2-28-1975

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February 28, 1975
Portland State University

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Transcribed by Dean Guenther, March 31 - April 14, 2021
Audited by Carolee Harrison, April 2021

HOST: Testing, testing… [audio skips and resumes mid-sentence] …break in our panel discussion where the speakers can address each other and any of you can join, and we hope you will. I am very pleased to introduce Professor Heinz von Foerster, who was born in Vienna. Last summer I spent a whole month there, and with all the simulation and modelling there's one thing I can tell you: we will never be able to simulate the Viennese properly. It just can't be done. Professor von Foerster has a doctorate in physics; he has many honors and appointments. He is Professor Emeritus, again, like almost all our speakers; interdisciplinary in character, and that's reflected in his titles, these departments of biophysics and electrical engineering at the University of Illinois. He has worked… he has been one of the pioneers in the area of cybernetics. He's written books and articles which are again indicators of his diverse interests: *Music by Computers*; *Nerve, Brain, and Memory Models*; and an article called "The Laws of Form" in the *Whole Earth Catalog*; just to give you a taste. I think most of you who have attended some of the other talks have already experienced his wit and wisdom, so I know we are all eagerly anticipating Professor von Foerster, and I'm very honored that we can have him here today. The subject is the curious behavior of complex systems: the lessons from biology. Mr. von Foerster. [applause]

HEINZ VON FOERSTER: Ladies and gentlemen, thank you very much for this charming introduction. You will see a reasonable simulation of a Viennese. I don't know whether it's good, you will have to go to Vienna and check for yourself. I will say first I would like to express

my congratulations to the systems planners of this conference. I thought this was extraordinary—fascinating, at least, for me. It is not to what I am referring here, to the variety of thoughts that have been presented. This is of course no miracle, there were six outstanding speakers who were of course contributing their own personal perceptions to this group. What impressed me most, however, was, in lack of a better word I would like to use, a resonance. A resonance amongst the speakers, of perhaps the most profound points of subtleties that were uttered by some of these experts in a somewhat nonchalant fashion. They were dropped like pearls without really saying, "Look, ladies and gentlement, here I have a wonderful pearl."

Now, since I have the great honor to be the anchorman in this sequence of marathonians, catatonians, if you wish, ten and a half hours of perpetual speech, I thought I should, rather than throwing another set of complexities at you, I thought what I should do is perhaps to kindle and to nourish some of the subtleties that have been presented by my previous speakers, and perhaps to complement them here and there as good as I can with some of the things to give them a glue, so that they appear to you as an integrated whole. So I've decided to, yesterday or this morning, interpret the title of my speech which was given to you by our chairman, which reads: "The curious behavior of complex systems: lessons from biology." I would like to interpret it now in the following way: I will talk about the behavior of complex systems in the biological context, as applicable to the management of complex systems in the social context. You see, my program is about that.

Now, a couple of years ago, ladies and gentlemen, I could have entertained you for hours, I'm sure, with charming metaphors, and parallels, and anecdotes, of the superficial parallelism between living organisms and social organizations. I could, of course, if you wished, say a few things of the parallels between the brain and between mankind. You have, as you know, in mankind, you have about 3 point… no, by now it's 4 billion people. This is $4*10^9$ people. The brain has about $10*10^9$, this is 10 billion neurons. So the ratio between the number of people on the globe and the number of neurons or nerve cells in your brain is about 1:2. So your brain is about twice as populated with individual neurons as the globe is, at the moment, populated with individuals. You can argue that, for instance, a neuron has on average about 3000 connectives to other elements in the brain. And we may argue and measure that people, individuals, in the course of their lives, have approximately the same number of informative connectives, including uncles, aunts, and it goes so on and so forth, and your grocer and your mailman to who you see and say hello and hi, and things like that. This might be the frequency of pauses that go on between a neuron and another.

Though you can, of course, go with the other beautiful metaphor, which is used quite frequently: the brain is the manager of your body. [laughter] Now, I think at the moment our

alimentary tract is the manager of our brain, you see. So you can switch these things around and things become a little bit softer. These metaphors become soft.

