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Evolution and the Purposes of Life

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When your dog takes a stick in its mouth, drops it at your feet, and then looks expectantly at you while signaling eagerness to run and retrieve the thrown plaything, you have no difficulty recognizing its intentions. Your dog's behavior is blatantly purposive, even if its "state of mind"—whatever that might mean—is very different from yours and mine.

Similarly, if your cat is "telling" you it wants to go outdoors (cats, unfortunately, are always on the wrong side of the door), or if you have watched a bird building a nest, or an amoeba engulfing a particle of food, or the fish in a still pool darting toward the shelter of an overhanging bank upon your approach, you accept what you see without great puzzlement. While we do not expect such *behaviors* from rocks, clouds, or volcanoes, they seem normal for living things.

And so they are. Even the "growth behaviors" of plants and the "chemical behaviors" of the individual cells in our bodies are in some sense intelligent and purposive, wisely directed toward need-fulfilling ends. Purposive—or *teleological* (end-directed)—activity is no merely adventitious feature of living creatures. Being "endowed with a purpose or project," wrote biochemist Jacques Monod, is "essential to the very definition of living beings." And according to Theodosius Dobzhansky, a geneticist and leading architect of the past century's dominant evolutionary theory, "It would make no sense to talk of the purpose of adaptation of stars, mountains, or the laws of physics," but "adaptedness of living beings is too obvious to be overlooked.... Living beings have an *internal*, or natural, teleology."

The curious thing, however, is that despite this emphatic recognition of the purposive organism, we find in textbooks of biology virtually no mention of purpose—or of the meaning and value presupposed by purpose. To refer to such "unbiological" realities is, it seems, to stumble into the unsavory company of mystics. Yet we might want to ask: if purposiveness in the life of organisms is as obvious as many in addition to Monod and Dobzhansky have admitted, why should it be impermissible for working biologists to reckon seriously with what everyone seems to know?

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It's a question we *will* ask. Be aware, however, that in struggling to answer it we may stir up unsettling doubts about the central biological concepts of evolution and natural selection.

What Is End-Directed Activity?

In his 1984 book, *Computation and Cognition*, the cognitive scientist Zenon Pylyshyn offered a classic example of purposive behavior. He asked his reader to imagine a pedestrian who is nearly struck by a car. The car swerves and crashes into a pole. The pedestrian goes over to the car, looks inside, then immediately runs to a telephone booth and dials 9 and 1. Can we predict what will happen next?

Most of us believe, quite rightly, that everything occurring in this situation is perfectly consistent with the natural laws governing physical events. This might lead us to think that we ought, at least in principle, to be able to predict what will happen next based on a strictly physical description of what happened. But nothing in the lawfulness of the physical events—the momentum and trajectory of the car, the forces at work in the pedestrian's muscular movements, or the interaction of parts in the telephone—tells us what significance the events held for the pedestrian or why the next thing likely to happen is the dialing of a second 1.

An adequate explanation of the story, Pylyshyn observes,

> must mention, among other things, that the pedestrian *perceived* the collision, *recognized* it as an event that is classified as an accident, *inferred* that there might be an injury, went over to *determine* whether anyone had in fact been injured, *deduced* from what he saw that that might be the case, *decided* to seek help based on the *knowledge* he possessed of the proper treatment of injured persons, *noticed* a telephone booth nearby, *recalled* the number for emergencies, and dialed the number with the *intention* of seeking help. [Italics in original.]

It is clear enough, then, that the *meanings* of what was happening were decisive for the pedestrian's actions and for our understanding of them. Things happened, in a broad sense, rationally—for reasons—and these reasons gained their sense only within the context of a tapestry of meaning vastly more diverse and multicolored than the concepts presented in a physics textbook. A context of meaning is a prerequisite for end-directed activity. Without meaning there would be no end to be directed toward, because no one state of affairs would be preferable to another or mean anything different from another.

Further, many of the meanings and reasons in our example came to bear upon, or issued from, the pedestrian as an *agent* with his own purposes. He was not a mere coagulated mass moved, along with all the other objects in the scene, by impinging forces. His agency and intention, centered in himself (*I must call 911 now!*) were the essential basis—the anchoring point and coordinating power—for much of the end-directedness we see in the scenario.

Now for a different example—one involving an animal with little, if any, of the conscious rational capacities of our pedestrian. The following extended passage about the chaffinch comes from a 1927 description by the British ornithologist Edward Max Nicholson (quoted in E. S. Russell's 1934 book *The Behaviour of Animals*):

> Here the male must leave the flock, if he has belonged to one, and establish himself in a territory which may at the time be incapable of sustaining him alone, but must later in the season supply a satisfactory food-supply for himself, his mate and family, and for as many birds of other species as overlap his sphere of influence. He must then sing loudly and incessantly for several months, since, however soon he secures a mate, trespassers must be warned off the territory, or, if they ignore his warning, driven out. His mate must help with the defence of the territory when she is needed; pairing must be accomplished; a suitable site must be found for the nest; materials must be collected and put together securely enough to hold five bulky young birds; eggs must be laid in the nest and continuously brooded for a fortnight till they hatch, often in very adverse weather; the young are at first so delicate that they have to be brooded and encouraged to sleep a great part of the time, yet they must have their own weight of food in a day, and in proportion as the need of brooding them decreases their appetites grow, until in the end the parents are feeding four or five helpless birds equal to themselves in size and appetite but incapable of digesting nearly such a wide diet. Enemies must be watched for and the nest defended and kept clean. When the young scatter, often before they can fly properly, they need even greater vigilance, but within a few days of the fledging of the first brood a second nest will (in many cases) be ready and the process in full swing over again. All this has to be done in face of great practical difficulties by two creatures, with little strength and not much intelligence, both of whom may have been hatched only the season before.

Here, too, organized behavior reflects the interests and needs, the perception, and the future requirements, of agents carrying out highly

effective, end-directed activity. To be sure, the bird is not consciously reflecting upon its situation. But, just as with the pedestrian, we make sense of what happens by interpreting it as a series of *reasonable* responses to the bird's ever-changing life context—all in the light of its own ends. While we cannot view the bird as inferring, deducing, and deciding, it is nevertheless recognizing and responding to elements of significance in its environment. There is a continual and skillful adjustment to a perceived surround that is never twice the *same* surround.

Commenting on this description, Russell, an accomplished marine biologist, noted the narrative connectedness of the events. "One action prepares for and leads on to the next until the end term is reached. Each stage in the chain or cycle is unintelligible to us except in its relation to what has gone before, and, more particularly, to what is yet to come." In this particular case, unlike some others we might have chosen, the behavior "is mainly instinctive, independent of previous experience, and to a considerable extent stereotyped and invariable."

