

SCIENCE AND THE SACRED

IN THE ZONE OF COMPLEXITY

Holmes Rolston III

Photographs by Linda Connor

In 1975 *PARABOLA*'S first issue went to press, and in the same year Holmes Rolston III published "Is There an Ecological Ethic?" in *ETHICS*, the first article in a major philosophical journal that challenged the then-widespread idea that nature is value-free and that all values stem from a human perspective. Rolston, one of the world's leading advocates for protecting the Earth's bio-diversity and ecology in recognition of the intrinsic value of creation, is widely known as the "father of environmental ethics." He asserts that our planetary crisis is primarily a spiritual one, and his article below inaugurates in *PARABOLA* an exploration of this crisis and what it demands of us.

EDITORS

A CONTEMPORARY SURPRISE HAS BEEN OUR WAKING UP

to the place of nature in the search to understand who we are, where we are—even what we ought to do. Just when humans seem to be moving further and further from nature, the natural world has emerged as a primary focus of concern. Nature, we have discovered, is the milieu of culture, or to use another metaphor, it is the womb of culture but a womb that humans never entirely leave. Like God, nature is "in, with, and under us."

Nature can do much without culture—several billion years of evolutionary history are proof of that—but culture can do nothing without nature as its ground. Humans depend on air flow, water cycles, sunshine, nitrogen-fixation, decomposition bacteria, fungi, the ozone layer, food chains, insect pollination, soils, earthworms, climates, oceans, and genetic materials. An ecology lies in the background of culture, natural givens that underlie everything else.

**WE HAVE BEEN DISCOVERING
DEEP SPACE AND DEEP TIME**

As well as pushing “deep down” from molecular to subatomic nature, with our instrumented intelligences and constructed theories, we now apprehend phenomena at structural levels from quarks to quasars. We measure distances

Our ancestors knew life only at native ranges, but we know life at evolutionary and genetic scales. Humans can seem minuscule at astronomical levels; they can seem ephemeral on evolutionary scales. If the length of the river of life were proportioned to stretch around the globe, the human journey would be halfway across a



MOONRISE: CLOUDS AND STAR TRAILS
LAKE TSOMORIRI, INDIA, 1998

from picometers to the extent of the visible universe in light years, across forty orders of magnitude. We measure the strengths of the four major binding forces (gravity, electromagnetism, the strong and weak nuclear forces), again across forty orders of magnitude. We measure time at ranges across thirty orders of magnitude, from picoseconds to the billions-of-years age of the universe.

county, and humans would have kept a journal for only a few hundred feet. The individual's reach would be a couple of steps! We are cosmic dwarfs.

But another perspective is possible: on the natural scale, the human world stands about midway between the infinitesimal and the immense. The mass of a human being is the geometric mean of the mass of Earth and the mass of a proton.

A person contains about 10^{28} atoms, more atoms than there are stars in the universe. In astronomical nature and micronature, at both ends of the spectrum of size, nature lacks the complexity that it demonstrates at the mesolevels, found in our native ranges on Earth. We humans do not live at the range of the infinitely small, nor at that of the infinitely large, but we may well live at the range of the infinitely complex. If we ask where the “deep” thoughts about this “deep” nature are, they are in the human sphere.

WE HAVE BEEN WAKING UP TO A HOSPITABLE UNIVERSE

We have found dramatic interrelationships between astronomical and atomic scales. These discoveries are commonly gathered under the name “the anthropic principle,” but they could better have been named “the biogenic principle.” Astronomical phenomena such as the formation of galaxies, stars, and planets depend critically on the microphysical phenomena. In turn, those midrange scales, where the known complexity mostly lies, depend on the interacting microscopic and astronomical ranges.

If the scale of the universe were much reduced, there would not have been enough time for elements to form. If its expansion rate had been a little faster or slower, then the universe would already have recollapsed or the galaxies and stars would not have formed. Change slightly the strengths of any of those four forces that hold the world together, change critical particle masses and charges, and the stars would burn too quickly or too slowly, atoms and molecules (including water, carbon, and oxygen) or amino acids (the building blocks of life) would not form or remain stable. This, we now say, is a “fine-tuned” universe.

Nature can aggregate and energetically build. The stars are the furnaces in which all but the very lightest elements are forged. The stars run their courses and explode themselves as supernovae to disperse their matter throughout space. Such matter is condensed as planets, and life evolves out of such elements. The human person is composed of stardust, fossil stardust!

What should we make of this? Sometimes we dismiss the puzzle. We are here; therefore we don’t find it really surprising that the universe would be the kind of place that has produced us. We knew before we started our search that the universe has all the prerequisites for our existence. But those who want a fuller explanation will find it quite impressive to discover that what seem to be widely varied facts really cannot vary widely. Indeed, many of them can hardly vary at all in order for the universe to generate the matter, life, and mind it has.

