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THE REBIRTH OF RATIONAL MORPHOLOGY:

Process Structuralism's Philosophy of Biology

David Resnik

Department of Philosophy, University of Wyoming, Laramie, WY 82071-3392, USA.

ABSTRACT

This paper examines a new challenge to neo-Darwinism, a movement known as process structuralism. The process structuralist critique of neo-Darwinism holds 1) that there are general laws in biology and that biologists should search for these laws; 2) that there are general forms of morphology and development and that biologists should attempt to uncover these forms; 3) that organisms are unified wholes that cannot be understood without adopting a holistic perspective; and 4) that no special, causal primacy should be given to the genes in development and morphology. This paper places process structuralism in its historical context, examines the philosophical underpinnings of the movement, and discusses some of the evidence used to support its claims.

1. INTRODUCTION

Before Darwin's heyday, rational morphology was a widely accepted paradigm in biology. Although the neo-Darwinian synthesis overthrew this movement, its legacy lives on in the process structuralist approach to evolution and development. This paper will place process structuralism in its historical context, examine the philosophical underpinnings of the movement, and discuss some of the evidence used to support its claims. It will argue that process structuralism represents an intriguing and robust alternative to current neo-Darwinian thought.

2. RATIONAL MORPHOLOGY

Rational morphology was primarily a 19th century movement inspired, in large part, by philosopher Immanuel Kant's view of nature and the Aristotelian belief in natural essences (Webster and Goodwin, 1982; Saunders, 1984).

Prominent leaders of this movement included Cuvier, Owen, Buffon, Goethe, St. Hillaire, and Driesche (Smith, 1992b). Kant defended the view that science is the search for universal laws, and that we cannot have an adequate understanding of a phenomenon until we have uncovered the laws which govern it (Kant, 1929). Kant also believed that teleological explanations and descriptions are indispensable in biology because organisms

are unified wholes whose parts serve some common ends or goals (Kant, 1928). This view of organisms implies that reductionistic methods, i.e. methods for understanding complex things in terms of their parts, should not work as well in biology as they do in the physical sciences since biology's objects are unified wholes, not collections of parts.

Aristotle believed that all particular things embody universal, timeless, forms or essences (Aristotle, 1947). Any object is a combination of various forms in physical material. An object consists of both essential properties (or its form) and accidental properties (or its material). Thus, a particular tree would consist of the form of the tree, e.g. its basic design plan, and the matter of the tree, e.g. the material out which it is made. Like Plato, Aristotle believed that God had made these basic essences at the beginning of time and that the essences do not change, although the physical world might change. An important implication of this view is that everything in the world should be classified according to its essential properties. Thus species, according to Aristotle, do not change (or evolve) because their essential properties do not change (Aristotle, 1947).

Thus, rational morphology's philosophical foundations consisted of three key ideas:

1) Universalism--science should uncover generalities or laws of nature.

2) Essentialism--essences (forms of archetypes) underlie all natural objects and processes.

3) Organic holism--organisms are unified wholes directed toward common goals. Hence, there are limits to the usefulness of reductionism in biology.

The rational morphologists implemented these ideas by aiming to discover biological archetypes governed by universal laws of form (Smith, 1992b). They took a holistic approach to this study and they asserted that the important problems in biology could not be understood only in terms of the parts of organisms (Saunders, 1984). The central problem of biology, according to the rational morphologists, was the problem of form: how can biological form (order, design) emerge from physical and chemical processes? They believed that comparative anatomy and embryology could provide answers to this problem by uncovering some of the basic forms in ontogeny and morphology. Once we understand these basic forms, we can understand how they generate the order we find in the biological world.

For instance, the rational morphologists knew that many animals share a common ontogeny: rats and horses both develop from fertilized eggs, their embryos undergo many cell divisions, their embryonic cells differentiate into various tissues, and so forth. A rat and a horse look very similar during ontogeny until they begin to diverge. Rats and horses also share many common anatomical features: they both have four legs, two eyes, a tail, a four-chambered heart, and so on. These similarities in ontogeny and morphology, according to the rational morphologists, result from underlying developmental forms or *bauplans*. The differences also result from differences in basic forms. Thus, all the order we find in the biological world, according to the rational morphologists, results from these timeless, universal forms.

An organism, according to the rational morphologists, is a unified whole composed or various forms (e.g. the form of the heart, leg, etc...) that work together to serve its ends. Species also manifest underlying forms and they do not change or evolve. Species should be classified according the basic forms they embody, which are revealed by their anatomical and ontogenetic characteristics. As one might expect, the rational morphologists generally resisted the evolutionary theories that were proposed during the 19th century, since an