

**A BRIEF CRITIQUE OF EVOLUTION
FROM THE DEVELOPMENTAL PERSPECTIVE©**
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Introduction

Evolution, not development, occupies the high theoretical ground in biology and bio-history, indeed, in the scientific community as a whole, and in large sectors of western society as well. The hegemony of evolution was clearly articulated by Theodosius Dobzhansky in his manifesto, "Nothing in Biology Makes Sense Except in the Light of Evolution."¹ Evolutionary literature invokes this slogan endlessly, reinforcing the view that evolutionary theory is the indispensable and only possible scientific theory of origins and change in the history of organic life.² The purpose of this essay is to make a brief evaluation of evolution from the perspective of macro-development in order to determine whether Dobzhansky is right. Is evolution essential for biology and does it shed light on *all* of biology?

DEFINITIONS OF EVOLUTION

What is evolution? The problem with defining the term is that the concept of evolution is subject to so many interpretations it is nearly impossible to find its core meaning. It is not considered a single unitary concept by some authors.³ It has even been called a smorgasbord of concepts.⁴ The lack of a clear, consistent definition of evolution poses a problem for those who wish to engage in a disciplined, critical discussion of it. What does Dobzhansky mean by "evolution" when he claims that nothing in biology makes sense without it?

Let us begin with a brief summary of evolution given by Plantinga:⁵

Organic life somehow arose from non-living matter by way of purely naturalistic means and by virtue of the workings of fundamental regularities of physics and chemistry. Once life began, all the vast profusion of contemporary flora and fauna arose from those early ancestors by way of common descent. The enormous contemporary variety of life arose, basically through natural selection operating on such sources of genetic variability as random genetic mutation, genetic drift and the like.⁶

We will examine this definition more closely in the light of three meanings of the term, evolution, which have been provided by Thomson⁷ that help pin down the concept. They are 1) change over time, 2) descent with modification from a common ancestor, and 3) natural selection.

Change Over Time

In the first, most general sense, evolution is said to mean *change over time*. Thomson asserted that "change over [geologic] time is the most solidly based fact of evolution." Wherever one finds biological change occurring over long periods of time, according to this definition, there one finds evolution as the causal agent. This view fits hand-in-glove with Dobzhansky's manifesto, and is probably the most widely employed meaning of the term. This broad definition, linking all organic change over time with evolution, along with

Dobzhansky's manifesto, establishes the hegemony of evolutionary theory since *by definition* evolution becomes an established fact.

There are three major defects in this interpretation of evolution. First, it is so broad and general that it defeats the purpose of clear, concise definitions, so necessary in science. It can cover almost any kind of long-term biological or paleontological change and thus loses its meaning. Second, and more important, *it effectively stifles scientific skepticism*, that attitude which scientists prize so highly and exercise so vigorously, but only rarely in evolutionary studies. What happens when a "change over time" is discovered in the fossil record which doesn't fit neatly into the evolutionary paradigm, as is the case, for instance, with the Cambrian explosion that occurred 530 million years ago? No need to think critically or to search for an alternative, non-evolutionary explanation. "Change over time" explains it all. That's it. Such an uncritical attitude, we hold, is not good science.

Third, Thomson's claim is an overstatement. Not every biological organism or system changes. Body plans, i. e., the basic architecture of all major groups of animals, called phyla, have remained essentially unchanged from the time they came into existence, more than 500 million years ago. How does one account for their permanence? Are they immune from Thomson's first definition?

In sum, Thomson's first definition, is overly broad, inhibits critical thinking and the suppresses the search for alternative explanations. It does not allow consideration of an alternative position—the indispensable role played by macro-development as a major source of change over time as discussed in the previous essay.

Relation Through Common Ancestry

The second important meaning of evolution, according to Thomson,⁸ is that *all organisms are related through common ancestry*, the process of descent with modification from a single common ancestor. All forms of life are thus allegedly interrelated. Descent with modification and the unbroken continuity of life, however, are merely assumptions or hypotheses, not objective facts, according to Thomson. He is right. Evolution predicts or hypothesizes common ancestry of all organisms because that's theoretically what evolution should produce.⁹ But is common ancestry born out by the facts?

