Even more than life itself: beyond complexity

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Abstract

This essay is an attempt to construct an artificial dialog loosely modeled after that sought by John Maynard Hutchins who was a significant influence on many of us including and especially Robert Rosen. The dialog is needed to counter the deep and devastating effects of Cartesian reductionism on today's world. The success of such a dialog is made more probable thanks to the recent book by A. Louie. This book makes a rigorous basis for a new paradigm, the one pioneered by the late Robert Rosen. If we are to make such a paradigm shift happen, it has to be in the spirit of the dialog. The relationship between science, economics, technology and politics has to be openly recognized and dealt with. The message that Rosen sent to us has to be told outside small select circles of devotees. The situation has even been described by some as resembling a cult. This is no way for universal truths like these to be seen. The essay examines why this present situation has happened and identifies the systemic nature of the problem in terms of Rosen's concepts about systems. The dialog involves works by George Lakoff, W. Brian Arthur, N. Katherine Hayles, Robert Reich and Dorion Sagan. These scholars each have their own approach to identifying the nature of the interacting systems that involve human activity and the importance of identifying levels of abstraction in analyzing systems. Pooling their insights into different facets of a complex system is very useful in constructing a model of the self referential system that humans and their technology have shaped. The role of the human component in the whole earth system is the goal of the analysis. The impact of the Cartesian reductionist paradigm on science and the related aspects of human activity are examined to establish an explanation for the isolation of Rosen's paradigm. The possible way to proceed is examined in the conclusion.

Introduction

I never met A. H. Louie even though I have the utmost admiration for what he has done. The book *More than Life Itself* should be a science best seller (Louie 2009). It is a monumental work. I say that with a very strong belief that it will have the same fate that the monumental works of Robert Rosen (1985, 1991, and 2000) which has never been given the place they earned in the body of knowledge we look to for our understanding of our world. Therefore I will try to answer the "Rosenesque" question "Why are these works given so little attention?" in this chapter. To do that I will need my own version of what Rosen did when he adopted the Metabolism –Repair (M-R) model (Rosen 1972). My model is not going to be dressed in the elegance nor carry the rigor of category theory. Why should it? What could I possibly add to that area after Louie produced this magnificent book?

No, that is not what I feel is needed now. Rather, I want to go back before Rosen to a man he was very much influenced by and whom he admired very much, Robert Maynard Hutchins. He wrote some wonderful things about Hutchins in the early parts of *Anticipatory systems* (Rosen 1985). What I want to resurrect from Hutchins is the notion of the *dialog*. Hutchins saw science in a way that Rosen understood and this, I believe, contributed to Rosen's work in some fundamental ways. His view required that we integrate our compartmentalized knowledge to regain the insights lost when the relationships were destroyed. Only then can the influences of one area of thinking on others and the self referential influences that return to it from them can be appreciated. However, for the reasons I will put forth as my answer to the question above, the dialog has effectively died. Something else far more powerful has replaced it. The specter of Cartesian reductionism is haunting our world.

In order to make what I just asserted as clear as possible I'd like to construct a dialog right here. It will consist of a limited number of contributors, but they have been chosen for their very special insights into the answer to my question. Not that they did this directly, but rather that they did it because they saw a part of the whole of which I will try to give an ever more extensive view.

The other members of this dialog are George Lakoff (Lakoff 2008, Lakoff & Johnson 1999), W. Brian Arthur (2009), N. Katherine Hales (1999) , Robert Reich (2007) and Dorion Sagan (2007). What they have done is unique yet that tells you nothing. So we are already confronting the problem Rosen addressed so well even though, as I will show you, he saw only a part of the whole himself. We need to talk about their contribution and their credentials so we are forced into the practice that is basically an antithesis to the dialog, namely putting knowledge into boxes. Nevertheless to try to give you a forecast of where we will be going on this trip, I'll try to introduce them and their fields of expertise.

Brian Arthur comes from the field of economics and was heralded by some for introducing complexity based notions into the field. Among them are the notion of lock-in and increasing returns which caused some discussion in that field. His book *The Nature of Technology* (Arthur 2009) is a very interesting study of technology and will be of some help in formulating the answer to the question.

