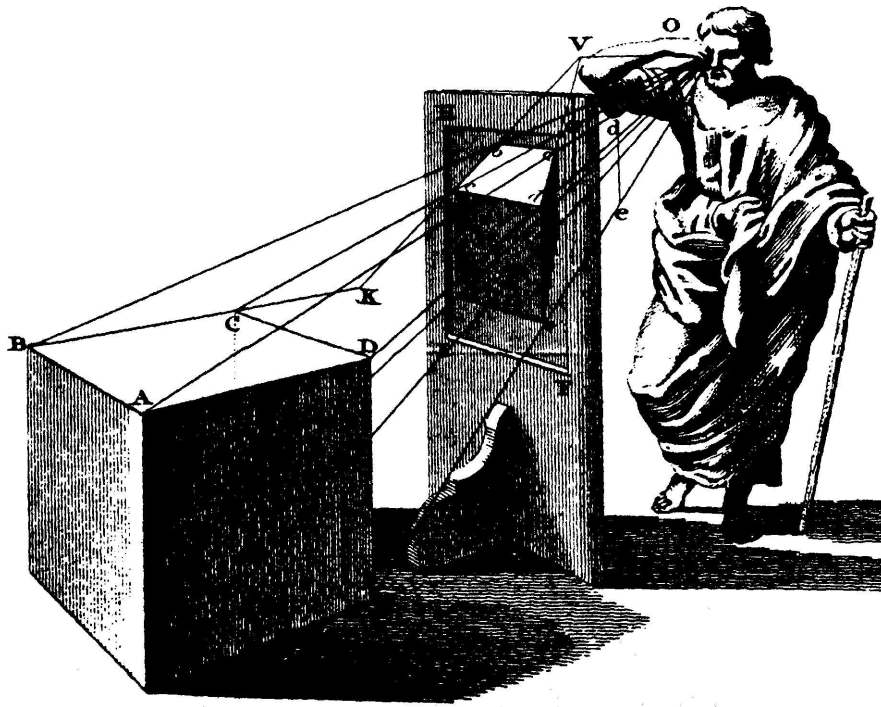




PERCEPTION OF THE FUTURE AND THE FUTURE OF PERCEPTION

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ABSTRACT

“The definition of a problem and the action taken to solve it largely depend on the view which the individuals or groups that discovered the problem have of the system to which it refers. A problem may thus find itself defined as a badly interpreted output, or as a faulty output of a faulty output device, or as a faulty output due to a malfunction in an otherwise faultless system, or as a correct but undesired output from a faultless and thus undesirable system. All definitions but the last suggest corrective action; only the last definition suggests change, and so presents an unsolvable problem to anyone opposed to change” (Herbert Brün, 1971).

Truisms have the disadvantage that by dulling the senses they obscure the truth. Almost nobody will become alarmed when told that in times of continuity the future equals the past. Only a few will become aware that from this follows that in times of socio-cultural change the future will *not* be like the past. Moreover, with a future not clearly perceived, we do not know how to act with only one certainty left: if we don't act ourselves, we shall be acted upon. Thus, if we wish to be subjects, rather than objects, what we see now, that is, our perception, must be foresight rather than hindsight.

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Epidemic

My colleagues and I are, at present, researching the mysteries of cognition and perception. When, from time to time, we look through the windows of our laboratory into the affairs of this world, we become more and more distressed by what we now observe. The world appears to be in the grip of a fast-spreading disease which, by now, has assumed almost global dimensions. In the individual the symptoms of the disorder manifest themselves by a progressive corruption of his faculty to perceive, with corrupted language being the pathogene, that is, the agent that makes the disease so highly contagious. Worse, in progressive stages of this disorder, the afflicted become numb, they become less and less aware of their affliction.

This state of affairs makes it clear why I am concerned about perception when contemplating the future, for:

if we can't perceive,
we can't perceive of the future
and thus, we don't know how to act now.

I venture to say that one may agree with the conclusion. If one looks around, the world appears like an anthill where its inhabitants have lost all sense of direction. They run aimlessly about, chop each other to pieces, foul their nest, attack their young, spend tremendous energies in building artifices that are either abandoned when completed, or when maintained, cause more disruption than was visible before, and so on. Thus, the conclusions seem to match the facts. Are the premises acceptable? Where does perception come in?

