet of air that goes up through the part of the klein form that is in contact with the external environment (where it is uncontained) and then becomes contained within itself and continues. For the first time you have a form which allows you to talk about something contained within itself . . . if I put my hand on my knee it forms a kind of hole where the "outside" is in complete contact with the arm and where the energy from my hand goes back through my body and *alters* what happens "outside" again as it passes from within my body down through my shoulder . . . I start to have a loop which is partly uncontained that is, really senses that which is outside itself, and partly contained, that is, it senses itself within itself. It is a form that begins to have the capacity to know about its own behavior as it behaves "outside," that is, in simple connection with the environment, and as it behaves "inside," as informational representation to the environment within itself.

Paul spoke of how the kleinworm has a capacity for anticipation and we find that anticipation has meaning only if we are considering a time-form geometry, a geometry of relations rather than things (no longer Newtonian geometry but an Einsteinian time-space form, a form that does not define time but is time that is by definition) . . . ("Taping something new with yourself is a part uncontained. To replay the tape for yourself is to contain it in your perceptual system . . .") When you model with a klein form you have to change your head around, because for the first time you can talk about time as influencing behavior. Consider the klein forms as being able to breathe. Let us say it is made of material with local energy that allows it to expand and contract. Image waves of contraction flowing in this material. The part that loops out into the environment—the unanticipated context—recurs through itself comparing the return with the rhythmic response on adjacent recursions. It changes its waveform to better maintain its intentional behavior. It is permeated by context. It has no walls. Yet it uses its structural infolding for maintaining itself changing in a sufficiently regular way to find new relations.



In biological systems rhythms pass through themselves interfering, augmenting, amplifying by setting resonant rhythms going which soak up energy which would otherwise be lost to relevant work. Rhythms that are more intracontained will tend to null out rhythms that are not convergent or that cannot find energies at the time they are needed . . .

To put it another way: Let's say you have a colony of birds and this colony of birds is in a mountain valley almost filling up the mountain valley, and the birds behave in the colony in a particular way that allows them to propagate so there are many more birds. The colony then becomes crowded, and individual birds start to behave in a crowded way; the colony is then changed. The way the colony changes influences the way the birds change. The way the birds change influences the way the colony changes, but the birds change and the colony's change are not simple additions; the colony is not made up of a million birds, nor is a bird made up of a colony, because there now starts to be *in time* an interaction, an active dynamic interaction between the single unit and the mass unit. The dynamic is not simply dividing the mass into the units. All of our theory and governmentology has been that the individual is simply a member of the class called mass. Now, however, we start to move to what the interaction is between the individual and the mass in a way that takes in the context which is beyond either the individual or the mass, that is, that which is contained around that totality; so we have always a system of three at least. You always have a context.

In the past all of our logic in all of our theory, in all of our ways of thinking, has been bound up with systems of two, systems basically true and false. But we know now that there's no such thing as high holy eternal noon, the time when all things are pure, because *things are always changing, because time always exists.* The klein form helps you get your head into a space where time starts to exist and where things are constantly in dynamic motion with a different kind of dynamic relationship than you get if you're talking about spheres. The concern used to be: how do you get the mass contained in the single member; how do you get the class contained in a member of the class. You could talk about how members made up the class but you could never talk about how the class made up the members; you were never able to talk about it with any geometric representation. But now people can talk about this in terms of triadic logic (the man who taught me what I know is Warren McCulloch, and Warren was searching for triadic logic in asking questions about things); that is, how do you set up a contexual logic so that your experiments aren't for the purpose of destroying context. Usually experiments are done so as to eliminate context . . . Now, if you eliminate context you're then into what I call *mechy max* systems. Mechy max systems are mechanical maximizing systems which operate by Newtonian physics, which operate like a clock with its clockworks. This is what Buckminster Fuller was talking about. There is for the clock a winder which is the energy source and there is the energy sync which is the fact that the hands of the clock go around; between the source and the sync are a number of levers of various sorts: wheels, ratchets, the great clumpers and the like, but *the output never effects the input;* there is always infinite source and infinite sync, infinite beginning and infinite end, and we find now that this is no longer a reasonable way to think. Now Bucky talks about spaceship earth and how man has to take it over, and I say bullshit, because man doesn't want to take anything over, because man is a part of the universe but he is not controller of the universe. Once you start to think that you must take it over it becomes like a Japanese garden. A Japanese garden is a garden that is arranged for man's purposes and basically has none of the mystery, none of the uncertainty . . . (literally I have talked with people from NASA, people who are high up in government who think of our taking over the whole earth, artificial climate, artificial creation of environments . . . of mechy max coming in, destroying the environment, and then recreating it . . .

