

*Challenges to Neo- Darwinism
and Their Meaning for a Revised View
of Human Consciousness*

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I. BASIC PREMISES OF THE SYNTHETIC THEORY

The odyssey of evolution in the history of ideas has been, in microcosm, much like the history of species, the macrocosm that it seeks to explain — peculiar, tortuous, unpredictable, complex, weighted down by past inheritances, and not moving in unilinear fashion toward any clear goal.

Darwin divided his life's work, explicitly and often, into two major goals: to demonstrate the fact that evolution had occurred, and to promote the theory of natural selection as its primary mechanism. In the first quest, his success was abundant, and he now lies in Westminster Abbey, at the feet of Isaac Newton, for this triumph. In the second, he made much less headway during his lifetime. By the close of the nineteenth century, natural selection was a strong contender in a crowded field of evolutionary theories, but it held no predominant position.

Darwinian concepts are now so canonical in evolutionary theory that students without historical perspective often assume it has been so since 1859. In fact, the triumph of natural selection as a centerpiece of evolutionary theory dates only to a major intellectual movement of the 1930s and 1940s, called by Julian Huxley (1942) the "modern synthesis." The synthesis validated natural selection as a powerful causal agent and raised it from a former status as one contender among many to a central position among mechanisms of change (the role assigned to natural selection later hardened to near exclusivity; see Gould, 1983). The modern synthesis is, essentially, the central logic of Darwin's argument updated by the genetic theory of variation and inheritance that he, perforce, lacked.

Ernst Mayr, leading architect and historian of the modern synthesis, offered this definition of its primary claims at a con-

ference that assembled all the leading originators (in Mayr and Provine, 1980, p. 1):

The term “evolutionary synthesis” was introduced by Julian Huxley . . . to designate the general acceptance of two conclusions: gradual evolution can be explained in terms of small genetic changes (“mutations”) and recombination, and the ordering of this genetic variation by natural selection; and the observed evolutionary phenomena, particularly macroevolutionary processes and speciation, can be explained in a manner that is consistent with the known genetic mechanisms.

Several major tenets may be distilled from this paragraph. I shall select three as inspirations for major critiques of the hegemony of Neo-Darwinism. Each has significance for a revised view of human consciousness and its evolutionary meaning.

1. *Chance and necessity*, Randomness and determinism occupy separate and definite spheres in the central logic of Darwin’s theory. As Mayr states above, genetic variation arises by mutation and recombination; it is then ordered by natural selection—chance for the origin of the raw material of change, determination for the selective incorporation of some of this variation into altered organisms.

The central logic of Darwinism requires that natural selection not merely operate, but that it be the creative force of evolutionary change. Selection wins its role as a creative force because the other component of evolutionary mechanics — the forces that produce the raw material of genetic variation — are random, in the special sense of “not inherently directed toward adaptation.” That is, if local environments change and smaller organisms are now at an advantage, genetic variation does not produce more small individuals, thus imparting a direction to evolutionary change from the level of variation itself. Variation continues to occur “at random,” in a broad spectrum about the average size. Selection must impart direction — and be the creative force of evolution —

by differentially preserving those random variants yielding smaller than average phenotypes.

Randomness is a part of Darwinian theory, but it has a very definite and restricted role (lest the central premise of creativity for natural selection be compromised). It operates only in the genesis of raw material — genetic variation. It plays no role at all in the production of evolutionary change — the selective preservation of a portion of this variation to build altered organisms.

Critics of Darwinism, Arthur Koestler for example, have often misunderstood this central tenet of Darwinism. They charge that Darwinism cannot be correct because a world so ordered as ours cannot be built by random processes. But they fail to understand that Darwinism invokes randomness only to generate raw material. It agrees with the critics in arguing that the world's order could only be produced by a conventional deterministic cause — natural selection in this case.

2. *The reductionistic tradition.* The central claim of the synthesis, and the basis for its alleged unifying power, holds that the phenomena of macroevolution, at whatever scale, can be explained in terms of genetic processes that operate within populations. Organisms are the primary Darwinian actors and evolution at all levels is a result of natural selection, working by sorting out individuals within populations (differential reproductive success). This argument reflects a reductionistic tradition, not of course to atoms and molecules of the classic physical version, but rather of such macroevolutionary events as long-term trends to the extended struggle of individual organisms within local populations.