Recently reported research calls into question the validity of common ancestry.¹⁰ The research focused on three very simple, but fundamental organisms, 1) yeast; 2) the bacterium, *E. coli*; and 3) the primitive bacterium called archaeobacterium. These three simple organisms are important because they represent the three kingdoms of life, the highest, most important division of living organisms—eukaryotes, eubacteria, and archaeobacteria. If there is a common ancestor, these simple, ancestral organisms should show it. But do they? The answer is no. They are found to be so genetically different from each other that it is hard to justify using one to explain the workings of another. Each has many unique genes that are not shared by the other organisms; they share only a small set of common genes. The authors of the study state:

In a real sense, organisms that contain unique constituent parts cannot be models for another...that is [they cannot be] physiological representative of many other organisms.

Having the whole genomes spread out for our examination underscores *how different from one another these organisms are* (Emphasis added).

In sum, the simplest representatives of the three kingdoms are genetically very different from each other. This makes it very difficult to maintain that they descended from a common ancestor. Thus, from the very start the kingdoms lack commonalty; they are discontinuous from each other.

Natural Selection

The third meaning of evolution is *natural selection*. In its historic meaning, natural selection occurs through small, accidental genetic variations, called mutations, in the germ cells of individual organisms, and the sorting out by the environment of the most adaptable and reproductively successful organisms produced by these mutations. Thus the fittest survive and reproduce. With the increase in the number of offspring of the most adaptive animals or plants the favorable mutation spreads through the population.

Natural selection is the historical core of evolutionary theory. It will be called "Darwinian evolution" because it was formulated by Darwin and remains the most basic meaning of evolution. Darwin asserted, "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous successive, slight modifications, my theory would absolutely break down."¹¹ It is the universal causal mechanism underlying Thomson's first two definitions of change over time and descent with modification. Without it they become merely descriptive statements. Thomson holds that the theory of natural selection has not seriously changed since Darwin's day.¹²

Alternative definitions. The centrality of natural selection, however, is not accepted by all modern biologists. "The entire body of technical advance in experimental and theoretical evolutionary genetics of the last fifty years has moved in the direction of emphasizing non-selective forces in evolution."¹³ The move has been toward genetic definitions of evolution. One such definition is "change in gene composition of a population." According to Gilbert¹⁴ and his colleagues, "The Modern Synthesis supported population genetics as the major focus of evolutionary science and viewed genetics as 'Darwin's missing evidence'.... Thus evolution could be completely explained by the mutation and separation of genes." According to Strickberger,¹⁵ gene-frequencies in a population change in a directional way by means of mutations, selection, migration of genes from one population to another. Neutral mutations, random mutations and genetic drift are claimed by some also to be important in changing gene frequencies in non-directional, non-selective ways.¹⁶

Criticisms of genetic definitions of evolution. Genetic definitions of evolution, emphasizing the genetic composition of populations rather than environmental sorting, also have their critics.¹⁷ As Wells¹⁸ reported,

Efforts to correlate evolution with changes in gene frequencies have not been very successful. Detailed studies at the molecular level fail to demonstrate the expected correspondence between changes in gene products and the sorts of organismal changes which constitute [what Lewontin called] the "stuff of evolution."

It does not matter, moreover, to the theory of phylo-development whether the mecha-

nism of evolution is a Darwinian mechanism, such as natural selection, or an alternative evolutionary mechanism. None is adequate to explain macroevolution—the origin and history of major innovations such as phyletic lineages, to be discussed below. They explain, at best, only microevolution, not macroevolution. These terms will be discussed in detail below.

Why has there been such a proliferation of alternative definitions to natural selection? We suggest that they arise because of the failure of the historical, Darwinian concept of natural selection to provide a compelling explanation of major events in the history of organic life, such as the spectacular rise of 50 or so phyla in the Cambrian explosion, and how these phyla changed over time in the history of complex, multisystem life.