Before we proceed, let me first remove some semantic traps, for—as I said before—corrupt language is the pathogene of the disease. Some simple perversions may come at once to mind, as when “incursion” is used for “invasion,” “protective reaction” for “aggression,” “food denial” for “poisoning men, beasts, and plants,” and others. Fortunately, we have developed some immunity against such insults, having been nourished with syntactic monstrosities as “X is better” without ever saying “than what.” There are, however, many more profound semantic confusions, and it is these to which I want to draw your attention now.

There are three pairs of concepts in which one member of these pairs is generally substituted for the other so as to reduce the richness of our conceptions. It has become a matter of fact to confuse process with substance, relations with predicates, and quality with quantity. Let me illustrate this with a few examples out of a potentially very large catalogue, and let me at the same time show you the paralytic behavior that is caused by this conceptual dysfunction.

Process/Substance

The primordial and most proprietary processes in any man and, in fact, in any organism, namely “information” and “knowledge,” are now persistently taken as commodities, that is as substance. Information is, of course, the process by which knowledge is acquired, and knowledge is the processes that integrate past and present experiences to form new activities, either as nervous activity internally perceived as thought and will, or externally perceivable as speech and movement (Maturana, 1970, 1971; Von Foerster, 1969, 1971).

Neither of these processes can be “passed on” as we are told in phrases like “... Universities are depositories of Knowledge which is passed on from generation to generation,” etc., for *your* nervous activity is just *your* nervous activity and, alas, not *mine*.

No wonder that an educational system that confuses the process of creating new processes with the dispensing of goods called “knowledge” may cause some disappointment in the hypothetical receivers, for the goods are just not coming: there are no goods.

Historically, I believe, the confusion by which knowledge is taken as substance comes from a witty broadsheet printed in Nuremberg in the Sixteenth Century. It shows a seated student with a hole on top of his head into which a funnel is inserted. Next to him stands the teacher who pours into this funnel a bucket full of “knowledge,” that is, letters of the alphabet, numbers and simple equations. It seems to me that what the wheel did for mankind, the Nuremberg Funnel did for education: we can now roll faster down the hill.

Is there a remedy? Of course, there is one! We only have to perceive lectures, books, slides and films, etc., not as *information* but as *vehicles* for potential information. Then we shall see that in giving lectures, writing books, showing slides and films, etc., we have not solved a problem, we just created one, namely, to find out in which context can these things be seen so that they create in their perceivers new insights, thoughts, and actions.

Relation/Predicate

Confusing relations with predicates has become a political pastime. In the proposition “spinach is green,” “green” is a predicate; in “spinach is good,” “good” is a relation between the chemistry of spinach and the observer who tastes it. He may refer to his relation with spinach as “good.” Our mothers, who are the first politicians we encounter, make use of the semantic ambiguity of the syntactic operator “is” by telling us “spinach is good” as if they were to say “spinach is *green*.”

When we grow older we are flooded with this kind of semantic distortion that could be hilarious if it were not so far reaching. Aristophanes could have written a comedy in which the wisest men of a land set out to accomplish a job that, in principle, cannot be done. They wish to establish, once and for all, all the properties that define an obscene object or act. Of course, “obscenity” is not a property residing within things, but a subject-object relationship, for if we show Mr. X a painting and he calls it obscene, we know a lot about Mr. X but very little about the painting. Thus, when our lawmakers will finally come up with their imaginary list, we shall know a lot about them, but their laws will be dangerous nonsense.

“Order” is another concept that we are commanded to see in things rather than in our perception of things. Of the two sequences A and B,

A: 1, 2, 3, 4, 5, 6, 7, 8, 9

B: 8, 5, 4, 9, 1, 7, 6, 3, 2

sequence A is seen to be ordered while B appears to be in a mess, until we are told that B has the same beautiful order as A, for B is in alphabetical order (eight, five, four, ...). “Everything has order once it is understood” says one of my friends, a neurophysiologist, who can see order in what appears to me at first the most impossible scramble of cells. My insistence here to recognize “order” as a subject-object relation and not to confuse it with a property of things may seem too pedantic. However, when it comes to the issue “law and order” this confusion may have lethal consequences. “Law and order” is no issue, it is a desire common to all; the issue is “which laws and what order,” or, in other words, the issue is “justice and freedom.”