But Russell is adamant that the instinctiveness of the animal's behavior does not make it *merely* mechanistic, directed only by "the physical and chemical stimuli impinging upon the sense organs of the animal." Not even "mechanical" reflexes can be understood in merely mechanistic terms: "There is no such thing as pure reflex action in normal behaviour; all so-called reflexes are parts of co-ordinated and generally 'purposive' or directive actions, and they cannot be understood until their relation to the objective aim of the whole action is known." The point is simply illustrated:

> A blackbird picks up a worm in its beak, and if it is feeding itself swallows it. This *might* be a purely reflex train of events. But if it is foraging for its family it does not swallow the worm, though on the reflex theory swallowing ought to follow automatically from the stimulus of the worm in the mouth. It keeps the worm in its beak and perhaps hunts for more before taking them back to the nest. The objective aim or "purpose" of the activity controls its detailed course, inhibits the normal swallowing reflex, if reflex it be.

Russell provides numerous examples of such context-driven end-directedness. One more will suffice. The small flatworm, *Girardia dorotocephala*, will, when turned upside down, go through a particular maneuver to right itself. It executes a spiral twisting whereby "the ventral surface of the head touches ground and the rest of the body follows rapidly." It is a classic sort of reflex reaction.

It happens that this little creature is also well-known for its ability to regenerate itself from amputated parts. Russell cites experiments in which a sizable triangular piece is cut from the midsection of a flatworm and placed upside down on a plate. The animal, or piece of animal, does indeed still try to right itself. But the normal means of doing so has been destroyed. So, instead, the crippled piece does something that presumably none of its ancestors has ever done: it curls one of its edges under its body and attaches the ventral side of the curled edge to the plate. Then, through a series of strong contractions, the rest of the piece flops over the attached edge, landing right side up.

Such behavior shows us, as Russell puts it, that "the end is more constant than the means of attaining it." This fundamental rule of end-directed behavior is easy enough to see in the case of the automobile accident. If the phone had turned out to be disconnected, the pedestrian might have looked for another one, or hailed a passing car, or returned to the injured driver to administer whatever first aid he could. The number of potential behaviors in response to any particular event is countless, depending on the contextual meanings at play. These meanings enable us, without difficulty, to see the same purpose at work in many different physical responses.

As for the flatworm, no one will think it is "considering its options" in the way the pedestrian might. But neither can we deny that a well-directed—even if, to us, scarcely comprehensible—intelligence is at work in its self-righting behavior.

And likewise with the chaffinches. The bland statement, "It's all instinctive" rides roughshod over the intelligent sensitivity expressed at every moment of their lives. If the nest is damaged by a storm, repairs will be made, using whatever materials are at hand. If a drought removes some of the feeding possibilities, an entirely different pattern of foraging may take hold. And so on with virtually every detail of behavior. *The end is more constant than the means*, and it requires an active intelligence capable of improvising responses within an infinite variety of unforeseeable circumstances in order for the end to be achieved.

The urge to cleanse our scientific descriptions of that active intelligence by restricting our attention to "objective physical facts" is powerful today, and will be a major focus of further discussion below. Here I suggest only that such cleansed, or reduced, descriptions, if they are effective, inevitably import elements of agency and intelligence under the table.

Pylyshyn illustrates the problem with terms such as "stimulus" and "response." They may sound rather humdrum and mechanistic, but "what

serves as the functional stimulus depends on how a person interprets the situation." If the pedestrian had found reason to view the accident as part of a movie rehearsal, the effective stimulus of the car's collision with the pole would have been quite different. Likewise, we do not count merely incidental or accidental movements as responses, but "only movements intended a certain way." If the pedestrian dialed a random number due to a sudden spasm in his hand, we would not consider this a response.

So in choosing what to describe as a stimulus or response, researchers implicitly lend the experimental subject their own interpretive understandings, whether the subject is a human being, a bird, or a worm. Without interpretive activity—activity through which meanings are apprehended—there is no story to be told, as opposed to a set of physical causes and consequences. And without a story, there is no organism.

Perhaps the most profound importation of under-the-table meaning occurs when we appeal to the "simple" fact of perception. The chaffinch does not live side-by-side with meaningless aggregations of matter. It *perceives a world* and makes *sense* of it—an achievement of live intelligence so great and so puzzling to our current science that we hardly know what to do with it. Every biologist would do well, I think, to spend time observing, say, a red maple leaf while asking herself, "What is this experience, this *awareness*, I am having at this very moment?"

No one can claim to understand such qualitative awareness solely in terms of the prerequisite physical functioning of the sense organs. Why does a circling red-tailed hawk see a landscape and a significant movement in the meadow grass, rather than a chaotically shifting array of meaningless pixels? Nothing but a form of intelligent awareness can give us coherent, stable *things*, each with its own meaning whereby one thing can be distinguished from another, and each with its integral place in the larger, unified tableau. As for "meaning" in the previous sentence: any scientific researcher for whom the word is taboo, or who cannot satisfactorily explicate it—no easy task!—needs to acknowledge something like a black hole at the center of her discipline, threatening to suck the coherence from it.

Some form of perceptive awareness is the only thing that can give us a world. And it is impossible to draw a hard-and-fast line of principle between, for example, our own seeing, the seeing of the chaffinch's eyes, the seeing of the simple eyespot of a flatworm, or the amoeba's still less differentiated perception of its immediate surround. In all these cases we have a sense-making activity that implies the organism is a present and intelligent center of awareness within a meaningful world. Any biology

ignoring this simple and decisive fact despite having to assume it every step of the way is an egregiously naïve biology.

Organisms present us with boundless mysteries and wonderful questions. But mysteries and questions, which are the prerequisite for scientific advance, can also be an invitation to narrow our vision so as to reduce the glare of the unknown.

A Discomfiting Inwardness

The idea of teleological behavior within a world of meaning is rather uncomfortable for scientists committed—as contemporary biologists overwhelmingly are—to what they call "materialism" or "naturalism." The discomfort has to do with the apparent *inward* aspect of the goal-directed behavior described above—behavior that depends upon the apprehension of a meaningful world and that is easily associated with our own conscious and apparently immaterial perceptions, reasonings, and motivations to act.

But, as we saw with the chaffinch and flatworm, the issues extend beyond our own sort of conscious, intentional behavior. All biological activity, even at the molecular level, can be characterized as purposive and goal-directed. As a cell grows and divides, it marshals its molecular and structural resources with a remarkably skillful "wisdom." It also demonstrates a well-directed, "willful" persistence in adjusting to disturbances. Everything leads toward fulfillment of the organism's evident "purposes."

Teasing out the meaning of these scare quotes may be the most urgent task for biologists today. As the Chilean neuroscientist and philosopher of biology Francisco Varela wrote: "The answer to the question of what status teleology should have in biology decides about the character of our whole theory of animate nature."