Reduction to struggles among organisms within populations is fundamental to Darwinism and underlies the logic of Darwin's own version of natural selection (Gould, 1982). Darwin developed his theory as a conscious analog to the laissez-faire economics of Adam Smith (Schweber, 1977), which holds as its primary argument that order and harmony within economies does not arise from higher-order laws destined for such effect, but can be justly

attained only by letting individuals struggle for personal benefits, thereby allowing order to arise as an unplanned consequence of sorting among competitors. The Darwinism of the modern synthesis is, therefore, a *one-level theory* that identifies struggle among organisms within populations as the causal source of evolutionary change, and views all other styles and descriptions of change as consequences of this primary activity.

3. *The hegemony of adaptation.* If evolutionary change proceeds via the struggle of individuals within populations, then its result must be adaptation. Natural selection operates by the differential reproductive success of individuals better suited to local environments (as a happy result of their combinations of genetic variation). The statistical accumulation of these favored genes within populations must produce adaptation if evolutionary change is controlled by natural selection. Of course, all Darwinians admit that other processes — the random force of genetic drift in particular — can produce evolutionary change as well, but the synthetic theory carefully limits their range and efficacy, so that they play no statistically important role in the net amount of phenotypic change within lineages. Since (under the second argument for extrapolation) long-term trends are nothing but natural selection within populations extended, then the phenomena of macroevolution reduce to natural selection as well and must be similarly adaptive throughout.

II. CURRENT CRITIQUES OF THE CENTRAL LOGIC OF THE SYNTHESIS

All three major premises of the synthetic theory have been criticized in recent years:

1. *Chance as an agent of evolutionary change.* In a major revision of Darwinian logic, chance has been elevated, from its traditional and restricted role as generator of raw material only, to a more active part as agent of evolutionary *change*.

Most debates in natural history center upon issues of relative frequency, not exclusive occurrence. Chance as an agent of evolutionary change in the phenomenon of “genetic drift” has long been recognized as orthodox, but traditional theory so restricted its occurrence and importance that it could play no major role in life’s history. The new arguments are distinctive in that they advocate a high relative frequency for chance and make it an important evolutionary agent of change in both the qualitative and quantitative sense. They also award an important role to chance at all levels of the hierarchy of evolutionary causation — at the molecular level of allelic substitution, the domain of speciation, and the largest scope of changing taxonomic composition in mass extinction.

The quasi-clocklike accumulation of DNA differences in phyletic lines, the empirical basis for the so-called “neutral” theory, or “non-Darwinian evolution” (King and Jukes, 1969), only makes sense if selection does not “see” the substitutions and if they, therefore, drift to fixation in a stochastic manner. Most models of sympatric speciation — though the relative frequency of this process remains unresolved and may be quite low — propose a genetic change quick enough to produce reproductive isolation (often by major alterations in number or form of chromosomes) prior to any selective revamping of the new form. The genetic trigger of speciation would therefore be random with respect to the demands of adaptation. I shall have more to say about mass extinction in the next section, but if these debacles really run on a 26-million year cycle (Raup and Sepkoski, 1984) triggered by cometary showers (Alvarez and Muller, 1984), then the reasons for differential survival cannot have much to do with — and must be random with respect to — the deterministic, adaptive struggles of organisms in the preceding normal geological times.

2. *The hierarchical perspective and the nonreducibility of macroevolution.* The material of biology is ordered into a genea-

logical hierarchy of ever more inclusive objects: genes, bodies, demes (local populations of a species), species, and monophyletic clades of species. Although our linguistic habits generally restrict the term “individual” to bodies alone, each unit of this hierarchy maintains the two essential properties that qualify it as an “individual” and therefore (under selectionist theories), as a potential causal agent in its own right — stability in time (with recognizable inception and extinction, and sufficient coherence of form between beginning and end) and ability to replicate with error (a prerequisite for units of selection in Darwin’s world). Traditional Darwinian gradualists would deny individuality to species by arguing that they are mere abstractions, names we give to segments of gradually transforming lineages. But under the punctuated equilibrium model (Eldredge and Gould, 1972; Gould and Eldredge, 1977), species are generally stable following their geologically rapid origin, and most evolutionary change occurs in conjunction with events of branching speciation, not by the transformation *in toto* of existing species. Under this model, therefore, species maintain the essential properties of individuals and may be so designated (Eldredge and Cracraft, 1980; Vrba and Eldredge, 1984).