AGAIN	AIR	APPLE	BRING	CHEESE	COLD
COME	DARK	DOCTOR	EAT	FIND	FOOT
HARD	HOUSE	INVITE	JUMP	LIVE	MILK
NEEDLE	NOW	QUICKLY	SADLY	SAND	SEND
SLEEP	SLOWLY	SOFT	SUFFER	SUGAR	SWEET
TABLE	TAKE	VERY	WATER	WEEP	WHITE

Figure 1: Example of 36 words printed on cards to be classified according to similarity in meaning

Castration

One may dismiss these confusions as something that can easily be corrected. One may argue that what I just did was doing that. However, I fear this is not so; the roots are deeper than we think. We seem to be brought up in a world seen through descriptions by others rather than through our own perceptions. This has the consequence that instead of using language as a tool with which to express thoughts and experience, we accept language as a tool that determines our thoughts and experience.

It is, of course, very difficult to prove this point, for nothing less is required than to go inside the head and to exhibit the semantic structure that reflects our mode of perception and thinking. However, there are now new and fascinating experiments from which these semantic structures can be inferred. Let me describe one that demonstrates my point most dramatically.

The method proposed by George Miller (1967) consists of asking independently several subjects to classify on the basis of similarity of meaning a number of words printed on cards (Fig. 1). The subject can form as many classes as he wants, and any number of items can be placed in each class. The data so collected can be represented by a “tree” such that the branchpoints further away from the “root” indicate stronger agreement among the subjects and hence suggest a measure of similarity in the meaning of the words for this particular group of subjects.

Fig. 2 shows the result of such a “cluster analysis” of the 36 words of Fig. 1 by 20 adult subjects (“root” on the left). Clearly, adults classify according to syntactic categories, putting nouns in one class (bottom tree), adjectives in another (next to bottom tree), then verbs, and finally those little words one does not know how to deal with.

The difference is impressive when the adults’ results are compared with the richness of perception and imagery of children in the third and fourth grade when given the same task (Fig. 3). Miller reflects upon these delightful results:

“Children tend to put together words that might be used in talking about the same thing—which cuts right across the tidy syntactic boundaries so important to adults. Thus all twenty of the children agree in putting the verb ‘eat’ with the noun ‘apple’; for many of them ‘air’ is

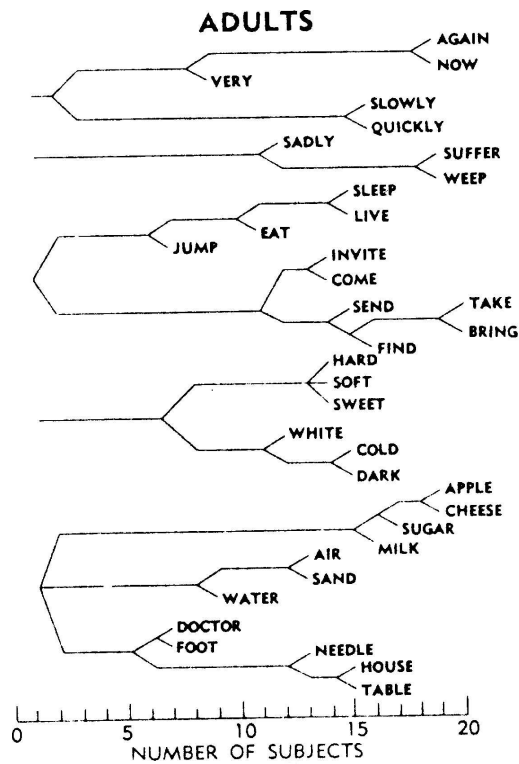


Figure 2: Cluster analysis of the 36 words of Fig. 1 classified by 20 adult subjects. Note that syntactic categories are faithfully respected, while semantic relations are almost completely ignored.