My own sense of the matter is that the question has yet to be fairly taken up within the core disciplines of biology. What appears certain is that as yet we have no secure answer to it. Even more important is what seems least recognized: to the degree that we lack understanding of the organism's purposive life we also lack a respectable foundation for evolutionary theory.

There are, in any case, two confusions to be avoided immediately. The first confusion is that the question about teleology in living organisms is often presented as a question about final causes, with conscious human planning as the model. One thinks of an external goal or end, which then must be aimed at. Avoiding any suggestion of such planning is considered

urgent when we try to understand biological or organic, as opposed to psychological, activities.

The concern is justified. What may be overlooked, however, is that we can speak of end-directed activity without assuming an external goal to be planned for and aimed at. We can, that is, think of the organism as simply *giving expression to the wholeness of its own nature*, which comes to an ever fuller realization over the course of its life.

The *telos* or end of teleological behavior, in other words, rather than being a goal "out there," freely conceived by a reflective organism, may simply be the organism's own completeness and wholeness—the fullness of its self-expression under all life conditions that present themselves. "Being-at-work-staying-itself" (a phrase used by the interpreter of Aristotle Joe Sachs) is one way to characterize the organism's teleological activity. The manner in which specific end-directed performances are carried out—cell division, production of proteins, avoidance of predators—can all be understood as partial aspects of that self-expression. They all participate in the distinctive character—the qualitative and meaningful existence—of a particular kind of organism.

Think again of the chaffinch. The "future-oriented" aspect of the bird's wisdom has something in common with the way a phrase or theme in an integrally unified work of music gains its full meaning only in the context of both the preceding and following sections of the composition. The unity, or wholeness, of the piece comes to expression in, and shapes, the parts and their relations. We do not feel that a given motif is there merely in order to cause or make possible a later one. The possibility arises, rather, from the unity and character of the composition as a whole.

I will continue to speak of end-directedness and purposiveness, but only in the confidence that the reader will oblige me by keeping the caveats of this present discussion in mind. And I will also employ the word "directive," an uncommon usage that may encourage an occasional pause for reflection upon the unsettled complexities of meaning central to our discussion.

The second source of confusion about teleology and inwardness lies in the failure to realize how weak and lamed our conscious human purposiveness and intelligence are in relation to biological activity. We struggle even to follow with our abstract understanding the unsurveyably complex goings-on in our own organs and cells, let alone to animate our material artifacts with the same sort of life. And when we achieve a pinnacle of effective self-expression as pianists or gymnasts, it is by grace of a body whose execution of our intentions is a mystery to our understanding.

We need to reject conscious human performance as a model for organic activity in general, not because it reads too much wisdom and effective striving into the organism, but rather because it reads far too little.

From Teleology to Teleonomy

Biologists' discomfiture with inwardness in any form is presumably why, in 1958, Colin Pittendrigh proposed "teleonomy" as a kind of de-psychologized substitute for "teleology." The new word was intended to capture the physically lawful character of end-directed biological activity (*nomos* meaning "law"), while avoiding any "spooky" suggestion of familiar intention, purpose, or intelligence—any suggestion, that is, of reasoned and meaningful behavior analogous to conscious human activity.

Biologists have long celebrated the fact that Darwin's evolutionary theory undermined the special status of humans and demonstrated that our ancestry is continuous with the "lower" animals. It does seem rather odd, therefore, to quarantine the various features of our own inwardness and agency, isolating them from biological and evolutionary theory in general lest the living kingdoms as a whole should somehow be infected by them.

In any case, Pittendrigh's "teleonomy" proved effective as a kind of antibiotic against too vivid a recognition of purposive living activity. Ernst Mayr, a major figure in twentieth-century evolutionary biology, gave the new word its staying power by harnessing it to the notion of a computer program: "A physiological process or a behavior that owes its goal-directedness to the operation of a program can be designated as 'teleonomic.'" Mayr claimed further that "the *program* for the [organism's] behavior computer" is provided by the "DNA code," yielding "a purely mechanistic purposiveness."

End-directedness, redefined in this way, remained for Mayr basic to our understanding of life. "The existence of a genetic program," he wrote, "constitutes the most fundamental difference between living organisms and the world of inanimate objects, and there is no biological phenomenon in which the genetic program is not involved."

If Mayr firmly established the notion of a teleology-taming program in modern biological thought, the most memorable framing of the issue probably came from the influential twentieth-century geneticist François Jacob, who wrote in 1970 that "For a long time, the biologist treated teleology as he would a woman he could not do without, but did not care to be seen with in public. The concept of programme has made an honest woman of teleology."

Honest? Where is the substance of this claim of legitimacy? While the widely embraced but vague idea of a DNA-based, computer-like program has had remarkable inertia among biologists, one cannot help noticing their reticence in recent years to make any substantial effort toward articulating how it actually works, or what it really is. The program "is nowhere to be found"—so wrote Lenny Moss, a biochemist and philosopher of science. We therefore face "the curious dilemma of accounting for biological events…on the basis of an entity invested with executive power, that doesn't exist."

Almost the entire literature of genetics and molecular biology today points to the problem. Researchers trying to tie down chains of cause and effect that originate with genes as elements of a controlling genetic program have ended up chasing hares in every direction, a vast number of which are "regulatory" and "controlling" factors headed *toward* DNA rather than away from it. As Moss put it, attempts to explain even the most immediate activity of genes "quickly devolve into an array of antecedent conditions which are exponentially more complex than the event one was trying to account for." Modern investigations of DNA inevitably deliver us to "the complex state of the cell/organism as a whole as the causal basis of the activity of the genes."

While DNA and its genes have been advertised as containing a program that explains the directive life of the organism, they appear to be not so much an *explanation* as an *expression* of that life. This emerges more clearly when we take a closer look at the performances in which DNA is caught up.

The Genetic Code

Underlying not only the idea of the genetic program, but almost the entire apparatus of biological explanation, we find the concept of *information.* This information is commonly thought to consist of abstract, mathematically manipulable *bits.* And bits in turn are easily conceived, or rather misconceived, as minuscule parts of a machine, where they act in the manner of elemental physical causes.

The language of information sounds satisfyingly technical—logically precise, concretely causal, and strictly divorced from soft-headed notions of sense or meaning. But it turns out that, in the overwhelming majority of its uses, the word "information" relies for its effectiveness upon elements of meaning, including purposiveness. The word just means, for us, "elements of meaning." So we can hardly help imagining certain collections of

those causal bits being *for* some meaningful activity or achievement—and we assume that they somehow possess the resources and instructive force to do the job. They effectively inform the ongoing activity.

