Natural Philosophy and Developmental Systems*

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Natural Philosophy is being revived by way of grounding it in thermodynamics and information theory. This discourse systematizes information from all the sciences so that every field of knowledge of nature supports every other as parts of a concept of general evolution. The point is to construct an intelligible picture of the world. Change in material systems involves both development and evolution. General evolution is primarily developmental, and the specification hierarchy of integrative levels can be used to model it. In this hierarchy, biology is seen as a kind of material system, and social phenomena as kinds of biological systems. This pattern implies there was a tendency toward psychology on the earth. This scheme is biased by having been produced by psychological, social, biological beings, integrating humans with the rest of nature, and so it embodies valuation. Natural Philosophy welcomes values in its constructions. There has never been a culture without an origination myth; general evolution, as constructed within natural philosophy, differs by referring to its own genesis within a picture of the genesis of the world.

NATURAL PHILOSOPHY

Currently we have the prospect of reviving a general systematic discourse that was marginalized in most scientific fields at the turn of the last century. I favor calling it Developmental Systems Theory -- alternatively, developmentalism -- but more commonly known today as General Evolution, which involves the idea of evolutionary progress. It is a continuation of the Natural Philosophy of Aristotle, Schelling, Spencer and Peirce -- which also influenced Marx, as well as Darwin (Richards, 1988, 1992). It is a theory of everything. It can be revived

today by being set upon new grounds -- namely systems science, thermodynamics and information theory (Salthe, 1993).

Natural Philosophy was, and should become once more, an attempt to derive from science discourses an intelligible understanding of our world, and of our place in it -- in short, a meaningful story of the world. From its inception it has had a developmental framework -- beginning with origins (as might be limned from the Big Bang theory, for example) all the way to endings (as might be derived, for example from thermodynamics, which is no longer a theory only of decay and destruction). Importantly, it features a role in the world for humans. Because of this it could be viewed as a competitor to established religions, but based in science rather than in ancient mythologies. Stress should be put on the descriptors "intelligible' and 'meaningful' here, and I hasten to add that these do not necessarily signify 'satisfying' or 'comforting'. It is more important to be able to fit one's life into the greater world, giving meaning to both, than to feel cozy about things.

Concerning the relationship of this grand theory to the currently hegemonic theory of organic evolution -- neoDarwinism (which all too many think of as *the* theory of evolution), the latter has a small, particular role in general evolution, namely to explain the adaptedness of biological systems to their local environments (Salthe, 1998). In this role it can explain only differences between closely related species. In respect to general evolution, the theory discussed in this contribution, neoDarwinism has been dubbed a form of 'special evolution' (Sahlins, 1960). Figure 1 gives a capsule history of various lines of development

of this way of thinking throughout Western intellectual history.

[Figure 1 goes about here]

This figure is a kind of archaeology of general evolution and similar conceptual orientations, showing their temporal occurrence in relation to each other. Personal names are in light type while driving ideas are in bold. The attempt is to show the deployment in Western thought of several ideas that are congenial with each other, not to show actual historical influences from person to person, as one would do in a history of ideas, although the latter would certainly be possible along any particular vertical arrow. This general discourse is defined partially in dialectic with another great Western thought pattern which rubbed against it right from the start -- what might be called radical historicism, and so this picture could be said to show only one half of the intellectual adventure of the West.

Unfortunately missing from this diagram are those who constructed the main sequence of stars in cosmology (see Terzian, 1999 for a brief recent view of this), and they ought to be added to Piaget and Kohlberg in developmental psychology, T.C. Schneirla's group in psychology, and to Marshall Sahlins in anthropology, as contemporary remnants of a formerly much more common way of thought. We can characterize this way of thinking as being driven by a desire to predict, which is why Francis Bacon appears here. In a deeper sense it is driven by a desire to understand, to have an intelligible story about the world we

inhabit, and about our own part in it.

Critics of this approach, who also trace back to Plato, claim that it always delivers an oversimplified picture. These are folks who look for details, mostly in hopes of gaining control over natural processes -- so-called practical folks, and specialists. They gradually disentangled most branches of science from the developmental mode of thinking throughout the Twentieth Century, and the process is still going on, for example, in developmental biology, where von Baer continues to be a target even now (e.g., Raff, 1996). It is clear that these two ways of thinking -- the synthesizing, systematizing way, championed here, versus the analytical, historical and critical both have their contributions to make. Here I am characterizing and supporting the contribution developmental systems theory can make as a part of Natural Philosophy. I am not here questioning the efficacy of the specialists' knowledge to extend our domain over nature, which is another issue, except to point out that an intelligible view of our place in the universe might provide some guidance for how we go about interfering in natural processes. There is a certain irony in the fact that, while neoDarwinism has made very little contribution to practical matters, it nevertheless was swept up in the general flight away from Natural Philosophy, becoming in the event, just another specialized knowledge -- about changes in the gene frequencies of populations from one generation to the next.

