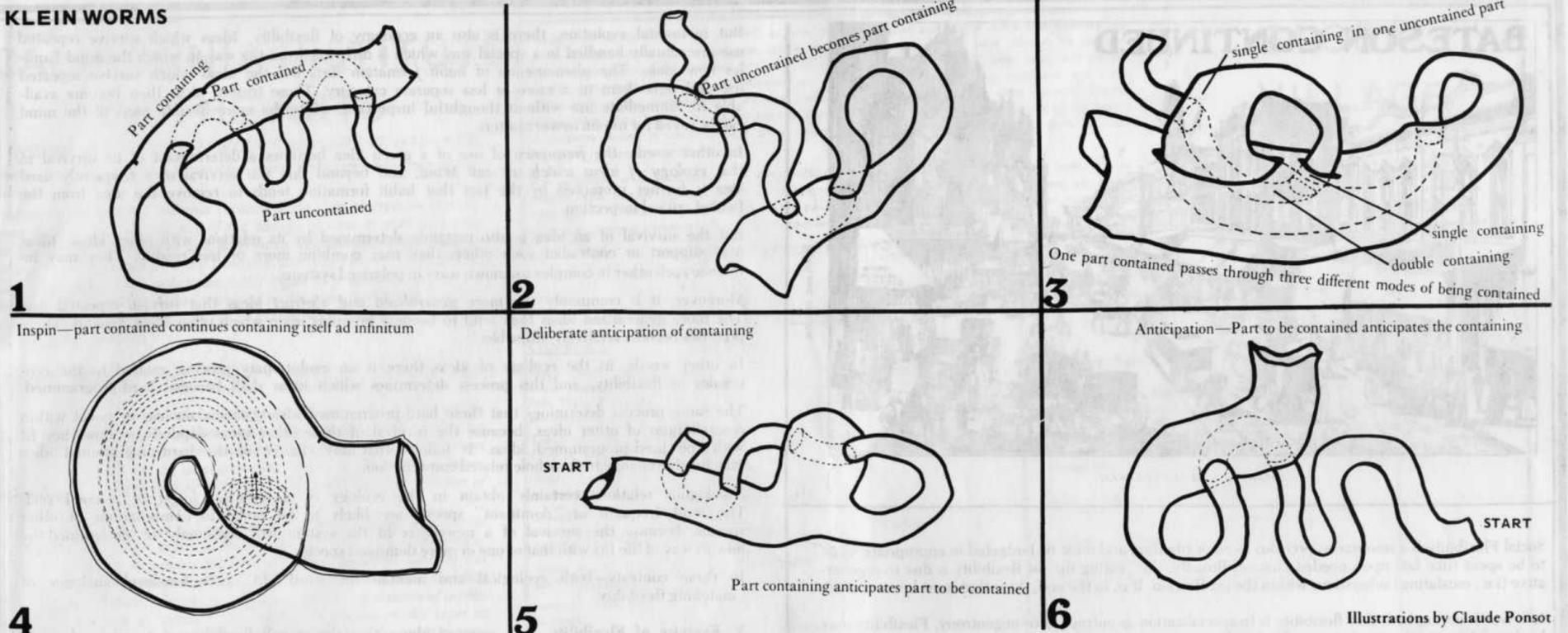


KLEIN WORMS



There are three specific areas where I think this topological calculus of intention can be of use: acid metaprogramming, a grammar of video infolding and perceptual sharing, and in soft control structures using plastic membranes.

Relative to acid metaprogramming I am not recommending LSD-25 to anyone nor am I endorsing Leary's approach. I am simply looking at some of the work that John Lily has done and suggesting this calculus might be useful in that context. Both in *Programming and Metaprogramming in the Human Biocomputer* and in *Mind of the Dolphin* Lily uses the notion of interlock to describe communication between people and between species. In *Programming and MetaProgramming* he describes a personal experience with acid that in some way undercuts the metaphor of interlock, and to me suggests that the Klein worms might be a better way to describe the process he calls "interlock." Here is Lily's description of that experience he titles "the key is no key."