These definitions of evolution and the definition of phylo-development may be compared with each other by employing two useful terms introduced by Raff,¹⁹ *programmed* and *unprogrammed* changes. Development and phylo-development are *programmed* changes, as discussed in the previous essay. Development is described in scientific literature as a goal-directed,²⁰ internally driven and programmed,²¹ hierarchical process²²—in stark contrast to evolution. All meanings of evolution are subsumed under *unprogrammed*—unplanned,²³ random (i.e., purposeless), externally directed process of natural selection of Darwinian evolution.²⁴ The table below displays these definitions.

Table 1.
Comparison of Programmed and Unprogrammed Changes

Programmed Changes	Unprogrammed Changes
Individual development	Change over time
Phylo-development: programmed changes in large groups of animals over time	Descent with modification from a single progenitor
	Natural Selection
	Accumulated random mutations / Change in gene frequency in a population / Random drift

There is beauty in simplicity. The simplicity of the definitions of **Programmed Changes** stands in stark contrast to the complicatedness of the definitions of **Unprogrammed Changes**, especially in the last row of the table. If Ockham's razor²⁵ is applied, it would certainly favor definitions under **Programmed Changes** because of their simplicity.

Two misconceptions. The terms development and Darwinian evolution are sometimes used interchangeably. For example, evolution, is defined in a biological dictionary,²⁶ as “The gradual *development* of complex organisms from simpler ancestral types over the course of geological time.” (Emphasis added). That is a mistake. Using them interchangeably glosses over the radical differences between the two.

Development, moreover, is sometimes mistakenly subsumed under the term evolution, on the mistaken assumption that development itself has evolved,²⁷ i. e., that evolution itself produced the process of development. This claim reflects the assertion fostered by Thomson’s first definition, that is, that evolution is the universal source of all biological change, and therefore, *by definition*, it is the well-spring of development. Such a conclusion is unwarranted. Phylo-development and evolution, by any definition, are two completely different biological processes, that operate on different mechanisms and produces different results.

The Hierarchical Structure of Life

An additional element must now be made to the definition of evolution given by Plantinga and elaborated by Thomson earlier in this essay. First, it is assumed by evolutionists that evolution produced not only the “vast profusion of contemporary flora and fauna” mentioned by Plantinga, but also, and more important, the *hierarchical structure of organic life*.²⁸ Hierarchical structure means that there are only a relatively few major disparate and dissimilar groupings of animals and plants, called phyla, at the “top” of the organic world; each phylum is divided, subdivided, and still further subdivided into lower taxonomic groupings, found at the bottom of the hierarchy, represented by countless species, making up what Planting called the “vast profusion of contemporary flora and fauna.”

The claim that evolution has produced all the phyla, the highest level of organic life, by means of natural selection is an absolutely indispensable plank in the evolutionary scheme of things. It is not enough that evolution produces the great variety of life at the lowest level of species; it is essential that evolution must also produce the very structure of life—its hierarchical nature. This means that natural selection must also operate above the species level forming the great groupings of animals and plants—the phyla, classes and orders.

In order to understand the importance of this concept, it is necessary make two distinctions regarding the taxonomic level at which natural selection works, according to Darwinian theory—*microevolution* and *macroevolution*.

MICRO- AND MACROEVOLUTION

Microevolution

The first concept is *microevolution*—natural selection working at the level of species and varieties. Gilbert²⁹ calls it evolution that is “concerned with the origin of varieties, and races within species.” These represent the countless tiny changes that occur at the very bottom of the hierarchy of life. These changes, however, are merely elaborations and variations

on the major themes found in the phyla. The engine that drives microevolution is natural selection. Natural selection is thus limited to making small changes at the species level.