Now, as I said a couple of years ago, I could have done that, and there are oodles of these very charming parallels and they are interesting also. However, there is, and Professor Maruyama would probably say, an emergent new paradigm in which we look at both biological systems, living organization, and where we look at the social organization. And these are profound changes in our appreciation, and all the superficial analogies collapse. Not only that they are misleading; they are even dangerous.

Let me give you immediately one of the extraordinarily dangerous consequences of taking these metaphors seriously. And that is, of course, the metaphor with which you'll be pissed at probably throughout your life. And that is that one says look, a cell is subservient to the good of the system of the body as a whole. And so is the individual subservient to the good of the nation. And if you have that, and you have that going for a while, I can only report to you from Germany, in which I was during the Hitler years. [laughter] Well, this phrase was painted on the walls, *ja*? And when the individual is nothing and the nation is all, what do you do with the individuals? You, of course, you can just dismiss them and put them into the ovens or you can exterminate them with Zyklon B as it has been done in the concentration camps.

Now, the whole metaphor must be reversed if you switch from society to individual; indeed, the cell is subservient to the body as a whole, and indeed the society should be subservient to the individual, and not the other way around. So in order to appreciate that, one has to realize the autonomy of a whole living organism, some autonomous entity. Any one of my cells in my body are not autonomous. They are heteronomous in the sense that they are serving, they are subservient to, my operation. I am an autonomous entity. My cells are not. My little finger is not autonomous. My arm is not autonomous. I can get rid of it in an operation. My semen is not autonomous. Fetus is not autonomous. However, I am autonomous even if I would have passed through a severe brain operation and I am not as I was before. As for instance, Mr. Bellman showed this morning, who clearly showed his perfect wholeness and autonomy in presenting despite of a major operation in the brain, a perfect paper to us all. So, it does not diminish the concepts of the autonomy associated with the individual. Here, I am making the reference to that which Churchman pointed out the other day: namely, don't forget the self. The self is exactly the one which is popping up if you contemplate autonomy.

Now if we really want to take some of the other metaphor, the living organization as a parallel for the organization of the living, a social organization, then we have to ascend to much higher abstractions in order to make these metaphors or parallels stick, or we have to go to much

deeper epistemologies. In any other place but this one, here with you, ladies and gentlemen, I would have hesitated to present to you these outlooks. But, in this organization here, particularly in this advanced systems doctoral program and the place where you have Mr. Linstone, the father of responsible futurology, and Dr. Maruyama, the father of a prophetic paradigmatology, I think I will have really no difficulty in presenting some of the points. You will probably tell me, "I know them already." But anyway, it might not be bad to make a reinforcement or attempt at least.

So, my strategy at the moment will be: I will present you several of the points that have been made again and again and again before me. I will present to you in a fresh, perhaps in a slightly different context; step number one in my three steps will be I would like to point out again a peculiar culturally embedded cognitive dysfunction which inhibits some of us to see management of complexity in a productive perspective. This is a dysfunction, I would like to point out, which is culturally embedded, which, as I said before, is now undergoing change in the way in which we look at the whole thing.

Number two is I will then talk to the topic proper, namely to management, and I will make an interpretation of management in a fashion so that I can deal with it. And I will interpret a managerial act as being a cognitive act. So, I will *equate* a managerial act with a cognitive act. Looks at the moment are somewhat surprising, but you will see they are complete parallel operations. Certainly, I will show that underlying both of the processes is one fundamental concept, as well in management, as is in cognition, and this is the concept of computation. Now this will be my point number two, and I will allow myself for a few moments to gallop through some kind of mathematical… artifices, I should say, or tricks, or perceptions, if you wish, to show the particular properties which are associated with these operations. This will be very fast; please don't worry, it will not request from you more than high school mathematics.

Then at the last, point number three, I will take some managerial and ethical consequences of all that, what that conference was trying to express. Again, you will see that managerial problems and ethical problems are closely related, as has been pointed out already again and again and again during this conference.