The thing that you learn when you start to play the game of building biological systems (what I call *biological optimizing systems or bioptemes)* is that there is a context which man has nothing to do with and is not in any way in control of. There's no way to recreate biological systems, because in the recreation you do what you did with hybrid corn; you make a better corn except that all the corn is exactly the same as the next; if any disease comes along it wipes out everything. There's no flexibility; *man-made ecology is of necessity a low variety system because it only contains that variety which man can conceive of. An ecological system is a high variety system* . . . We're making "toys" which help us to think about ecology. In these biological systems that we're trying to create, however, we don't have control of the total system—we don't have control of the tools that we've built. "They" have a life of their own which is insensitive to the life that forms around them; each one is different from the next and if some part doesn't work it doesn't stop operating.

However, in a mechy max system, which is a clockwork, if one wheel stops turning the whole thing, because it's like a simple chain, and there's a weakest link, stops. If you have a densely interconnected system within itself where all the parts are connected with all the other parts, then all these parts are less densely connected with that which is outside which is the context; no two systems, then, are alike, and if any part dies, which it will, inevitably (because in some ways you try to make them as improperly, as inaccurately, as sloppily as you're able) . . . if any part dies then the thing just has a different way of going about its behaviors—it may not have the same behaviors, it may not have the same purposes, it may not achieve the same purposes, it may have different purposes . . . but death has occured naturally and in one clump which leaves a hole, and that hole is taken up by the regeneration and evolution of other species which fill the hole.

In mechy max systems there are no holes because everything is as uniform as possible.

I started out as a physician and with mechy max biology, the biology of low information systems, the biology of vision: you see something, but you're not aware of the *effect* of your seeing; you smell something and you're not aware of the *effect* of your smelling; you hear something and you're not aware of the *effect* of your hearing—your hearing is not active (you're not aware of its activity though actually it is active), but with touch and the sensuous world you start to get into if you touch something, then you touch it, it touches you; you move it, it moves you; you change it, it changes you, and it's happening simultaneously. You are no longer in the world of weak interconnection—when you're into densely connected systems you're into everything that happens effecting everything else that happens; when you're talking about densely interconnected systems you're talking always about *effect*. . . . In eastern philosophy you talk about breathing out as well as breathing in; in western philosophy you talk about breathing in—everything is in; everything is need, everything is desire. And *effect*, breathing out and the sense of breathing, the whole sense of rhythming is something that eastern philosophy brings us close to. Western philosophy is the world of things . . .

In mechy max systems, low variety systems, you have as I said toys which operate like clockwork. There are carnivore mechy max's that eat people and eat animals—military machines of all sorts; and there are herbivore mechy max's—the tractors and the cranes and the giant earth movers which eat up all the greenery and spit out lines of sugar cane, of corn, fields of cultivated plants that are domesticated plants. You have a whole field of one kind like a whole group of people of one kind. The herbivores also stack up mud into houses and into new apartment buildings and they proliferate more mechy max within this: washing machines, heaters; the mechy max have gradually been taking over the people and we have what we call plastic people, mechy max people. Biological systems become like Newtonian machines. People become like Newtonian machines. Their logic is like that.

photo: J. Sibert

Now the way this happened mostly is by the omnivores: the omnivores eat the herbivores, eat the carnivores. The omnivores are mostly made out of paper, out of form: they are called Internal Revenue Service, Social Security, health insurance, health center, mental health center. They are places where people are conditioned to act in mechy max ways; they are places where plants are conditioned so they will all be exactly the same as each other. Simplification in the mechy max style occurs by reducing the information to as low a level as possible by reducing the consequences of the environment as much as possible. The clock is so set up that the metals all counterbalance each other so that the heat changes *will not effect* the movement of the wheels and is not context or environment sensitive in any respect, that is, to reduce context sensitive. Biological systems operate quite to the contrary. Whatever happens, they have within them the capacity to cope so the animal is not taught, or he is not genetically made up to deal with a particular streaming of water; he's brought up to cope in such a way as to loop again the behavior of that which is outside himself, and go back and reconsider what was outside himself *in terms* of his behavior, and *recycle* his own behavior through himself *altering* it in such a way so as to maintain survival, or to evolve survival so as to relate to the external world.

Biological systems are not all made the same. People may seem in many ways more like each other than they are like monkeys or rabbits, but every person has entirely different characteristics from the next, except that these differences coalesce or converge each in its own recipe to mate people who are somewhat similar. Inherently though there are enormous differences between people. Some of that difference is not obvious. Some of the flexibility in any natural system is not apparent because it's not being used. It's stored, like with wild wheat. Wild wheat looks like wheat but all the different kinds of wild wheat have a different genetic structure, more different than wheat that's been carefully selected like the wheat we see in mechy max books—*quality controlled*. Everyone knows exactly what kind of wheat they're going to get. In real wild systems there is enormous flexibility because many different kinds of components mix in such a way that the mixture is convergent towards a product or towards a creature which is sort of naturally similar—the manifest behavior and rhythms and identity is similar, but what makes it up is different. The wildness is not used and is non-apparent, but if something happens to the environment the wild potential still allows changes to occur because the flexibility is there available. A kind of wild system has a capacity for maintaining itself that a domesticated system does not.