This is evident in the most basic and routine language relating to that ultimate information-bearer, DNA. For example, references to *defects* in DNA replication, *errors* in gene expression, and the *surveillance* for, and *correction* of, such defects and errors make it clear that we are not merely talking about causal processes. Physical interactions as such never err. To make a mistake implies that there is some intended and meaningful end that has been put at risk.

This assumption of purposive activity is so universal as to pass almost unnoticed in discussions of how organisms or cells or molecules *communicate*, *signal*, *interpret*, and *edit* existing information, send and decode *messages*, and so on. There is no sense, after all, in the idea of sending a signal or message if you are just going to continue interacting according to nothing but physical necessity. The normal, if unreflective, assumption is that these "informational" molecules are participating in organized, coordinated activity addressing the needs of a living context.

The intermingled ways of thinking about bits of information—as elemental physical causes on one hand, and as bearers of meaning on the other—would, if separated, yield utterly different views of the natural world. Yet the unconscious merging of the two conceptions is what sustains much of the contemporary biological conversation.

The situation is nowhere seen more clearly than when we turn to the so-called genetic code—the mapping between the "letters" of DNA and the amino acids of proteins—whose elucidation was supposed to lay open the "book of life." But the effort at deciphering the book has, in recent years, proved stunning and revelatory only by shifting the picture dramatically away from explanatory bits of digitally coded information.

"Genomes are incredibly dynamic," write one pair of researchers. The thousands of genes in the human genome exist within the three-dimensional space of the cell nucleus, wrapped up with exceedingly complex and shifting arrangements of protein, RNA, and other molecules. As significant cellular events occur, the chromosomes are said to move and "breathe" in different rhythms, attach to and detach from nuclear structures, condense here and expand there, form loops—and loops within loops—and establish fateful liaisons between countless locations along their length.

The double helix twists upon itself more tightly, or else relaxes. It engages in decisive electrical interactions with its protein partners, is

relocated from here to there within the nucleus, and is subject to mechanical pushes and pulls from the fibers of the extra-nuclear cytoskeleton. The shape—and even more, the qualities of the movements—of all the players in the drama are the materials of the larger narrative.

None of these activities—and many more we could speak about—can be said to issue from the chromosomes themselves. Rather, they require influences and regulatory factors arriving from all quarters of the cell or the wider organism. And a common rule is that the rate, rhythm, and form of what happens are fully as important for the outcome as any supposedly encoded content of the elements at play. (For more detail, see my *New Atlantis* essay "Getting Over the Code Delusion," Summer 2010.)

The work uncovering this dynamic reality is only now reaching white heat, and researchers have been struggling to find the right language for what they are seeing. It is no longer surprising to hear such words as "orchestration," "choreography," and "dance." And so the expressive gesturing characteristic of the organism as a whole works all the way down to the cell and its smallest parts, catching them up in contextual significances.

"The statement, 'genomes exist in space and time in the cell nucleus' is a trivial one, but one that has long been ignored in our studies of gene function"—so write two leaders of the current work: Job Dekker, head of a bioinformatics lab studying the spatial organization of genomes at the University of Massachusetts Medical School, and Tom Misteli, a research director at the National Cancer Institute. The last decade, they say, has taught us that "gene expression is not merely controlled by the information contained in the DNA sequence," but also by "higher-order" interactions and the features of nuclear organization and context.

What this shows is that the idea of a DNA code with "controlling information" is a one-sided caricature. We are looking not at a code but at a play of animated cellular substance caught up in meaningful form. The moment-by-moment outcomes look more like balletic expression than like the results of a digital logic.

Yet the pull of old habits of thought is hard to resist, compromising even honest efforts to capture the new realities. John Rinn, director of a genomic research lab at Harvard, has said of the nuclear space and its chromosomal drama, "It's genomic origami.... It's the shape that you fold [the genome] into that matters. This has to be the 3-D code of biology."

The attraction of code, with its suggestion of a frozen, mechanistic logic, remains strong. Indeed, some researchers write about multiple

DNA codes—up to a dozen and more. They try to catch the liveliness of the overall performance by multiplying codes so as to approximate, however roughly, specific aspects of it, much as a choreographer might use a standard notation to indicate specific features of dance movement. But why not explore what it might mean to recognize and understand the liveliness—the dance—in its own terms?

There is no molecular "code" that the cell does not modify and employ flexibly in the service of its own needs. No code is embodied in an instructional mechanism accounting for the organism. Informational codes are our own rule-of-thumb abstractions from the organism's living performance. When we imagine a code as determinative, we are always smuggling back into our imagination the meaningful organic behavior from which we have done the abstracting.

Hidden Assumptions

The mechanistic, programmed organism is a deception. It turns out that nothing is controlled in the required way. The relevant processes—generally involving trillions of diffusible molecules making their way in a watery medium—remain "on track" only because the organism, as a unified center of agency, is being-at-work-staying-itself. It is wisely coordinating, redirecting, revising, and sustaining the overall form and coherence of countless interactions, including all those interactions involving what once was thought to be the explanatory program.

The hidden importation of cognitive capacities we saw in the use of words such as "stimulus" and "response" occurs throughout the vocabulary of biology, and can be observed in physiological research as well as in behavioral studies. Terms such as "regulate" and "control," ubiquitous in the technical literature, imply a recognition of needs, a reckoning with contextual significances, and a power of intelligent direction and coordination of complex molecular processes.

Such hidden assumptions are almost impossible to escape. This is because we ourselves are organisms—and we are those particular organisms in whom organic agency rises, at least in small part, to the level of experience. We know cognition and intention *from the inside*. We have no way to shake our familiar awareness of what it means for organisms to *do things*—what it means, that is, in terms of willful striving and coherent ideation, whether fully conscious, half-conscious, or unconscious.

Even that most severe ancient atomist, Democritus, found it somehow natural to grant his material atoms an occasional joyride, where they

could swerve unaccountably from their otherwise determinate paths. The point was made by the philosopher and philologist Owen Barfield, who wrote that "the system of materialism…is in fact only maintainable by the surreptitious smuggling in of unreduced 'immaterial influences'" to explain the agency we observe in nature. Having noted the famous swerve of Democritus' atoms, Barfield reminded us (in 1971) that

> today the immaterial agent of change is more likely to be impounded in some such term as "tendency" or "pattern" or "mutation" (another way of saying "change") or "norm" or (in more up-to-date biology) "code", "message" or "information"—the whole change from e.g. a single cell to a complex living organism requiring no more than amino-acids and genes—plus, of course, an ability to code and decode, which last need not be unduly stressed.

"The trouble," Barfield concludes, is that "particles *as such*…cannot even arrange and rearrange themselves without more. Yet, if one credits them with immaterial 'swerves' or 'tendencies' and so forth, he has forgotten that those are the very things he was purporting to explain *by* them."