Now, ladies and gentlemen, brace yourselves. I am now going into the gallop and will start with my point number one! I have absolutely no doubt that all of you who are here share with me the view that the crucial problems of today are societal. The problem: complexity of the society. On the other hand, the gigantic, conceptual, problem-solving apparatus that Western culture has developed is counterproductive not only to solving these problems, but essentially of perceiving these problems. The blind spot which does not allow us to perceive of these social

problems has two roads: the one is that we follow, or some parts of our culture follow, the traditional approach to problem solving through reductionism; and the other is the explanatory paradigm which is in our Western culture always used as causation.

Now both of these structures are now under assault. Now, of reductionism I do not have to talk too much, because our chairman was kind enough already to explain to us that reductionism is doing nothing else but destroying the problem it wants to explain. It's because if you have a large problem, and you don't understand it, you chop it into pieces. If you don't understand the pieces, you chop it again, you chop, you chop, you chop, until it is so small that you understand it. So reductionism is an ego trip where you come out with success always. Therefore, reductionism leads you to a position which allows you to know everything about nothing. [laughter] However, you may say, "Okay, let's go, then, to the other route, let's go to the holism," and go to the larger and larger systems. Ultimately, then, you know nothing about everything. [laughter] Both ways are not really the things to be recommended, so the question now is what we have to do. The most important thing is, of course, we have not to chop, we have to look. We can't look, and that is the point I am trying to make.

Now, why can't we look? Now there's the next paradigm of our explanatory system: causation. Causation is, by now, particularly in the research with social systems, inoperative. It is inoperative because if you consider the law, or the supposed law, which transforms the past cause into the present effect, it is in itself changed by the very effect it produced. In other words, there's a long restriction of what is called in systems theory non-trivial machines. A non-trivial machine, whenever it has computed a new step, is a different machine. So it is very difficult to have a non-trivial machine to become predictive. The usual way in which we do it is to trivialize the machine, and this is what our educational system is for. The children are coming into school, they are unpredictable; you don't know what they will say when you ask them five times five. So then what you do is you trivialize them so that they are predictable citizens and will be no troublemakers henceforth. Some of you are of course resisting to this thing, and I wish you good luck. [laughter]

Now briefly, this is the aspect of the non-trivial machine, and if you want to understand society, we have to understand non-trivial machines. Now there is a very interesting observation, and this has been first made to my knowledge by a gentleman who is, I'm sure, very familiar to you. This is Carlos Castaneda, who was reporting about one of his teachers, his great teacher, who is Don Juan, a Mexican *brujo*. Don Juan wants to teach Castaneda how to see, and Castaneda has great difficulties. He always wants to explain things, and things he cannot explain he cannot see. So Don Juan always tells him, "Now look, Carlito, look! See! Don't explain things. Look what you can see." Carlito has great difficulties, and he is explaining these great difficulties now in

four volumes. [laughter] I recommend to look into these four volumes, because they really give way to comprehend what it means to see.

Now unfortunately, you see, at that point, he and we have a blind spot. And you know what a blind spot is. We all have a blind spot. Our retina has a spot of about two or three millimeters in diameter where there are no cones or rods, and therefore we cannot see. However, ladies and gentlemen, what's that? You are not running around with a black spot in your vision. Not so. You don't see that you don't see, and that is a dysfunction of second order. And it is these kinds of dysfunctions which we have to realize if we want to understand what is going on. It's perfectly clear that the therapy for dysfunctions of the second order must be therapies of the second order. We will come to that later.

The popularity of Castaneda persuades me to think, again, in terms of Magoroh Maruyama's idea of new emerging paradigms; that we are indeed experiencing the development, or the emergence, of a new paradigm. The emergence of a new way of how to look at things. And the first thing, I think, which comes to our cognisance is that the old idea that properties that apparently are associated with things are indeed properties that belong to the observer. So, that means the properties which are thought to reside in things turn out to be properties of the observer. I'll give you immediately an example. A good example, for instance, is obscenity. You know that there is a tremendous effort even going up to the Supreme Court which is almost a comedy worthy to be written by Aristophanes. Who wants to establish what is obscene? Now it's perfectly clear that "obscene" is, of course, a property which resides in the observer, because if you take a picture and show it to Mr. X, and Mr. X says, "This picture is obscene," you know something about Mr. X, but nothing about the picture. [laughter]