Few evolutionists would deny this hierarchy in a descriptive sense, but traditions of the modern synthesis specify that causality be sought only at the level of organisms — for natural selection operates by sorting organisms within populations. Richard Dawkins has challenged this view, but in the interests of an even further and stricter reductionism (1976, 1982). He argues that genes are the only true causal agents and organisms merely their temporary receptacles. I strongly disagree with Dawkins (Gould, 1983), since I feel that he has confused bookkeeping (which may be done efficiently in terms of genes) with causality. But I feel that he has inadvertently made an important contribution to the theory of causal hierarchy by establishing numerous cases of true gene-level selection — that is, selection upon genes that occurs without a sorting of bodies and that has no effect upon the pheno-

types of bodies. The hypothesis of “selfish DNA” as an explanation for iteration of copies in middle-repetitive DNA (with no initial benefit or detriment to organisms at the next hierarchical level) represents the most interesting proposal for independent gene-level selection (Doolittle and Sapienza, 1980; Orgel and Crick, 1980).

If genes can be selected independently of organisms, then we may extend the causal hierarchy upward as well. Deme-level selection has long been advocated by Sewall Wright in his theory of “shifting balance” (Wright, 1931). Species selection may be a more potent force than traditional Darwinian sorting of organisms in both the spread of features within clades and the differential success of some clades over others. True species selection relies upon properties of species as entities — propensity to speciate in particular — that cannot be reduced to characteristics of organisms, and therefore cannot be explained by natural selection operating at its usual level. The expanded hierarchical theory remains Darwinian in spirit — since it advocates a process of selection at several levels of a hierarchy of individuals — but it confutes the central Darwinian logic that evolutionary events at all scales be reduced for causal explanation to the level of organisms within populations (Gould, 1982, 1985).

3. *Critique of adaptation.* A potent critique against the hegemony of adaptation has arisen from the theory of neutralism — the claim that much genetic change accumulates in populations by genetic drift upon allelic variants that are irrelevant to adaptation, and that natural selection therefore cannot recognize. Although these critiques are valid and were historically important in breaking the hegemony of adaptation, I shall bypass them here because I wish to discuss the evolution of phenotypes, and neutral changes, by definition, do not affect phenotypes.

At the level of phenotypes, the critique of adaptation does not claim a discovery of new evolutionary processes that actively produce substantial phenotypic change without natural selection. The

critique remains content with the conventional idea that natural selection is the only identified agent of substantial and persistent evolutionary change. In what sense, then, can we speak of a critique of adaptation?

Suppose that every adaptive change brings with it (since organisms are integrated entities) a set of nonadaptive sequelae far exceeding in number and extent the direct adaptation itself (see Gould, 1984a and 1984b for specific examples). Suppose then that these sequelae serve as constraints and channels that powerfully determine the limits and directions of future evolutionary change. Natural selection may still be the force that pushes organisms down the channels, but if these channels are the only paths available, and if they themselves were not constructed 'as a direct result of adaptation, then phenotypes are as much determined by the limits and potentialities set by non-adaptation as by the direct change produced by natural selection itself.

Of course, traditional Darwinians do not deny that adaptation entails non-adaptive consequences. This theme is, for example, the classic material of allometry, a subject named and popularized by the great Darwinian Julian Huxley (Huxley, 1932; Gould, 1966). But these consequences are conventionally viewed as superficial, epiphenomenal and non-constraining; natural selection, after all, can break an allometric correlation when necessary. Moreover, although Darwinism does not deny the existence of powerful constraints upon pathways of evolutionary change, the constraints are attributed to past adaptations for different roles. Thus, features of the phenotype are either current adaptations or past adaptations to different circumstances that constrain current change. Adaptation reigns. Darwin himself, a careful student of constraints and correlations, wrestled long and hard with this problem and finally resolved it in favor of adaptive supremacy in a key but neglected passage in the *Origin of Species* (1859, p. 206):

All organic beings have been formed on two great laws — Unity of Type and the Conditions of Existence. By unity of

type is meant that fundamental agreement in structure, which we see in organic beings of the same class, and which is quite independent of their habits of life. . . . The expression of conditions of existence . . . is fully embraced by the principle of natural selection. For natural selection acts by either now adapting the varying parts of each being to its organic and inorganic conditions of life; or by having adapted them during long-past periods of time. . . . Hence, in fact, the law of Conditions of Existence is the higher law; as it includes, through the inheritance of former adaptations, that of Unity of Type.