Or, in terms more directly related to the current discussion: if—as in the concerted voice of the research literature today—we credit a vast array of molecules and molecular processes in the organism with powers to "regulate," "control," "modify," and "adapt" the genetic program to changing circumstances and the needs of the moment, then we have forgotten that these are the very sorts of living, teleological powers the program was supposed to explain in the first place. Moreover, those powers belong not to "controlling" molecules but to the organism as a whole.

The Meaning of Wholes

One of the most notable cell biologists of the past century, the National Medal of Science recipient Paul Weiss, spoke of micro-indeterminacy and macro-determinacy. By this he meant that the organic processes at a lower level of observation possess degrees of freedom that are reined in at higher levels of observation. For example, if the experimentalist removes a limb bud from an embryonic amphibian, mixes up the entire cluster of cells, and then restores the disordered group of cells to its proper context in the embryo, a normal limb will still develop. Extreme positional freedom among those cells is compatible with the ultimately reliable formation of the limb as a whole. Likewise, relatively unconstrained molecular activities yield much more stable results at the whole-cell level; and, in turn,

cell-to-cell variation gives way to a consistent overall character at the tissue and organ levels.

In every biological system, Weiss writes,

> while the state and pattern of the whole can be unequivocally defined as known, the detailed states and pathways of the components not only are so erratic as to defy definition, but, even if a Laplacean spirit could trace them, would prove to be so unique and nonrecurrent that they would be devoid of scientific interest. This is exactly the opposite of a machine, in which the pattern of the product is simply the terminal end of a chain of rigorously predefined sequential operations of parts. In a [biological] system, the structure of the whole coordinates the play of the parts; in the machine, the operation of the parts determines the outcome.

It's a worthwhile exercise to keep this in mind while imagining whether a single, fertilized egg cell could, in any machine-like manner, determine or compute its own elaboration into the tissues, organs, and overall form of a developing, trillion-celled human being—and continue that precise, bottom-up, machine-like determination over several decades while repairing wounds, healing injuries, and adjusting to every new circumstance from minute to minute and year to year. And, of course, the machine design of that single, original cell would also have to provide for the actual performance of heart, liver, brain, and other organs, with their infinitely complex, moment-by-moment, mutual adjustment.

Imagining the organism to be a machine in these terms is, of course, absurd. One has the impression that thoughts about the machine-organism are not often actually *thought*—not, at least, with conscious attention to the phenomena they are supposed to illuminate.

Weiss's remark that events at the component level of the organism are too irregular and nonrecurrent to be of causal interest relative to a higher level may remind us again that, for organisms, the end is more constant than the means. We habitually want parts, as mere physical causes, to explain wholes. But when we truly recognize biological wholes, we are mentally participating in reasons and meanings, which alone can establish a contextual unity, and which can never be explained by the constituent physical events through which they achieve their expression. *The purposive end is more constant than the physical means.*

What we have learned in all the foregoing is that, whether we are speaking of conscious human behavior in response to an accident, or the life cycle of a bird, or the molecular interactions through which genes are expressed, neither physical lawfulness nor any code-based "necessity" can

lay bare for us the coherence, significance, and end-directedness through which we make sense of living activity. We grasp a biological context *as such* only in terms of its reasons, meanings, and purposiveness.

But this is as much as to say: the organism is no more an artifact assembled from parts or discrete traits than it is a collection of tissues or bag of chemicals. It is, first of all, an *activity*. Its functions are a *functioning*. It is an *organizing center*. When its striving ceases—when the molecules in its cells move according to the laws of chemistry and physics alone, with no meaningful coordination, no narrative direction such as we see in the complex choreography of cell division—then the organism no longer exists.

Putting it a little differently: the organism is not so much an artifact as an originating presence, a power of self-expression. Consistent with this, it *grows* its functioning parts; they are not put together by someone, or some power, acting from the outside. So the functional unity of the organism—the way its parts play together, and even what the parts are—obviously must be changing all along the way. If the organism were machine-like, it would be a different, newly constituted and redesigned machine each time you looked at it.

How, then, can we conceive the organism as a center of activity? What is meant by its agency? One way to answer this question is by beginning with the fact that every organism is narrating what we might refer to as its life story—something that, for example, a rock loosened by ice and tumbling down the steep slope of a mountain ravine does not do in anything like the same manner. The pattern of physical events in the organism is raised to the level of a biography whose "logic," or meaning, unfolds on an entirely different level from the logic of inanimate physical causation. When we tell a story, the narrative threads convey meanings—for example, motives, needs, and intentions—and these are never a matter of mere physical cause and consequence.

So when I speak of the organism's *wise agency* and its *purposive striving*, I refer to its capacity to weave, out of the resources of its own life, the kind of biological narrative we observe, with its orchestration of physical events in the service of the organism's own meanings. I make no hypotheses to explain this intentional agency and story construction. I only note that the fact of story construction is immediately demonstrable in every organism. The narrative of tasks undertaken and accomplished is there to be seen, and is characterized as such in every paragraph of biological description.

Moreover, our recognition of intelligent and intentional activity does not require us to understand its source. We have no difficulty distinguishing the significance of English text on a page from that of pebbles

distributed on a sandy shore, even if we know nothing about the origin of the text. We can declare a functioning machine to be engaged in a purposive operation, whether or not we have any clue about who engineered it. And if we find live, intelligent performances by organisms, we don't have to know how, or from where, the intelligence gets its foothold before we accept the testimony of our eyes and understanding.

Let us now turn to the larger historical, or evolutionary, stage upon which end-directed behavior is said to originate and become understandable in mechanistic terms.

"As If" Teleology

It's true, on one hand, that most observers cannot help acknowledging the organism's peculiarly insistent, directive activity, as when philosopher of biology Robert Arp writes:

> Thinkers cannot seem to get around [evolutionary biologist Robert Trivers's] claim that "even the humblest creature, say, a virus, appears organized to *do* something; it acts as if it is trying to achieve some purpose," or [political philosopher Larry] Arnhart's observation that "…Darwin's biology does not deny—rather, it reaffirms—the immanent teleology displayed in the striving of each living being to fulfill its specific ends.…Reproduction, growth, feeding, healing, courtship, parental care for the young—these and many other activities of organisms are goal-directed."

But here, on the other hand, a strange ambiguity begins. For even if what Arp points out seems obvious, he cannot quite bring himself to accept it at face value. So he hedges those remarks with a crucial qualification: "with respect to organisms, it is useful to think *as if* these entities have traits and processes that function in goal-directed ways" (italics in original). In other words, the organism's purposive behavior is not quite what it seems.

It has long been a feature of evolutionary biology to explain the "as if" directedness of organisms by pointing to a process that is itself not directed—natural selection. As the prominent evolutionary theorist August Weismann wrote in 1909, "the principle of selection solved the riddle as to how what was purposive could conceivably be brought about without the intervention of a directing power."