George Lakoff's field is Cognitive linguistics but much of the applications of his ideas have direct bearing on the political life of the United States. In particular, he sheds light on one of Rosen's most profound lines of thinking, the way we talk about causality. He also has an approach to philosophy that recognizes the interplay between the mind and the body that "houses' it. Rosen had much to say about this and when we put their ideas together we can find many important ways to go forward. Lakoff, like Rosen, has many books written developing his central theme. Like Rosen, his ideas reach beyond traditional boundaries and therefore reading his work takes the patience of one who understands that deep ideas are networks of interconnections that can not be strung out in a line as is required by our language.

N. Katherine Hayles has written one of the most thorough historical analyses of how we came to be where we are now. Her assertion that we have become “posthuman” and the influence of Wiener’s cybernetics are a welcome addition to our dialog,

Robert Reich has captured the systems nature of economics in his concept of “supercapitalism”. He takes the operation of the economic monster beyond human design and conspiracy to a systems level befitting what Rosen taught us about systems.

Last but not Least, Dorion Sagan creates a vision of the world never realized before. Probably far more in tune with the modern posthuman world than any of us he asks important questions that go beyond the scope of this essay. However his view of the earth system is very close to my own and I introduce that by reference for all to study,

Worldviews, models and levels of abstraction

Here at the beginning of this essay it is necessary to look at whole things before we attempt to see parts of the analysis. So we will start at the top. Each of us is, among other things, one of Rosen’s “anticipatory systems”. This is true at least in the sense that we carry a model of our world in our minds. The other attribute that Rosen required of these systems is that they act in response to what their world model tells them. At this point in history many of us question whether or not that is really true of us. The model we make and use is ***never*** the real world. Rosen used the modeling relation to model this. I will go far outside of the carefully laid down context in which he made the modeling relation. I want to go as far as to the very world view we use to replace what is really our world. We will never know that world but by shadows so the model becomes very important as a surrogate world. Rosen dealt with this in the limited context of science, in particular, physics, and taught us that the world of the physicist is a surrogate world.

Here we have a second aspect of reality that will come up again and again. If our model of the way we make models is not accurate we have a problem that, among other important things, involves circularity (Mikulecky 2007 a & b). We are going to have to accept that this idea works for us. Its essence is that we map observations from our sensory input into formal systems which we can manipulate in our minds. We carry out these mapping in a manner that is unconscious much of the time as Lakoff has demonstrated, but we even formalize that as if everything were conscious. Once we have made a manipulation, the result is again compared with sensory input and we make a judgment about how well the formal system matches the way the sensory data changed. This is the very best we can do. The process is loaded with subjective mind activity and other mind manipulations that we understand poorly. Lakoff’s work begins to reveal just how messy this whole situation is. The combination of physiological and psychological factors that act upon the sensory input before we try to encode it into a formal system is just beginning to be understood. I will venture to say that it never will be completely understood. Our entire history is also a factor here. It is all too easy to design experimental situations that demonstrate the dependence of sensory perception on learning. So called “magicians” are often as schooled as scientists on certain aspects of this if not more.

Clearly there is a danger in moving away from the limited context Rosen used to make his points. On the other hand, unless we try the whole legacy becomes locked in that context. That is something he made very clear. In that context the fact there are no largest models begs us to go beyond and try to extend Rosen's insights to a total world view that encompasses at least all of the earth system we call home.. As we broaden the context it has to be even more true that more models and ways of interacting with the world have to be taken together to see more than a few facets.. We must remember that there can be no largest model. However, to the extent that this idea of how we operate in the world was useful in the context Rosen defined, it suggests that we can use it to broaden that scope.

My main point here is that we make models at all sorts of levels of abstraction. Rosen's M-R system models were an abstract way of dealing with myriad of processes and functions in a living organism without needing to understand the details. Louie has helped make this a rigorous scientific accomplishment. At that level of abstraction and in the context of those models we have had our own world view broken open and we can deal with the question of life as a well posed question for the first time(Mikulecky 2000). The mappings in the modeling relation at that level of abstraction in that context are deemed to be well suited to make it a useful model. What are its uses? They, in fact, are useful for answering the important question "Why are organisms different from machines?" in the context of M-R systems and beyond to the extent that the formal M-R system commutes at that level of abstraction.