In the mechy max system you try to maximize particular behavior, simplistic behavior so as to accomplish the one simple purpose which may be for instance to scrape up earth; scraping up earth in such a way so as to destroy all of the green things; all of the worms and ants; the earth boring mechy max truck or scraping thing doesn't pay any attention to what it picks up. It tries to plant but it always replants in such a way as to destroy the variety: a meadow is not like a grassy lawn. There were meadows, meadows had bushes, the bushes lived by trees, and all of these, each part, was related to all other parts, and if anything came along, a big wind came along, it might destroy some of the trees but the bushes and the small trees would grow up again and if some grass eating thing came along, well, there are other forms of grass, but now you build lawns.

One cannot talk about genetics, Gregory Bateson's point, in terms of classes of animals and creatures. You can't talk about the genetics of deer or the evolution of deer. You have to talk about the evolution or genetics of deer in *relation* to grass and the evolution of plants. You can't separate the evolution of one particular aspect of life from another because when you think biologically then the whole world becomes interconnected and everything effects everything else, and everything contains everything else, and even beyond the world if you want to be spiritual about it, so that all things are in contact with everything else.

We are trying to develop a language of becoming; not a language of explaining which is what science has done, but a language of describing becoming which is what ecology's about, and not even explaining becoming, since everyone has within them the sense of the whole world in all of its parts. Our intuitive sense of becoming can be very rich provided we give up the mythology of the mechy max.

We're developing systems now that operate by touch, so if you touch them you intervene in their loops. They are not paying attention to you. They're paying attention to that you've interfered with their usual mode of operation. To reestablish their mode of operations they have to behave in particular ways that allow them to continue to exist in their style which is very different from their sensing you. They don't sense you as you, as a plant doesn't sense a tree as a tree. It senses that it has more shade and it must grow in a different way to find its sun. The other plant, the tree, in a way presses upon it; it becomes environment to it just as we are environment to each other and for the first time we can now talk about humans as environments to the rest of the world, or humans as environments to animals—we don't think of ourselves as the center of the world anymore; we're just environment, and there are many environments.

Mechy max organizations are doomed at this point because they're not capable of managing the high information level that people want and need in order to survive. We have to accept that we are continuous with biological systems and have never been otherwise. In biological systems control is explicit. The mechy max myth is government control of the people and the government is a set of forms (I'm not talking about human people—they lost control of the government); the government is a mechy max system like a great earth moving device that now moves people about like a big clock that has all sorts of ratchets and all the people have to fit into ratchet position; literally in government the positions you have are not related to the people—they're related to the positions in the forms and forms do not have power. People have power, so power to the people is a joke because the people already have the power, but they haven't exercised it . . .

Fuller is trying to reprogram the mechy max system to make it work better and my statement goes this way—the system is self-destructing now and the myth that the mechy max have power must now be destructed rather quickly among people. It's this attitude, that the mechy max have ultimate power, that the big machines have ultimate power, that has put us where we have been eating up all sorts of garbage, the machines put out in order to keep the system going . . . so we eat chicklets . . .

I went through the stores and through the city recently (I've been living and working in the country lately and getting along on very little money) and looked at the whole city in terms of the destruct that's going on because all the products that are made are really just a bi-product of tally—the mechy max omnivores is a paper system and its single purpose is tally; tally is money; money is just keeping tally; mechy max operates by keeping tally; the game has been how you maintain the tally as gross national product for example, population rate for example, interest rates for example—these are all tally forms, banking, insurance . . . all parasitic operations are tally systems of the mechy max—the money system. This is not wealth. Wealth is the capacity of any organism to obtain that which is necessary for its own survival, and more than that to obtain that which is necessary to optimize its evolution and to maintain a kind of evolutionary stability that allows everything the whole world over to continue to prosper in a way that's healthy . . .

I'm not talking about getting rid of all mechy max, however; (man's controlling nature was perfectly fine as long as he didn't have too much influence; it is just that the proliferation of the mechy max has become so enormous that the destruct not only of the mechy max but of the total earth is now possible); we are talking about biological optimizing systems. A maximum is where you try and get more and more and more; it grows and grows and grows; the bigger it is the better it is. If you don't think of optimal size, schooling is to pour more and more into your head and you no longer think of optimal pouring into your head in relationship to experience. There *are* optimal positions where you would have some mechy max but they wouldn't have grown like a cancer. Cancers kill their host and after a while the cancer dies because the person who has the cancer dies. Well the mechy max at this point, the industrial system, the tally system, is like cancer. It is now proceeding to kill its host which is the earth . . .