The idea was simple: there is always variation among organisms, and the ceaseless culling of the less fit among them by natural selection leaves the field to those organisms bearing the most useful variations. These are

the organisms most fit for survival and reproduction—best adapted for functioning successfully in their prevailing environments. Their successful functioning makes them appear to be purposive beings; their traits and activities serve the purpose of survival. But Weismann wants to assure us that there is no real purposing at work—no "intervention of a directing power."

Julian Huxley, who coined the term "Modern Synthesis" to describe the canonical, twentieth-century formulation of what is also called "neo-Darwinism," wrote in 1942:

> It was one of the great merits of Darwin himself to show that the purposiveness of organic structure and function was apparent only. The teleology of adaptation is a pseudo-teleology, capable of being accounted for on good mechanistic principles, without the intervention of purpose, conscious or subconscious, either on the part of the organism or of any outside power.

Here, again, we are said to be saved from the "intervention" of an alien force, as if an organism's native purpose and intelligence were an offense against the natural world.

And, several decades later, the author who gave us the "selfish gene" warned us how hard it can be to escape illusion: "So overwhelming is the appearance of purposeful design that, even in this Darwinian era when we know 'better,' we still find it difficult, indeed boringly pedantic, to refrain from teleological language when discussing adaptation." And yet, as Richard Dawkins is ever ready to instruct us, "the theory of natural selection provides a mechanistic, causal account of how living things came to look as if they had been designed for a purpose."

Dawkins's formulation has the virtue of making explicit the idea that the organism is a designed artifact, or machine. The purposes posing the original problem—purposes that seemed to arise from a directional striving and a live sensing of the requirements of the present moment—have been quietly assumed away. They now become the *functions* of a machine-organism programmed in the past. So the question about the organism's purposeful activity has disappeared in favor of the question about whether the *design* of the artifactual organism was purposeful or not.

Of course, Dawkins's own strong predilection runs toward purposeless design by natural selection, a "blind watchmaker" who gives us an apparent purpose that—not to worry!—isn't quite the real thing. On the other hand, the opponents Dawkins seems usually to have in mind prefer an intelligent designer. What seems to have fallen out of the argument on

both sides are the living powers of the organism itself, which have vanished into the automatisms of engineered machinery. For many intelligent design advocates, those powers have been transferred to a mysterious designer who, having messed around with everyone's ancestors, remains conveniently obscure for current scientific investigation. What we will want to know is whether the evolutionists' designer is any less obscure.

Pursuing an Illusion Is Hard to Do

A rather odd urgency sounds through all this earnest insistence that, while organisms certainly *look as if* they possessed intelligent agency, we should not be so foolish as to be swayed by the evidence of our eyes. And the "as if" claim is curiously vague. How, after all, might we distinguish between an organism capable of expressing wise intention and an organism capable of conjuring an overwhelming illusion of wise intention? Is there, in fact, evidence that can properly override the judgment of our own eyes?

Suppose that, having watched a powerful drama in which the players improvised on Shakespeare's *Hamlet*, we were told that its meaningfulness—all the evident thought and intention of the players, all the unpredictable, yet coherent and directed storytelling activity—was somehow an illusion. What could we possibly make of this? Isn't an appearance of meaningful dialogue already meaningful dialogue—and wouldn't it remain so even if we subsequently found that it came to us, not as we thought, but in a ghostly vision? Pointing to a ghost that speaks meaningful words to us would do nothing to banish the problem of meaning.

The same would be true if a robot spoke those words. We would recognize a real intelligence somewhere behind the production of the meaningful speech. However wooden and un-lifelike the robot's performance, the question would not be *whether* we were seeing evidence of real intelligence, but *where* was its live origin.

It is easy to believe that the casually spoken aphorisms about "as if" teleology have never clearly been thought through. They may serve mainly as a convenient smokescreen for covering theoretical confusion—or, perhaps, a means of self-reassurance in the face of a powerful awareness of one's own interior life, an awareness virtually impossible to shake off. "Yes, we are sometimes moved by profound meaning, and we pursue our own intentions in the context of such meaning; but that's okay because none of this is quite what it seems to be."

Or, which is much the same thing: "Darwin assumed only variation and natural selection, resulting in adaptation. The results are the same as if they had been 'intended.'" If the results are in fact the same as if they were intended, then perhaps we should be open to the possibility that they simply were intended.

The thing to hold on to in all this is natural selection. If there seems to be real purpose in organisms, so we're told, then natural selection explains it, or explains it away, in mechanistic terms. If there is only an illusion of purpose, natural selection is the responsible agent behind the illusion. Just as we trace the machine's intelligence and intentions to a human designer, we must trace the organism's intelligence and intentions, such as they may be, to natural selection, the blind, mindless, unintelligent, yet wondrously effective designer whose existence Darwin exposed.

Direction Before Selection

If, as Ernst Mayr wrote in 1964, Charles Darwin's theory of natural selection "solved the problem of teleology," what, exactly, needed solving? The vexation for biologists lay in the threat of "inwardness"—the organism's seemingly intelligent and willful striving, and its ability to improvise, in every manner of circumstance, the coherent, directional narrative of its own life. As we saw earlier, meaningful narratives do not so much arise from physical interactions as shape them and speak through them. While perfectly lawful in physical terms, a life story as such cannot be *accounted for* in those terms. This bothers all those who long for a purely mechanistic understanding of the world.

The problem of teleology, with its apparent inwardness, has been thought to present itself on two fronts. It occurs wherever a conscious, purposive designer, traditionally taken to be God, is assumed to have created organisms, and again wherever the organism itself, once created, becomes a locus of end-directed functioning. Resolving the issue of teleology has meant, for the biologist, eliminating inwardness on both fronts, and the argument often makes little distinction between them.

Consider again Julian Huxley's "good mechanistic principles" that account for each adaptation—principles that presumably explain the evolutionary *origin* of the adaptation. But the organism's purposiveness, which he says is "apparent only," seems to refer to the *present functioning* of an organism already possessed of whatever adaptation is under discussion. And then, when Huxley dismisses the intervention of conscious or unconscious

purpose, "either on the part of the organism or of any outside power," he blends the two concerns in one phrase.

It turns out that there is good reason for the seeming inextricability of these two dimensions of the teleological problem—a point I will return to in the next section. But for now I will focus primarily on natural selection as the supposed explanation for the origin of end-directed or adaptive features of the organism.

We will not forget that teleology has also been "legitimized" in a different manner. Earlier we heard that it is the genetic program that transforms the biologist's teleological mistress into a respectable woman, ridding her of all disreputable, non-mechanistic features. How, then, do these two solutions—the genetic program and natural selection—relate to each other? The answer, as I will try to suggest, is that they relate within a tissue of unanswered questions, circular reasonings, and under-the-table assumptions.