Now, here is why a general, synthetic theory like Natural Philosophy is needed today. Our natural senses -- sight, smell, touch, and so on -- provide information by way of certain dimensions of the natural world -- *and* , very

importantly, they all impact us simultaneously, each corroborating information coming from the others, making it increasingly robust. In contrast, the information we gain from the specialized sciences is usually constructed around single modalities -- different aspects of light, sound waves, pressure, temperature, chemical signals, and so on, and, indeed, under the guidance of theories in different fields of inquiry that have only accidental relationships, if any, to each other. Natural Philosophy is needed to synthesize these different specialized knowledges even as the body spontaneously synthesizes messages from its different sensory modalities. Without this important function, the robustness of our specialized records and interpretations must be in doubt, in the way brought to our attention in the last few years by those who study the social construction of knowledge. I believe that a nature constructed by Natural Philosophy as a developmental system would be the best answer to the social deconstructivists (for whom each specialized knowledge by itself is a “sitting duck”). Under the aegis of Natural Philosophy, every field of knowledge of the natural world would support every other as parts of a total system.

DEVELOPMENT AND EVOLUTION

In connection with the particular theory of everything espoused here, I prefer the term ‘development’ instead of the more popular term ‘evolution’ because the sense of the “general” in general evolution is that the changes of interest are constitutive (as in those, for example, describing the fate of the main sequence of

stars), not haphazard. Constitutive changes would be predictable because they would be, in the strong sense of the word, processes, and not just concatenations of capricious events, as in the neoDarwinian view of organic evolution. Constitutive changes are characteristics of a given system, part of what it is to be that kind of system. Thus, an embryo progresses from being a blastula through gastrulation, on into neurulation, and so on until it reaches the goal of its transformations, the reproductive adult. These ontogenetic changes constitute what it is to be an vertebrate.

After examining many usages of the terms ‘development’ and ‘evolution’ in a field where both occur commonly -- in biology -- I was able to boil down the following operational definitions (Salthe, 1993): development is *predictable directional change* , while evolution is the *irreversible incorporation, or accumulation, of historical information* , which can be synonymized with individuation. Individuation refers to the process whereby a particular system becomes increasingly different from others of its kind, a process of differentiation by way of incorporating the effects of its experiences into its form and behavior. Organic evolution involves individuation, whereby alterations in genetic information accumulate in different lineages. (NeoDarwinism can explain some of these historical changes, but has nothing to say about whatever constitutive -- therefore predictable -- changes may be going on at the same time.) Many, if not most, observable changes in material systems involve both development and individuation. The deep issue here is whether change is going to be seen as being at base intelligible rather than taken to be haphazard (as it is

held to be, for example, in neoDarwinian theory). Change has implicitly been constructed developmentally in Natural Philosophy for quite a good reason, as only such changes can be described as being general -- that is, can be generalized as similarities across classes of systems. These are usually represented, for convenience, as a series of stages of development.

Again, it should be clear that any changing dynamic system will both develop *and* individuate. My point is that only developmental changes are stable enough, by being repeated, to be comparable between instances and kinds of systems, and therefore reliable enough to form the bases on which discourses can be erected. Evolutionary change runs to "apples and oranges". If any tendencies or trends to change in certain directions are discovered, as in, say, convergence in biological evolution, these would be, in my account, developmental tendencies. NeoDarwinians just ignore them.

THE DEVELOPMENTAL ACCOUNT

So then, let us examine a diagram to clarify some distinctions I want to make. Figure 2 shows an example of Natural Philosophy in the developmental mode I have been describing, and how it would bridge the gulf between the natural and social sciences and integrate our presently divided mental world into a thinkable whole.

[Figure 2 goes about here]

The format I use here is from set theory. Each label refers to a class of phenomena, with most of them embedded in others as subclasses. There could, no doubt, be still other classes inserted here and there in connection with particular viewpoints, but these familiar ones are sufficient to illustrate my points. This figure actually summarizes in a general way the thrust of all of Natural Philosophy. Here it is cast as what I term a specification hierarchy of integrative levels (Salthe, 1993). This is a formalism first used by Plato, and was later chosen by Aristotle to model change. In that interpretation the levels labeled here would be viewed as stages of development -- of the world.