I believe that our views on the causes of phenotypic change have become stalled in a strict Darwinism that has already offered its valid insights — and that each critique of Darwinism offers an important new perspective. I shall illustrate the potential of each critique to expand our view of evolution in specific cases by discussing their potential impact upon the event of most immediate concern and importance to us — the evolution of human consciousness.

III. CONSCIOUSNESS AS COSMIC ACCIDENT

Four controlling biases of Western thought — progressivism, determinism, gradualism, and adaptationism — have combined to construct a view of human evolution congenial to our hopes and expectations. Since we evolved late and, by our consciousness, now seem well in control (for better or for worse), the four biases embody a view that we rule by right because evolution moves gradually and predictably toward progress, always working for the best. These four biases have long stood as the greatest impediments to a general understanding and appreciation of the Darwinian vision, with its explicit denial of inherent progress and optimality in the products of evolution.

Yet Darwinism does not confute all our hopes. It still smuggles the idea of progress back into empirical expectation, not by the explicit workings of its basic mechanism (which does, indeed,

deny inherent advance), but by an accumulation of superior designs through successive local adaptations (see Gould, 1985, for a resolution of this apparent paradox). All the great modern Darwinians have come to terms with (and supported) the notion of evolutionary progress, even though they recognized that the basic mechanism of natural selection contains no explicit statement about it (Huxley, 1953; Simpson, 1949; Rensch, 1971; Stebbins, 1969; Dobzhansky, 1972). Moreover, in viewing selection as a deterministic process, Darwinism supports our hope that the directions of change have their good reasons. In this Darwinian climate, we may still view the evolution of human consciousness as the predictable end of a long history of increasing mentality. Yet our new ideas about the importance of randomness in evolutionary change — particularly at the highest level of mass extinction — seriously upset this comforting and traditional notion and strongly suggest that we must view the evolution of human consciousness as a lucky accident that occurred only by the fortunate (for us) concatenation of numerous improbabilities. The argument is not based on a waffling theoretical generality, but on a specific empirical claim about a single important event: the Cretaceous mass extinction.

We may summarize the exciting ferment now reorganizing our ideas on mass extinction (see summary in Gould, 1985) by stating that these major punctuations in life's history are more frequent, more sudden, more severe, and more qualitatively different than we had realized before. I believe that Alvarez *et al.* (1980) have now proved their originally startling claim that a large extraterrestrial body struck the earth some 65 million years ago and must, therefore, be viewed as the major trigger of the Cretaceous extinction. Enhanced levels of presumably extraterrestrial iridium (the empirical basis of the Alvarez claim for the Cretaceous) have now been found at other extinction boundaries as well — so we may have the basis for a general theory of mass extinction, not merely a good story for the Cretaceous.

The meaning of the extraterrestrial theory for human consciousness as a cosmic accident begins with a basic fact that should be more widely known (but that will surprise most non-professionals, who assume something different) : *dinosaurs and mammals evolved at the same time*. Mammals did not arise later, as superior forms that gradually replaced inferior dinosaurs by competition. Mammals existed throughout the 100 million years of dinosaurian domination — and they lived as small, mostly mouse-sized creatures in the ecological interstices of a world ruled by large reptiles. They did not get bigger; they did not get better (or at least their changes did nothing to drive dinosaurs toward extinction). They did nothing to dislodge the incumbents; they bided their time.

Structural or mental inferiority did not drive the dinosaurs to extinction. They were doing well, and showing no sign of ceding domination, right until the extraterrestrial debacle unleashed a set of sudden consequences (as yet to be adequately specified, although the “nuclear winter” scenario of a cold, dark world has been proposed for the same reasons). Some mammals weathered the storm; no dinosaurs did. We have no reason to believe that mammals prevailed as a result of any feature traditionally asserted to prove their superiority — warm-bloodedness, live bearing, large brains, for example. Their “success” might well be attributed to nothing more than their size — for nothing large and terrestrial got through the Cretaceous debacle, while many small creatures survived.

In any case, had the cometary shower (or whatever) not hit, we have no reason to think that dinosaurs, having dominated the earth for 100 million years, would not have held on for another 65 to continue their hegemony today. In such a case, mammals would probably still be mouse-sized creatures living on the fringes — after all, they had done nothing else for 100 million years before. Moreover, dinosaurs were not evolving toward any form of consciousness. In other words, those comets or asteroids were the *sine quibus non* of our current existence. Without the

removal of dinosaurs that they engendered, consciousness would not have evolved on our earth.