Up until now we haven't had anything to take the place of the mechy max mythology. We haven't had a sense of living systems, biological systems, being a totality; that the earth is a biological system; that the rocks are biological systems; that they're alive; that everything is alive but there are some things that seem much less alive: those are the rocks, the air. We must talk about these as special cases of living things which man basically has very little connection with because they're so different from man and he hardly comprehends their aliveness just as we don't comprehend really the aliveness of crickets. We comprehend better the aliveness of mice because mice are more like us—they're mammals; we don't comprehend reptiles; we don't comprehend birds as well as we do monkeys, because the metaphor of any biological system is itself, because it is *self-referent* and *self-organizing* . . . We were talking about the klein form; about effects at a distance returning to be infolded. That is, any biological system makes noise—it does things which are sort of trial and error and which don't get anywhere; that are fairly random. Those things which are random by definition don't persist; those things which converge into a behavior help to maintain the particular "thing" that has been going through trial and error behavior. If these converge, then the resultant behavior persists and we don't call it random anymore. Randomness or noise is the trial and error of biological systems.

Mechy max people proceed by considering things in a modular form—houses are ticky tack all like each other—or in uniform form. That is, all the ocean is like all the rest of the ocean. It's possible to dump atomic waste into the ocean because you know it will be diluted by the total ocean—but this does not occur. Atomic waste that's been dumped moves around in *clumps* in the ocean. It maintains its integrity; it stays together. The fish are alive. They concentrate the mercury and the mercury goes up the food chain and gets concentrated. Atomic waste gets concentrated. The world is of clumps and all the clumps are different—clumps of people are just different kinds of people.

The idea of clumps is very important because part of the mechy max mythology is that things start off as uniform and then develop into highly differentiated sets. This is not so. Everything starts out as highly differentiated from the outset though there are holes, discontinuities, which may be invaded by one set or another. Life processes operate against things becoming uniform and operate towards things becoming more highly differentiated.

One of the most fascinating problems is what happens when there is no leadership. In our cells there is no leader, but mechy max thinks of genetics as a great leadership system (as if genetics operates separately from what happens in the womb—what the mother ate, what kind of life she was leading).

You must start out with the fact that there are clumps. (Only God could organize from zero with everything uniform—that was in the mind of the religious people who organized from zero . . . it's interesting he organized in seven days, in rhythms.). . .

Let's say you have a group of people together who are not together because there is a leader, but *are* a leaderless group. After a while they'll organize so that they get jobs done and sometimes they'll organize without a leader; sometimes they'll have a leader for a particular function—sometimes for a day or a month; all of this is different depending on the different kinds of people who happen to be in that group, so there's a natural type of organization that happens among a group of people, but it's not uniform. The rules are not the same across many cultures. Each culture has its own style. You don't start with randomness. Randomness and infinity are mechy max terms. Randomness as a continuous state can only be created with great difficulty; it's a mathematical state which doesn't occur in nature at all. What happens in nature is you get things grouping together in clumps which behave over time in such a way as they may continue to exist as a group . . .

. . . and these clumps can only come in contact with those things which are physically adjacent or that are informationally adjacent or rhythmically adjacent. If you have two systems which have similar rhythms and if the rhythms are slighty different they'll start to rhythm together . . . to form simpler rhythms. There may be many different kinds of instruments but the rhythms tend to group in clumps. If you think of our communication process then those things which have similar rhythms are able to speak to each other; those which are very different rhythms are not able to speak to each other. So there are different communications that occur between elements of a system which are of different rhythms . . . There's a certain kind of self-organization that occurs with a rock group making music together, or with two people making love. You may start when you're making love a new rhythm, but whether it'll catch on depends on where your partner's at and whether it's a random rhythm that has meaning and catches other random rhythms. What may start out as noise—that which does not have meaning, that which is not information, that which does not produce change—because at that point you're in transition, may be a rhythm your partner picks up on and plays back, and plays back again until a new rhythm is organized. You've gone through the transition into a new rhythm. What was noise becomes information, because it *did* have effect, it was that change which produced an effect. Rhythms tend to

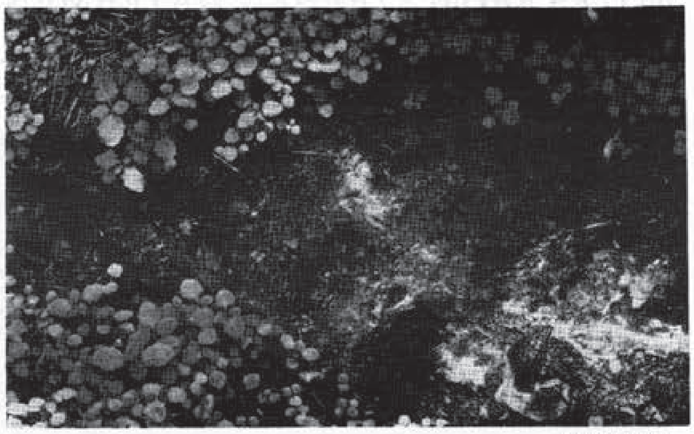


Photo: J. Sibert

organize so that that which is relatively random and meaningless drops out, and that which was meaningless may be the very thing that sets off the next transition.