Mathematical transformations were next tried in the approach to the locked rooms. The concept of the key fitting into the lock and the necessity of finding the key were abandoned and the rooms were approached as "topological puzzles." In the multidimensional cognitive and visual space the rooms were now manipulated without the necessity of the key in the lock. Using the transitional concept that the lock is a hole in the door through which one can exert an effort for a topological transformation, one could turn the room into another topological form other than a closed box. The room in effect was turned inside out through the hole, through the lock leaving the contents outside and the room now a collapsed balloon placed farther from the self metaprogrammer. Room after room was thus defined as turned inside out with the contents spewed forth for use by the self-metaprogrammer. Once this control "key" worked, it continued automatically to its own limits.

With this sort of an "intellectual crutch" as it were, entire new areas of basic beliefs were entered upon. Most of the rooms which before had appeared as strong rooms with big powerful walls, doors, and locks now ended up as empty balloons. The greatly defended contents of the rooms in many cases turned out to be rela-

tively trivial programs and episodes from childhood which had been over-generalized and over-valued by this particular human computer. The devaluation of the general purpose properties of the human biocomputer was one such room. In childhood the many episodes which led to the self-programmer not remaining general purpose but becoming more and more limited and "specialized" were entered upon. Several levels of the supra-self-metaprograms laid down in childhood were opened up.

The mathematical operation which took place in the computer was the movement of energies and masses of data from the supra-self-metaprogram down to the self metaprogrammatic level and below. At the same time there was the knowledge that programmatic materials had been moved from the "supra-self position" to the "under self-control position" at the programmatic level. These operations were all filed in meta-program storage under the title "the key is no key."

*Programming and MetaProgramming,
Lily, pp. 42-43*

Relative to video infolding it is near impossible to describe in words even using Klein worm graphs what I'm talking about. The following will mean little to anyone except those who have had some experience of taping with themselves at different levels.

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.

At one level that of reality that is left off the tape is the part uncontained
Raw tape replayed is part contained in the head
If it is somebody else's tape you are watching you can to an extent share in this live perceptual system via the tape he took.
To watch another's edited tape is to share in the way he thinks about the relation between his various perceptions in a real time mode. This enters the realm of his intention.
If you are editing some of your tape along with tape somebody else shot and he is doing the same thing using some of your tape then it is possible to see how one's perceptions relate to another's intentions and vice versa.

Relative to sharing perceptual systems it is somewhat easier to talk about since there are parallels with photography and film.

The most explicit experience of this mode of perceptual sharing came in the early days of Raundance when Frank Gillette, Ira Schneider, Michael Shamberg and myself "shot" twelve rolls of tape on earth day. Both in replay that evening (we laughed our heads off digging each others tape while the old perceptual imperialist, Walter Cronkite explained Earth Day for us) and in the edits that followed each of us got a good idea of how each saw and thought about the events vis-a-vis the others.

Relative to soft control systems using plastic membranes I am thinking mostly of the soft cybernetic work being done by Warren Brody, Avery Johnson and Bill Carrigan. The sense of the sacred and the transcendental that surrounds some of the inflatable subculture is to me a kind of pseudomythology. Consciousness might be better invested in designing self-referencing structures where awareness is imminent in the structure and its relation to the users; not by being invested in a religious way to a "special" structure that does not relate intelligently to the users.

A Klein Worm couch is a suggestion of a possible way of moving in that direction. It could be built of strong polyurethane, filled with air, perhaps by a constant flow from a pump. People might interrelate kinetically through the changes in the air pressure. Design of the actual couch could be arrived at experimentally by combinations and transformations of the structures described above.

Illustrations by Claude Ponsot

RESTRUCTURING THE ECOLOGY of A GREAT CITY
 by Gregory Bateson



Originally prepared for a symposium of city planning, Oct. 26-31, 1970, sponsored by the Wenner-Gren Foundation for Anthropological Research.