This, in my experience, has been the source of very much confusion. It is reasonable to assume that Rosen devised the M-R model for simple organisms and was concerned with using it as a way of dealing with the intractable "What is Life?" question Rosen (1991). The level of abstraction was clear although in the 1972 paper (Rosen 1972) he laid down a broader systems approach defining the abstract input-output diagrams and showing how they analogue the more rigid version defined by the reductionists for machine like models. Not until he wrote *Life Itself* (Rosen 1991) did he actually define the machine in causal terms. It was there where he developed the category theory formulated syntax and the accompanying semantics to its fullest. Since then there has been speculation and discussion about how the M-R model relates to all the rest of biology and, in particular, how the M-R "organism" relates to other organism in an ecosystem, etc. My answer to that is that it does not. The abstract M-R "organism" is a model created to answer a very important question, not a working model for biology.

I have asserted that the reasoning that produced the M-R model could be adapted to other levels of abstraction especially the level of the earth system or as some say Gaia (Sagan (2007). This assertion is very controversial yet it has led me to a number of valuable advances in my own thinking and I am now ready to reformulate this whole idea in terms that should be more acceptable to those who were justifiably critical of my original sketch.

The earth system and the M-R system organism

The essential difference, among many others, between the earth system and the M-R system organism is the inclusion of one very important component in the earth system that adds something the simple notions of metabolism, repair and replication can not represent. It is this extra component that makes the earth system far more interesting. Before discussing that additional component, it is worth reviewing what it means to try to apply the M-R model at this level of abstraction. I believe my initial analogy is sound in this respect. The notions of a "metabolism", a "repair" system and the replication of functional components in the original M-R model are all there and clearly manifested in very different forms from the Rosen organism. The diagram, the syntax, that was created for the abstract organism is clearly less than complete for the earth system except for an illustration that such a closed causal set of relationships can be identified at this level. That is important because it establishes the distinction between an "organismic" model of the Earth System and the reductionist's machine like model. My sense of what much of the discussion about climate and global warming bogs down on is exactly this point. Too many scientists are too ready to apply machine centered reasoning to the earth system and this causes problems for them .The discussion quickly degenerates to one Hutchins warned us about so many years ago. We end up measuring and counting rather than reasoning. He once quipped something about a Social "Scientist" as being one who found significance in counting telephone poles.

I just introduced the component that does make the earth system far more difficult to understand than the organism, namely the fact that the earth system includes humans and the products of their actions. Rosen was a student of Rashevsky (1954) and certainly was interested in problems of a sociological nature. Rashevsky believed that the new "relational" approach would help us understand systems at that level of abstraction as well as it did the lower levels.

The problem is complicated because, as those of us who have been convinced by Rosen that there is a severe limit imposed on our thinking by Cartesian Reductionism should understand quite well by now, the effect of reductionist training and the framing of most of the important questions and ideas in science has profound and lasting effects many of which are invisible from within that world view. George Lakoff's work on framing comes to pour aid in a big way here (Lakoff 2004). Most of the barriers to breaking free from the Cartesian Reductionist world view have been pushed to a level in our minds that is not conscious. It is quickly triggered by simple words or phrases that we respond to without conscious choice. And here we meet the most severe challenge to making progress. Lakoff questions the value of trying to progress politically if we are locked into an 18th century enlightenment world view (Lakoff 2008). The disembodied mind, the myth of objectivity, and so much more are baggage we have to be able to shed (Johnson and Lakoff 1999). As I mentioned above, the modeling relation was where Rosen hit us hard with this reality. The only part of our models that is free from operational subjectivity is the formal system we use as a surrogate for what is out there. If we examine the formal system carefully we will find that it too is "tainted" by subjectivity in many ways. One of the most obvious is that it was chosen by its user in the first place.

The modeling relation is not widely taught in science. Most people are puzzled by it when they first encounter it, usually while reading Rosen. I have a presentation that deals with this problem at some length. I'll summarize by stating that one of the most powerful things that the reductionist world view has accomplished is to convince us that we need no modeling relation. There is a largest model that is simply the reductionist paradigm superimposed on and replacing reality and that ends it! No encoding or decoding between formal system and our perception of the world are necessary. Once that idea becomes a part of our world view, the Rosen approach seems to bring in things that are necessarily outside science. Lakoff's work on framing is a necessary study if you really want to get the full impact of this.

Among the reasons it is so important is the recognition that none of us are outside this deep structuring of our own worldview. We may have learned about it from Rosen, but we have not erased it from our being. Thus when we consider the validity of using the semantics from the M-R system at higher levels of abstraction we have problems.

Closed loops of causality and their meaning: impredicativity, self reference, ambiguity and technology.