Darwinists tout recent experiments and field studies, called “evolution-made-visible” or “evolution-in-action,” conducted along the lines of the studies of Kettlewell’s³⁰ peppered moths and Darwin’s Galápagos finches,³¹ as if they validated Darwinian macroevolution. In a recent review of such studies Jonathan Weiner³² remarked that, “Charles Darwin didn’t think you could watch evolution in action. But modern biologists,” he says, “are getting a good look at the processes such as natural selection and even at the origin of species.”³³

Weiner went further. He extrapolated these studies, and others, into a model of how evolution worked in the entire history of life. He claimed that these microevolution studies, which he called radiations, show how macroevolution operated to produce the major groups of animals—vertebrates, fish, amphibians, insects, human beings. He said,³⁴

The history of these radiations *is the history of life*, from the explosive radiations of the bizarre fauna of the Cambrian, 540 million years ago, to the radiations of the first jawless vertebrates, the Agnatha, in the Ordovician, 500 million years ago; the radiation of fish in the Devonian; amphibians and insects in the Carboniferous; dinosaurs and mammals beginning in the Triassic; angiosperms and yet more insects in the Cretaceous; and in the Pleistocene, a few million years ago, radiation of herbs and human beings (Emphasis added).

His extravagant interpretation is made without a shred of supporting evidence, yet his claim is probably widely accepted in the scientific community. How does one stem this tide of misinterpretation and unbridled extrapolation of microevolution displayed by Weiner? Niles Eldredge,³⁵ a well-established evolutionary paleontologist, tried to do it in this way:

...it is dawning on us all, geneticists and paleontologists alike, that the constant genetic churning within individuals, and even within populations, does not mean that the constantly running motor of genetic change will necessarily alter the way a species looks even through long segments of geologic time. Rather than assuming that the small-scale changes necessarily add up, inevitably, to large-scale change as the geologic ages roll, many of us now see that evolution is a hierarchical process—and that what happens at one level need not specify what goes on at the next higher level.

In sum, the evidence clearly suggests that microevolution brings about only small, adaptive modifications at the level of individuals and species, but does not initiate major groups of animals or large innovative changes in the basic morphology of these groups. Microevolution thus produces only minor variations, never major innovations. In short, variations at the lowest level of varieties and species (microevolution) cannot be extrapolated into large scale changes at higher taxonomic levels (macroevolution).

Macroevolution

Modern Darwinists cannot be satisfied with such a limited role for evolution. They assume that microevolution inevitably becomes something much larger—macroevolution. Macroevolutionary theory presumes that species become modified by natural selection, and after many generations become grouped into higher taxonomic levels; that’s allegedly how

the great groupings of animals called phyla were supposedly formed. Macroevolution, in this view, is the engine that drives the formation of major groupings of animals and plants, the hierarchical structure of organic life, not just minor variations.

Thus the second and by far the most important part of evolution is called *macroevolution*—evolution “concerned with the origin of higher taxa.”³⁶ Macroevolution refers to natural selection working above the species level, by means of which novel, higher taxa and large groupings of animals, called phyla, are formed over geological ages. Concerning macroevolution, Raff³⁷ said,

In macroevolution we come face to face with what goes on over the long time spans that are the theater for the evolution of novel anatomies. Macroevolutionary events lie beyond the short-duration processes of an individual or microevolution in a small population.

As discussed above, it is widely held that microevolution can be extrapolated into macroevolution. Macroevolution supposedly causes larger morphological innovations above the species level throughout the history of organic life. According to Gilbert³⁸ et. al.,

One of the major tenets of the Modern Synthesis has been that...the phenomena of macroevolution, the evolution of species and higher taxa, are fully explained by the microevolutionary processes that gives rise to varieties within species. That is, the origins of higher taxa can be explained by population genetics.

Although Darwinian authors consistently hold that macroevolution is a real, bona fide evolutionary process, it is beginning to be questioned in some quarters by evolutionists themselves. For example, Eldredge,³⁹ a highly regarded paleontologist said,

Rather than assuming that the small-scale changes necessarily add up, inevitably, to large-scale change as the geologic ages roll, many of us now see that evolution is a hierarchical process—and that what happens at one level need not specify what goes on at the next higher level.

The following needs to be stated unequivocally: There is no fossil or biological evidence that provides support for macroevolution. Data demonstrating macroevolution is nonexistent. Although minor variations, such as the shapes of the beaks of Darwin’s finches, are clearly the work of natural selection, there is absolutely no empirical evidence that natural selection was involved in the origin of finches and birds in the first place, or in major innovations in any other phylum.

