

Holistic Darwinism

Introduction

The New Evolutionary Paradigm

A major shift is currently underway in evolutionary theory. Neo-Darwinism - the reductionist, mechanistic, gene-centered approach to evolution epitomized by the selfish gene metaphor of Richard Dawkins - has come under assault from various quarters. These attacks have included the following:

- A growing appreciation for the fact that evolution is a multilevel process, from genes to ecosystems; coevolution has come to be recognized as a many-faceted phenomenon.
- A revitalization of group selection theory, which was banned (too hastily) from evolutionary biology more than thirty years ago.
- An increasing recognition that symbiosis is an important phenomenon in nature and that symbiogenesis is a major source of innovation in evolution.
- A broad array of new, more advanced game theory models, which support the growing evidence that cooperation is commonplace in nature and not a rare exception.
- New research and theoretical work that stresses the role of developmental dynamics, “phenotypic plasticity,” and organism-environment interactions in evolutionary continuity and change; an inextricable relationship between nature and nurture are the rule, rather than the exception.
- A flood of publications on the role of behavior, social learning, and cultural transmission as pacemakers of evolutionary change, a development that is especially relevant in relation to the evolution of humankind.
- New insights into the nature of the genome, and increasing respect for the fact that the genome is neither a “bean bag” (in biologist Ernst Mayr’s caricature) nor a gladiatorial arena for competing genes but a complex, interdependent, cooperating system.
- The emergence of hierarchy theory, which stresses that the natural world is structured and influenced by hierarchies of various kinds.
- The rise of systems biology, a new field that emphasizes the systemic properties of living organisms; one scientist, writing in the journal *Science*, called it “whole-istic biology.”
- The claims advanced by various theorists for the role of autocatalysis, self organization, network dynamics, and even “laws” of evolution (though I remain guarded about them).

The crux of the debate, however, has to do with the evolution of complexity. An individualistic, gene-centered theory seems insufficient to account for the evolution of more complex, multileveled biological systems over time. It is increasingly evident that the selfish gene metaphor is inadequate. A more appropriate metaphor is the cooperative gene (see Corning 1996a; Ridley 2001). Thus, a major challenge for evolutionary theory is to develop a better understanding of cooperation and complexity in the natural world. Many theorists are now look-

ing beyond the individualistic, mutation-competition-selection paradigm.

Accordingly, the term Holistic Darwinism is not an oxymoron. Nor does it refer to some metaphysical abstraction. It is a candidate name for the new paradigm that is emerging as an alternative to Neo-Darwinism. It also involves a theory about the role of “wholes” in evolution.

First and foremost, Holistic Darwinism views evolution as a dynamic, multilevel process in which there is both “upward causation” (from the genes to the phenotype and higher levels of organization) and “downward causation” (phenotypic influences on differential survival and reproduction), and even “horizontal causation” (between organisms). In this paradigm, the emergence of higher-level “individuals” (in Michael Ghiselin’s characterization) are not epiphenomena; they act as wholes and exert casual influences as distinct evolutionary units. They may constrain, control, and even differentially determine the fate of various parts (genes). To borrow a metaphor from the biologist Egbert Leigh (1977), selfish genes are subject to the “parliament of the genes.” I call it the “selfish genome” model, but the principle applies equally well to selfish groups, selfish colonies, selfish packs, selfish bands, and even selfish nation-states, as we shall see (see also Corning 1997a).

A second major feature of Holistic Darwinism is that it serves as an umbrella for a broad theory of cooperation and complexity in nature first proposed in *The Synergism Hypothesis* (Corning 1983). This theory has recently been gaining support among biologists and social scientists. Both the historical background and more recent developments relating to this theory are detailed in chapter 1.

A critique of Neo-Darwinism and the case for Holistic Darwinism are presented in chapter 2, along with a brief introduction to the Synergism Hypothesis. The hypothesis, in brief, is that synergy - a vaguely familiar term to many of us - has been a wellspring of creativity in the natural world and has played a key role in the evolution of cooperation and complexity at all levels of living systems. This theory asserts that synergy is more than a class of interesting and ubiquitous effects in nature. It has also been a major casual agency in evolution; it represents a unifying explanation for complexity at all levels of living systems.

Moreover, this theory is fully consistent with Darwin’s theory. It involves only a different perspective on the evolutionary process. In contrast with gene-centered theories, or postulates of self-organization and emergent “laws” of complexity, the Synergism Hypothesis represents, in essence, an economic (or, more precisely, bioeconomic) theory of complexity. It is postulated that the functional payoffs produced by various kinds of synergy have been the drivers of this important evolutionary trend. After a brief survey of the many different kinds of synergy in the natural world (including examples drawn from a variety of disciplines), the case for the Synergism Hypothesis is presented in detail in chapter 3, along with some ways of testing the theory.