This position paper consists of the following parts: 1. A rather lengthy gathering of generalities about biological systems; and 2. An attempt to apply these generalities to practical problems. Since I know little about Manhattan, I have chosen two books by authors who are involved in problems of city life and planning and have applied the touchstone of theory to these books.

First, it will be convenient to have not an ultimate goal but some sort of abstract idea of what we might mean by ecological health. Such a general notion will both guide the collection of data and guide the evaluation of observed trends.

I suggest then that a healthy ecology of human civilization would be somewhat as follows:

A single system of *environment combined with high human civilization* in which the flexibility of the civilization shall match that of the environment to create an ongoing complex system, open-ended for slow change of even basic (hard-programmed) characteristics.

We now proceed to consider some of the terms in this definition of systemic health and to relate them to conditions in the existing world.

I. A High Civilization. It appears that the man-environment system has certainly been progressively unstable since the introduction of metals, the wheel, and script. The deforestation of Europe and the man-made deserts of the Middle East and North Africa are evidence for this statement.

Civilizations have risen and fallen. A new technology for the exploitation of nature or a new technique for the exploitation of other men permits the rise of a civilization. But each civilization, as it reaches the limits of what can be exploited in that particular way, must eventually fall. The new invention gives elbow room or flexibility, but the using up of that flexibility is death. (I owe this insight to Mr. Philip Wylie.)

Either man is too clever, in which case we are doomed, or he was not clever enough to limit his greed to courses which would not destroy the on-going total system. I prefer the second hypothesis.

* Notes on the Syntheses of Form by Christopher Alexander, Harvard University Press, 1964; and *The Uses of Disorder: Personality and City Life* by Richard Sennet, Knopf, 1970.

It becomes then necessary to work towards a definition of "high."

A. It would not be wise (even if possible) to return to the innocence of the Australian aborigines, the Eskimo and the Bushmen. Such a return would involve loss of the wisdom which prompted the return and would only start the whole process over.

B. A "high" civilization should therefore be presumed to have, on the technological side, whatever gadgets are necessary to promote, maintain (and even increase) wisdom of this general sort. This may well include computers and complex communication devices.

C. A "high" civilization shall contain whatever is necessary (in educational and religious institutions) to maintain the necessary wisdom in the human population and to give physical, aesthetic and creative satisfaction to people. There shall be a matching between the flexibility of people and that of the civilization. There shall be diversity in the civilization, not only to accommodate the genetic and experiential diversity of persons, but also to provide the flexibility and "pre-adaptation" necessary for change (e.g., the heterozygosity of wild species.)

D. A "high" civilization shall be strictly limited in its transactions with environment. It shall consume unreplaceable natural resources *only* as a means to facilitate necessary change (as a chrysalis in metamorphosis must live on its fat). For the rest, the metabolism of the civilization must depend upon the energy income which Spaceship Earth derives from the sun. In this connection, great technical advance is necessary. With present technology, it is probable that the world could only maintain a small fraction of its present human population, using as energy sources only photosynthesis, wind, tide, and water power.

II. Flexibility. To achieve, in a few generations, anything like the healthy system dreamed of above or even to get out of the grooves of fatal destiny in which our civilization is now caught, very great flexibility will be needed. It is right, therefore, to examine this concept with some care. Indeed, this is a crucial concept. We should evaluate in our survey, not so much the values and trends of relevant variables, as the relation between these trends and ecological flexibility.

Following Ross Ashby, I assume that any biological system (e.g., the ecological environment, the human civilization and the system which is to be the combination of these two) is describable in terms of inter-linked variables such that for any given variable there is an upper and a lower threshold of tolerance beyond which discomfort, pathology and ultimately death must occur. Within these limits, the variable can move (and is moved) in order to achieve *adaptation*. When, under stress, a variable must take a value close to its upper or lower limit of tolerance, we shall say, borrowing a phrase from the youth culture, that the system is "uptight" in respect to this variable, or lacks "flexibility" in this respect.