What would it take to demonstrate that macroevolution did actually form higher taxonomic levels of animals? Darwin gave the answer.⁴⁰ It would take the production of hundreds and thousands of generations of species at the bottom of life’s hierarchy that would be modified by natural selection until they could be grouped into a higher taxonomic level, i. e., the genera. Many genera would likewise need to be modified and grouped into families, families into orders, etc., until the highest level was reached at the top of the hierarchy—the phyla. However, no such building up from the bottom of life’s hierarchy to the top has ever occurred. There is no trail of such a progression of species to be found in the fossil record. Evolution-made-visible studies are merely trivial investigations microevolution that signify

only changes *within* species, nothing of importance for macroevolution. Natural selection and changes in gene frequencies in populations operate only at the level of species.

What then is left of macroevolution? Nothing. It is an empty hypothetical construct, like Santa Claus, that has no referent in the real world of nature. It simply does not exist. It clearly should be abandoned as a scientific concept.

Why does macroevolution continue to live on in evolutionary literature, and in the popular mind? Because it is an absolutely indispensable component in the evolutionary world view. Without it the evolutionary world view would collapse. Evolutionists cannot abandon it, because if they did their world view would self-destruct.

The Cultural Significance of Macro-evolution

As a universal theory. By now it is well known that evolution is not just a biological theory. It has become a much larger framework, a theory about how the entire universe works. Huxley⁴¹ stated it this way, "All aspects of reality are subject to evolution, from atoms and stars to fish and flowers, from fish and flowers to human societies and values—indeed, that all reality is a single process of evolution." Huxley is talking about *macroevolution*, not about some trivial microevolutionary phenomena. If evolution produced only minor variations among fish and worms, it could never support Huxley's claim about its universality. His claim would be a joke if macroevolution were not the one indispensable evolutionary process. Here then is one reason why the concept of macroevolution does not die. It is the linchpin that holds together all the elements of the universal theory of evolution.

That's not all. Let's look at the philosophical context within which science works. Science operates on the naturalistic assumption which "holds that all explanations must finally make reference to objects in space-time. There is no non-natural order to which an appeal can be made."⁴² So far so good. It is a short step, however, from this reasonable assumption to the much larger metaphysical claim that *nothing exists that cannot be studied scientifically*. Metaphysical naturalism thus rules out the action of a Supreme Being in the affairs of the natural order. This is made possible because natural selection has replaced God. This view pervades not only the scientific community but large segments of the western world as well. Denton (1986) has provided a dramatic interpretation of the cultural importance of the theory macroevolution in Darwinian evolution. He stated,

The cultural importance of evolution is therefore immeasurable, forming as it does the centrepiece, the crowning achievement, of the naturalistic view of the world, the final triumph of the secular thesis which since the end of the middle ages has displaced the old naive cosmology of Genesis from the western mind...

Ultimately, the Darwinian theory of evolution is no more or less than the great cosmogenic myth of the twentieth century. Like the Genesis based cosmology which it replaced, and like the creation myths of ancient man, it satisfies the same deep psychological need for an all embracing explanation for the origin of the world which has motivated myth makers of the past, from the shamans of primitive people to the ideologues of the medieval church (pp. 357-8).

Purposelessness of Evolution

A second addition needs to be made to the definitions of evolution given by Plantinga and Thomson at the beginning of this essay. It is this: *the history of organic life is devoid of purpose*. According to the evolutionary framework, evolution is a “Blind Watchmaker” as Dawkins calls it.⁴³ “Man is the result of a purposeless and materialistic process that did not have him in mind. He was not planned,” as Simpson claimed.⁴⁴

As Denton asserted,

The entire scientific ethos and philosophy of modern western man is based to a large extent on the central claim of Darwinian theory that humanity was not born by the creative intentions of a deity but by the completely mindless trial and error selection of random molecular patterns (p. 357).