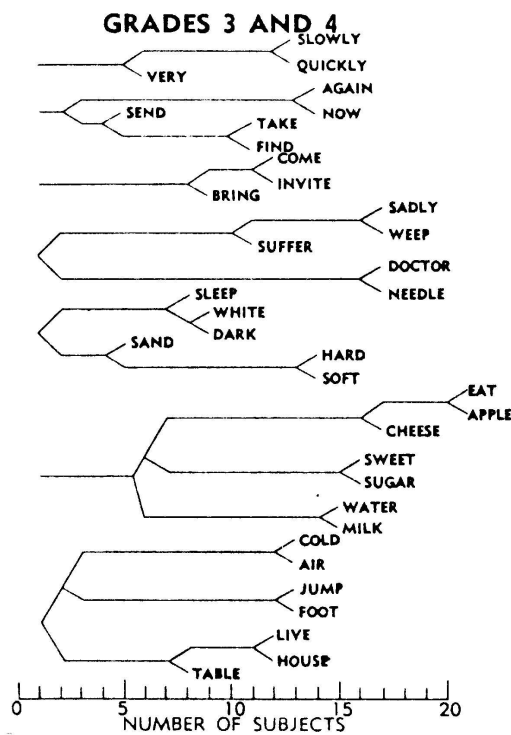


Figure 3: The sample 36 words of Figs. 1 and 2 classified by children in the third and fourth grade. Note the emergence of meaningful cognitive units, while syntactic categories are almost completely ignored.

'cold'; the 'foot' is used to 'jump'—You 'live' in a 'house'; 'sugar' is 'sweet', and the cluster of 'doctor,' 'needle,' 'suffer,' 'weep' and 'sadly' is a small vignette in itself."

What is wrong with our education that castrates our power over language? Of the many factors that may be responsible I shall name only one that has a profound influence on our way of thinking, namely, the misapplication of the "scientific method."

Scientific Method

The scientific method rests on two fundamental pillars:

- (i) Rules observed in the past shall apply to the future. This is usually referred to as the principle of conservation of rules, and I have no doubt that you are all familiar with it. The other pillar, however, stands in the shadow of the first and thus is not so clearly visible:
- (ii) Almost everything in the universe shall be irrelevant. This is usually referred to as the principle of the necessary and sufficient cause, and what it demands is at once apparent when one realizes that "relevance" is a triadic relation that relates a set of propositions ($P_1, P_2, \dots$) to another set of propositions ($Q_1, Q_2, \dots$) in the mind (M) of one who wishes to establish this relation. If P are the causes that are to explain the perceived effects Q , then the principle of necessary and sufficient cause forces us to reduce our perception of effects further and further until we have hit upon the necessary and sufficient cause that produces the desired effect: everything else in the universe shall be irrelevant.

It is easy to show that resting one's cognitive functions upon these two pillars is counter-productive in contemplating any evolutionary process, be it the growing up of an individual, or a society in transition. In fact, this was already known by Aristotle who distinguished two kinds of cause, one the "efficient cause," the other the "final cause," which provide us with two distinct explanatory frameworks for either inanimate matter, or else living organisms, the distinction being that the efficient cause *precedes* its effect while the final cause *succeeds* its effect. When striking with a match the treated surface of a matchbook, the striking is the (efficient) cause for the match to ignite. However, the cause for my striking the match is my wish to have it ignited (final cause).

Perhaps, with this distinction, my introductory remarks may appear much clearer. Of course, I had in mind the final cause when I said that if we can perceive of the future (the match being ignited), we know how to act now (strike!). This leads me immediately to draw a conclusion, namely:

At any moment we are free to act toward the future we desire.

In other words, the future will be as we wish and perceive it to be. This may come as a shock only to those who let their thinking be governed by the principle that demands that only the rules observed in the past shall apply to the future. For those the concept of "change" is inconceivable, for change is the process that obliterates the rules of the past.

Quality/Quantity

In order to protect society from the dangerous consequences of change, not only a whole branch of business has emerged, but also the Government has established several offices that busy themselves in predicting

the future by applying the rules of the past. These are the Futurists. Their job is to confuse quality with quantity, and their products are “future scenarios” in which the qualities remain the same, only the quantities change: more cars, wider highways, faster planes, bigger bombs, etc. While these “future scenarios” are meaningless in a changing world, they have become a lucrative business for entrepreneurs who sell them to corporations that profit from designing for obsolescence.