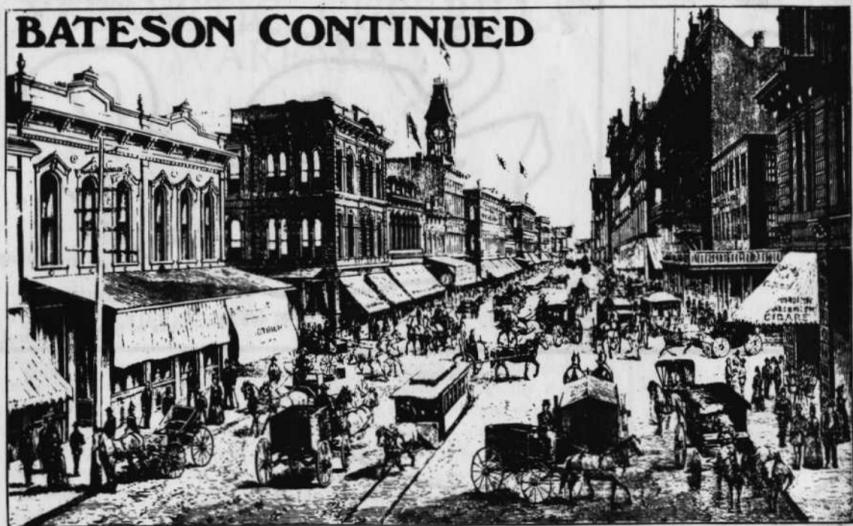
But, because the variables are interlinked, to be uptight in respect to one variable commonly means that other variables cannot be changed without pushing the uptight variable. The loss of flexibility thus spreads through the system. In extreme cases, the system will only accept those changes which change the tolerance limits for the uptight variable. For example, an over-populated society looks for those changes (increased food, new roads, more houses, etc.) which will make the pathological and pathogenic conditions of over-population more comfortable. But these *ad hoc* changes are precisely those which in longer time can lead to more fundamental ecological pathology. (For a discussion of the *ad hoc* problem, see attached "Statement on Problems Which Will Confront the Proposed Office of Environmental Quality Control.")

The pathologies of our time may broadly be said to be the accumulated results of this process—the eating up of flexibility in response to stresses of one sort or another (especially the stress of population pressure) and the refusal to bear with those by-products of stress (e.g., epidemics and famine) which are the age-old correctives for population stress.

The ecological analyst faces a dilemma: on the one hand, if any of his recommendations is to be followed, he must first recommend whatever will give the system a positive *budget of flexibility*; and on the other hand, the people and institutions with which he must deal have a natural propensity to eat up all available flexibility. He must create flexibility and prevent the civilization from immediately expanding into it.

It follows that while the ecologist's goal is to increase flexibility, and to this extent he is less tyrannical than most welfare planners (who tend to increase legislative control), he must also exert authority to preserve such flexibility as exists or can be created. At this point (as in the matter of unreplaceable natural resources), his recommendations must be tyrannical.

BATESON CONTINUED



MIRVETS OF ENTERPRISE.

Social Flexibility is a resource as precious as oil or titanium and must be budgeted in appropriate ways, to be spent (like fat) upon needed change. Broadly, the "eating up" of flexibility is due to regenerative (i.e., escalating) subsystems within the civilization. It is, in the end, these that must be controlled.

It is worth noting here that flexibility is to specialization as entropy is to negentropy. Flexibility may be defined as *uncommitted potentiality for change*.

A telephone exchange exhibits maximum negentropy, maximum specialization, maximum information load, and maximum rigidity when all its circuits are in use and one more call would jam the system. It exhibits maximum entropy and maximum flexibility when none of its pathways are committed. (In this particular example, the state of non-use is not a committed state.)

It will be noted that the budget of flexibility is multiplicative or fractionating (not subtractive, as is a budget of money or energy).

III. **Distribution of Flexibility.** Again following Ashby, the *distribution* of flexibility among the many variables of a system is a matter of very great importance.