The other one is, for instance, the concept of order. We are fond to say, "This is very nicely ordered," and "There is more order," then, "Here is more order," "This is disordered," and things like that. Of course, order, again, is a property of the perceptive property of the observer. I would like to make that pretty clear to you, because the next step is, of course, to show you that complexity is not residing in things. It is residing in your capacity to see it. Now, may I have the first slide now, which is my order slide. Now you see here two sequences of numbers, and here you have a very nicely ordered sequence: 1, 2, 3, 4, 5, 6; and you can now predict the next number which happens to be 7, then 8 and 9 as so on. Now underneath, you find a very odd sequence which is not at all well-ordered. It is a random sequence.

Now I propose if you want to have some fun, why don't you chop down the lower sequence, you see, and give it to your mathematician friends and ask them what is the generating formula for that sequence. And if you sit, and sit, and sit, and after about a week he will come back to

you and will be very angry and say, “I didn’t find it.” Now, if you really want to make him very angry, you tell him, “Look, man, that is a perfectly ordered sequence. I’ve ordered these numbers in alphabetical order according to the names of the numerals.” [laughter] [applause] Eight, five, four, nine, just in the telephone directory you could find it. So, this is as well-ordered as the other. And that you laughed, *ja,* is the sign that you flicked from the state of disorder to the state of order, and that, of course, gave you a tremendous pleasure. [laughter]

Now, I could go slightly more rigorous on that example, just for those who would like to have something to really hold on. In the case of order of a sequence, you can express that extraordinarily rigorously by saying, “The order of an arrangement is directly associated with the links of the description for that arrangement, given a particular language.” It’s always in relation to a language. For instance, you could take a Turing machine, which is supposed to compute this sequence, and the input, the first typed description would then be the description of that output of the machine. So you could say the length of that description is a description of the state of the order of that system. For instance, in the first row, you could do a very short description, you see, n+1 is equal to... or the next number is just 1 plus the previous number. That is the whole description which is necessary for the first sequence. And the other one, if you know it, you say alphabetical. If you do not know, then you have to say eight, five, four, and the description becomes very long.

Now with this example, I will now switch to the final thing as being, with reference to a language, with reference to a machine, with reference to an observer, all these concepts have references to observers, machines, languages, or whatever. That is complexity. Complexity can be defined in that context, exactly in the context, as the length of computation that is necessary to produce a particular arrangement. Or, if you want to go one level above, you can say the length of the algorithm which is allowing me to compute that organization or that arrangement is a measure of the complexity of a system. So they see very clearly it is highly dependent upon what kind of a language you use—that means what kind of a perceptive system you have—that looks into that thing and says, “It takes me that much amount of programming in order to compute that sequence, that arrangement, that organization.” OK, now we can turn off this slide. I have pointed that out.

Now, this leads me immediately to the major point which has been made now in this conference three or four times, and that was the point that a basic concept, a basic viewpoint of our Western culture is now crumbling. If you stick out your ears you can even hear it collapsing. Tremendous noise! And this is the concept of objectivity. Objectivity, very briefly formulated, is the properties of the observer shall not enter in the descriptions of his observations. The properties of the observer shall not enter into the descriptions of his

observation. Now this is, of course, the definition of objectivity. There are many other content-equivalent paraphrases; you can get them through various books, but I think that point is particularly salient for our group here. The description should be observer-independent, yeah? Of course, this is real nonsense in the description already! Because how can you make a description if you don't have an observer? And the very job is, of course, of an observer, that his properties show up in his descriptions. So, objectivity clearly is nonsense. There's no doubt about that. However, some philosophers believe now if you negate it, and you generate subjectivism, that makes sense. However, ladies and gentlemen, as you very well know, if you negate a nonsense, you get nonsense. So you can't do that. Subjectivism is as nonsensical as objectivism, and we can't deal with these things at all. The question now arises, the real concrete question is, now, "What is the observer? How can we deal with the observer? What are his properties?" Now this is the end of my section number one, and I am now proceeding to my point number two. I will have the connection with point number two established at once.