This is the “cosmogenic myth” for which the Darwinian paradigm provides essential scientific authority—the rise of humanity by nonpurposive mechanisms of Darwinism. This myth challenges the historic claims of Judeo-Christian that God created the human race. The myth also gathers strength from its subtle offer of moral freedom, the release from being accountable to a Higher Being. Thus evolution is seen to be indispensable not only to biology, as Dobzhansky claimed, but also to the world view of western society. To dislodge and revise the Darwinian world view would be as difficult now as it was to uproot the Genesis cosmology centuries ago. Little wonder then that the Darwinian paradigm has weathered the storms of criticism that have lashed its foundations over the years.

The above discussion raises an important question regarding the integrity of science: Can the Darwinian paradigm ever be driven by data after it has become the centerpiece of the dominant, all-encompassing naturalistic world view of Western culture? With evolutionists as cultural gurus, has the intellectual and philosophical investment in the cosmogenic myth become so heavy that evolutionary scientists can no longer be objective about evidence that may even remotely undermine this world view? Are they enslaved by the world view their paradigm has created? Does funding for evolutionary research and the high status of evolutionists as culture’s gurus depend on this world view?

AN INTEGRATION

How then are macro-development and evolution to be brought together in an integrated theory of the origins and history of organic life? Since microevolution cannot be extrapolated into macroevolution it will require a new interpretation. It is replaced by macro-development. Phylo-development is considered the driving biologic force that originated and shaped the great animal groupings, the phyla. Neither natural selection, nor any other evolutionary process was significantly involved in this great historical production. Thus the “top” of the hierarchy of nature is the work of phylo-development. As geologic time went on, however, phylo-development began to lose steam and natural selection began to assert itself. Today phylo-development no longer produces major innovations.

Natural selection became a significant biological force about 250 million years ago, when the major phyletic themes had already been laid down, and increased in importance up to the present time. The enormous variety in the flora and fauna is the work of natural selection.

In short, deep biohistory, from the time when the first complex animal and plant life appeared, can be accounted for best by phylo-developmental principles introduced in the previous essay; recent bio-history can be explained by microevolution. Phylo-development predominates in the early history of phyletic lineages; microevolution comes into play later when the fires of phylo-development begin to burn low and when minor adaptive changes are needed to enhance survivability.

References and Notes

¹ Dobzhansky, Th., "Nothing in Biology Makes Sense Except in the Light of Evolution." *American Biology Teacher* 35 (1973): 125-129. The manifesto is, technically speaking, a hypothesis; and a null hypothesis, at that. That means it is falsifiable. Thus, if one or more biological phenomena can be explained without relying on an evolutionary variable, than the statement is falsified.

² Much of everyday, normal biology, however, is "made sense of" without any light whatsoever from evolution. A biochemist, for instance, needs no light from evolution to make sense of his/her biomolecular experiments and analyses. Avraham Sonenthal, in a letter to *The Scientist* went much farther. In criticizing a previously published article in the journal, he wrote, "The article calls evolution 'the backbone of modern biology.' I beg to disagree. No product, discovery, medical procedure, or advance has come out of evolutionary theory. Without evolutionary theory, all practical biology would stand just as it is. No major corporation has a 'Department of Evolution' because scientists who have to produce results don't use it." Sonenthal, A., Letter to the Editor *The Scientist* 14 (July 7, 1997) p. 10.

³ Thomson, K. S., "The Meanings of Evolution" *American Scientist* 70 (September-October, 1982) pp. 529-531.

⁴ ReMine, W. J., *The Biotic Message* (Saint Paul, MN: St. Paul Science, 1993) p. 125.

⁵ Plantinga, A., "Methodological Naturalism?" *Origins and Design* 18 (Winter, 1997) pp. 18-27.

⁶ This essay will not address the first sentence in Plantinga's summary, that is, the problem of the origin of life. It has been adequately addressed by a number of researchers, such as, Thaxton, C. B., Bradley, W. L., Olsen, R. L. *The Mystery of Life's Origin* (New York: Philosophical Library, 1984); Shapiro, R., *Origins* (New York: Summit, 1986).

⁷ Thomson, K. S., "The Meanings of Evolution" pp. 529-531.

⁸ Thomson, K. S., "The Meanings of Evolution" p. 529.