I have moved finally into the space which I call *eco-space*. Eco-space is self-referencing such that the existence of time and space and size and materials and energy are all in constant rhythmic motion so there is no way to repeat behavior. Eco-space is triadic. Eco-space is recursive. It is not a place of beginnings and endings, of inputs and outputs discreet from each other. Eco-space is auto-correlating . . . self-organizing . . . I have moved into rhythms, ecological rhythms. *The thing that's most constant when you're talking about nature and biology is rhythms and time things;* that's where the most important information lies, information being denied by in large by science. In our kleinform sponge there can be many currents and rhythms looping themselves and each other, spreading and flowing like a meadow or forest or like the living sponge in the sea, or the sea as a sponge: a current of water moves swiftly between two coral heads; it hits a back flow and is turned back, like the stocking looping outside then across through the flow jetting intra-contained through its own streaming. It intervenes in its own becoming. Dive into the water and surface through the bubbles you made and dive again. Wind back through yourself a tape of yourself talking and behaving so that you can relate to yourself as you will be when you watch the tape, then infold again.

A topology that uses rhythms intermingling and flowing around and through each other would let us build walls secondarily, rather than as categorical dividers. TV networks do not have walls . . . Swim in its currents, feel them, where the activity of the space changes abruptly, sediment—slower changing stuff—is laid down. The slow rhythm—a "now" memory, infolds and gives context to faster events which in turn give the slow rhythm meaning.

Scuba swimming deep in the ocean one can feel the eddys and rhythms of fluid filling the holes which one would have called cells. Coral reefs grow in slow time—slow rhythms wearing volcanic rivulets into bridges of sponge, volcanic bubbles and the sea twisting and turning *rhythms* the sand into ripples—and these ripples and sand spits *rhythm* the sea and the growing of coral and the wearing of rock—and all these are rhythms. Swimming below one knows one's own rhythms and the rhythms of breathing and blood and that nothing is still. Putting one's face mask close to the ripples of sand one can watch the grains flowing. But to sense that flow of slow things like sand, or equipment or hard wired programming—the flow of these walls, we must change our rhythm and swim in their time and size grain. Ten year interval time; equipment distribution size.

Time lapse in 10 year intervals. Focus for large size objects. "Now" is a 10 year duration.

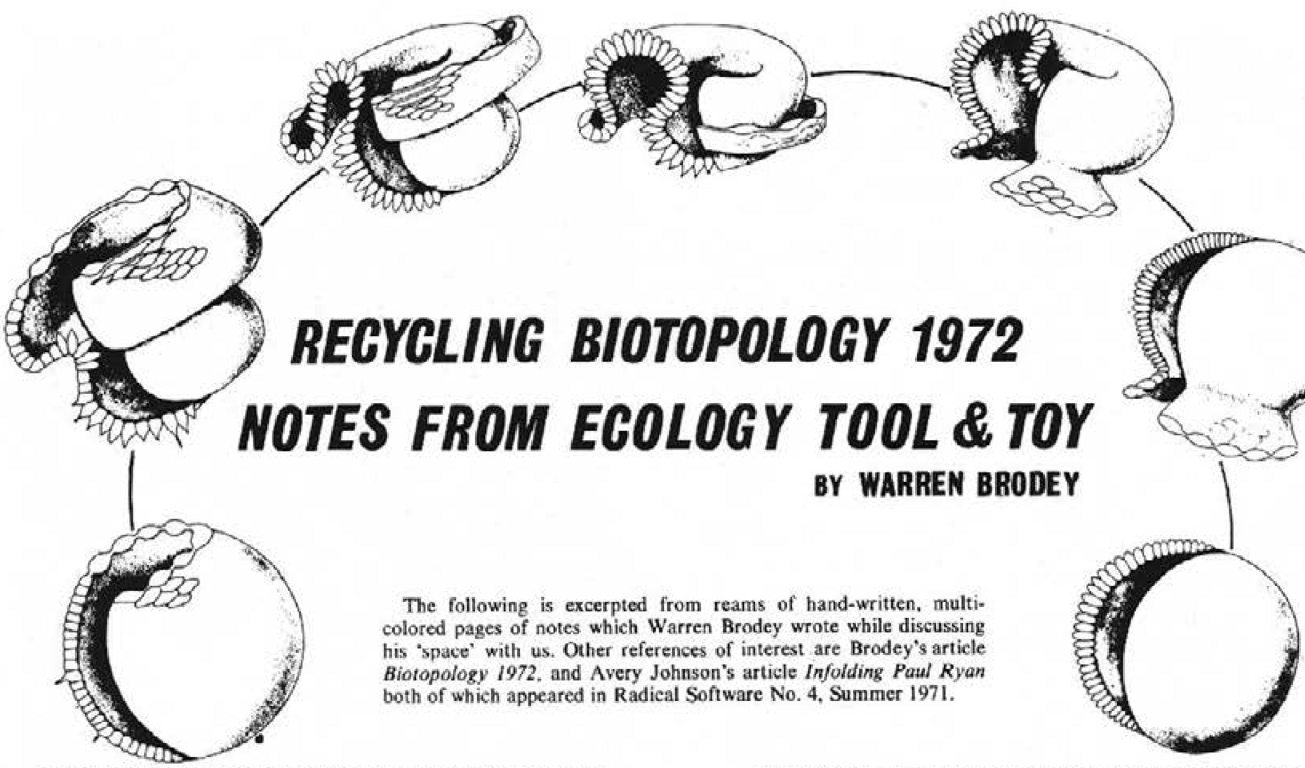
Infolded time lapse taping will show the rapid change of events ordinarily called unchangeable. Time taping can be tailored to find patterns. When I was with Bateson in Hawaii we both longed for a series of time lapse shots of Honolulu showing the cancerously money producing developments destroying the cities' survival environment. Month by month one can see the cancer growing. Day by day it is hidden. By changing time grain of the taping appropriately, complex rhythms are simplified. Then one can feel the repititiousness and code the kind of information/materials/energy flow that follows one to glue into our new biotopology conceptions.