The first problem is that there is no mechanistic program determining the nature of organisms, as I have argued above, and elsewhere. Since the evolutionary process is universally presented to us as a tinkering with programs and executive machinery, the absence of the program and machinery leaves such theorizing untethered from reality.

But we can set this aside, since there is an even more fundamental problem. *Whatever* model we apply to the individual organism's end-directed behavior, whether that of the genetic program or anything else—or, even better, if we ignore models altogether and look at the phenomena that alone can justify them—we again come to a standstill. The reason is straightforward: however we conceive the directive activity of the organism, *that activity*, so conceived, is what the evolutionary process of natural selection must *assume*.

Everyone agrees that natural selection cannot work unless the organisms available to it are capable of carrying out all the activities necessary to their life and survival, while also reproducing and preparing an inheritance for their offspring. But these are the very activities that presented us with the problem of teleology in the first place. If natural selection must assume them in order to do its work, then to say it solves the problem of teleological origins looks very much like question-begging.

This becomes clearer when we realize that purposiveness is not merely a feature of this or that particular trait. It is inseparable from life as such—you could almost say it *defines* those self-organizing, self-maintaining, and self-expressive activities we call "living." Whatever role we imagine natural selection to play in generating functional adaptations

such as hands and eyes, it does not account for the *fact* of end-directed behavior, which is inseparable from the fact of life itself. It relies on all the fundamental living activities that must already have been displayed in the very first organisms available for selection.

This truth has not been entirely missed. In 1962, the philosopher Grace de Laguna wrote a paper on "The Role of Teleonomy in Evolution" in which she said of natural selection that it is only on organisms "as teleonomic systems that it can operate." And, she explained, "only when we think in teleonomic terms, and regard the structure as end-directed, does it make sense to speak of 'selection' at all."

It appears, then, that, despite the many claims on behalf of natural selection, it does nothing to explain the origin of end-directed, purposive functioning. And neither does it do anything to remove the unwanted aspects of that functioning—nothing over and above the reconceptualization of teleology already attempted by advocates of the machine-organism and genetic program. Any such reconceptualization, if it could be taken seriously, would simply have to be assumed in discussions of natural selection.

Natural Selection as Agent

All this usefully underscores a still more general problem—and source of perennial abuse—in evolutionary theory. At least part of the reason so many can easily imagine natural selection doing things to transform our understanding of teleology is that they can so easily imagine natural selection as an agent capable of *doing things*.

The philosopher Susanne Langer saw part of the issue clearly when, in a 1967 book, she described the evolutionary history of life in terms of "this constant interplay of forces, which makes shifting obstacles and openings for each individual so that variously equipped organisms are differentially brought to grief." But the interplay, she reminds us, "is not a mechanism":

> The frequent references, in the literature, to the "mechanism of selection" bear witness to the beguiling influence of the term "natural selection," which seems to refer to an act, or at least a function, of some specific power. "Natural selection" is a historical pattern, not a mechanism; it is the pattern of the natural history of life.

More recently, the pioneering developmental systems theorist Susan Oyama has made very much the same point:

> Nature is not a deciding agent, standing outside organisms and waving them to the right or the left. However much we may speak of selection "operating" on populations, "molding" bodies and minds, when the metaphorical dust has settled, what we are referring to is still the cumulative result of particular life courses negotiated in particular circumstances.

Nothing could be more evident than that whatever happens under the name of natural selection must arise within the "natural history of life." The phrase "natural selection" adds nothing at all to this reality. What it does do, with its connotations of agency, is make it easy to project certain philosophical prejudices upon the pattern—for example, the belief that we are looking at a blind evolutionary mechanism acting upon machine-organisms and capable, with remarkable facility, of creating the observed diversity of life.

But, of course, the real pattern is supremely complex—and unknown to us until we actually investigate and characterize it. For many centuries the prevailing belief was that every biological kind was an expression of an unchanging essence, or archetype. With or without a theory of natural selection, there was no way to decide, except through observation of actual life patterns, between that view and an evolutionary interpretation. The resolution of the question required an understanding of the geologically embedded fossil record, which was eventually recognized as a partial record of the historical pattern of life.

Yet the urge to project our assumptions upon that pattern via the selective agent-mechanism imagined as shaping it has been difficult to quell. This urge complements our strange willingness to lose sight of the only true source of agency we observe on earth, which is the organism. Once we reduce this organism to a machine, and once the machine is reduced to genes suffering occasional random modifications, there is no life left to account for the meaningful change we see.

So the agent of change has been projected upon a theoretical abstraction. Having been put out of sight, the narrative life of organisms no longer interferes with the evolutionist's theoretical niceties. Yet the fact remains: natural selection represents nothing other than the pattern of living activities within shifting environments. As an abstraction, it cannot even *work with* this pattern; it is just another name for it.

We can now understand why the "two" problems of teleology—evolutionary origins and present functioning—are so readily conflated. There really is only one issue. Evolution is not a separate force or

mechanism accounting for the origin of this or that feature of the pattern of life. It *is* that pattern, and the pattern alone bears the story of how organisms evolve new features. We understand life by studying life, not by picturing a vague mechanism capable of directing its course. There is no separate or second story. This is why the invocation of natural selection to explain the presence or functioning of teleological features ends up assuming, rather than explaining, the features under consideration. The attempt at a second story simply dissolves back into the only story there is.

All of which takes us back to an earlier point: the organism is not so much something with a causal, physical origin as it is a *power of origination*—or a power of storytelling. It manifests itself in *becoming*—in the coordinated and directive aspect of organic processes moving toward fullness of expression—and is not something explained by the physical lawfulness of those processes. When we have understood this inward, originating power, might we not find ourselves better equipped to think about primordial origins?

I have no quarrel with the reader who senses radical and unexplored implications in some of the foregoing remarks. They need exploring. But for now it is enough to acknowledge that, given the unclarity of our understanding of the purposive life of organisms, any evolutionary theory rooted in notions of random variation and mindlessness is a theory hanging upon a great question mark.

This is the question mark we heard emphasized by Francisco Varela, when he wrote that "the answer to the question of what status teleology should have in biology decides about the character of our whole theory of animate nature." And yet, instead of addressing the issue, evolutionary biologists have systematically evaded it by labeling the question mark a *pseudo*-question mark—all without any workable explanation, and all in order to preserve mindless natural selection, rather than the wisdom so evident in organisms, as the true agent of evolution.

The Specter of Vitalism

Does all this mean we must live with teleology as illegitimate—as, to return again to the earlier metaphor, the biologist's mistress? I do not think so. The concern about effective mental intentions or occult forces alien to the material world is, I am convinced, produced by the entrenched dualism that has given us a long-running "mind-body problem," and it shows every promise of disappearing when we manage to let go of that dualism. I will briefly suggest what I mean.

