

Network Causality

I am writing this as a response to recent discussions centering on work by Deacon, Juarrero, and others. We seem to be at a point in history where the Faustian idea quoted by one of the “fathers” of network thermodynamics, George Oster, has come into play. The line is “When concepts fail, words arise.” This quote may be a self referential example of what I am trying to express with inadequate language.

When Robert Rosen died I went to his Daughter’s home after the short memorial service. I was given copies of his unfinished work. This was 1998 less than ten years after my book on Network Thermodynamics was published. One piece that was especially exciting was apparently a beginning of a next phase of his work. It had to do with networks of causality. It was merely a sketch with little detail. It seems appropriate now to reflect on why that might be a logical next step. I mention Oster and my own work in Network Thermodynamics because it is. In my mind, a missing puzzle piece.

Before I explain that, let me say that what makes me uncomfortable about the whole Deacon controversy is that it is getting us off track. Rather than a problem in who had what ideas first and who should have cited whom, the work needs to be seen in context. That context is complex in its own right. The self referential aspects of this discussion are an example of our problem (and a key to its resolution). To put bluntly, the creation of new words to try to categorize levels of abstraction and their proposed emergent properties is at best, a new form of reductionism. That is both good and bad for our minds work that way. The problem lies in the human trait to become the parent of ideas and then defend your children with passion.

Among the many things Robert Rosen made clear after he tackled these same problems over fifty years ago is that the result of the last wave of reductionist efforts has helped us but then became a prison for our thought. The crux of that prison was the notion that there could be a largest model and that anything falling outside the scope of that model was “unscientific”. If we have not learned anything else from this we need to understand the way Rosen broke free from the prison. He never proposed that his work would replace reductionist thought. He gave the only meaningful definition of a complex system that I know to this day. It stated that there could be no largest model and that if we could interact with a system in an infinite number of ways then we needed an infinite number of models none of which could be derived from the others.

It seems that the hidden agenda in the present attempt to go beyond reductionism is to find a new largest model. This is an understandable unintended consequence of the way we have been thinking for hundreds of years. It is there in philosophy as it is in science.

The recent works are laudable in their attempts to lay down some concepts about how things can happen in processes as complex as the mind or evolution. This might excuse an apparent lack of humility. However the problem is much deeper and the surface has merely been scratched. One reason I can say this with conviction is that there is a lot missing in Deacon’s approach as there is in the others. The result is that Deacon becomes one of the ten (or more) blind men describing the elephant.

Now to jump to the point. Oster and Perelson have two very important papers in the Archives of Rational Mechanics. They formalize their work on Network Thermodynamics with Katchalsky (who was, in my mind, a genius). Peusner (another genius) wrote books and papers on Network Thermodynamics that have revolutionary things in them. My own book on Network Thermodynamics is replete with computer models of sophisticated network model with applications ranging from molecular models to ecosystems and important contributions to cancer chemotherapy. I would love to rant about these findings for they

are very relevant to the discussion in ways that almost no one has noticed. Maybe I need to do that, but somewhere else. I want to extract but a few of the things we learned (but few others did) from that large body of (neglected) work. The irony is that we were in the heart of the beast and did things that even the reductionists had to ignore to keep their hold on the “largest model.” Network thermodynamics grew out of physical systems theory and is basically the way thermodynamic (main relational) reasoning can be married with hard core reductionist ideas to produce something more than the mere sum of those parts.

What was done was the use of the two ideas underlying electrical network theory, namely constitutive relations characterizing real physical components like resistors, capacitors, transistors, etc. with the topology of the networks in which they were connected. How dull; you may think. No because what we learned was very exciting. The key was the concept of “multiports” which represented **coupled** processes. These are the crux of how negative entropy, or organization gets produced in the real world. Every multiport was a description of interacting physical processes such as diffusion and volume flow in a membrane, for example. Coupling to chemical reaction made “active transport” transparent. Tissues like sodium transporting epithelia became easily modeled. These were examples of **emergence** in the most clearly reductionist setting one could have. The causal aspects were not looked at with the care they should have been for causal reasoning was relatively unknown to us at the time. What is clear now about all these models is the fact that they were not capable of being reduced to direct causal representations. Already the whole, causally, was far more than the sum of its parts.

Now to get to the point. What Deacon and the others are doing is inventing language ignoring these aspects of reductionist thought and throwing out the baby with the bath water. I am in no way implying that models of mind and evolution can be built with these concepts. I am saying that what they seem to attribute to systems at higher levels of abstraction and give names to have some very interesting counterparts in the reductionist world.

Now to what Rosen accomplished over fifty years ago. By creating a new kind of **causal** network he was able to formalize the concept of organism in a special kind of model using category theory. His abstract block diagrams were the escape from the reductionist prison for they allowed the use of function rather than physical objects to be the things modeled. In so doing he provided a very clean conceptual framework using representations that had their origins in the way we modeled physical networks.. The fact that our physical networks were able to exist at levels spanning molecular machines to ecosystems and had demonstrated emergent properties at all those levels in physical systems can not be swept aside. We were able to do this because we learned how to include topological relational aspects of the system along with hard core physical properties. Rosen left the physical properties out and made a leap forward. These ideas are very relevant and missing in the present discussion. It therefore is bogging down in apparent new ideas with lots of new words to characterize them. Things like this progress slowly and will come only from a multifaceted view of complex reality. Deacon will not give us a new largest model or will Rosen or will Network Thermodynamics, nor will anything else!