The healthy system, dreamed of above, may be compared to an acrobat on a high-wire. To maintain the ongoing truth of his basic premise ("I am on the wire"), he must be free to move from one position of instability to another, i.e., certain variables such as the position of his arms and the rate of movement of his arms must have great flexibility, which he uses to maintain the stability of other more fundamental and general characteristics. If his arms are fixed or paralyzed (isolated from communication), he must fall.

In this connection, it is interesting to consider the ecology of our legal system. For obvious reasons, it is difficult to control by law those basic principles upon which the social system depends. Indeed, historically, the United States was founded upon the premise of freedom of religion and freedom of thought—the separation of Church and State being the classic example.

On the other hand, it is rather easy to write laws which shall fix the more episodic and superficial details of human behavior. In other words, as laws proliferate, our acrobat is progressively limited in his arm movement but is given free permission to fall off the wire.

Note, in passing, that the analogy of the acrobat can be applied at a higher level. During the period when the acrobat is *learning* to move his arms in an appropriate way, it is necessary to have a safety net under him, i.e., precisely to give him the freedom to fall off the wire. Freedom and flexibility in regard to the most basic variables may be necessary during the process of learning and creating the new system.

These are the paradoxes of order and disorder, which the ecological analyst and planner must weigh.

Be all that as it may, it is at least arguable that the trend of social change in the last 100 years, especially in the USA, has been towards an inappropriate distribution of flexibility among the variables of our civilization. Those variables which should be flexible have been pegged, while those which should be comparatively steady, changing only slowly, have been cast loose.

But still and all, the law is surely not the appropriate method of stabilizing the fundamental variables. This must be done by the processes of education and character formation—those parts of our social system which are currently *and expectably* undergoing maximum perturbation.

IV. **Flexibility of Ideas.** A civilization runs on ideas of all degrees of generality. These ideas are present (some explicit, some implicit) in the actions and interactions of persons—some conscious and clearly defined, others vague, and many unconscious. Some of these ideas are widely shared, others differentiated in various subsystems of the society.

If a budget of flexibility is to be a central component of our understanding of how the environment-civilization works and a category of pathology is related to unwise spending of this budget, then surely the flexibility of ideas will play an important role in our theory and practice.

But frequency of validation of an idea within a given segment of time is not the same as *proof* that the idea is either true or pragmatically useful over long time. We are discovering today that several of the premises which are deeply ingrained in our way of life are simple, untrue and become pathogenic when implemented with modern technology. (Several of these ecologically pathogenic ideas are marked with asterisks below.)

A few examples: "The Golden Rule," "an eye for an eye," and "Justice."

"The commonsense of scarcity economics" *versus* "the commonsense of affluence."

"The name of that thing is 'chair'" and many of the reifying premises of language.

"The survival of the fittest" *versus* "the survival of organism-plus-environment."

Premises of aesthetics, mass production, "challenge, pride," etc., etc.

The premises of transference, ideas about how character is determined, theories of education, of all biological fields.

Patterns of personal relatedness, dominance, love, etc.

The ideas in a civilization are (like all other variables) interlinked, partly by some sort of psychology and partly by perceptual consensus about the quasi-concrete effects of action.

It is characteristic of this complex network of determination of ideas (and actions) that particular links in the net are often weak but that any given idea or action is subject to multiple determination by many interwoven strands. We turn off the light when we go to bed, influenced partly by ideas of privacy, partly to reduce sensory input, etc.

The result of this multiple determinism has been called "over-determinism" and is characteristic of all biological fields—

Against this complex background it is not easy to construct a theory of flexibility of ideas and to conceive of a *budget* of flexibility.

There are, however, two clues to the major theoretical problem. Both of these are derived from the stochastic process of evolution or learning whereby such interlocked systems of ideas come into being. First we consider the "natural selection" which governs which ideas shall survive longest, and second we shall consider how this process sometimes works to create evolutionary *culs de sac*.

(More broadly, we regard the grooves of destiny into which our civilization has entered as a special case of evolutionary *cul de sac*. Courses which offered short-term advantages have been adopted, have become rigidly programmed, and have begun to prove disastrous over longer time. This is the paradigm for extinction by way of loss of flexibility.)