But here I must leave off. If you have followed me into this space you may lead me through the enormous holes I see all around me filling them with energy/information/materials/time which as it resonates, converges or dies, or provides the surprises which may evolve the means of survival.

We must leave the old space. There is no life there.

A 1 hour tape from which the above transciption was made is available. See inside back cover for tape offering.
Special credit and thanks from Warren to Paul, Gregory Bateson, Avery Johnson, Lita Osmundsen, Judy *Johnson,* Frank Gillette, Beryl *and many others. . . .*

See article by Avery Johnson entitled *Infolding Paul Ryan*.



RECYCLING BIOTOPOLOGY 1972
NOTES FROM ECOLOGY TOOL & TOY

BY WARREN BRODEY

The following is excerpted from reams of hand-written, multi-colored pages of notes which Warren Brodey wrote while discussing his 'space' with us. Other references of interest are Brodey's article *Biotopology 1972*, and Avery Johnson's article *Infolding Paul Ryan* both of which appeared in Radical Software No. 4, Summer 1971.

I am working on building biopteme s to play with, to learn consequences.

If I am lying down on a floor area which is an air structure made of interwoven kleinforms that can expand or contract depending in part on their neighbors' behavior, the heat and light in the room, and on how I interface with its efforts to reduce its information to a manageable level, and the space itself is like being under the soft umbrella of an oak tree waving lively in the wind, or being inside a bubble of scum lively with creatures . . . what would it be like? Would we use verbal language as we know it, at all?

This is a different space. It is not a return to the nature of our ancestors . . . Or is it?

As Avery Johnson puts it, "The meaning to an organism of an object or an event is to be found in the response of the organism to it."

This different kind of space that I work in and play in and dig in even when I'm going nothing by mechimax values I call biopteme technology; the technology of biological optimizing systems. If you live in that space or want to, let us know . . .

In this new space we go beyond being passive and we don't try to build dams and causeways to stop the waves as our way of being active . . . We build active surfboards that play with us and the waves.

If you read Norbert Weiner's book *God and Golem Inc.*, or McCulloch's book *Embodiments of Mind*, you will be closer to knowing that embodiments of biological-like behaviour make useful toys with which to engage in more dense communication with other surrounds and creatures. But both McCulloch and Weiner lived in the tradition of Science.

We know we must leave the old Space, Science, Technocracy, the world of Universals and Universe Cities . . .

As we find intermediate tools and toys that enable us to play with natural phenomonen, the level of gentleness and courtesy we experience is environment to other human and more varied species.

Courteous technology is not technocracy/bureauocracy.

A toy is not painful and you can learn without words. Animating a drawing is not like building a toy of material, energy, information that pays attention to trying to maintain its own kind of behavior—and is able to die. Soft systems are toys that have the richness of information texture that you see in a TV picture of a kitten but not in the printout of its parametric fragmented technocratic description.

You will understand better when you provide a TV camera, as Joe Seale has been doing it, with the capacity to look for density of information. Avery Johnson had an ordinary movie camera actively looked for edges following them. Imagine the TV camera is like a creature, the creature of the feedback patterns and you and this creature work together to find patterns that you might not have seen by yourself. Imagine walking among trees you have been dancing with, rythmically making visual patterns with. How differently they will feel. My experience is that you begin to notice slow rythms that become an envelope of complex rythms, gentle yet urgent that bring you to a longer now, a sense of non-frenetic time within which one's—my life energy is augmented, and life itself is enhanced.

