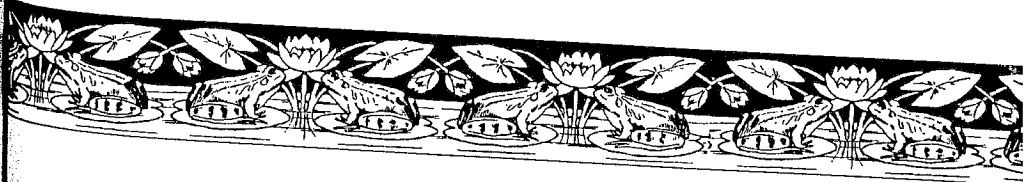
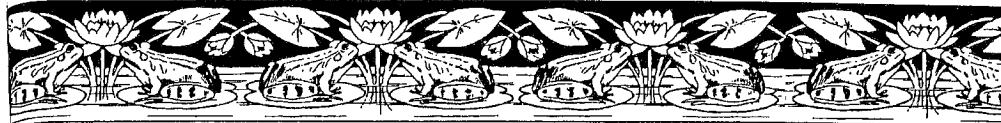


The Big Questions:
Birth and Death

Elliott A. Norse





When the editors first asked me to write about relationships of ecology and religion, I felt both honored and hesitant. This interface is rich with topics worth examining, and examining two bodies of thought that have so often seemed in opposition seemed most intriguing. However, I am not an expert in religion—even my own religion (Judaism)—and was concerned that I would, therefore, have to offer a personal perspective. That poses a problem: Personal perspectives are very personal. And what could be more personal for a scientist—a person whose objectivity and rationality about *what is* is one of two defining characteristics (the other being curiosity about what is)—than to reveal thoughts and feelings about religion, much of which lies in the realm of faith beyond the outermost reaches of rationality?

I accepted because the gulf between science and religion underlies nearly all of the crises that threaten the Earth and its inhabitants, including the biggest crisis: stopping the loss of the Earth's biological diversity and integrity. Throughout my life I have met people who believe that humans are the only species that counts, that the Earth and all other species exist for us to use as we wish. This viewpoint is so prevalent that it cannot simply be dismissed. Increasingly in recent years, however, I have met people who believe that humans are stewards who must protect and tend nature. These two contrasting views are both based on values that stem from religious beliefs about humans' place in the universe, not from science. As the crush of human population enters the last redoubts of nature, the fate of the Earth's species and ecosystems—a subject of increasing concern to scientists—is likely to hinge on which of these two views prevails. Hence, anything that might inspire people to start bridging the gap between religion and science could lessen the plagues that (choose one or both) God or our human nature visits upon us.

First, a clarifying definition: Among the biological sciences, which focus the diverse processes of life, ecology is the study of interactions among species and their environment. Most ecologists study interactions in microorganisms, plants or nonhuman animal species. But because

humans are the species that most profoundly affects the millions of other species and the environment we share—the Earth—human ecology is central to most any discussion about the environment.

In addition to its fascinating ramifications, there is a powerful political reason to explore the possibilities for reconciliation between ecology and religion. The USA was torn over civil rights for black people and the Vietnam War in the 1960s and '70s. In both cases, pressure built steadily for fundamental change but society's inertia was insurmountable until religious congregations became committed and actively involved. When tens, hundreds, then thousands of congregations and religious leaders demanded change, things changed.

Now our planet is facing the most devastating biological catastrophe in its last 65 million years: the massive worldwide loss of biological diversity and integrity. American society is again politically torn. On one side are those who believe that consumption of the resources in public lands and waters and private ownership of land take precedence over all other values, that God wants humankind to dominate and subdue the Earth. On the other side, those who believe that we have responsibility to be stewards of our environment, to care for Creation and for the interests of future generations even if it means that some people must curtail their appetites and delay financial gains for the short term.