IV. EXAPTATION AND THE FLEXIBILITY OF MIND

Strict adaptation entails a paradox for students of evolutionary change. If all structures are well designed for immediate use, where is the flexibility for substantial change in response to severely altered environments? The conventional answer calls upon a phenomenon of “preadaptation” — the idea that structures actively evolved for one use may be fortuitously fitted for easy modification to strikingly different functions (feathers, evolved for thermo-regulation, then available for flight, for example). But preadaptation speaks only of one-for-one substitutions based on previous adaptation. Can we identify a *pool* of flexibility in uncommitted structures?

Vrba and I have argued that strict adaptationism has blinded us to the absence of an important concept in our science of form (Gould and Vrba, 1982). Some evolutionists use “adaptation” for any structure that performs a beneficial function, regardless of its origin. But a long tradition, dating from Darwin himself, restricts “adaptation” to those structures evolved directly by natural selection for their current use. If we accept this stricter definition, what shall we call structures that contribute to fitness but evolved for other reasons and were later coopted for their current role? They have no name at present, and Vrba and I suggest that they be called “exaptations.” Preadaptation is, of course, a related concept — a kind of exaptation before the fact (feathers on a running dinosaur are preadaptations for flight; unaltered on a bird, they are exaptations). But preadaptation does not cover the range of exaptation because it refers to structures *adapted* for one role that are fortuitously suited for another. Preadaptation does not cover the large class of structures that never were adaptations for anything, but arose as the numerous non-adaptive sequelae of

primary adaptations. These are also available for later cooptation as exaptations (see examples in Gould and Lewontin, 1979, mostly from architecture and anthropology, where the concept does not threaten conventional thought and is therefore easier to grasp and accept). Surely, since non-adaptive sequelae are more numerous than adaptations themselves, the range of exaptive possibility must be set primarily by non-adaptation. Thus, if flexibility is primarily a result of possibilities that remain labile either because they have no current function (potential exaptations) or because their currently adapted structure can do other things just as well (preadaptations), then the major basis of flexibility must lie in non-adaptation. The old adage that flexibility correlates positively with complexity is correct, but the reason is not primarily — as usually stated — that complexity is itself so highly adaptive, but rather that increased complexity implies a vastly greater range of non-adaptive sequelae for any change, and hence a greatly enlarged exaptive pool.

Flexibility and computing power are the interrelated keys to the power of human consciousness. Among the usual reasons cited for extreme flexibility of human consciousness are the biological neoteny that probably keeps our brain in a labile, juvenile state (Gould, 1977) and the unparalleled potential of the non-somatic culture that our brains have made possible. These are indeed the two major reasons for human flexibility, but both are reflections of a single underlying theme: no biological structure has ever been so pregnant with exaptive possibilities as the human brain; no other biological structure has ever produced so many nonadaptive sequelae to its primary adaptation of increased size.

I do not doubt that the brain became large for an adaptive reason (probably a set of complex reasons) and that natural selection brought it to a size that made consciousness possible. But, surely, most of what our brain does today, most of what makes us so distinctively human (and flexible), arises as a consequence of the non-adaptive sequelae, not of the primary adaptation itself — for the

sequelae must be so vastly greater in number and possibility. The brain is a complex computer constructed by natural selection to perform a tiny subset of its potential operations. An arm built for one thing can do others (I am now typing with fingers built for other purposes). But a brain built for some functions can do orders of magnitude more simply by virtue of its basic construction as a flexible computer. Never in biological history has evolution built a structure with such an enormous and ramifying set of exaptive possibilities. The basis of human flexibility lies in the unselected capacities of our large brain,

This perspective also suggests that we must radically revise our methodology for thinking about the biological basis of essential human institutions and behaviors. An enormous, and largely speculative, literature attempts to interpret anything important that our brains do today as direct adaptations to the environments that shaped our earlier evolution. Thus, for example, religion may be a modern reflection of behaviors that evolved to cement group coherence among savannah hunters. But religion might as well record our human response to that most terrifying fact that a large brain allowed us to learn (for no directly adaptive reason) — the inevitability of our personal mortality. I suspect that most of our current cognitive life uses the non-adaptive sequelae of a large brain as exaptations, and does not record the direct reasons why natural selection originally fashioned our large brain.