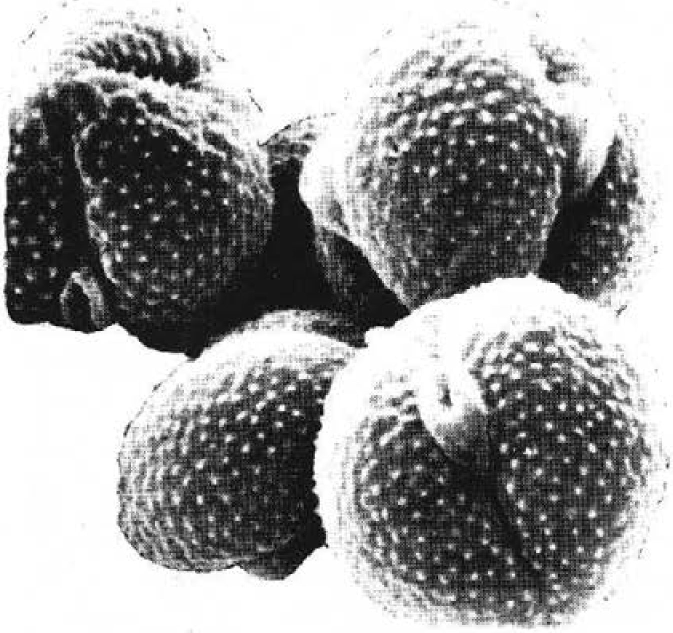
We are playing with ways of changing VTR systems so they allow the user to play time games, to use the VTR as a tool for studying ecology.

Build a TV set that is like your eye . . . it looks for what it wants to see.

continued

The new soft technology, soft control, soft systems are embarrassing to those who live in the print world . . . soft architecture is revealed by the plant as lecturer in experiencing biostructure . . . the plants way of coping by materially, informationally, energetically behaving in time.

Soft structures are like sponges with kleinform cells, that impinge on each other by pressing, exchanging heat chemicals, each cell is a space not a boundary. We are cells in the macro beast we call the System, we crowd, we exchange heat chemicals with our surround which loops these and many others back through our System to become a part of the uncontained portion again and this vitality is a fine structured flow of consequences intwined.



I found a new way to think of kleinforms. Remember I said there was a world of spherical cells. This is what you see when you cross section dead biological material and deny its liveliness as expressed in energetic and information flow that does not stay inside the snapshot boundary. Behaviours loop around the cell walls permeating the spaces that coalesce more densely . . . but do I mean information spaces, energy spaces, timely rythmic similarly spaces. No! Put these all into one unfragmented living way, there are no words; build it. But loops over time spiral and we're still talking linear holes and spaces are not spirals; the loop crawls out of itself extending beyond its boundary bit by bit. Oh, this sounds like nonsense. As Joe Seale put it, imagine your hand on your hip and thus forming a loop of energy, information, material and then your elbow sprouts a purple flower that grows breathing its way into the center of the loop, joining its walls to the donut (what a terrible word . . . for something so beautiful as a flower growing out of your elbow and breathing in the space your arm encloses.) A kleinform is not a cross section of a stopped click snapshot.

It flows back through itself, defining itself as it flows. A relation with Joe cannot be a snap shot. He has no energy for unshared space with unshared resources.

Each person is a clump of ecological meaning that can be known best in his way of giving meaning to what we experience as sharing.

Do Soft Structues have any value as meta tools? Yep, gets you unprogrammed, teaches you about ecology. Courteous systems cannot be mechanical, timeless, objects.

If the material is hard with hinges and joints, there can never be enough variability freedom to engage in nonlinear multiplicative activities.

Can you build a structure that in the simplest way behaves like the plant you are watching. If you try you will ask yourself questions that no descriptive biologist ever thought to ask, in your new problem. you are asking synthesizing questions not analytically fragmenting.

Consider . . .

A chair-like structure, that if you move so it rocks forward inflates a pad under the small of your back so that it is well supported, or oscillates several rythmically swelling air bags so they relax your back.

Or try telegrasp . . .

a system made of plastic foam, air which can expand/contract locally which tries to keep its movement organized in a manner relative to what's happening in its environment. Its movement may be mediated by telephone so its head is in Chicago, its tail in New York. If you massage its head, its head and tail will both react so as to try and maintain their connected organization in spite of your interference. The behavior in Chicago relates to which way you touch the lively system in New York and so the person grasping the head in N.Y. will receive information as to the style with which the tail was grasped in Chicago. Thus begins the technology of biological-like soft systems as a tool as well as a toy.

I speak of assembling a critical mass of toys made by people who are using them as a language to imitate and evolve their way of connecting softly with wind and shrubs and paramecium.

You won't understand as easily until you watch a time lapse image of a paramecium (a single celled critter) and try to build a much larger swimming thing that moves like a paramecium, whose image you can overlay on the image of the critter, now slowed or speeded as well as changed in size so you can imitate it even by overlaying an image of your own body as you try physically to dance in rythm with its dance.