The question hangs in the air, "Who is the observer? What is the observer?" Objectivity is gone, subjectivity is gone. Can't do that. Holism is gone, reductionism is gone. So at the moment, lots of things have gone. Now we have to produce something. Now I was... the first time, indeed, had the honor to be invited to come to a conference where the major title was "Managing complexity." So I said, "Managing complexity. Yeah, hm. Very interesting. Now let's look at what is managing." I like a particular dictionary, this is the *American Heritage Dictionary of the English Language*, and I was checking what is "managing." So I looked up the word "to manage." So there I found the following fascinating thing, just so you know what it is: "To manage is to direct or control the use of; handle." Weird. Number two: "To manage is to exert control over; to make submissive to one's authority, discipline, or persuasion." Now clearly, management, something which is reducing, here decrees a freedom, according to this definition. Now I was looking up immediately into European roots, and the next neighbor which gave me a clue as to the deeper meaning of managing, which has of course to do with *manus*, "to handle with your hands," or to *un*-handle with your hands. And here I found the next neighbor, *manacle*: "a device for confining the hands, usually consisting of two metal rings that are fastened about the wrists and joined by a metal chain." Now you know what management is. [laughter]

However, ladies and gentlemen, this was the old paradigm. If you remember, in that conference, three times the following thing was uttered: "Whenever we start to manage, we must increase the degrees of freedom of the system to be managed." To be clear, what has been presented by these people is a complete reversal of that description or definition of management which comes from the old ages of the early paradigms. So we are already within

the new paradigm, where we would like to see how do we increase the possible choices of the system to be managed.

Now, after having pointed that out, and looking into the richer interpretation of management, I will now make my identification of the concept of management with the biological concept of cognition. I say the managing act is essentially a cognitive act, clearly, because in management you have to do two operations. The one is the sensation, the perception, and the cognition of the state of affairs as they are being seen. The second one is that you act upon them in order to either redo them, undo them, overdo them, put them together, order them, whatever you have. So, if we consider now management as a cognitive act, we have to consider now what is cognition. Now cognition, of course, is a monolithic concept, and the necessity arises now to break down that monolithic concept in such a semantic form that is accessible to our conceptual tools. And this is what I should do at the moment. I make a proposal. May I have the next slide?

I propose, again, to interpret cognition as "computing a reality." Cognition is computing a reality. You might be a little bit shocked by the concept of computation. I would like to assure you that computation is not at all associated with purely numerical quantities. Computation comes from the Latin *com*, together, *putare*, to contemplate. So computation means to contemplate, in concept, several things. So a computation is to contemplate things together, different kinds, and then drawing a conclusion, generating new insights, and things of that sort. So computation is a very, very general expression for all reorderings, rearrangements, changes, things of that sort. That we call a computation.

Now computing a reality might strike some of you as very funny. First of all, "Why *a* reality? This is an indefinite article. How can you do that? There is just *the* one reality! We are just looking out and there it is, yeah? Pinch my nose and here we are." Now but in the mean time, I think, ladies and gentlemen, the idea that we are talking about realit*ies* has so frequently been presented today that I do not have to press that point at all. The point is, of course, the reality of a Navajo, the reality of an Indian, the reality of a multimillionaire, the reality of a slum-dweller are quite different realities. And this the computation of such a reality. Now one may, of course, argue very clearly, for instance, "Dear Heinz von Foerster, you are not computing your wristwatch here. You are not computing the galaxies. What you do is, perhaps, you are computing a description of these things." And I yield. Now may we have the next slide, please?

And my proposal is I would now give in and say: computing descriptions of a reality. Now if we have descriptions of a reality, then we are exactly where we were yesterday, when Don Michael was talking about the myth. This is what we are doing: we're computing myth of a reality. They

are computed, and therefore you have various myths. Now if you turn to neurophysiologists they will tell you, “Oh, well if you look here, the retina is of course the first sensory element. There are rods and cones. They probably compute a description of the image which is being projected on them. Then immediately the neurons take over; they compute a description of what they see on the retina, and then they compute on the bipolar cells of the description of what they see and then they... [talking faster, intentionally babbling and becoming incoherent] lateral nuclei… et cetera, et cetera.” You get descriptions computed again and again and again and again. In order to account for that, we come to the next slide.