With the diagnosis of the deficiency to perceive qualitative change, that is, a change of our subject-object and subject-subject relationships, we are very close to the root of the epidemic that I mentioned in my opening remarks. An example in neurophysiology may help to comprehend the deficiency that now occurs on the cognitive level.

Dysgnosis

The visual receptors in the retina, the cones and the rods, operate optimally only under certain conditions of illumination. Beyond or below this condition we suffer a loss in acuity or in color discrimination. However, in the vertebrate eye the retina almost always operates under these optimal conditions, because of the iris that contracts or dilates so as to admit under changing conditions of brightness the same amount of light to the receptors. Hence, the scenario “seen” by the optic nerve has always the same illumination independent of whether we are in bright sunshine or in a shaded room. How, then, do we know whether it is bright or shady?

The information about this datum resides in the regulator that compares the activity in the optic nerve with the desired standard and causes the iris to contract when the activity is too high, and to dilate when it is too small. Thus, the information of brightness does not come from inspecting the scenario—it appears always to be of similar brightness—it comes from an inspection of the regulator that suppresses the perception of change.

There are subjects who have difficulties in assessing the state of their regulator, and thus they are weak in discriminating different levels of brightness. They are called “dysphotoc.” They are the opposite of photographers, who may be called “photoc,” for they have a keen sense of brightness discrimination. There are subjects who have difficulties in assessing the regulators that maintain their identity in a changing world. I shall call individuals suffering from this disorder “dysgnostic,” for they have no way of knowing themselves. Since this disorder has assumed extraordinary dimensions, it has indeed been recognized at the highest national level.

As you all know, it has been observed that the majority of the American people cannot speak. This is interpreted by saying that they are “silent”; I say they are *mute*. However, as you all know very well, there is nothing, wrong with the vocal tract of those who are mute: the cause of their muteness is deafness. Hence, the so-called “silent majority” is *de facto* a “deaf majority.”

However, the most distressing thing in this observation is that there is again nothing wrong with their auditory system; they could hear if they wanted to: but they don’t want to. Their deafness is voluntary, and in others it is their blindness.

At this point proof will be required for these outrageous propositions. *TIME Magazine* (1970) provides it for me in its study of Middle America.

There is the wife of a Glencoe, Illinois lawyer, who worries about the America in which her four children are growing up: “I want my children to live and grow up in an America as I *knew* it,” [note the principle of conservation of rule where the future equals the past] “where we were proud to be citizens of this country.

I'm damned sick and tired of *listening* to all this nonsense about how awful America is." [Note voluntary deafness.]

Another example is a newspaper librarian in Pittsfield, Massachusetts, who is angered by student unrest: "Every time I see protestors, I say, 'Look at those creeps.'" [Note reduction of visual acuity.] "But then my 12-year old son says, 'They're not creeps. They have a perfect right to do what they want'" [Note the un-adult-erated perceptual faculty in the young.]

The tragedy in these examples is that the victims of "dysgnosis" not only do not know that they don't see, hear, or feel, they also do not want to.

How can we rectify this situation?

Trivialization

I have listed so far several instances of perceptual disorders that block our vision of the future. These symptoms collectively constitute the syndrome of our epidemic disease. It would be the sign of a poor physician if he were to go about relieving the patient of these symptoms one by one, for the elimination of one may aggravate another. Is there a single common denominator that would identify the root of the entire syndrome?

To this end, let me introduce two concepts, they are the concepts of the "trivial" and the "non-trivial" machine. The term "machine" in this context refers to well-defined functional properties of an abstract entity rather than to an assembly of cogwheels, buttons and levers, although such assemblies may represent embodiments of these abstract functional entities.

A trivial machine is characterized by a one-to-one relationship between its "input" (stimulus, cause) and its "output" (response, effect). This invariable relationship is "the machine." Since this relationship is determined once and for all, this is a deterministic system; and since an output once observed for a given input will be the same for the same input given later, this is also a predictable system.

Non-trivial machines, however, are quite different creatures. Their input-output relationship is not invariant, but is determined by the machine's previous output. In other words, its previous steps determine its present reactions. While these machines are again deterministic systems, for all practical reasons they are unpredictable: an output once observed for a given input will most likely be not the same for the same input given later.