The essential nature of these features of real systems is dealt with magnificently in Louie's book. I will merely try to augment what he shows so clearly in formal terms using syntax and semantics with some additional semantic attributes. I will point out, at the risk of knee jerk rejection, that this is in the spirit of postmodern thinking (Cilliers 2000). It is my narrative. The impact of knowing that these structures are part of models of the real world is very far reaching. The whole notion of a complexity of the real world that escapes the tools of the reductionist and is outside their surrogate world is revolutionary in nature! As Louie establishes with great care and rigor, formal systems with these properties are not simulable. This has profound consequences and is the basis for Rosen's many comments about the "hard science" vs. "soft science" relationships. These relationships have more and more tended to cause the analysis of complex reality to be replaced by a set of simulable machine like models. This is the worst possible way to avoid the true nature of a complex problem and it also enables us to remain ignorant of the fact that this is actually what we have done. These ideas are not unknown. They have been expressed in many ways. What is new is that we now have a means for demonstrating this to the harshest reductionist skeptic using methods that are the best available to them. The only remaining problem is to get them to look at it all with an open mind. If one needs a demonstration that scientific "objectivity" is used selectively, this issue is it (Mikulecky 2007b). This point will arise again as I develop this thesis and it will, in fact, be a self referential aspect of what we do. More on that later.

If we were to create a causal diagram for the earth system there would be one closed loop that would not resemble the loops in the M-R organism. This loop would entail the products of human ingenuity loosely called "Technology". This loop in particular is a very difficult one to assign a simple structure to. Human activities are also difficult to diagram since they are so diverse. Embedded in the earth system they are a special part of the biosphere. They consume, they prey upon other members of the biosphere, they plant and farm, they pollute, and so on. A few import aspects of this all can be singled out to try to simplify the matter, but in this case any attempt to reduce the system is difficult at best. Nevertheless, without trying to achieve anything close to the rigor of the M-R system, we can utilize its semantics in spite of a syntactic void.

Human activity in the Earth System: A system within the system

Human activity in the Earth System has one very obvious and outstanding characteristic: It grows without apparent limit (Hales 1999). This growth consumes resources and produces waste like other members of the biosphere yet is different in its character. Among the many important differences one stands out in the context of this discussion. The ingenuity of the human mind is unique among the members of the biosphere. Humans are capable of sensing things about the rest of the system and responding to what they learn in ways that the other members can not even approximate. Individual species in the biosphere demonstrate remarkable ability in this respect but always in a very limited scope. Humans, on the other hand, often are able to learn from them and mimic their ability in some way.

As a "self organizing" component of the biosphere, human "evolution" proceeds at a rate that is phenomenal when measured in terms of its impact on the whole system. It is also phenomenal in terms of its ability to organize itself. Its organization has been characterized in many ways but there is a focus here that takes us right back to Rosen's arguments about science and the question posed at the beginning of this essay.

The main propositions

The first proposition I will try to defend is this:

> Only those aspects of science that enable the existing system to continue to grow are incorporated into the system. All the others are given a special place that allows them to continue but makes them impotent to change the system in any significant way.

This needs quite a bit of elaboration if it is to even approach being defensible. First of all, why are these aspects of our activity tolerated at all? If, for example, Rosen's ideas were understood and adopted on any significant scale, the world would change. Rosen know this and he went into it at some length in his taped interview in 1997.
(http://www.people.vcu.edu/~mikuleck/rsntpe.html)
Rosen was quite candid in his estimate of the very low percentage of people who actually understand his ideas.