I write at a time when the so-called "Wise Use" Movement (an alliance of right wing property-rights anti-environmentalists fueled by shrimping, ranching, logging, mining, real estate and agribusiness interests) and its followers in the 105th Congress are pressing for weakening of the Endangered Species Act after having succeeded in overriding environmental protection provisions of the ESA, the National Environmental Policy Act and the National Forest Management Act during the 104th. While a seemingly secular desire to maximize short-term profit is a clear theme in this anti-environmental coalition, there is an unmistakable religious undercurrent to justify it; in some instances, religious justification comes to the surface. For example, James G. Watt, the former Secretary of Department of the Interior under President Ronald Reagan who is revered by anti-environmentalists, stated that consuming resources only hastens the coming Apocalypse and hence, the Kingdom of Heaven. The blatant anti-environmentalism of his reign in the early 1980s was blunted by leaders of both major parties in Congress, but his philosophical followers in Congress made major

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gains in the 1994 elections that continue to influence US policy to this
day.

Modern religious belief affects our environment both for better and
worse. As a scientist, two things are clear to me:

- 1) that humankind is absolutely dependent on biological diversity,
that the millions of other species and the ecosystems they consti-
tute provide the products and services on which our well-being and
survival depend; and
- 2) that the accelerating impact of 5.8 billion humans profoundly
threatens the diversity and integrity of life on Earth.

As an observer and participant in the making of public policy for
nearly 20 years and as a citizen concerned about the well-being of my
country and planet, I am convinced that humankind will not succeed in
slowing and stopping environmental disaster of scarcely imaginable pro-
portions unless organized religions of all kinds mobilize and act decisively
on behalf of our environment. Science is essential—we need objective
information on the status of species and ecosystems and the processes
that sustain life—but it is not sufficient. Too few people are able or will-
ing to trust science. Rapprochement between science and religion seems
to be the only hope.

Although there is no lack of topics worth exploring, limitations of
space in this book and the scarcity of similar opportunities led me to
conclude that I should have a go at *The Big Questions*: where we come
from and where we go, birth and death, generation and degeneration.
These (along with what we do while we are here) are central questions
for people of both science and faith, and have profound implications for
the environmental crisis and the strife among nations, within nations and
within individuals that, in combination, make us feel that we are ever
farther from the Eden whence we came.

Be forewarned: my explorations might seem strange, presumptuous
or even offensive to some people. Birth and death are such big topics to
contemplate that for many they are too awesome or awful, terrific or
terrible (these pairs of words, now used as opposites, really mean the
same thing) to speak or even think about. In polite conversation, people
customarily avoid mention of processes such as egestion, mating, birth,
disease and death, or allude to them by using euphemisms. (For example,
I remember vividly how my mother and her friends always said "CA" as

a way to avoid pronouncing the dreaded name cancer, as if speaking its name gave it power) But such processes are the subjects that biologists study, the very stuff of our science, so I hereby request "special dispensation" from the reader to examine The Big Questions. It is my intention to provide food for thought and even comfort to religious people who have grappled with big questions and have not always been satisfied with the answers. And by doing so, I hope to help, at least in the minds of some, to help reconcile ecology and religion. So, having put some Gregorian chants on the CD player and closed my eyes for a moment, I'm ready to take the plunge.

BIRTH: NULLIPARITY AND IMMORTALITY

I have three stepsons, but like clerics in some religions and many environmentally conscious people, I chose not to have my own children. By the most basic biological criterion, stepchildren don't count and nulliparity (not having biological children) makes me a failure. Yet I have an inherent love for children, and I often wonder what it would have been like to have a child who bears my genes, a child I could have nurtured since birth and taught about trees and insects and why the wind blows. Yet something that arose from my Jewishness has ameliorated the sadness that I have often felt about being childless.

Evolution is the central concept in biology. An understanding of how living things change through time and how their inherited features affect their persistence in our always-changing world is integral to the study of life at all levels of biological organization, from molecules to ecosystems. I cannot imagine a real biologist who does not understand that, just as I cannot see why understanding evolution must be irreconcilable with believing in God or being devoutly religious. It is deeply troubling that some religious traditions and many of their adherents have rejected a body of understanding that is demonstrable to anyone open to the overwhelming weight of evidence and reason. It is hardly less troubling that many of my colleagues in biology, having come from religious traditions whose teachings reject biologists' vast and growing understanding about evolution, have, as a result, felt compelled to loosen or even cast off the cloak of religion. Both science and religion—the two most powerful founts of concern about the fate of life on our world—and our living planet have all lost as a result.