In a simple learning experiment (or any other experience), an organism, especially a human being, acquires a vast variety of information. He learns something about the smell of the lab; he learns something about the patterns of the experimenter's behavior; he learns something about his own capacity to learn and how it feels to be "right" or "wrong"; he learns that there is "right" and "wrong" in the world. And so on.

If he now is subjected to another learning experiment (or experience), he will acquire some new items of information; some of the items of the first experiment will be repeated or affirmed; some will be contradicted.

In a word, some of the ideas acquired in the first experience will *survive* the second experience, and natural selection will tautologically insist that those ideas which survive will survive longer than those which do not survive.

But in mental evolution, there is also an economy of flexibility. Ideas which survive repeated use are actually handled in a special way which is different from the way in which the mind handles new ideas. The phenomenon of *habit formation* sorts out the ideas which survive repeated use and puts them in a more or less separate category. These trusted ideas then become available for immediate use without thoughtful inspection, while the more flexible parts of the mind can be saved for use on newer matters.

In other words, the *frequency* of use of a given idea becomes a determinant of its survival in that *ecology of ideas which we call Mind*; and beyond that the survival of a frequently used idea is further promoted by the fact that habit formation tends to remove the idea from the field of critical inspection.

But the survival of an idea is also certainly determined by its relations with other ideas. Ideas may support or contradict each other; they may combine more or less readily. They may influence each other in complex unknown ways in polarized systems.

Moreover, it is commonly the *more generalized and abstract* ideas that survive repeated use. The more generalized ideas thus tend to become *premises* upon which other ideas depend. These premises become relatively inflexible.

In other words, in the ecology of ideas there is an evolutionary process, related to the economics of flexibility, and this process determines which ideas shall become hard-programmed.

The same process determines that these hard-programmed ideas become nuclear or nodal within constellations of other ideas, because the survival of these other ideas depends on how they fit with the hard-programmed ideas. It follows that any change in the hard-programmed ideas may involve change in the whole related constellation.

(Analogous relations certainly obtain in the ecology of a redwood forest or a coral reef. The most frequent or "dominant" species are likely to be nodal to constellations of other species, because the survival of a newcomer to the system will commonly be determined by how its way of life fits with that of one or more dominant species.)

In these contexts—both ecological and mental—the word "fit" is a low-level analogue of "matching flexibility."

V. **Exercise of Flexibility.** It is asserted above that the overall flexibility of a system depends upon keeping many of its variables in the middle of their tolerable limits. But there is a partial converse of this generalization:

Owing to the fact that inevitably many of the subsystems of the society are regenerative, the system as a whole tends to "expand" into any area of unused freedom.

It used to be said that "Nature abhors a vacuum," and indeed something of the sort seems to be true of unused potentiality for change in any biological system.

In other words, if a given variable remains too long at some middle value, other variables will encroach upon its freedom, narrowing the tolerance limits until its freedom to move is zero, or, more precisely, until any future movement can only be achieved at the price of disturbing the encroaching variables.

In other words, the variable which does not change its value becomes *ipso facto* hard-programmed. And, indeed, this way of stating the genesis of hard-programmed variables is only another way of describing *habit formation*.

As a Japanese Zen master once told me, "To become accustomed to anything is a terrible thing."

From all of this it follows that to maintain the flexibility of a given variable, either that flexibility must be *exercised*, or the encroaching variables must be directly controlled.

We live in a civilization which seems to prefer prohibition to positive requirement, and therefore we try to legislate (e.g., with anti-trust laws) against the encroaching variables; and we try to defend "civil liberties" by legally slapping the wrists of encroaching authority.

We try to prohibit certain prohibitions, but it might be more effective to encourage people to know their freedoms and flexibilities and to use them more often.

Characteristically the exercise of even the physiological body, whose proper function is to maintain the flexibility of many of its variables by pushing them to extreme values, becomes a "spectator sport," and the same is true of the flexibility of social norms. We go to the movies or the courts—or read newspapers—for vicarious experience of exceptional behavior. And *per contra*, our flexible variables are monstrously exercised in war and revolution.