In order to grasp the profound difference between these two kinds of machines it may be helpful to envision "internal states" in these machines. While in the trivial machine only one internal state participates always in its internal operation, in the non-trivial machine it is the shift from one internal state to another that makes it so elusive.

One may interpret this distinction as the Twentieth Century version of Aristotle's distinction of explanatory frameworks for inanimate matter and living organisms.

All machines we construct and buy are, hopefully, trivial machines. A toaster should toast, a washing machine wash, a motorcar should predictably respond to its driver's operations. In fact, all our efforts go into one direction, to create trivial machines or, if we encounter non-trivial machines, to convert them into trivial machines. The discovery of agriculture is the discovery that some aspects of Nature can be trivialized: If I till today, I shall have bread tomorrow.

Granted, that in some instances we may be not completely successful in producing ideally trivial machines. For example, one morning turning the starter key to our car, the beast does not start. Apparently it changed its internal state, obscure to us, as a consequence of previous outputs (it may have exhausted its gasoline supply) and revealed for a moment its true nature of being a non-trivial machine. But this is, of course, outrageous and this state of affairs should be remedied at once.

While our pre-occupation with the trivialization of our environment may be in one domain useful and constructive, in another domain it is useless and destructive. Trivialization is a dangerous panacea when man applies it to himself,

Consider, for instance, the way our system of education is set up. The student enters school as an unpredictable “non-trivial machine.” We don’t know what answer he will give to a question. However, should he succeed in this system the answers he gives to our questions must be known. They are the “right” answers:

Q: “When was Napoleon born?”

A: “1769”

Right!

Student = Student

but

Q: “When was Napoleon born?”

A: “Seven years before the Declaration of Independence.”

Wrong!

Student = Non-student

Tests are devices to establish a measure of trivialization. A perfect score in a test is indicative of perfect trivialization: the student is completely predictable and thus can be admitted into society. He will cause neither any surprises nor any trouble.

Future

I shall call a question to which the answer is known an “illegitimate question.” Wouldn’t it be fascinating to contemplate an educational system that would ask of its students to answer “legitimate questions” that is questions to which the answers are unknown (H. Brün in a personal communication). Would it not be even more fascinating to conceive of a society that would establish such an educational system? The necessary condition for such an utopia is that its members perceive one another as autonomous, non-trivial beings. Such a society shall make, I predict, some of the most astounding discoveries. Just for the record, I shall list the following three:

1. “Education is neither a right nor a privilege: it is a necessity.”
2. “Education is learning to ask legitimate questions.”

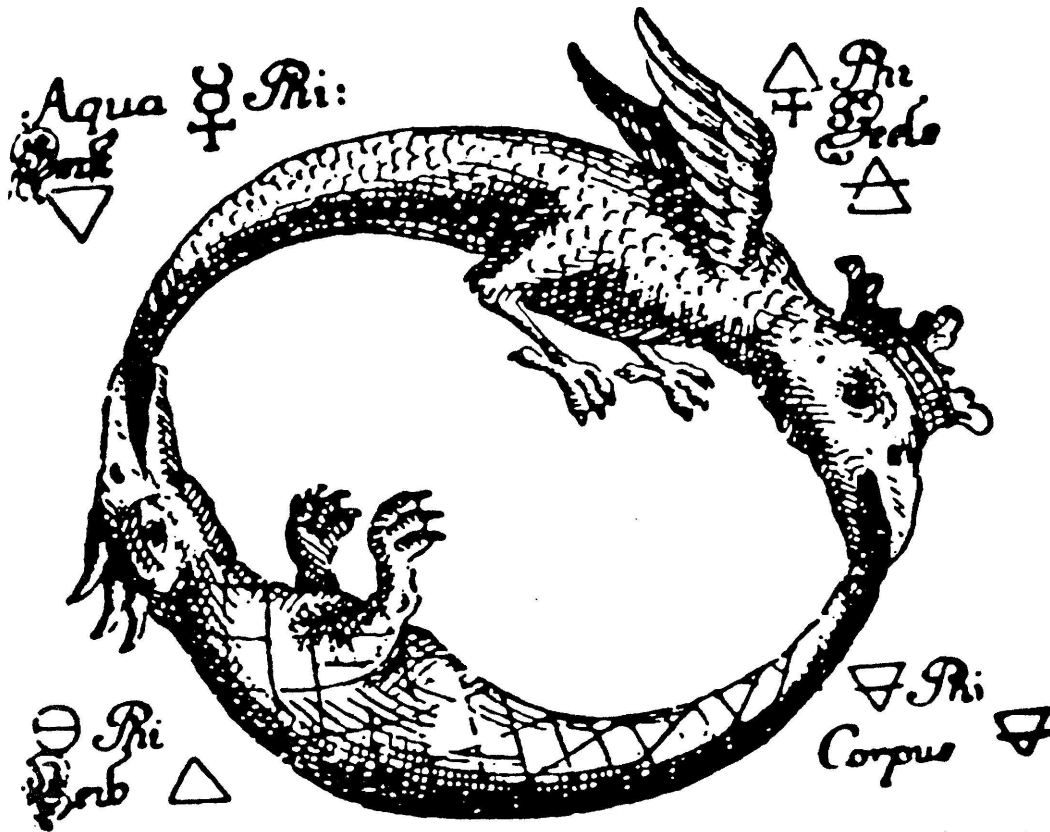
A society who has made these two discoveries will ultimately be able to discover the third and most utopian one:

3. "A is better off when B is better off."

From where we stand now, anyone who seriously makes just one of those three propositions is bound to get into trouble. Maybe you remember the story Ivan Karamazov makes up in order to intellectually needle his younger brother Alyosha. The story is that of the Great Inquisitor. As you recall, the Great Inquisitor walks on a very pleasant afternoon through his town, I believe it is Salamanca; he is in good spirits. In the morning he has burned at the stakes about a hundred and twenty heretics, he has done a good job, everything is fine. Suddenly there is a crowd of people in front of him, he moves closer to see what's going on, and he sees a stranger who is putting his hand onto a lame person, and that lame one can walk. Then a blind girl is brought before him, the stranger is putting his hand on her eyes, and she can see. The Great Inquisitor knows immediately who He is, and he says to his henchmen: "Arrest this man." They jump and arrest this man and put Him into jail. In the night the Great Inquisitor visits the stranger in his cell and he says: "Look, I know who You are, troublemaker. It took us one thousand and five hundred years to straighten out the troubles you have sown. You know very well that people can't make decisions by themselves. You know very well people can't be free. We have to make their decisions. We tell them who they are to be. You know that very well. Therefore, I shall burn You at the stakes tomorrow." The stranger stands up, embraces the Great Inquisitor and kisses him. The Great Inquisitor walks out, but, as he leaves the cell, he does not close the door, and the stranger disappears in the darkness of the night.

Let us remember this story when we meet those troublemakers, and let us keep the door open for them. We shall recognize them by an act of creation:

"Let there be vision: and there was light."



References

- Brün, H. (1971). "Technology and the Composer," in Von Foerster, H., ed., *Interpersonal Relational Networks*. pp. 1–10. Cuernavaca: Centro Intercultural de Documentacion.
- Maturana, H. R. (1970). "Biology of Cognition" BCL Report No. 9.0, Biological Laboratory, Department of Electrical Engineering, University of Illinois, Urbana, 93 pp.
- Maturana, H. R. (1971). "Neurophysiology of Cognition," in Garvin, P., ed., *Cognition, A Multiple View*, pp. 3–23. New York: Spartan Books.
- Miller, G. A. (1967). "Psycholinguistic Approaches to the Study of Communication," in Arm, D. L., ed., *Journeys in Science*, pp. 22–73. Albuquerque: Univ. New Mexico.
- TIME Magazine*. (1970). "The Middle Americans," (January 5).
- Von Foerster, H. (1969). "What is Memory that It May Have Hindsight and Foresight as well?," in Bogoch, S., ed., *The Future of the Brain Sciences*, pp. 19–64. New York: Plenum Press.
- Von Foerster, H. (1971). "Thoughts and Notes on Cognition," in Garvin, P., ed., *Cognition, A Multiple View*, pp. 25–48. New York: Spartan Books.