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What drives evolution is an imperative inherent in the DNA molecule, the imperative to reproduce itself. This recalls a saying I first heard from my wonderful high school zoology teacher, Norman Scovronick, that evoked howls of laughter from his students: "A chicken is an egg's way of making another egg." The notion seems delightfully absurd. Eggs can't think or act. And besides, that's not the way people usually look at things.

But let's examine this. An Atlantic cod in a fish market (assuming, after overfishing on Canada's Grand Banks and Georges Bank between Canada and the USA, that we can still find one) seems like a substantial fish in its own right, weighing several pounds and possessing eyes, a barbel on its chin, jaws, fins, scales and internal organs that outfit it for life in the cool waters above the seabed. But from the perspective of its genes, it is nothing more than a nicely equipped package for proliferating its unique combination of the genetic information coded in its DNA. Not only is its distinctive anatomy a manifestation of this genetic imperative; so are its distinctive behaviors, internal physiological processes and the interactions with myriad other species where it lived. The same is true of the teeming *Escherichia coli* bacteria in our large intestines, the trees that (if we're lucky) line the horizon and, not least, us.

The general statement of this principle is: What we are and what we do is our genes' way of getting us to maximize our "Darwinian fitness," the term evolutionary biologists use to measure genetic contribution to future generations. Darwinian fitness doesn't necessarily mean large muscles, sharp teeth, high speed or brilliance. It means success—generation after generation—in perpetuating an organism's DNA.

Reproducing the carrier of those genes is how nature does this. And reproduction means not only the actual production of offspring, but the investment in them that affects the probability that they will pass on their genes.

Species can be arrayed along a continuum in parental investment per offspring. Each sexually reproducing plant or animal gathers energy that it uses to maintain itself and to reproduce. Some individuals are more successful than others at gaining energy and nutrients (just as some people manage to get higher incomes than others), but each individual of each species has only so much energy to invest in reproduction. Some species, such as most octopuses, Pacific salmon and century plants, mobilize all the energy they devote to reproduction and spend it at once,

reproducing in a "big bang," then dying. Others, such as mussels, rhinoceroses and Douglas-fir trees produce young repeatedly after they are mature. But whether they reproduce just once or repeatedly, because the energy that can go to reproduction is finite, there is a crucial trade-off that species have been forced into over evolutionary time. Some species (for example, Atlantic cod) have developed reproductive strategies that include making huge numbers of young but invest little in each of them, and others (for example, great white sharks) make few young but invest a great deal in each.

Evolutionary biologists have long known that parents in many species take care of their young in many ways. Some pack more food into their eggs or seeds, others watch over their young. But it is revealing that a number of species also invest in individuals that are not their own young, for example, their siblings. There is a strong evolutionary reason for this: The individuals they help bear more of their genes than others do.

Allow me to explain from my individual perspective: Any of the kids I might have fathered would have had half of the genes in the nuclei of my cells and half of those in my wife's. My mother and father each had half of my genes, but they are no longer alive. My sister has about half of my genes (it could be more or less than half by chance alone), but her reproducing days are over. Her son, my nephew, is my closest relative who can still reproduce; he shares roughly a quarter of my genes. That is why, in an evolutionary sense, it pays me to invest in improving his Darwinian fitness; doing so improves my fitness as well. Indeed, nothing I do for myself will improve my fitness because I decided to have no children, but whatever I do to improve his fitness is evolutionarily advantageous for me, in that they help me pass on at least some of my genes. Possibilities might include introducing him to (presumably fertile) women, teaching him the intricacies of growing tomatoes or giving him money for his unborn children's college tuition. Such acts are my best prospects for getting my genes perpetuated. My next closest relatives who could still reproduce share only about one sixty-fourth of my genes, so my nephew, with one-fourth, is clearly a far better bet.

In an evolutionary sense, I share fewer genes and am progressively less close to people outside my particular family who are members of the interbreeding population of which I am a member (which could be

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So, I share fewer genes and am progressively less related to my particular family who are members of the family of which I am a member (which could be

Jews, Americans or whatever), to humankind as a whole, then to other hominoids (humans share about 98% of our genes with chimpanzees), other primates, other mammals, other chordates, other animals, other eukaryotic organisms (those with a nucleus clearly bounded by a membrane, including plants and fungi), and other living things (we can call the others bacteria for simplicity's sake, although they are fundamentally far more diverse than our eukaryotic kin). The mice hunted by spotted owls in the ancient forests of Douglas-fir trees and the bacteria that live on and in them are all my relatives—we share the same evolutionary origins some tens of millions (mice), hundreds of millions (owls) or billions (bacteria) of years back—but they are all much more distant kin than my species, my population and my family.