⁹ Although there is continuity in many universal constituents of life, such as, DNA, enzymes, tRNA, cell membranes, *Hox* genes, etc., that does not mean that there is continuity morphology and function in major life forms. Bricks, stone, mortar and wood may be used in building a barn or cathedral, but the forms and used of each are very different.

¹⁰ Clayton, *Nature* (May 29, 1997). See also Miklos, G., et. al., "An Essential Cell Division Gene of *Drosophila*, Absent from *Saccaromyces*, Encodes an Unusual Protein with tubulin-like and myosin-like Peptide Motifs" *Proceedings National Academy of Science* 94 (1997) pp. 5189-5194; Oliver, S. G., "From DNA Sequence to Biological Function" *Nature* 379 (1996) pp. 597-600.

¹¹ Darwin, C., *The Origin of Species* (London: John Murray, 1859) p. 189. Quoted in Gould, S. J., "Punctuational Change" Berggren, W. A., and VanCouvering, J. A., eds., *Catastrophes and Earth History* (Princeton, NJ: Princeton University Press, 1984) p. 25.

¹² Thomson, K. S., "The Meanings of Evolution" p. 530.

- ¹³ Johnson, P. E. "The Political Crisis of Scientific Materialism" *First Things* (Date) (pages) (From e-mail May 12, 1997).
- ¹⁴ Gilbert, S. F., Opitz, J. M., Raff, R. A., "Resynthesizing Evolutionary and Developmental Biology," *Devel. Biol.* 173 (1996) pp. 357-372. The authors quote Dobzhansky as follows, "by 1951 Dobzhansky could confidentially declare, "Evolution is a change in the genetic composition of populations. The study of mechanisms of evolution falls within the province of population genetics." Dobzhansky, Th., *Genetics and the Origin of Species*, 3rd ed. (New York, Columbia Univ. Press: 1951).
- ¹⁵ Strickberger, M. W., *Evolution* (Boston: Jones and Bartlett, 1990), pp. 433-451.
- ¹⁶ ReMine is extremely critical of the concept of natural selection. He said, "Natural selection is not a simple unified thing. It is smorgasbord of disjointed, conflicting mechanisms. From the smorgasbord, evolutionists select whatever mechanism they think appropriate to explain the origin of a given biological design...cryptic coloration, bright coloration, high speed, low speed, large size, small size, and all the many causes of survival." ReMine W. J., *The Biotic Message* (Saint Paul, MN: St. Paul Science, 1993) p. 125.
- ¹⁷ Gilbert, et. al., stated, "Numerous biologists, especially paleontologists and the Soviet school of population biologists, had argued against this view." (p. 358).
- ¹⁸ Wells, J., "Homology in Biology: A Problem for Naturalistic Science." Presented at a conference on Naturalism, Theism, and the Scientific Enterprise, University of Texas at Austin, (Feb. 20-23, 1997). Wells went on to say, "According to Rudolf Raff and Thomas Kaufman, evolution by DNA mutations is 'largely uncoupled from morphological evolution.'" Raff, R. Kaufman, T., *Embryos, Genes, and Evolution* (New York: Macmillan: 1983) p. 67.
- ¹⁹ Raff, R. A., *The Shape of Life* (Chicago, University of Chicago Press, 1996),p. 30.
- ²⁰ Mayr, E. "Cause and Effect in Biology." In Lerner, D., ed., *Cause and Effect* (New York: Free Press, 1965), pp. 33-50. Quoted in Dobzhansky, Th., Ayala, F. J., Stebbins, G. L., Valentine, J. W., *Evolution*, (San Francisco, Free Press, 1977) p. 502.
- ²¹ Thomson, K. S., *Morphogenesis and Evolution* (Oxford: Oxford University Press, 1988), p. 23. See also Raff, R. A., *The Shape of Life* (Chicago: The University of Chicago Press, 1996) p. 30
- ²² von Baer, K. E., *Entwicklungsgeschichte der Thiere: Beobachtung und Reflexion* (Konigsberg: Borntrager, 1828).
- ²³ Raff, R. A., *The Shape of Life* (Chicago: University of Chicago Press, 1996) p. 30.
- ²⁴ Darwin, C., *Origin of Species* 1859. 6th ed. 1872. (London: Reprinted in Everyman's Library, Dent, 1928). Dawkins, R. *The Blind Watchmaker* (New York: Norton, 1987).
- ²⁵ Reese, W. L., *Dictionary of Philosophy and Religion* (Atlantic Highlands, NJ: Humanities Press, 1980) p. 399. The usual formulation of Ockham's razor, also called the Principle of Parsimony, is "Entities are not to be multiplied beyond necessity."
- ²⁶ Marten, E. A., ed., *Dictionary of Life Sciences, 2nd ed, rev.* (New York: Pica Press, 1984) p. 131. See also Steen, E. B., *Dictionary of Biology* (New York: Barnes and Noble, 1971) p. 174. One of the dictionary definitions of evolution is "the development of race, species, or other group" given in *Webster's Third New International Dictionary of the English Language Unabridged* (Springfield, MA: Merriam Webster, 1993) p. 789.
- ²⁷ Raff, R. A., *The Shape of Life* (Chicago: University of Chicago Press, 1996). In several places Raff writes about the "evolution of development," pp. xiv, xvii, 211.