A third major feature of Holistic Darwinism is that it fully acknowledges the “teleonomy” (purposiveness) of living systems and incorporates this important aspect of the natural world into the casual dynamics of the evolutionary process itself. This pertains especially to behavior, which has often served as a “pacemaker” of evolutionary change (in Ernst Mayr’s famous characterization). Sometimes this is referred to as the “Baldwin effect” (see chapter 2), but credit for the idea that a change in an organism’s “habits” can influence the course of evolution should properly be given to Jean Baptiste de Lamarck (even though he guessed wrong about the “mechanism” involved). The role of teleonomy and self-determination in evolution, as well as the relationship between synergy and self-organization, are discussed in chapter 4.

A fourth feature of Holistic Darwinism is that it also encompasses the phenomena associated with emergence - the recently rediscovered nineteenth century term for the idea (traceable back to Aristotle) that wholes may have distinct properties that transcend their parts. The re-emergence of emergence is reviewed in some detail in chapter 5, along with a discussion of how emergence relates to synergy and the Synergism Hypothesis.

Another important aspect of Holistic Darwinism is that it also applies to human evolution and to the evolution of human cultures and their political systems. In fact, synergy played a key casual role in the evolution of humankind, and so did cybernetic (political) processes - decision making, social communications, social control, and feedback. Nor are such processes unique to our species. Analogous cybernetic processes are found in slime molds, leaf-cutter ants, naked mole rats, killer whales, and our closest primate relatives, among others; they are a fundamental feature of social life. The intimate relationship between synergy, cybernetics, and the bioeconomics of sociality is discussed in chapter 6. Devolution, which provides a major opportunity for testing this theory, is defined and explored in chapter 7.

Finally, Holistic Darwinism embraces the recently revitalized “superorganism” concept, which has regained respectability in evolutionary biology after a long, ideologically tainted period in the wilderness. Actually, the so called organismic analogy has ancient roots. It was first articulated by the classical Greek theorists as a way of characterizing human societies, and it has been utilized by many other political theorists over the past two thousand years. However, the term superorganism itself was coined by the nineteenth century polymath Herbert Spencer, who focused especially on the division of labor and the problem of functional integration in complex systems. The history of this concept is briefly reviewed in chapter 8, along with a survey of the many examples found in nature. It is also stressed that cybernetic processes are essential concomitants of superorganisms of all kinds. More important, this broad evolutionary perspective also applies to the ongoing political evolution of human societies, including the prospects for global governance.

Part 2 of this volume comprises three chapters on the subject of bioeconomics - a key element of the paradigm shift identified with Holistic Darwinism. Over the years, much has been made of the relationship between “the economy of nature” (a term of art that Darwin borrowed from Linnaeus) and human economics. More recently, there has been much cross-fertilization between biology and economics, especially in areas such as behavioral ecology, evolutionary game theory, evolutionary economics, ecological economics, and the like. However, the connection between biology and economics goes beyond analogies, and beyond methodologies. There is also a deeper-level homology, which the new interdisciplinary of bioeconomics is helping to illuminate. In a nutshell, the fundamental linkage between biology and economics derives from the fact that humans share with all other living species the fundamental problems of survival and reproduction. This bedrock challenge is multifaceted, ongoing, and inescapable; it can never be permanently solved. Indeed, whether we are aware of it or not, the overwhelming majority of our activities as a species are devoted to various aspects of the survival problem (either directly or indirectly). A human society represents, quintessentially, a “collective survival enterprise.” This important metatheoretical issue is addressed in chapter 9 in the course of a review essay on how the new interdisciplinary of evolutionary economics should be defined and developed.

Chapter 10, “Bioeconomics as a Subversive Science,” elaborates on this theme and mounts a frontal challenge to the basic premises of traditional (neoclassical) economics. In effect, bioeconomics redefines the nature and purpose of a society, and an economy. The “ground-zero premise” (so to speak) of the life sciences is that survival and reproduction represent the basic problem for all living organisms, and this bedrock challenge applies also to human societies. It is the “paradigmatic problem” for all economies, and economic performance must ultimately be judged in these terms, not in relation to economic measures. Indeed, even traditional income and standard of living measures may be woefully inadequate. Chapter 11, an expansion on an essay that originally appeared in the *Journal of Bioeconomics* (Corning 2000), follows through on this theme. It applies the concept of biological adaption specifically to human societies and develops a detailed framework of fourteen basic needs that define the parameters of the survival/reproduction problem for humankind. There is also a brief introduction to the “Survival Indicators” program, which represents an effort to deploy an array of concrete measuring rods, or gauges, for adaptation similar to the economic and social indicators that are already widely used by social scientists and policy makers.

