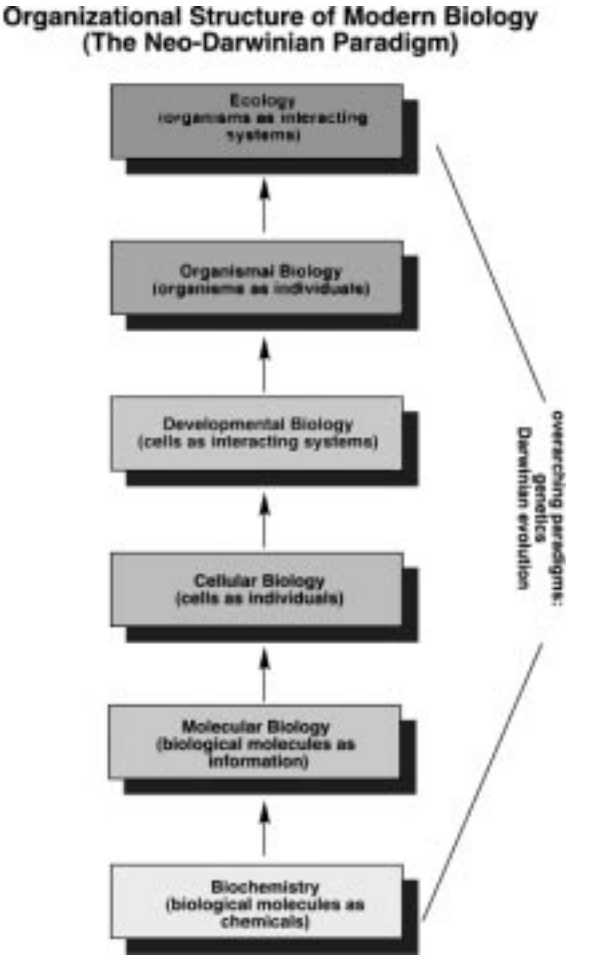
On Polanyi, Clayton, and Biology: Some Musings of a Recovering Reductionist

Martinez Hewlett

ABSTRACT Key Words: causality, emergence, molecular biology, physicalism, reductionism, supervenience. *Michael Polanyi critiqued the then burgeoning field of molecular biology and the neo-Darwinian synthesis that has since come to characterize the structure of modern biology. He pointed out correctly that the reductionistic approach lacked explanatory power in the case of living systems. Philip Clayton addresses the importance of Polanyi's thinking, even though it was not appreciated at the time it was presented. He argues, however, that while some aspects of Polanyi's biological perspective are important in considering emergent phenomenon, other ideas are less well received in the modern era. This article discusses the pros and cons of the Clayton view and presents a model for a biological structure that might embrace emergence and supervenience*

At the beginning of the 21st century, we have the opportunity, through the eyes of Clayton and Polanyi, to look critically at the discipline of biology. We see, much to the dismay of many of us who practice this science, a field that is lost in its 19th century roots while trying to espouse 20th or 21st century models.

The two principle organizing features of modern biology are products of the intellectual climate of the European 19th century, and, as expected, both reflect the prevailing philosophical assumptions of determinism and reductionism. These two ideas, Mendelian genetics and Darwinian evolution, come together in the middle of the 20th century to produce the Neo-Darwinian synthesis. As a result, the hierarchical structure of modern biology can be represented by the bottom-up organizational structure shown in Figure 1:



The extreme position of the ontological reduction represented in this figure is typified by the physicalism of biologists such as Francis Crick and Richard Dawkins, along with philosophers such as Daniel Dennett. In fact, at the heart of the much touted Human Genome Project is the conviction that sequencing all of human DNA will ultimately tell us everything there is to know about what it means to be human.

This philosophical assumption is inherent in models of the human nervous system that attempt to explain consciousness as merely an "epiphenomenon" of the biochemistry of neuronal activity.

Polanyi on Biology

The philosophical position of ontological reductionism was critiqued by Polanyi at its most important level, when he pointed out that the information content of biological macromolecules such as DNA could not, in fact, be accounted for simply by the chemistry of the molecules. He stressed that the information must be insensitive to the chemistry, otherwise all DNAs of biological entities could not be composed of the same four nitrogenous bases.

Polanyi's critique has been largely ignored in the modern synthesis. However, beyond this simple demonstration of the fallacy inherent in the assumptions of modern biology, Polanyi offered a wider vision, that of the emergence of systems from assemblages of the subunits contained within the system. It is this proposal that is the focus of Philip Clayton's presentation.

From the standpoint of a recovering biological reductionist, as Philip Clayton characterized me in 1998, this offers an opportunity to recast one's philosophical base. But before I propose an emergentist view of my own, let me comment on some of the contributions and critiques that Clayton discusses with respect to the work of Polanyi.

Clayton on Polanyi

As Clayton rightly points out, Polanyi's contributions to the current discussion cannot be overstated. His characterization of boundary conditions, both active and passive, as well as his theory of knowledge and mind become central to any present-day treatment of emergent phenomena. Of greater importance, I believe, is his theory of structure and information, with its explicit appeal to top down causality. I emphasize this because of the nature of biological information and because the focus of the biological physicalist has always been on the primacy of the informational molecules *qua* chemicals.