WE HAVE BEEN WAKING UP TO NATURE’S SIMPLICITY AND COMPLEXITY

The world is simple in (at least some of) its principles and rich in phenomena. The physical sciences have revealed the astronomical extent of matter coupled with its reduction into a few kinds of elements and particles, which dissolve into interradiating wave fields. Taxonomists have enlarged the array of natural kinds, while biochemists have found only the materials of physics organized everywhere in repetitive chemistries, such as the citric acid cycle or DNA at the core of life. Evolution has traced every life form back to monophyletic origins, while ecology has interwoven these myriad forms in trophic pyramids. This macroscopic web is matched by the unity revealed by the X-ray spectrometer. The natural pageant

is a symphony of motifs, each interesting, often orchestrated, sometimes chaotic, and all spun from a few simple notes.

Where once there were no species on Earth, there are today five to ten million. Prokaryotes dominated the living world more than three billion years ago; there later appeared eukaryotes, with their well-organized nucleus and cytoplasmic organelles. Single-celled eukaryotes evolved into multi-celled plants and animals with highly specialized organ systems. First there were cold-blooded animals at the mercy of climate, later warm-blooded animals with more energetic metabolisms. From small brains emerge large central nervous systems. Although biologists continue to debate “progress” in natural history, there is some kind of an arrow on evolutionary time.

WE HAVE BEEN WAKING UP TO INFORMATION IN EARTH HISTORY

Those who studied physics a century back were taught that there are two fundamental things in the world: matter and energy. Einstein found that matter and energy are different forms of the same thing. Recently biologists have been insisting on another metaphysical level: information. That is what is coded in DNA, a “cybernetic” molecule. So our evolutionary history stands in marked contrast with events on other planets in our solar system, such as the gases that swirl around Jupiter. On Earth, something can be learned.

An organism is “informed” about how to make its way through the world, how to cope in its niche. Past achievements are recapitulated in the present, with variations; these results are tested

today and then folded into the future. Random mutation figures into a larger generative process; species generate and test new possibilities. The challenge is to get as much versatility coupled with as much stability as is possible. This requires keeping past knowledge while exploring nearby areas for better adaptation.



GROVE, 2003
HAWAII

Contemporary geneticists insist that to think of this process as “blind” is a partial understanding. A more comprehensive perspective interprets plant and animal species as information-processing entities of impressive achievement and adaptive competence. The genes function to conserve life; they also make possible a creative upflow of life struggling through turnover of species and resulting in more diverse and complex forms of life, producing more out of less over millennia. The molecular processes are quite sophisticated; organisms regularly develop such features as a dragonfly’s wings, which human engineers admire.

WE HAVE BEEN WAKING UP TO SURVIVAL AND ADAPTED FIT

The astronomical picture is of a paradoxically vast, simple, but user-friendly universe. Because of the struggle, the biological picture can seem radically different. Within the rock cycle—orogenic uplift, erosion—there is no natural



TREES, 2000
O'HIA, HAWAII

selection. Nothing is competing, nothing is surviving, nothing needs adapted fit. But organisms must compete and struggle to hold a place against other lives. To be alive is to have problems.

Again, however, there is a more inclusive perspective. The very idea of adapted fit also requires a niche, a place to be, and includes a life-support system. An ecology is a home. The currents of life flow in an interplay of environmental conductance and environmental resistance. An environ-

ment that was entirely hostile would slay all; life could never have appeared within it. An environment that was entirely irenic would stagnate life. The vital natural process is of conflict and resolution. Take away the friction, the stress, and would the structures stand? Would they move? The organism is tested for how much information it can contribute to the next generation. Survival of the fittest turns out to be survival of the senders. Suffering? Struggle? Yes. But if we may borrow a word from the Socratic philosophers, life is in “dialectic.”

The evolutionary picture is of nature laboring in travail. The root idea in the English word “nature,” going back to Latin and Greek origins, is that of “giving birth.” Birthing is creative genesis, which certainly characterizes evolutionary nature. Birthing (as every mother knows) involves struggle. Earth slays her children, a seeming evil, but bears a crop in their stead. This pro-life, generative impulse is the most startling and valuable miracle of all. The “birthing” is nature’s orderly self-assembling of new creatures amidst this perpetual perishing. Life is ever “conserved,” as biologists might say; life is perpetually “redeemed,” as theologians might say. Or, to adapt a biblical metaphor: The light shines in the darkness, and the darkness has not overcome it.