I propose we have a condition: if computing of descriptions of descriptions of descriptions of descriptions of descriptions in an infinite recursion. Now the interesting thing, what you have here, is that, first of all, reality is gone already, *ja*? We have not to worry about it. Reality here is embedded in the recursion itself, which suggests to you that reality is not to be confused with apples, with chairs. Reality is something else, has a different logical structure. In most of the cases, I hear people speak about reality as if they are chairs and apples. Reality has a different logical structure. Now of course, computing descriptions can be wrapped up, of course. A description can be considered a computation. May we have the next slide? And then, of course, we have cognition as computations of computations of computations in an infinite regress.

So, to wrap it up, next slide, we have now to be concerned with recursive computations, or, if you wish, next slide, management of management. This is a second order concept. Recursive management. This was the point which was made again and again and again during this meeting, namely that the manager is to be part of the system he manages. And this is indeed exactly the thing that takes place in living organisms—that they are their own managers, there is no something that manages their whole system. It manages it all the time. Therefore, it functions. It is a heterarchical organization, and no hierarchical organization.

Let me do, now, a brief for those who are interested in the more formal expression. Let me do a very brief excursion into mathematical formalism, because some of you may immediately catch on to what it is, and will be highly amused by that, what happens when you consider what is called recursive function theory very seriously as that conceptual tool to handle problems of that sort. May we have the next slide. Here, I show you the very simple concept that we have a function, y, which is the result of a transform on a variable x_1. t is a function, any function, squaring, cosine, sine, whatever, or a more complicated function. $t(x_1)$. Now if you have a recursive operation, then x_1 will be $t(x_2)$, and then x_2 of course, in the recursive operation, will be the transform of another variable, x_3, and so on and so forth. And finally, you have then this fabulous expression, where if y is equal to the transform on the transform on the transform on the transform… and I have to go on to go here.

Interesting, please note, that the so-called independent variable here, the independent variable is gone! It's not here! It's the reality, computed away by a recursive computation, yeah? Now the interesting thing, however, if you have this expression, infinitely long, in the following form, it can be solved, that thing. Of course we can solve that equation; it's very easy. Because this is an infinite sausage, clearly. But so is this the same infinite sausage. You see that? From here that's the infinite sausage, *t* of *t* of *t* of *t*, now I'm starting here, and say *t* of *t* of *t* is exactly the same infinite sausage. So I can replace this infinite sausage by *y* itself. Next slide. Therefore *y* is *t(y)*. And solve for *y*. The sum of these functions, which have a solution, that are stable, some of the functions, which do not have a solution, they are "instable." And I have put a little bar on top of those things to say these are the values for which solutions exist. $\bar{y}$, $t(\bar{y})$. This is a "self-function," if you wish, an eigenvalue, an eigenfunction, an eigenoperator, the German word of *Eigen* has been used, has been brought in from quantum physics and wave mechanics, the eigenvalue of the Schroedinger expression and things like that. The eigenvalues are the stable values, the self-values, the computation of the self of that recursive system which computes itself.

Now, some of you who have little electronic pocket calculators can play that game of stable eigenvalues. For instance, take any arbitrary number in your pocket calculator, put it in, take the square root of it. Take the square root of that, take the square root of this, take the square root of that, and what you get is, of course, a smaller and smaller number until you reach 1, and 1 is the eigenvalue of the infinite recursion of square root operation. And that you can do if you have .000001 and you take the square root, you go up, you go up, you go up until you are 1. So one is a stable value with respect to the transform which is called a square root. And so you can have many others. The next higher level is, of course, that you are not talking about functions with eigenvalues, but operators with eigenfunctions, and then meta-operators with eigenoperators, et cetera. For instance, mathematically inclined members of this group may appreciate that the exponential function is the eigenfunction for the differential operator, because if you differentiate into the power of x, what do you get? e^x. It is exactly the same situation. So you can go up to higher operators. Now, with this slide I am through with my dissertation of the circular computation, and we can take that off. That slide can go off and we are through. We are through. Lights out. Lights out. Good.