Clayton also offers necessary critiques of Polanyi's work. I would like to focus on two of these criticisms: Polanyi's interpretation of developmental biology and Polanyi's choice of philosophers or philosophies.

Developmental biology, including neurobiology, is perhaps the most active area of investigation within the general rubric of modern biology. When Polanyi considered the state of this discipline in the early 1960's all of biology was under the strict influence of the molecular biology paradigm. It is no wonder that, given his view of the reductionist mode of Jacob and others, he reacted strongly in another direction. His acceptance of "morphogenetic fields" and "gradients" can be seen, in retrospect, as errors. However, a closer examination of modern developmental models shows that such concepts as positional effects, cytoplasmic determinants, gradients of morphogens, and cell-to-cell signaling are commonly invoked. All of this means that, while "the cell nucleus contains the core information necessary for a cell's development" (Clayton, this meeting), it is likely that the DNA is a necessary but not sufficient explanation. Is it possible that Polanyi was partially correct?

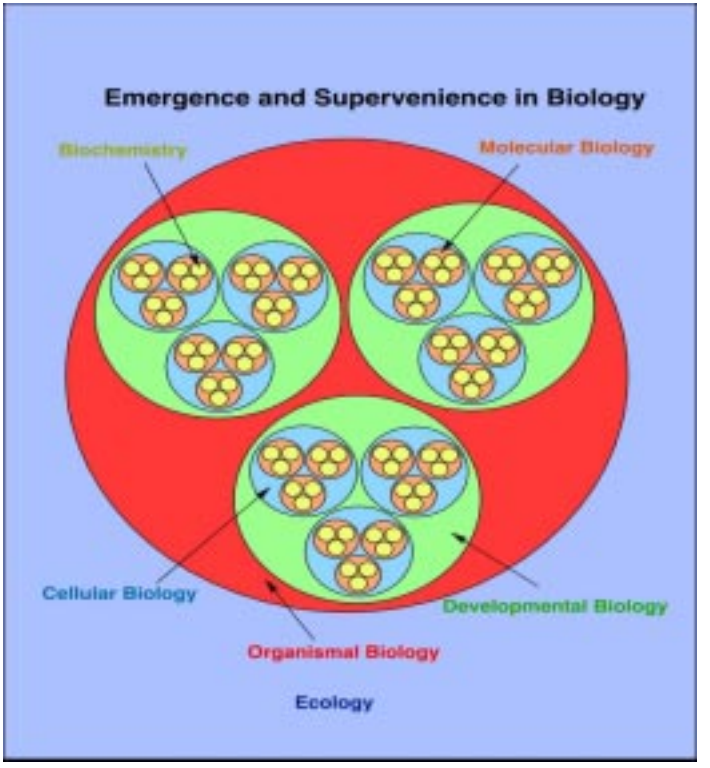
Clayton states that Polanyi may have "bid on the wrong philosopher." In his argument, Clayton mentions Aristotle's doctrine of *entelechy* as the critical flaw in this choice. Clayton wishes to avoid the "quasi-

Aristotelian metaphysic" in the development of emergentism. He focuses on strong supervenience as an explanatory model that strengthens the idea of emergence for consideration by theologians. In his seminal work, *God and Contemporary Science,* Clayton argues for "causal powers" as the strongest argument for downward causation in the case of strong supervenience.

However, the idea of causal powers strikes me as quite Aristotelian. William Wallace, in his book "The Modeling of Nature," develops a contemporary philosophical approach that he calls the causal model. In this work he argues that, like Aristotle, one can use the world of artifacts as an explanatory model for the natural world. In this model he recognizes four causes: matter, form, agent, and end. His recasting of the Aristotelian/ Thomistic view can easily be reconciled with a downward causation model, although the philosopher Michael Dodds prefers the term "inside out causality." So, it seems to me that the idea of causal powers fits nicely into this neo-Aristotelian view. *Entelechy*, of course, must be abandoned in any contemporary argument, in the same way that *elán vital* is a concept that has no explanatory usefulness. But it may be going too far to throw out the model with the interpretation.

A New Biology Emerging?

On the one hand, Polanyi has pointed out the logical error that lies at the heart of the molecular paradigm of the modern synthesis. On the other hand, Polanyi and Clayton both have constructed an important argument for supervenience and emergence as an explanatory model for the nature of consciousness and the mind. In between these two statements lies the entire hierarchical structure of modern biology. In order to bridge this, it will be important to reconstruct the view. To do this, it will be necessary to employ first the weak supervenience of Kim. In this model (Figure 2) the emergent properties of higher order structures are emphasized by the space that is not included in the sum of the subvenient parts. In addition, since no arrows are shown, the direction of the causation is left unstated.



This model may not satisfy the strong supervenience sought by the theologian. However, it may serve as a starting point in the discussion with biologists still lost in the hierarchy. I offer it as a lure that might rescue my colleagues who remain addicted to the powerful yet limited drug of ontological reductionism.