Part 3 then addresses the theoretical foundations of evolutionary theory in general - and Holistic Darwinism in particular - at a much deeper level. Two major areas of modern physics, namely thermodynamics and information theory, have made significant incursions into evolutionary theory over the past twenty years or so, and some major claims have been made on behalf of both the so-called entropy law and Claude Shannon’s statistical information theory. In chapter 12, based on a paper coauthored by the late Stephen Jay Kline (emeritus professor of engineering at Stanford University and a leading expert on thermodynamics), the pretensions of these theoretical schools are sharply criticized. Major alternatives to these formulations are then developed in chapter 13 (on thermoeconomics) and chapter 14 (on control information). These new formulations are entirely compatible with Darwin’s theory and with the teleonomic, cybernetic approach to the role of information in evolution, that is described in part 1. The term *thermoeconomics* refers to the use of economic criteria to understand the role of energy, and control information describes a new, cybernetic (functional) kind of informa-

tion that is measured in terms of the energy that can be controlled in a given context. Examples are provided to illustrate each concept.

Finally, Part 4 included some writings that examine the long-standing and vexed debate over evolutionary ethics - an inescapable aspect of any paradigm shift in evolutionary theory. The history of this debate is briefly summarized in a review essay (chapter 15), and it is argued that evolutionary ethics is indeed an idea whose time has come. Once the narrow, constricted, individualist caricature associated with Neo-Darwinism is replaced by the more balanced, ecumenical, economically oriented paradigm of Holistic Darwinism (not to mention a more balanced view of human nature and the role of cooperation in human evolution), the main theoretical impediment to a robust evolutionary ethics is removed. In chapter 16, this perspective is applied specifically to a critique of a recent volume on the sociobiology of democracy. The authors of that work hold a dour view of democracy's prospects, but I disagree with their analysis.

The ethical implications of Holistic Darwinism are more fully articulated in a final essay entitled "Fair Shares" (chapter 17), which seems especially relevant in light of recent economic trends. The two major twentieth century political ideologies are critiqued and the durable concept of fairness - now a "hot" research area in the social sciences - is advanced as a more balanced alternative. The important advantage of this middle-ground alternative is that it is grounded in an evolutionary and biological framework; it has a strong empirical basis. (This is reflected in the subtitle, "a biological approach to social justice.") Chapter 17 could also have been subtitled "beyond John Rawls," for it does not rely on an artificial philosophical construct; it grounds (and justifies) the concept of fairness in the biological sciences, and it implies certain specific principles for how to apply this criterion in human societies. It reaches the conclusion that we cannot avoid making ethical choices and that many of these have significant consequences for our ultimate survival and reproductive success. As the biologist Garrett Hardin (1972, p. 360) pointed out:

We cannot *predict* history but we can *make* it; and we can *make* evolution. More: we cannot avoid making evolution. Every reform deliberately instituted in the structure of society changes both history and the selective forces that affect evolution - though evolution may be the farthest thing from our minds as reformers. We are not free to avoid producing evolution; we are only free to close our eyes to what we are doing.

One final note: Many of the chapters in this volume previously appeared in peer-reviewed journals during the past few years, though they have been edited and updated in various ways. Others served as the basis for presentations at professional meetings, including the International Society for the System Sciences, the New England Complex Systems Institute, the Human Behavior and Evolution Society, the International Society for Human Ethology, the International Society of Endocytobiology, and the Association for Politics and the Life Sciences. The relevant citations and acknowledgments are included at the end of the book. However, it should be stressed that this is not simply a disparate collection of writings on various subjects. Each chapter forms an essential part - a building block - for the theoretical structure that I have called Holistic Darwinism; each chapter is a part of a synergistic whole that, it is hoped, will help to advance the emerging new, post-Neo-Darwinism evolutionary paradigm. Three of the major aspects of this new paradigm, to reiterate, are synergy, cybernetics, and bioeconomics. More important, in this paradigm, selfish genes are the servants, not the masters. To borrow a punch line from a later chapter, many "engines" have been proposed to account for the evolution of complexity, but the engine is nothing without the car. It is time to focus on the car.