What this figure shows, for example, is that biological systems are special kinds of material systems. It also characterizes psychological phenomena as kinds of social phenomena. It also shows, somewhat more tendentiously perhaps, that in order to have sociological phenomena, you had to have biology first. So, sociology materially *implies* biology -- in the sense that it conceptually subordinates it. That is, generalizing, development is epigenetic -- previous stages are not transcended or discarded, but form the framework for the next stages, which will be refinements of the earlier ones. And so we see that the theory shown here is materialist -- nothing that happens (or happened) can be transcended, only modified, or reinterpreted. Sociological phenomena reinterpret biological phenomena even as they integrate them. The figure also suggests that this sequence was necessary -- canonical -- not optional or the result

of accident. In other words, while levels might be left out for some purposes, they cannot be shuffled and still make an intelligible picture -- for example, you could not imagine biological systems coming into being before there were chemical systems.

This theory, which seeks to reveal developmental aspects of (what is usually called) evolution that are generally ignored today, allows certain interesting questions to be asked. For example, all change that is represented, as in this model, as the emergence of subclasses must have the form of a tree, as shown by the branching in Figure 2 -- so that there could be several coordinate subclasses at any stage. This is because nature is not fully predetermined. Yet, the presentation shown here, even while being technically correct in suggesting such other branches as possibilities, implies that there was nevertheless a preferred directional tendency toward psychology. This might be interpreted to have been brought about by way of structural attractors of material events, acting as final causes. Since the picture could presumably be redrawn with, say, the properties of mosquitoes being kept in mind as the most refined, or highly developed (I cannot say that I know what these would be!), we need to see that this *is* a biased picture, but not for that reason wrong. Note that with the mosquito (or the dandelion -- or even the icicle!) as the privileged end product of evolution, the earlier stages would still be the same. The pattern and principle of this representation (which accurately reflects the import of Natural Philosophy, and also reflects the logic of our own thinking) would not be changed by emphasizing a different end. In other words, while the theory can be used, most importantly,

to validate our own appearance in the world, it would be robust to other perspectives as well.

VALUATION

So we need to keep in mind, for example, that there *are* material systems that are coordinate with biology (at the same level of phenomena), as shown here. Abiotic dissipative structures like tornadoes and icicles have all the basic properties of biological systems, except the stability, and its consequent complicatedness and variety, won for biological systems by genetic information. This shows, again, that this representation is biased by the fact of having been produced by psychological, social, biological beings -- ourselves. Even plants have been quietly left on a sideline. They are certainly social, but any psychology, or coordinate analog of psychology, that they might have has eluded (most of) us to date. Note that the question of a plant's property, if any, that would be coordinate with human psychology can be raised by this model. Since it could not be in just any kind of model, the model can be heuristically productive as well, as any good one should be.

So, this representation embodies the selective process of valuation, showing ourselves as the results -- almost it seems, the final causes -- of natural processes. This is a plus, rather than a minus, of the viewpoint espoused here, because it integrates humans with the rest of the world in an intelligible way. Note, for example, that if we consider ourselves to be just physical systems, this has the

effect in this particular perspective, not of demeaning us, but of making us kin with many more natural systems than would be apparent if we focused only upon our own more particular properties. Note that in this framework such a focus would not be reductionist. Natural Philosophy does not deny the effect of values upon its constructions, and, indeed, welcomes them. Its purpose is to make knowledge intelligible -- which is another way of saying that it is in the business of constructing a science-based myth (used not pejoratively, but in the ethnographic sense) that will allow us to feel "at home in the universe". This is quite unlike the weak general implications of the specialized sciences which, in the absence of anything better, imply that the world exists independently of our interests and has nothing whatever to do with our values, or even our existence.

For example, I would like to suggest that each of us as individuals has undergone the very stages shown here in our own development from conception to where we are today -- our ontogeny -- even as has the world of which we are microcosmic parts. We began as physical gradients in an egg cell, went on to become cells, embryos, fetuses, children, and so on. Yet each one of us is still rooted in the most basic processes of our universe, and is also at the tip of a branch of the very world itself, which integrates everything else in its interests. This bias that represents the business of the world as having been to produce us is not vicious if we keep in mind that it is a permissible emphasis -- which it can be if it does not falsify or misrepresent any of the processes involved, as constructed by the various specialized sciences.