E. S. Russell observed that when you or I raise an arm, the act possesses perfect unity in our experience. We do not feel ourselves confronted by a mind-body problem. The problem arises through our reflection upon the act. The reflection, of course, is necessary. But if it leads to a formulation of problems belied by our immediate experience—if we do not find empirical justification for the formulation—then we might do well to consider whether we have gotten fundamentally off track in our thinking.

I believe we *have* gotten off track. The fear of slipping into "vitalism"—the idea that living things are alive because of some nonphysical vital force—arises only because we have so much difficulty reckoning with the presence of ideas *in the world* rather than merely *in our heads*. I mean potent, shaping ideas. After all, the mathematical relations we apprehend in the physical world are neither forces nor physical things; they are purely conceptual. Yet we can reasonably say that such relations—for example, those given by the equation $F=Gm_1m_2/r^2$, representing Newton's law of universal gravitation—in some sense *govern* material reality. The relations tell us, within the range of their practical applicability, something about the *form* of physical interactions. We do not try to make an additional, vital force out of the fact that a mathematical idea, as a principle of form, is "binding" upon an actual force.

Form, as much as substance, is a primary reality. The two are as inseparable as the north and south poles of a bar magnet. I refer to ideas of form as "potent" and "shaping" not because I would make forces out of them but because there is no manifest substance—no substantial being—that is not also a *shaping* (or *being shaped*) in accordance with ideas of form.

The scientist, in fact, knows the natural world only insofar as formative ideas can be discovered in it. Without them, there is nothing—no this or that with a particular, recognizable character. Shaping ideas are what constitute substance as *this* substance, and so bring it to manifestation. The world is manifest because it is comprehensible, lending itself by its own nature and through its own ideas to the understanding consciousness, just as it lends itself to the perception and purposive activity of every organism.

The distinctiveness of biology is owing to the fact that the complex ideas and intentions that matter for it come to a focus in organic centers of agency. And they are more directly accessible to us than many of the ideas underlying the inanimate realm because we ourselves are organisms. But it remains true here as elsewhere that the formative ideas observed in nature are intrinsic to nature and should not, in any field, be interpreted as "wannabe" forces, vital or otherwise.

I referred above to an entrenched dualism. Having inherited mind and matter as the incommensurable products of Descartes's cleaving stroke, the scientist today rightly concludes that something is badly awry. But, rather than going back and undoing that fateful stroke in order to find a different way forward, he meekly accepts both mind and matter from Descartes's hand, and then decides he can be rid of the contradiction between them only by throwing away one of them.

And so not only is the world badly riven, but essential aspects of its nature are discarded. Form as a causal principle disappears from view, and any attempt at acknowledging it is likely to be condemned as an appeal to vital forces or to discredited ancient philosophy. At the same time, attempts to explain form mechanistically end up being circular, since the form one is trying to explain also appears in the explanation. This happens, for example, when the form of organic structures is "explained" by invoking chemical substances (morphogens) that "just happen" to be distributed throughout tissues in a manner already expressive of the form one wants to explain.

The attempt to sustain the materialistic view based on a single half of the crudely dichotomized Cartesian world is a sickness from which contemporary thought cannot seem to free itself. Yet biologists, like all scientists, inevitably acknowledge an undivided world in one way or another. This is why the organism's well-directed forming and organizing activities provide the very principles by which biologists themselves define relevant fields of inquiry. Cells must divide, proteins must be synthesized, signals must be sent, received, and interpreted—all depending on local contexts and the needs of the organism as a whole. If the researcher does not have a well-formed narrative—an end-directed *achievement*—to investigate, he does not have a biological project, as opposed to a chemical or physical one.

If the fear of vitalism and shaping ideas is misdirected, then it suggests that the entire project of legitimizing or "naturalizing" teleology was misconceived from the start. At the very least, we might admit that there are many questions remaining to be clarified.

Questions Refused

Recall our pedestrian and the automobile accident. The undesirability of human injury, the compelling reasons for seeking help, the significance for the pedestrian of surrounding events—these meanings are what give the story its form and direction.

Much the same is true of the narrative about the life of the chaffinches, even when we deny to the feathered protagonists anything like our own conscious reflection. Their behavior relates to their own needs and interests, as well as the needs and interests of their offspring. Inanimate objects do not have such needs and interests. And we all wholeheartedly relate to such meaning in the lives of our dogs and cats.

This, it seems to me, should be held clearly in mind when we fret about the substantial portion of the public that refuses to take evolutionary theories seriously. When people are told that the meanings they recognize in all organisms, including themselves, *aren't really there*—when they are told that their own experience (upon which modern science was so insistently founded) is a kind of illusion originating in processes fundamentally alien to the nature of that experience—then perhaps their disbelief is not only inevitable, but also healthy.

And, to be sure, this is what they have mostly been told. According to the late William Provine, a distinguished historian of biology and contributor to theoretical population genetics, "naturalistic evolution has clear consequences that Charles Darwin understood perfectly." In particular: "No gods worth having exist; no life after death exists; no ultimate foundation for ethics exists; no ultimate meaning in life exists." These conclusions, Provine claimed, "are so obvious to modern naturalistic evolutionists" that they require little defense.

Provine's remark testifies to a science that has slipped its empirical moorings, unaware of its own biologically unsecured pretensions. Such unawareness is probably a prerequisite for his grandiose metaphysical pronouncements upon gods, death, ethics, and meaning. A similar unawareness seems to accompany the explanations of teleology we have heard.

Evolution-based pronouncements have somehow become far too *easy*. When theorists can lightly pretend to have risen above the most enduring mysteries of life, making claims supposedly too obvious to require defense, then even questions central to evolution itself tend to disappear in favor of reigning prejudices. What is life? How can we understand the striving of organisms to sustain their own lives—a striving that seems altogether hidden to conventional modes of understanding? What makes for the integral unity and compelling "personality" of the living creature, and how can this personified unity be understood if we're thinking in purely material and machine-like terms? Does it make sense to dismiss as illusory the compelling appearance of intelligent and intentional agency in organisms?

It is evident enough that the answers to such questions could crucially alter even our most basic assumptions about evolution. But we have

no answers. In the current theoretical milieu, we don't even have the questions. What we do have is the seemingly miraculous agency of natural selection, substituting for the only agency we ever actually witness in nature, which is the agency of living beings.

It is one thing to assert the undoubted reality of life's evolution on earth. But if *theories* of evolution—proposals about how it has occurred—are the matter of real interest today, I hope the discussion above will suggest the value of a little humility on our part in the face of profound and unanswered questions.