There are many variations on the theme of organisms passing on their genes. From evidence including the spread of antibiotic resistance, biologists learned that some bacteria can pass genes to other species of bacteria. Many animals, plants and fungi undergo the more familiar kind of sexual reproduction, which involves halving a parent's genetic legacy and combining with that of another parent, but some have some kind of asexual reproduction, which creates genetically identical copies of a parent. Of course, life is a gamble, and many individual organisms never pass on their genes. But it is clear that the driving force that compels pines to produce copious pollen, salmon to swim hundreds of miles to suitable spawning beds and people to spend so much time thinking about money and sex (and buying "sexy" cars, clothes and make-up) is genetic.

This evolutionary perspective sheds an evolutionary light on God's biblical command to the ancient Hebrews to "be fruitful and multiply" and God's promise that they will become exceedingly numerous. It also explains features of Judaism that are still practiced to varying degrees, including the centrality of marriage and the family (now under assault by secular society, but still central in Judaism), the requirement that a man whose brother dies must marry and care for his brother's widow and children (no longer practiced), and the prohibition against sexual intercourse when a wife is menstruating and hence, unable to conceive (still practiced by many observant Orthodox Jews). All of these are pro-natalist practices; whether they became religious rules by accident or design, they have been instrumental in the survival of a people that has long been surrounded by other peoples, some of them enemies. Our individual behavioral drives (again, human sexual desire is an evolution-

ary means contrived by our genes to ensure their perpetuation) and the elaborate and strict codes of behavior embodied in the rules in Judaism and other religions have the mutually reinforcing effect of pushing us to increase our fitness relative to that of other individuals and groups.

Unfortunately, our sex drives, which were so essential to our survival when our populations were small and vulnerable and which are a source of great pleasure for many, also have some very negative consequences in today's world. On an individual level, they are a component in behaviors that harm other people emotionally (for example, rape, incest and child molestation) and cause death (for example, by passing on the AIDS virus). Even more important, they propel the births of huge numbers of children into families ill-equipped to care for them, creating what seem to be endless cycles of misery and social pathology, and increasing pressure on the other species of living things.

On a population level, the desire to pass on our genes is almost universally accompanied by a disdain or hatred for other populations whose genes differ even slightly from our own, leading to discrimination, competition and even genocide against other populations of people. To justify killing our fellow humans, even our very close relatives (e.g., Serbs and Croats), we need only to dehumanize them, that is, to distance them from us genetically in our minds. This "us versus them" distinction underlies the inter-religious, inter-ethnic and inter-national conflicts that cause so many deaths and divert such vast amounts of resources to weapons that could end our existence suddenly or kill us over a slightly longer time span by diverting resources from other essential endeavors.

Newspapers and TV shows focus disproportionate attention to acquiring resources, to sex and to people killing one another. But as horrific as it is when someone blows up a building to make a political point or takes the life of a spouse in a jealous rage, people killing people is not nearly so great a threat to us as another that most people think about far less. What threatens humankind more is the damage we do to other species that are more distantly related to us, the devastation of biological diversity, the living things that (choose one or both) God or evolution shaped and nurtured. Why? Because humankind is utterly dependent on biological diversity: everything we eat, every drop of water we drink, every breath of air we breathe comes to us courtesy of myriad living things serving their own interests. The perfumed air, sweet water and delicious fruits of Eden were and are gifts from living things, certainly no

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less the creations of God than we are ourselves. Yet most religions and
 laws extend far less protection to other species than they do to humans.
 It is ironic and revealing that people who fervently proclaim themselves
 "pro-life" for opposing abortion are seldom outspoken in opposing the
 rampant destruction of life in our forests, lakes and seas.