I would like to draw your attention also to one other little item which might be of interest for the very, very systems, large systems, complex systems engineers here. The eigenvalues here clearly demonstrate a type of stability which you do not get in the usual way of differential equation approach, where you are looking… maybe you have simultaneous differential equations, you look for a stable solution for those. We got them at the first lecture with the cycles and all the things, et cetera, et cetera. The logical type of the eigenvalue stability is an

entirely different structure, and I will not go into this thing. I will leave it to you to play around with that, but you will discover it for yourself. The logical type of the eigenvalue stability is of an entirely different kind than the type of solutions which we got in our first lecture, which are also falling into that as a subset. But the other things are of much, much larger complexity and can be used in an entirely different form.

With this, I think I have come to an end to my point number two, where I was promising you I will give to management a biological interpretation by calling a managerial act a cognitive act. Now we understand cognitive acts are recursive computations in which, in some instances, stable states of affairs are reached, and in some other cases, instability shows up and boom the whole thing goes. We could show, also, very interesting cases of what is called multi-stable states or, as Ashby called them, another category of the polystable states. And again, there are interesting algebraic relations where you can build up a more and more complex system by nonlinear compositions of such stable points. Now, with this little excursion, I would like now to go back to my main thread.

My main thread now runs into point number three, where I said I would like to draw managerial and ethical conclusions to what has been said during this conference. Now I think, if you wish, you could say that the old paradigm was the management of observed systems, and the new paradigm that is coming about is the management of observing systems, which is now including, of course, the observer into the whole concept of recursive management. There is a beautiful parallel presented by Gordon Pask, the British cybernetician, a delightful character. If you do not know of his papers, I would strongly recommend you read Pask, it's delightful. Gordon Pask makes the following distinction: he says there are two ways of an interaction of the observer with the system. The one is that the observer is incurring the system by determining or by stipulating the purpose of the system. The observer is incurring into the system by stipulating its purpose. The other, the second order management, is that the observer is entering into the system by stipulating his own purpose.

And if we consider the management of social systems, then this is one of the crucial points one has to consider. Because if we do not allow the observer to enter the system by being allowed to stipulate his own purpose, then it will be the system that is going to stipulate his purpose. That means, in other words, what you will get is the preparation and the excuses for all those who say, "I am not responsible for my deeds. It is the other chap who told me what to do, who ordered me what to do." You switch from an autonomous system, where the actor is responsible for his action, to a heteronomous system, where you make always the other one responsible for your action. And therefore, with having brought in with your autonomy and self-management, the concept of responsibility may have exactly reached the last level, the

ethical level. And that is, of course, that we may ask what is ethics and in which way has it to do with these problems, and they are quite clear.

Ethics, as you all know, is a conceptual machinery to compute morals. And morals are managerial devices for behavior. So ethics is a general theory of management. Follow? Morals tell you always what to do, *ja,* and then, you know, what's a good boy or bad boy, good girl or bad girl. Now, in the ethics of the old, you will find that it computes pre- proscriptions, in the sense of do-nots. It always tells you what not to do. Thou shalt not X, Y, Z. Thou shalt not X, Y, Z. That's the old paradigm. The new paradigm is, of course, prescriptive, by that you say "do" and not "do not." These are quite different ethics, and I would like to contemplate that. Now anyway, therefore, I would propose the new managerial, categorical imperative, which is a "do" imperative, which says, "Act always so as to increase the number of choices."

With this, I think I have come to the end of my formal part, and since I am the last speaker on this panel, I would like to express the great gratitude of all of those who have been so kindly invited to participate in this conference, to this outstanding management of this wonderful conference. Thank you very much. [applause]

HOST: I don't think there's any way I can say anything to properly follow up the hour we've just spent. I think we will have a short break and then have a panel discussion, where you can raise questions on this and the other talks. And I hope you will be here to participate and we'll have a very active discussion. So we'll have a fifteen minute break while we rearrange the… [crowd chatter in background] no, we don't have to... We'll be back here in… we'll resume in fifteen minutes. [background talking increases; program ends]