Given that, it seems our job is to go forth and spread the word. Some of us have tried very hard. The spreading is not proceeding as fast as we would like, to put it mildly. The reason I have come to the point where I will try to do the self-referential task of using these ideas to analyze why these ideas have had the small impact they have is because for me it is not the first time. I have also been involved in a large project within the Cartesian reductionist paradigm that has had a similar fate. Network Thermodynamics (Athans et al 1974, Blackwell 1968, Branin 1966, Brayton 1971, Breedveldt 1984, Cruziat & Thomas 1988, Mikulecky 1993 &2001, Oster et al, 1971 a,b &c, 1973 a&b, 1974, Perelson & Oster 1974, Perelson 1975, Peusner 1970, 1982, 1983 a,b & c, 1986 a & b, Peusner et al 1985 is a huge body of knowledge that has both theoretical and practical implications that go far in revolutionizing reductionist simulation and the core understanding of thermodynamic theory. Curiously, the work done in that area produces examples of how a whole quickly can become more than and different from its parts, among other things. It uses relational concepts to provide a metric for the energy/entropy spaces that is common to all realizable systems. (Caplan, 1966, 1968, Peusner 1985c, 1986b). It extends the elegant Tellegen's Theorem (Tellegen 1952) from electronics to all physical systems. It recasts Onsager's (1931 a & b, deGroot and Mazur 1962) seminal, but inadequate, work in terms that demonstrate clearly that most of what Onsager (Onsager 1931 a & b, deGroot & Mazur 1962) discovered was because he was dealing with the topological properties of connected networks and not because of the very strained statistical mechanics he was forced to use. The very deep papers of Oster and Perelson casting chemical reaction theory in a form using modern nonlinear mathematics are largely unknown (Abraham and Marsden 1978, Abraham and Shaw 1982, 1983, 1984, 1987, 1988, Oster and Perelson 1974, Perelson and Oster 1974), I mention all this to support my claim that there is a very stable system that encompasses our scientific world as an integral part and actually does a subtle but effective job of controlling it. I could go into detail about a myriad of examples, but that is not what we need. We need to understand this in the context of Rosen's ideas about systems and their nature. We need to understand this in terms of the causal network of interacting functional components and that brings us back to the semantics of the M-R system and its application to the Earth system as whole. That brings us to another proposition:

> The human aspect of the earth system, which is stable in a very special sense, has produced functional components that have their short term stability locked to their ability to help the whole system grow.

This idea is new as far as I know. Normally system stability is defined in terms of stationary states or something close to that. Even in stationary states there is a measure of their activity that grows, namely the total entropy they have produced. The human activity in the earth system is very different. Humans have organized their economies and their way of existing to maintain their dominance within the earth system. They have learned to reproduce and increase their numbers with some loss but an overall gain in numbers. Even wars, natural disasters and disease are not able to curtail this expansion. If it were a matter of mere numbers this essay would never have had come to mind. Along with the increase in number there has been an increase in the use of resources and the production of waste that is amplified many times. This is where the work of Brian Arthur (2009) helps us see another systems level aspect of the human contribution to the functional components operating within the earth system. He has an entire book devoted to the nature of this activity and its evolution. He is also in tune with the problem of context dependence and levels of abstract when it comes to technology. For our purposes it is his abstract notion of technology that tells us the most. He also has a question he wishes to answer:

> Do technologies –individual ones- share any common logic? In particular, do they share any common structure in the way they are organized?

I'd say he has a problem in posing the question this way. The problem is that he is trying to describe technology in isolation. As I have pointed out in the development so far, the issue of technology is tied to the issue of system stability and its requirement for growth. The nature of technology as is the nature of science is very dependent on what it provides for this growth process. For a particular example we can consider modern consumable electronic technology which is developing rapidly because of the economic drive. People are making money with it. It has functional significance that changes human activity and the frames that the human mind uses to operate on a day to day basis. The money it generates on the market goes back, in part, to making more technology and so on.

There is an aspect to all this that is very hard to pin down. The lock in phenomenon Arthur developed in his earlier work is neglected in his present work and yet it is central and manifest in a way that is different from the original formulation. How easy is it to deliberately replace one technology with another? Often it is next to impossible. Arthur described lock in terms of inferior technologies winning a competition because of timing and circumstance. Among his examples was the QWERTY keyboard the VHS video tapes and the gasoline engine. I won't go back over the specifics of these examples for my point is merely that his examples establish a feature of the large system technology is embedded in. It is also an economic system and also a system driven by human consumption patterns that are far from rational.

What Arthur does not explore that Lakoff focuses on is the political side of all this. The ability to decide what gets marketed and what does not is part of a system that yields to powerful influences among humans and the game is fixed. If that is so the same must be true for science and technology. Hence my assertion that only that science and technology that helps the system grow has its causal roots in the ability of factions to control what new science and technology will be called upon to contribute to the scheme. Certainly an idea that interferes with the ongoing flow of goods and services to produce wealth for a select group is not going to be supported. If it becomes threatening enough to that process and suggests changes that will undermine vested interests, it will be discredited and its impact made artificially questionable. I would venture to say the areas involving global warming, pollution, and energy consumption fit this category.