In focusing so much on even trivial aspects of humankind (who was
 caught stealing what, who is wearing what this year, who won what
 game, how much is someone willing to pay for what stock, etc.) we are
 missing a much, much larger story whose outcome will determine our
 survival and our prospects of finding oneness with what made us. The
 news (one has to look carefully for it, for news media devote very little
 attention to it) is worrisome. The Earth is rapidly losing species. They
 are being eliminated by overexploitation, physical destruction and chem-
 ical pollution of their habitats and the introduction of alien species to
 places where they had never before occurred. Ecosystems (tropical rain-
 forests, ancient temperate forests, coral reefs, tallgrass prairies, the
 entire Aral Sea) are disappearing. The biogeochemical processes that
 maintain the habitability of our planet have been pushed so far out of
 whack that the carbon dioxide content of the atmosphere is rising steady-
 ly, far more dangerous ultraviolet radiation is scourging the land and sea,
 less and less water is fit to drink and the topsoils that feed us are being
 eroded and washed into the sea.

What is causing these enormous changes? The human population,
 which is already severely stressing the Earth's life support systems, is
 doubling every 40 years. Nearly everybody is struggling to raise his or
 her standard of living by increasing the consumption of resources;
 everyone wants to live as they see Americans living on syndicated broad-
 casts of *Dallas* and *Dynasty*. But the Earth's living systems cannot handle
 even current assaults without breaking down. As 90 million more people
 join us annually and we urge them to emulate our patterns of consump-
 tion, we are undoing the integrity of our planet, which, for those who
 believe in God, is destroying God's Creation.

These causes, in turn, are being driven by psychological, spiritual
 and genetic forces within us. Processes at both the individual and popula-
 tion levels underlie our rapidly increasing destruction of our environ-
 ment. We fill our own needs so that we can reproduce and cover the
 Earth with our progeny. And we seek to eliminate anything unlike us
 that competes with us and inadvertently eliminate those that don't serve

our purpose. Once we killed lions and wolves because we feared that they might eat us. The species we are eliminating now are those whose bodies or homes we covet, or simply disregard.

Whether we are willing to recognize it or not, we are kin to all other life on this planet, and our fate is inextricably intertwined with the diversity of life. If the living things that generate our medicines disappear, we will sicken. If the living things that regulate our climate are killed, we will suffer ever-increasing occurrence of "unusual" weather. The fishes in our waters whose livers are consumed by tumors, the lichens that can no longer survive the polluted air of our cities, the dolphins succumbing to new kinds of epidemics and the mounting numbers of endangered species are all sending us a message, one as clear as the messages of the Biblical prophets: we are doing something very wrong, and we must change our ways. If we ignore them, we will pay dearly, just as the ancient Hebrews did when they ignored God's biblical commands.

Humans have enormous power. Unlike any other species in the Earth's history, we have taken on the God-like power of changing the entire planet, thereby threatening all of its inhabitants, including ourselves. Whether we have God-like wisdom and compassion to curtail the destructive use of our power is an open question.

What most distinguishes humankind from all other species is something that I first realized by contemplating my religion. The persistence of the Jews as a more or less identifiable entity for more than three millennia has been a product of our distinctive culture. The commandments and traditions about what we can and cannot eat, how we must treat our families, other people, beasts, trees (yes, there is strict prohibition, even during the siege of an enemy town, against destroying its fruit trees) and the land, and how goodness is rewarded and wrongdoing is punished, have all been detailed and passed between succeeding generations in the Torah, the Talmud and other religious writings. This is culture, the non-genetic information passed among contemporaries and, through myths, principles, songs, stories, writings, films, art and artifacts, among generations. Some came to modern Jews from crowded European ghettos of the 1940s, some from impoverished Ukrainian shtetls of the 1880s, some from Egypt's flourishing Jewish communities in the 1200s, some from the scholarly debates in Babylonia in the 400s, some from the time of David, Moses and Abraham 1,400, 1,800 and 2,500 years earlier.

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Realizing that this ancient set of accumulated ideas and principles is my
legacy led me to see that for myself and for all people, there is an alter-
native to Darwinian fitness.

In essence, passing on genes—the most basic function of life—main-
tains information, temporarily defying entropy, the disordered state
described in the Second Law of Thermodynamics that ultimately pre-
vails in any system. While entropy will eventually prevail and the pass-
ing of genes will end (because the Universe is finite, there is no chance of
immortality), the story of life is and will be a very, very long one. While
continents drifted apart, asteroids crashed into the Earth and the Wise
Use Movement arose and prepared its assault, living things have main-
tained and modified the fragile genetic thread of continuous information
since the dawn of life, more than 3,500 million years ago. The vast
majority of bearers of that information have disappeared. But because
some succeeded in passing on their genes before they died, there are
today 10, 30, perhaps even 100 million different species of guardians of
their variants of the DNA that miraculously assembled when the Earth
was young. This remarkable diversity of life, each individual singlemind-
edly devoted to perpetuating its version of that information, is the great-
est of (choose one or both) God's or evolution's inventions.