²⁸ This concept has its origin in Darwin, C., *The Origin of Species* (London: Dent, 1859, 6th ed. 1872; reprinted in New York: Everyman's Library, 1928) pp. 112-115, 120-121; Eldredge, N., *Evolutionary Macroevolutionary Dynamics* (New York: McGraw-Hill, 1989) p. 1.

²⁹ Gilbert, S. F., Opitz, J. M., Raff, R. A., "Resynthesizing Evolutionary and Developmental Biology," *Devel. Biol.* 173 (1996) pp. 357-372.

³⁰ Kettlewell, H. B. D., "Selection Experiments on Industrial Melanism in *Lepidoptera*." *Heredity* 9 (1955) p. 341.

³¹ Dobzhansky, Th., "Species and Their Origins," in Dobzhansky, Th., Ayala, F. J., Stebbins, L., and Valentine, J. W., *Evolution* (San Francisco: Freeman, 1977) pp. 186-7.

³² Weiner, J., "Evolution Made Visible," *Science* 267 (Jan. 6, 1995) pp. 30-33.

³³ Weiner reported a number of so-called "evolution-made-visible" studies. •Endler, for example, observed that guppies in the wild, which were endangered by predatory fish, blend with the sand on the stream bed for camouflage, whereas in streams where they were not endangered they displayed more visible colors, with spots bigger than sand grains. Endler built artificial streams in his laboratory and seeded them with guppies and predators. The results were the same as those found in nature. In Weiner, J., *Science* 267 (Jan. 6, 1995): 30-33. See also Reznick, D. N., Shaw, F. H., Rodd, F. H., Shaw, R. G. "Evaluation of the Rate of Evolution in Natural Populations of Guppies (*Poecilia reticulata*)" *Science* 275 (March 28, 1997) pp. 1934-1937. •A study by Schluter showed that a population of sickleback fish began to change shape and feeding habits when a new competitor forced the fish toward a different ecological niche. In Schluter, D., "Experimental Evidence That competition Promotes Divergence in Adaptive Radiation" *Science* 266 (November 4, 1994) pp. 798-800. •Peter and Rosemary Grant reproduced and extended Darwin's original studies of finches, and reported that changes in the type of available seeds produce changes in the beak size and shape of the finches within a single year. See Grant, P. R. and Grant B. R., "Hybridization of Bird Species," *Science* 256 (April 10, 1992) pp. 193-197. •Vrijenhoek found that sexually and asexually reproducing lines of topminnows vary in their resistance to flatworms, which burrow into their bodies and give them black spot disease. In Weiner, J., *Science* 267 (Jan. 6, 1995) pp. 30-33.

³⁴ Weiner, *The Beak of the Finch*, (New York: Random House, 1994) p. 208.

³⁵ Eldredge, N., "What Drives Evolution?" *Earth Magazine* (December, 1996).

³⁶ Rensch, B., *Evolution Above the Species Level* (New York: Columbia University Press, 1960). Also, Gilbert, et. al.,