These are not laws as we have them in science. System stability need tot require that these things always happen. It merely requires that they happen often enough to preserve the wealth and power relations for those who benefit from them. Yes I have now stepped beyond the boundaries of "good science". I merely suggest that those boundaries are also a product of the very system we are contemplating.

A picture begins to emerge here that is very hard to accept because it does relate science to its benefactors directly and does acknowledge some of the findings Arthur comes to in his study. He spends quite a bit of his thinking looking at technology as an evolving process. It is here that we get the real insight to the link between his ideas and those I put forth in this essay. Let us look at some of his thoughts on the "mechanisms" of evolution.

He refers to the collection of technologies we now have including those that have faded out of the picture. He speaks of "self –creation" and autopoiesis and the creation of technologies from existing technologies. He makes a simple observation: novel technological entities can only be made using methods and components already existing in the world. This is close enough to the cell theory in biology to be of interest. Cells can only arise from other cells. The causal relations here are different in that efficient cause in technology at some point requires human input. Cells are closed to efficient cause. Here is where levels of abstraction become very important. At some level in the earth system, the human component is inside the system and now in a very real sense we have causal closure. The system "technology" at its most abstract level contains the human source of efficient cause. More than that because of the influence of economics and politics the human activity is no longer free to be anything the human mind might dream about. Lock in at the economic market levels becomes analoged by lock in at the systems level.

Arthur shows he has the spirit of the systems idea when he says:

> Of course, to say that technology creates itself does not imply any consciousness, or that it uses humans somehow in some sinister way for its own purposes. The collective of technology builds itself with the agency of human inventors and developers much as a coral reef builds itself from the activities of small organisms. So, providing we bracket human activity and take it as given, we can say that the collective of technology is *self-producing* – that it produces new technology from itself.

This is the point! There is neither grand conspiracy nor design. Technology has this nature when humans are involved. The question then becomes one of how possible it is for humans to perceive their role in this and consciously control it. The role and fate of science is deeply entwined in the answer to that question. George Lakoff has much to say about this when he discusses how the "political mind" operates:

> And what does cognitive science have to do with this? The answer is the cognitive unconscious- the system of concepts that structure our brains but that we can't see directly. Most of what we understand in public discourse is not in the words themselves, but in the unconscious

> understanding that we bring to the words. As Charles Fillmore has Shown, each word is defined relative to at least one conceptual frame . Those frames evoke other frames in the system. Understanding involves drawing out the logic of the frames.

Like Rosen, Lakoff's ideas are radical. They challenge the way we like to view ourselves as rational beings. The context for his analyses is the world of politics, but in the spirit of the dialog we are using these aspects of mind activity in a broader context. We could also argue that the answer to the question about the acceptance of Rosen's work is in the politics of science, but that is, in a sense, misleading. Even the concept of a "politics" separate from the whole of activity in the doing of science looses important relationships. We have recognized, with the help of Rosen's deep analysis of how we make models, that there is an entrance of our biases and our learned ideas (including Lakoff's frames) into the way we perceive sensory input at the very start. We have a circle here that is difficult to break. In a very real sense we see what we have been programmed to see. We therefore miss important aspects of what we look at.

Furthermore, as Lakoff points out, the very words we use to formulate our thoughts and to communicate are already heavily loaded with what we have learned. Is it no wonder that we have unconscious reductionist ideas even when we are struggling with all our intellectual might to free ourselves from its influence? Is it no wonder that many who read Rosen assign the old semantics because new ideas can only be introduced slowly and with difficulty through metaphor?

Thus technology is not something as carefully designed and controlled as we like to think it is. It is often postulated that if the human mind can conceive a technological advance it will come into being. This has been true all along. Genetic engineering, atomic bombs, etc have been challenged on moral grounds yet they always come into being. Once a technological advance occurs it can be put on the shelf. This happens when its impact threatens the system's status quo and existing patterns of benefiting interests that tend to control it. We have struggles between factions that want clean air and climate stability and others who see these ideas as a threat to their self interest. That seems like the whole of it but it is not. Both factions muster scientific agents and cull out the observations that fit their model. They also find ways to discredit their opponents. The wonders of the genetic apparatus are revealed only to be patented rather than offered to the community at large. There is clearly an economic component to all this. All these features of the system are seen as conscious choices by humans who seek certain outcomes. However, if we are to use Lakoff's ideas as we have thus far then we are obligated to adopt them as a whole. If we do that then human activity is far less conscious than that. Here's a glimpse of what he has to say based on cognitive neuroscientific research:

> On the other hand, most of us think we know our own minds. This is because we engage in

> conscious thought, and it fills much of our waking life. But what most people are not aware of, and are sometimes shocked to discover, is that most of our thought-an estimated 98 percent-is unconscious. . It is below the level of consciousness. It is what our brains are doing that we can not see or hear. It is called the cognitive unconscious and the scientific evidence for its existence and for many of its properties is overwhelming. Unconscious thought is *reflexive*- automatic, uncontrolled.