What makes humans different from all other forms of life about
which we know is the degree to which we employ culture as a second
means of passing information from generation to generation. Certainly
other species have culture: Many years ago a small English bird called a
blue tit learned to pull the tops off milk bottles, allowing it to drink the
cream, and passed this information on to others far faster than a genetic
mutation could spread through the population. And some years ago a
Japanese macaque monkey invented washing grain on a beach before
eating it, apparently as a way to avoid ingesting sand, thereby passing it
on to others via "monkey see, monkey do." It is even hypothesized that
Atlantic cod learn migration routes from other cod. But the amount of
nongenetic information passed along in other species (with the possible
exception of dolphins and great whales) is a mere trickle relative to the
great flowing river of human culture. Through our myths, tales, apho-
risms and books, we maintain the nongenetic stream of information
flowing through the days, years and millennia. Whether or not my
genes came from Moses, Hillel, Maimonides, Einstein, Michael SoulJ or
Mel Brooks, important parts of my culture certainly did. My identity is

shaped by their ideas, along with those of Lao Tzu, Aristotle, Hildegard von Bingen, Darwin, Robert MacArthur and many others who do not appear to have been members of my Jewish gene pool. I have many cultural parents.

Genetically I am a dead-end, a failure. I may love my tall, strong stepsons, but they are not my spawn. Yet I do not feel like a failure, because I have made many a contribution to posterity, my bid for immortality. I whispered a joke to a girl in my third grade class that might have changed her thinking. I played a recording of Carl Nielsen's Symphony #3 for my sister and thereby changed the mix of music to which she listens. I wrote a chapter and some books on biological diversity that have changed the minds of some decision makers about the way we treat life on Earth. Very soon, in a few minutes or decades, I will die, but I have strewn humankind and this planet with my cultural legacy. The fate of my genes is already determined, but what my brain has thought and shared, and the actions that have resulted, might, just might, have irreversibly changed the future of life on God's Green Earth, at least in small ways. For that, I feel satisfaction.

Our genes compel us to reproduce. Since long before biblical times, our cultures have reenforced that message (the Cro-Magnons of Europe carved robustly curvy female fetishes tens of thousands of years before the Canaanites' strikingly similar ones). But culture—including religion—also provides us an alternative means of attempting immortality by sending our concepts and recipes, jokes and rituals, beliefs and ethics into the future. Individuals' cultural contributions are no more equal than their genetic contributions, but most everyone has something to contribute, and some have contributions of such enduring value that vast numbers of people will adopt them (often without knowing the source) and share them with others.

In the Torah and teachings of some other religions, the miracle of life is symbolized by a tree. If we are to avoid killing millions of twigs and branches in the Tree of Life and then the trunk and roots themselves, it will be because we embraced this alternative way to seeking immortality. Our evolving culture will replace our evolving genome as the focus of our generative energy. To save the Earth and ourselves, we must employ the ancient, uniquely human way of transmitting who we are to satisfy our deeply imbedded drive for immortality.

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DEATH: WE ARE IMMORTAL

Gary Fields, my oldest friend, lives on the other side of the conti-
nent, but we are closer than most brothers. Not long ago he sent me a
note that caused me to cry. He told me that the mother of his closest
pre-Elliott childhood friend had died. Her own son—Gary's childhood
friend—had died in his early 20s, and she thought of Gary as a special
link to the son she had lost. Now she, too, was gone.

My heart went out to him. I asked myself "What is a friend?" and
an answer immediately leapt into my head: a friend is someone for
whom you cry. Death had cut the thread of her life, he grieved, and I
grieved for him. And for the loved ones I have lost. And for the people I
have never met who die in filthy refugee camps, angry inner cities and
lonely apartments. I cried and cried. Then I started thinking about why
we die.