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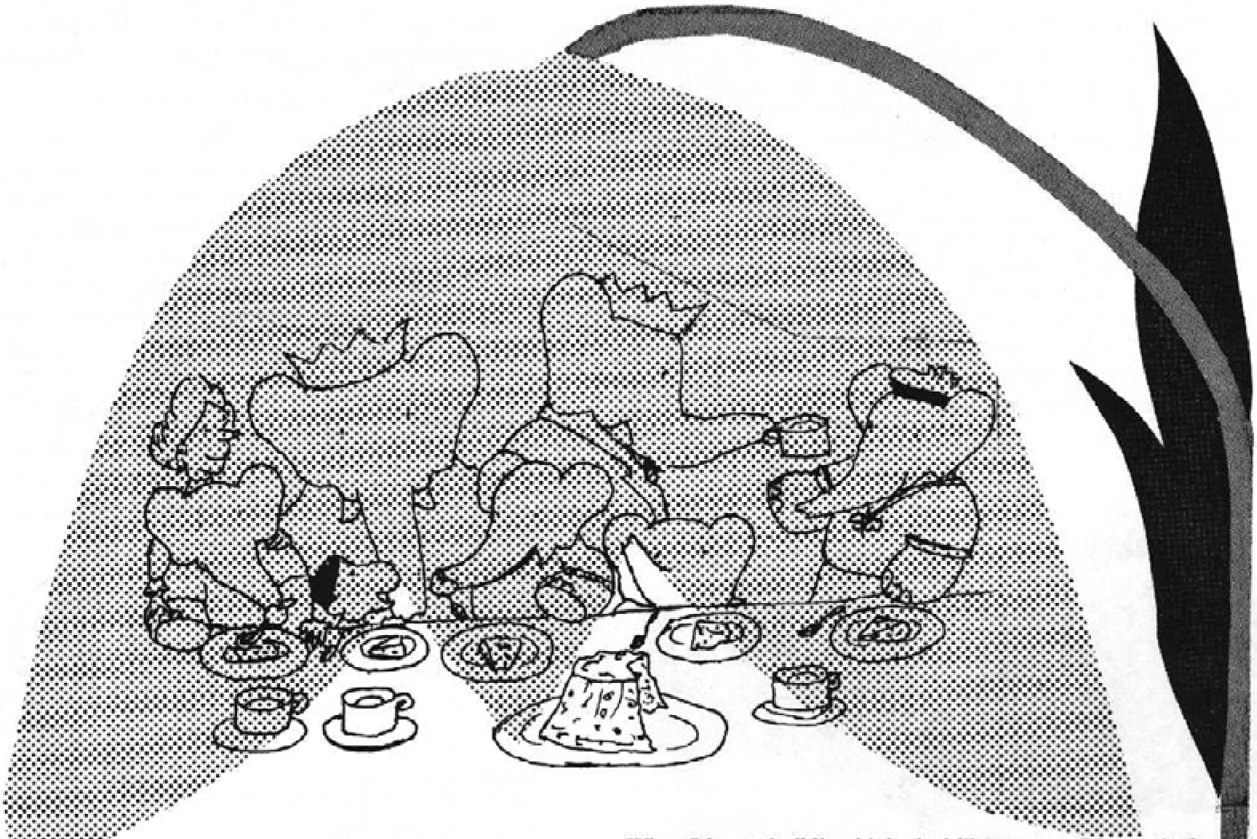

My Worm:

I built a worm-like lively thing one day two years ago. I made it about a foot long and about 3" in diameter out of polyurethane. I had valves, actually fluidic-flip-flops on-off valves, and I attached them so each of the 5 segments swelled then contracted one after the other. I watched caterpellars and worms, and snakes to try to figure out how to do it. They were teaching me, and the more I tried to get my worm to put its stiff velvet pile feet down and push on the cloth so it would move, the more carefully I watched how creatures do it cause I had a problem—A way to figure out an alternative to wheels. Anyway I did get the peristalsic wormy motion and I did get it to move along. Then I figured a better way for my purposes, I would like someone else to build one—sometimes I imagine a lot of people getting into it.

Over that place you eat build a dome of velvet, get a beach umbrella . . . gently let it change the way it drapes with the frequency pattern or loudness of your voice; or build the chair that pays attention to your shifting about—a simple electric wiggle meter, a pressure switch, each time you wiggle you compute structurally like leaves reaching for sun, that can create more optimal forms of energy out of diffuse, less structured forms.

Build it to touch. The house you live in programs you . . . it is a command language . . . you are forced to make body decisions that do not optimize your energy . . . you are faced by soul murder where concrete and steel deny your body access to the energy flow of other plant and animal and living spaces.

When I began building biological like systems I learned of my need for the new space. But I like building a nest and toys so I thought it best to use my building and making and thinking and playing to learn again from other creatures.

Well, this is a taste of the space which has been our alternative to doing nothing while we climb out of the mechimax death trap.

Ecology Tool and Toy Network will happen if people can make a meadow of high variety participation, a forest of protective umbrellas under which seedlings can grow to know their effect.

I will enjoy communication by tape or any other exchange. But here I must leave off. If you have followed me into this space you may lead me through the enormous holes I see all around me filling them with energy/information—materials —time which as it resonates, converges, or dies, or provides the surprises which may evolve the means of survival.

We must leave the old space. There is no life there.

We are in very different territory.

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