Rosen's ideas about what he sometimes referred to as "systems hood" (Rosen 1986) is implicitly built on these aspects of human brain function. His understanding of what makes the whole more than the sum of its parts is crucial here. The parts are what we readily identify in any system. What is more difficult is the very heart of any system,-its functional components. We can only see these in the whole system. They only are defined in that context. We see them in terms of what the system does rather than what we think it is.

Thus we can see technology as a systems property if we focus on what it does. It involves human activity but that is also a systems property in that it has been structured by the history of the humans involved and their unconscious mind activities that lead to supporting the system. That human activity in functional form is deeply involved in making available the resources for the creation of new technology and new scientific ideas. It also is involve din the decisions about what new science and technology is to be undertaken as well as what will be done with its outcome.

In our Cartesian world we single out another human activity that is the heart of the allocation of resources for the world of science and technology. That activity is economics. It is very clear that new science and technology in the forms utilized by the system rarely arise in poor countries. Wealth and economic growth are the requirements for this system.

Another voice in our dialog is that of Robert Reich who has a modern view of economic activity compatible with our systems view. He calls his facet of the system "supercapitalsim". His thesis is very much like the one I am developing here. There are functions in the world of resource allocation that are assuming a identity of their own and one which is clearly less and less under the control of human conscious thought. Here in the area where villains and conspiracy theories abound, a simple idea emerges. The parts do not matter as much as we have thought. Players can come and go. It is the functions that sustain themselves.

One example he gives links to a whole body of social thought. The notion also is part of the scheme of biological evolution and ecosystem relations. It is a rather simple and obvious idea that often fails to be acknowledged. It is this: In a stable complex system an agent can disappear and there will almost always be another to assume its function so that the transition occurs almost without notice. In biological terms evolution progresses to keep niches filled. Once they are filled the attempt to fill them meets resistance and is usually terminated.

The picture of the system is becoming more and more defined as we put these Cartesian parts back together into the whole that operates in a manner that needs them to be there along with a host of interactions that were lost to us when we took the system apart. Clearly these parts seem far less difficult to control when seen from the perspective of the reductionist. The system now needs to be redefined in terms of its functional components and then we someday might be able to construct a causal diagram. That is why the work of Rosen as developed by Louie is our best hope to see our world as the integral system that it is. At the level of abstraction we have reached there are still crucial links to other aspects of the earth system missing. The "model", should we ever make one, at the present level is incomplete without linking it to the whole, much as Rosen's organism standing alone is incomplete. Nevertheless the M-R conceptual framework does seem to provide grounds for elaborating a semantic part of the model without syntax to represent it. Such a narrative can be given another facet when the work of N. Katherine Hayles (Hayles 1999) is introduced to the dialog. In particular, her discussion of *reflexivity* is a very important facet of what the system is all about:

> Reflexivity is the movement whereby that which has been used to generate a system is made, though a changed perspective. To become a part of the system it generates.

Her assertion that we have become *Posthuman* has many implications not the least of which is that we have become part of a technological entity that has transformed our nature. Here is one aspect of what she means:

> But the posthuman does not really mean the end of humanity. It signals instead the end of a certain conception of the human, a conception that may have applied, at best, to that fraction of humanity who had the wealth and power and leisure to conceptualize themselves as autonomous beings exercising their will through individual agency and choice.

The picture Hayles paints is carefully researched and documented. It is a narrative that has much to offer to our discourse. The interesting thing about both this "post-modern" kind of narrative and the efforts of constructivism is that they, in a sense, resurrect the dialog of Hutchins by breaking through reductionist walls and allowing us to explore the connections between things the reductionists insisted on keeping apart. As soon as we allow this the world is a different place from that created as the reductionist surrogate.