V. HIERARCHY AND THE SIMULTANEOUS CONSCIOUS CONTROL OF LEVELS

Hierarchies of inclusion, like the genealogical hierarchy under discussion here, maintain an important property of asymmetry. Sorting at any high level must produce effects at all lower levels by shuffling their units (individuals) as well (see Campbell, 1974, on downward causation). This property of hierarchies is responsible for the causal confusion of reductionists who assume that

because lowest-level units — genes in this case — are always sorted, then this sorting (which they confuse with, and call, selection) must record the causal locus of change. But, again, bookkeeping is not causality, and this argument is invalid. Thus, when species selection operates and certain kinds of species are removed from or differentially added to a clade, proportions of organisms and frequencies of genes must also change within the clade — although the cause of sorting resides at the species level.

The converse, however, is not true. Sorting at low levels does not necessarily produce any effect at all upon the character or relative numbers of higher-level individuals. Lower-level sorting may be effectively insulated from any effect upon higher levels. Thus, at least initially, mobile genes may increase their number of copies within genomes without producing any effect upon bodies, demes, or species. This invisibility is the basis of the selfish DNA hypothesis.

Organisms — the quintessential Darwinian actors — normally can only operate directly for themselves. This produces the paradox of overspecialization when benefits to individuals entail eventual extinction of species because bizarre specializations so limit flexibility in the face of environmental change. Imagine what evolutionary possibilities would be opened if this asymmetry could be broken, and if lower-level units could work simultaneously both for their own fitness and for the fitness of those higher units in which they reside. Yet this cannot happen in a world of unconscious objects, for how could a gene work actively for its body, or a body for its species, when individuals only “see” selection at their own level and cannot know (because they are unaffected by) the forces and directions of higher-level selection?

But human consciousness has ruptured this system. We can use conscious thought to break through the bounds of our own level and to understand what we might do as individuals to enhance or injure the groups in which we reside. In short, we can work directly on our own higher-level fitness. We also have the

genetic flexibility — since we are not programmed automata — to choose actions injurious to ourselves but beneficial to our groups, even though natural selection has been working only on our individual-level fitness for so long. Thus, we can behave altruistically not only because certain organism-level processes — kin selection and reciprocal altruism — select for self-abnegation as a good Darwinian strategy, but primarily because we can understand the importance of group-level fitness and have the genetic flexibility (probably for non-adaptive reasons, and not necessarily as the result of millennia of kin selection) to act accordingly. In this sense, the strict Darwinian explanations for altruism offered by sociobiology are inadequate.

For the first time in biological history, organisms can actively pursue fitness not only for themselves but at several levels of their own hierarchy. The gain in potential power and flexibility is staggering. We can now speed and alter the evolution of our species at unprecedented rates and effectiveness. We have broken the ordering principles of the evolutionary hierarchy.

This unique mode of evolution also presents new challenges. If we lived in a world of intrinsic harmony, where fitness at one level inevitably enhanced fitness at others, our new abilities would simply allow us to tap a positive feedback loop between individual and species-level fitness *ad majorem hominis generisque gloriam*. But our world is not so pleasant. The components of fitness at one level are just as likely to depress (as in overspecialization) as to enhance fitness at higher levels. Consciousness puts us in the uncomfortable position of being the only species that can directly affect the components of both its individual and species-level fitness — and of finding that they often conflict. What then are we to do? Shall our great athletes press for even higher salaries and imperil the health and finances of their game's organization?

I have argued that three criticisms of strict Darwinism — randomness, non-adaptation, and hierarchy — each has important implications for a revised view of the evolutionary meaning of

human consciousness. Some readers might draw a pessimistic message from the coordinated theme that less predictability, less order, less design attended the evolution of our unique mentality. They may be justly reminded of the *Rubaiyat's* famous couplet,

Into this Universe, and Why not knowing
Nor Whence, like Water willy-nilly flowing.

I draw no somber conclusions from these arguments. I do not believe, first of all, that the answer to moral dilemmas about meaning lies with the facts of nature, whatever they may be. Moreover, I see only hope in the flexibility offered to human consciousness by its evolutionary construction. If our mentality evolved for no particular predictable reasons, then we may make of it what we will. If the major activity of our brain records the non-adaptive sequelae of its construction as a powerful computer, then evolutionary adaptation does not specify how we must behave and what we must do. *Vita brevis* to be sure, but what possibilities.

Ah, make the most of what we yet may spend,
Before we too into the Dust descend . . .
Here with a little Bread beneath the Bough . . .
Oh, Wilderness were Paradise enow!

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