(How did Ancient Rome prevent the Saturnalia from becoming addictive?)

VI. **Applications.** I shall now consider the thesis of Richard Sennett's book, *The Uses of Disorder*.

The book is about making mature human beings in city environments. He argues:

1. At adolescence (and he is presumably but not explicitly concerned with male adolescence) a person's powers of action are disproportionately great, compared with his experience. There is thus a temptation to withdraw from action into a purified and simplified philosophy of life which will avoid recognizing the rough-and-tumble which is life's fullness.
2. This purified and simplified philosophy, Sennett argues, is the theme of suburban middle class life and of modern city planning, slum clearance. In general, the attempt to achieve *clarity* in life plans and designs is an expression of this withdrawal.
3. In poverty-stricken and racially mixed neighborhoods, men grow up with multiple contacts and multiple struggle. This makes for a greater richness in daily life—and perhaps for human beings who did not need to erupt from time to time in major explosions of war.

This thesis is closely akin to what I have said above about the need to exercise the flexibility of some of the variables which define an ecological system. But I suspect that Sennett may be going too far. It is not the case that *all* variables and parameters must be flexible.

I argued above that (in the case of the acrobat) certain variables must be flexible in order that other variables and parameters may remain more or less constant.

Flexibility is not an absolute value to be pursued for its own sake but is a necessary condition for the *survival and stability* of certain other conditions of life.

Which conditions or parameters should we seek to perpetuate? Sennett recommends the use of disorder for the preservation of some possibly higher order—but the precise sort of order which is to be preserved is undefined except by the contrast which Sennett draws between "adolescence" and "maturity." The "disorder" of Sennett's ideal city is to shake people out of their tendency to withdraw from the fullness of life into some sort of "head trip."

As I read it (and I may be wrong), Sennett recommends an "ego trip" in the hurly burly of the city as a cure for withdrawal into a head trip.

I believe that this is only another way of avoiding the fullness of life, a way which is already conventional in many parts of our civilization and a way which is already bankrupted by the uses to which we put technology, when guided by competition and ego premises.

Alexander's book is a very different kettle of fish. He is concerned with minimizing the sorts of *misfit* between a technological produce (a kettle or a city) and the uses of that product. He does not discuss the effect of using his product upon the souls of the people who use it. The book is, in fact, illustrated by an example in which Alexander works out in detail the steps for designing an Indian village for 600 people. In this example, the whole complex detail of Hindu culture is taken as given—as the condition to which the product must be adapted—and which (therefore) will inevitably be perpetuated by the use of the product. We may pray for the inhabitants of his village that the philosophy of life incorporated into it is not too full of nonsense.

The question which I raised in discussing Sennett, "What variables should we preserve?" is simply answered by Alexander in terms of the synchronic characteristics of the given culture at the given moment. This would be fine and useful for the restructuring of Manhattan if we were dealing with a problem of fitting plans to an already accepted and existing philosophy and way of life. Nevertheless, Alexander has contributed importantly to the techniques of planning and design.

I return to the question, "flexibility for what?" How should we identify the sacred?

The best answer I can give to this question is in terms of cultural transmission. What little biology we know indicates that in all such systems, if there is a differentiation between reproduction and on-going life (i.e., a differentiation between soma and germ plasm), then the *relative* stability of the latter is essential. And all that was said above about the pathogenic result of the loss of flexibility goes to show that these pathologies expectably hit those parts of our culture which are relatively unchanging in other (healthier) cultures—i.e., the transmission system.

We return then to the old truisms that reproduction is (and "should" be) the spice of life—not *multiplication*, but *replication*. And that, at the social level, the core institutions are the family, the school and the church.

It is for these (or rather, the processes which these perform) that flexibility must be achieved and maintained in the remainder of the system.

These should be (but today are not) the sources of delight.

It is conventionally assumed that family, school and church should be the backbone, the source of rigidity in the community. This is upside down.

This paper has now opened more questions than I can answer. So I need your help—