This is the spirit Hutchins sought. Throughout his life the system moved away from his ideas. The reductionist philosophy was an integral part of the way things developed. It almost seems silly to have thought that it was possible to win acceptance for ideas and world views that exposed and sought to replace this highly successful paradigm.

That raises the question that must be asked of anyone putting forth a narrative such as this one: So where do we go from here? The answer should leap out at us, but it may not. The system is not asking for our ideas. It does not want them and certainly does not need them as it is presently operating. Can it go on this way forever? The limited capacity for it to behave as a real anticipatory system suggests that it can not. When crucial problems affecting large parts of the biosphere and threatening the survival of so many of its members including humans are capable of receiving the same effective total rejection as have the ideas of Rosen, there seems to be little reason to hope for a change in trajectory. Too many reliable analysts are questioning that direction of that trajectory. In Hayles very thorough analysis of how we became "posthuman" she concludes this way:

> Like many other pioneers, Wiener helped to initiate a journey that would prove to have consequences more far-reaching and subversive than even his formidable powers of imagination could conceive. As Bateson, Varela, and others would later argue, the noise crashes within as well as without. The chaotic, unpredictable nature of complex dynamics implies that subjectivity is emergent rather than given, distributed rather than located solely in consciousness, emerging from and integrated in a chaotic world rather than occupying position of mastery and control removed from it.

Conclusion: The dialog is a victim of the system

The dialog Hutchins advocated was not an intellectual exercise. It was a prophetic reaction to the ever growing dominance of Cartesian reductionism in all aspects of human thought and its subsequent impact on society. When Rosen was invited to the Center for the Study of Democratic Institutions a few decades later the issue was still not clearly understood. Rosen himself left us with an incomplete understanding of his own world view because he was so careful to write in a style that was aimed at convincing those who pretend to be objective and scorn subjectivity. Their charade is an honest result of the process. The self referential nature of all this is deeply embedded in the very things Rosen sought to put into an understandable form.

Now, some decades after that, the picture is fairly clear. The dialog can be artificially constructed from the fragmented works of the scholars who have seen facets of the whole. Moreover, had A. Louie been included in a real version of this dialog he would have provided the crucial work to put an end to all attempts to label Rosen's revelations as lacking scientific rigor and force.

In his taped interview Rosen gives a crucial insight into the process that would keep his ideas from coming to the place of leading the paradigm shift he required of the system. He describes having arguments in the beginning then the subsequent ultimate containment, being ignored totally. Yes a few of us have stuck with his ideas because we were convinced. We too were marginalized. This is no conspiracy; it is a system at a level of abstraction that prohibits the identification of heroes and villains.

Realizing the conditions for a real dialog at this point in history would require far more than sitting these scholars down in a room for some period of time. Each of them has the subconscious baggage that the system has given them as an integral part of their education and experience. The context in which such an event would happen is totally unsuited for such an exchange. We are here because the necessary conditions for the real dialog were gone almost a century ago when Hutchins tried to rally support for it. The fragmentation of knowledge and the conceptualization of that knowledge as a ‘thing” rather than a process was complete then. It still amazes me how difficult it was for Robert Rosen to go on and produce what he did in this system. It also amazes me that he could find and nurture students like A. Louie who now have carried the work to this crucial point.   It is now there for the entire world to have. The very tools that emerged from the reductionist paradigm are marshaled against the fallacies in that paradigm and can not be undone or refuted.

If I were to look to anyone at this point as a possible candidate for leading the dialog it would be George Lakoff. He has done more to establish the basis for future dialog than any one else I can identify. The understanding of our own mind workings he has provided and the systematic way he has developed for us to break away from the Cartesian framing that we all respond to unconsciously are the only ways that seem to come to grips with what has us bogged down.   For the visionary imagination I’d call upon Dorion Sagan.We need a rebirth of the dialog and we need it fairly quickly. Many of us are up in years and the world seems to be approaching crises rather rapidly when the time lag for any result we might come up with is considered. Hutchins knew that isolating science, especially if it isolated itself, would bring us to something like the state we are in. Any real reversal of the isolation has to combine science with all other aspects of human thought in the way that Robert Rosen pioneered. We could be on the threshold of a new era, but only if we act soon and we act totally and decisively. I hope that dream is realizable. Being forced into an obscure corner of history is not the place for the magnificent work we have had the privilege of sharing.   We are far from finished.

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