WE HAVE BEEN WAKING UP TO HUMAN UNIQUENESS

We humans are the most sophisticated of known natural products. In our hundred and fifty pounds or so of protoplasm, in our three-pound brain, is more operational organization than in the whole of the Andromeda galaxy. On a cosmic scale, humans are minuscule atoms. Yet the brain is so curiously a microcosm of this macrocosm. Not only evolutionary biologists but also astrophysicists are studying

their own origins, since our elements were made in the stars. They are an end of the beginnings that they are watching, one of the consequences of the stellar chemistry, which now can reflect over this world. We

THE HUMAN BRAIN IS CAPABLE OF FORMING MORE POSSIBLE THOUGHTS THAN THERE ARE ATOMS IN THE UNIVERSE.

humans too are “stars” in the show. In that sense, the most significant thing in the known universe is still immediately behind the astronomer’s eyes!

Animal brains are already impressive. In a cubic millimeter (about a pinhead) of mouse cerebral cortex there are 450 meters of dendrites and one to two kilometers of axons; human brains multiply the mouse cerebrum three thousand times. Our protein molecules are 97% identical to those in chimpanzees. But we have three times their cranial cortex. This cognitive development has come to a striking expression point in the hominid lines leading to *Homo sapiens*, going from about 300 to 1,400 cubic centimeters of cranial capacity. The connecting fibers in a human brain, extended, would wrap around the Earth forty times.

Some transgenetic threshold seems to have been crossed. The human brain is of such complexity that descriptive numbers are astronomical and difficult to fathom. A typical estimate is 10^{12} neurons, each with several thousand synapses (possibly tens of thousands). Each neuron can “talk” to many others. This network, formed and re-formed, makes possible virtually endless mental activity. The result of such combinatorial explosion is that the human brain is capable of forming more possible thoughts than there are atoms in the universe.

The surprise is that this intelligence becomes reflectively self-conscious and builds cumulative transmissible cultures. An information explosion becomes pinpointed in humans. Humans alone have “a theory of mind”; they know that there are ideas in other minds, making linguistic cultures possible. Our ideas and our practices configure and re-configure our own sponsoring brain structures. In the vocabulary of neuroscience, we have “mutable maps.” For example, with the decision to play a violin well, and resolute practice, string musicians alter the structural configuration of their brains to facilitate fingering the strings with one arm and drawing the bow with the other. The human brain is as open as it is wired up. Our minds shape our brains.

WE HAVE BEEN WAKING UP TO AN EARTH ETHICS

Ethics has been around for millennia; the Golden Rule is perennial. But waking up to nature has brought, recently, an environmental turn in ethics. This starts with human concerns for a quality environment, and some think this shapes the ethic from start to finish. Humans are the only self-reflective, deliberative moral agents. Ethics is for people. But humans co-inhabit Earth with five to ten million species. If the values that nature has achieved over evolutionary time are at stake, then ought not humans find nature in itself morally considerable?

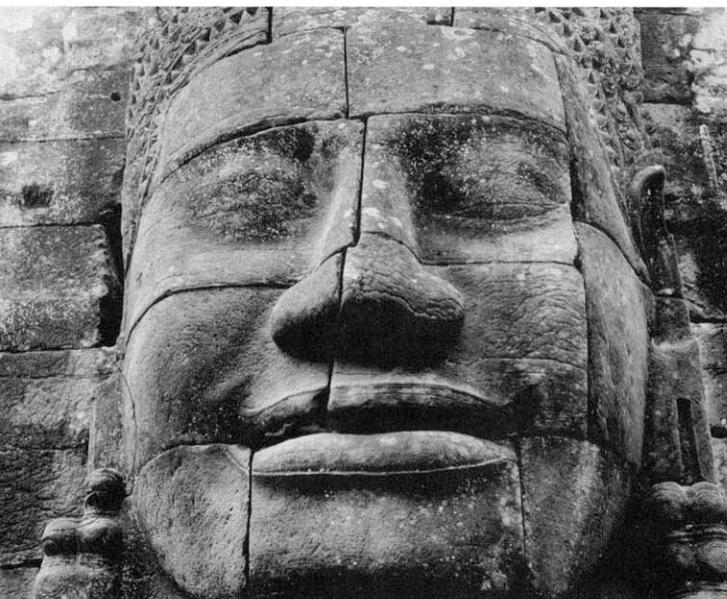
Nature has equipped *Homo sapiens*, the wise species, with a conscience. Perhaps conscience is less wisely used than it ought to be when, as in classical Enlightenment ethics, it excludes the global community of life from consideration. When the sole self-consciously moral species acts only in its collective self-interest toward all the rest, a paradox results. Environmental ethics claims that we humans are not so

“enlightened” as once supposed, until we reach a more considerate ethic.