This teleological cum developmental aspect of Natural Philosophy was no

doubt one reason for its abandonment, at the turn of the last century, in a general enthusiasm for harnessing science to solving various pragmatic problems. Consequently one can find today only remnants of its constructions here and there, as in cosmology (Chaisson, 2001) and psychology (Sabelli and Carson-Sabelli, 1989). Even fields that have had minimal impact upon our material well being, like the study of organic evolution, went through a period when all traces of developmental tendencies were eliminated from the discourse. This led to the marginalizing even of some of the architects of neoDarwinism, like Julian Huxley (see Figure 1), shortly after he began to show interest in the concept of evolutionary progress. This scientific focus on -- even fetish of -- gaining objectivity still today continues to have the effect of denigrating attempts to generalize across the sciences, which, we might remind ourselves, has been a central purpose of Systems Science. Alongside this bias, a currently widespread fear of ideology in our society inherited from the last World War and the Cold War, leads many to argue against undertaking any such discourse at all, leaving all myth making by default to the traditional religions.

I will wind down with two assertions -- (a) there has never been a culture without an origination myth -- providing some sense of possible or desirable destiny, and (b) it seems clear that our prospects for understanding the world in the Twenty First Century will have to be rooted in a comprehensive scientific perspective, and take the form of a whole-system description. In this regard, I end with another figure.

[Figure 3 goes about here]

This figure suggests other directions which natural philosophy in this format could explore. I have constructed the specification hierarchy a bit differently in this version. Here we begin with Charles Peirce's concept of Universal or Absolute Mind (Esposito, 1980; Raposa, 1989; Turley, 1977). You could, if you prefer, use instead Aristotle's Logos as the most general integrative level here. Both represent the creative ground of vague potential from which everything else can come. That cognition is shown here emerging from a more primordial Mind emphasizes the fact that this diagram, *and* the concept of Universal Mind, are themselves the results of very highly specified cognition, so that this diagram would itself be located inside yet more embedded brackets within the cognitive realm in the diagram! Our modern origination myth, unlike any others before it, I think, will have to be self-referential, referring to its own origin as well as to that of the world it describes. Here we meet again the social construction of knowledge, but from a different angle which allows us to incorporate it, too, into Natural Philosophy!

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REFERENCES

Esposito, J.L. 1980. *Evolutionary Metaphysics.* Ohio University Press: Athens, OH.

Chaisson, E.J. 2001. *Cosmic Evolution.* Harvard University Press: Cambridge, MA.

Raff, R.A. 1996. *The Shape of Life: Genes, Development, and the Evolution of Animal Form.* University of Chicago Press: Chicago.

Raposa, M.L. 1989. *Peirce's Philosophy of Religion.* Indiana University Press: Bloomington, IN.

Richards, R.J. 1988. The moral foundations of the idea of evolutionary progress: Darwin, Spencer, and the neoDarwinians. In Nitecki, M.H. (ed.) *Evolutionary Progress.* University of Chicago Press: Chicago.

Richards, R.J. 1992. *The Meaning of Evolution: The Morphological Construction and Ideological Reconstruction of Darwin's Theory.* University of Chicago Press: Chicago. .

Sabelli, H.C. Carson-Sabelli, L. 1989. Biological priority and psychological supremacy: a new integrative paradigm derived from process theory. *American Journal of psychiatry* 146: 1541-1551.

Sahlins, M.D. 1960. Evolution, specific and general. In Sahlins, M.D. and E.R. Service (eds.) *Evolution and Culture.* University of Michigan Press: Ann Arbor, MI.

Salthe, S.N. 1993. *Development and Evolution: Complexity and Change in Biology.* MIT Press: Cambridge, MA.

Salthe, S.N. 1998. The role of natural selection theory in understanding evolutionary systems. In Van de Vijver, G., S.N. Salthe and M. Delpos, (eds.) *Evolutionary Systems: Biological and Epistemological Perspectives on*

Selection and Self-organization. Kluwer Academic: Dordrecht.

Terzian, Y. 1999. The complexity of stellar death. *Science* 286: 425-426.

Turley, P. T. 1977. *Peirce's Cosmology.* Philosophical Library: New York.

Figure Captions

Figure 1. An archaeology of the developmental half of Western science discourse, showing genealogies of various lines of thought within developmental systems theory.

Figure 2. A specification hierarchy modeled as classes and subclasses, showing the genesis of the world.

Figure 3. A specification hierarchy tracing one lineage, showing the emergence of cognition.