Several billion years’ worth of creative toil, several million species of teeming life, have been handed over to the care of this late-coming species in which mind has flowered and morals have emerged. Ought not those of this sole

wolves extirpated, whooping cranes and their habitats disrupted, ancient forests cut, Earth threatened by global warming—these are ethical questions intrinsically, owing to values destroyed in nature, as well as instrumentally, owing to the human resources jeopardized. Humans need to include nature in their ethics;

humans need to include themselves in nature.



FOUNTAIN HEAD: SMILE, 2000
ANGKOR WAT, CAMBODIA

moral species do something less self-interested than count all the produce of an evolutionary ecosystem only as resources to be valued for the benefits they bring? Such an attitude hardly seems biologically informed, much less ethically adequate. Its logic is too provincial for moral humanity.

Contemporary ethics has been concerned with being inclusive. Environmental ethics is even more inclusive. It is not simply what a society does to its minorities, handicapped, children, or future generations, but what it does to its fauna, flora, species, ecosystems, and landscapes that reveals the character of that society. Whales slaughtered,

WE HAVE BEEN WAKING UP TO SPIRIT IN NATURE

In the most organized structure in the universe, molecules, trillions of them, spin round in and generate the unified, centrally focused experience of mind.

These events have “insides,” subjective experience. There is “somebody there” already in the higher animals, but this becomes especially “spirited” in human persons. The peculiar genius of humans is that, superposed on

biology, we become, so to speak, “free spirits,” not free from either the worlds of nature or culture, but free within those environments.

That humans are embodied spirits, capable of thinking about themselves and what they can and ought to do, is beyond dispute. The act of disputing it in fact verifies it. The self-actualizing characteristic of all living organisms doubles back on itself in this reflexive animal with the qualitative emergence of what the Germans call “*Geist*,” what existentialists call “*Existenz*,” what philosophers and theologians often call “Spirit.” An object, the brained body, becomes a spirited subject.

There is an order of magnitude change. This cybernetic, cognitive emergence does not “reduce” well; rather it tends to “expand.” The past is not a good guide to

what the future holds when there is this massive singularity. That brings, again, paradox and dialectic. Are we part of nature, or apart from nature? Yes and no. Nature hardly seems up to the guidance of the child she has delivered; science, for all its genius, does not teach us what we most need to know: what we ought to do, either when caring for other humans or conserving nature.

For some, that is cause for freedom and relief. Humans are self-defining animals. They do not need to consult nature, but are intellectually and morally free. But also it seems fitting that humans be defined in their place. Otherwise, we cancel all promise of showing a systematic unity between human life and cosmic or earthly nature. It is one thing to be set free in the world, another to be set adrift in it. So that—if you like—has now become the main agenda: what is the place of this spirit awakened in nature?

WE HAVE BEEN WAKING UP TO THE NUMINOUS

Science removes the small mysteries to replace them with bigger ones. Nature evokes awe, a sense of the sublime. We confront the limit questions; we still experience awe looking into the night sky or at the Vishnu schist at the bottom of the Grand Canyon. In our quest for understanding, we climb one summit to see further peaks: a “mountain range” effect. The area of the island of knowledge grows only to enlarge the shoreline where it touches the unknown: a “coral reef” effect. Our beams probe farther out, only to confront more dark sky. There is an explosion of knowledge, but nature escalates as a wonderland.

Even in the known, mystery remains. Where there is light, is the light any less puzzling? We cannot see the other side of a radically inexhaustible nature. We can-

not see even what we do see rationally enough to evaporate the mystery: a universe fifteen billion years old, exploding from a vacuum, fine-tuned from the start, immense in size, coming to a unique and most complex expression point in Earth, generating a natural history with rich biodiversity, at the apex of which we humans stand, searching across forty orders of magnitude, from quasars to galaxies, across scales from DNA to global biosystems, discovering that we humans ourselves have staggering possibilities, able to think more thoughts than there are atoms in the universe, with escalating powers for good and for evil.

WE HAVE BEEN WAKING UP TO A CRUCIFORM NATURE

The nature of nature is a millennia-long struggle for life, perpetually perishing, perpetually regenerated. Such evolutionary history is the predecessor of the theme of death and rebirth omnipresent in myth and religious tradition everywhere on Earth. Darwinians see this truth: there is struggle for survival. But so far from making the world absurd, such struggle is a key to the whole, as a transformative principle, transvalued into its opposite. The capacity to suffer through to joy is a supreme emergent and an essence of Christianity. Yet the whole evolutionary upslope is a lesser calling of this kind, in which renewed life comes by blasting the old.

That is the deeper meaning of a pasqueflower encountered at Easter in the still wintry Rocky Mountains. Since the beginning, the myriad creatures in their suffering through to something higher have been giving up their lives as a ransom for many. We awaken, finally, to the great divine “yes” hidden behind and within every “no” of crushing nature. ■

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