This must be one of the most puzzling, painful questions we can
ask, and one of the greatest benefits of religions is the comforting
answers they provide. Some religions hold out the promise of a perfect
Heaven for good people or martyrs; others opt for reincarnation,
another go-around here on Earth, albeit in a different package. One way
or another, religions give us hope for transformation and immortality.

It seems so illogical: we are brilliant painters or loving friends or
special saleswomen or cheery babies or insightful scholars and death
takes us. We go quietly or we go fighting for every last breath, sudden-
ly or with lots of warning, but death still wins. Always.

How can we live knowing this? Seeing our friends and family mem-
bers go? Knowing that we will precede or follow them? Death must be
the biggest of all mysteries.

I don't want to die. It has taken me all this time to start understand-
ing myself enough to heal the inevitable damage of upbringing, to have
found the woman I love, to cherish in fullness my closest friends and my
family, to make my contribution to my species and my world, to savor
so many things. I don't want to die and I don't want anyone I love to die.
But it's going to happen, and with all my friends and skills and scientific
knowledge, I'm absolutely powerless to stop it.

But while there is no antidote to death, there is amelioration. I can
live every minute of my life as if it counts, savor the good things of this
world, fight to protect them, laugh, sing, celebrate, see, feel, taste, learn,
give, love and... die.

If only we had assurance that we and our loved ones will somehow survive, that we will again be reunited and all will be right. Religions ask us to accept this on faith, and great numbers of people do, at least sometimes. But as experienced clergy know all too well, faith is difficult to accept and maintain. If only we had some demonstrable indication that we will be here forever....

We do. And I will be the first to admit that it is not all that we would like, it is not the universal talisman that will comfort all people whenever faith falls short. But I suspect that it would be of some comfort to some people sometime, and on a question notably short of satisfying answers, that is not nothing.

You see, we are made of chemical elements: carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorous, calcium, iron and many others. When our mothers are pregnant, they nurture us with these elements as we grow *in utero*, then provide precisely what we need through their milk and, with our fathers (those who are lucky enough to have fathers who do this), feed us until we can feed ourselves. Eating and breathing provide our cells the chemical energy we need to do work—walking, lifting, digesting and thinking—and the chemicals from which we make our bodies. We cannot absorb all the chemicals we ingest, so we egest the remainder. And we cannot forever hold on to all that we have absorbed, so we excrete or exhale them. Ingest, inhale, egest, excrete, exhale, on and on and on. In maintaining this flow of chemical elements, we transform ourselves and our environment.

The availability of the chemicals of life depends on living things. The Earth's atmosphere, at first, was a witches' brew of chemicals that you and I could not breathe. It was fine for various early marine bacteria, however, which prospered in these conditions for aeons. The air became breathable for us (and poisonous for most of them) because, starting more than a billion years ago, blue-green bacteria in the sea produced enough oxygen as a waste product of their photosynthesis that the atmosphere started accumulating free oxygen. This was a disaster for many of the early bacteria, which took refuge in places where oxygen couldn't reach, but spurred the evolution of ones that could tolerate and use oxygen. Life created our modern, breathable (except in Los Angeles, Beijing and a growing list of similar places) atmosphere.

Similarly, phosphorous is a vitally important nutrient for plants (when people buy bags of garden fertilizer marked with three numbers,

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such as 20-5-10, the middle number indicates the percentage of phospho- rous). Usable forms of phosphorous are generally in scarce supply on the Earth's surface because plants suck it up so quickly. But there are places where plants are scarce and phosphorous concentrations are very high. One of the best-known is on small islands and cliffs where seabirds have roosted for thousands of years. The phosphorous compounds from the fishes they have eaten and egested accumulate on the rocks, forming thick guano deposits. People mine these deposits for use as fer- tilizer.

There are also places where calcium compounds accumulate because animals and plants with calcium skeletons have lived and died in vast numbers. The most famous of these where this process is still ongoing is Australia's Great Barrier Reef, where countless corals, clams, snails and calcium-absorbing algae have harvested calcium from the water that flows across them and incorporated it into their bodies, only to die and be overgrown by still other organisms doing the same thing until a thick layer of calcium carbonate, or coral rock (a kind of lime- stone) accumulates. The young stages of seaweeds, corals, snails and many other organisms settle on coral rock and, by growing, contribute to the growth of the reef. From the bodies of the dead come the sub- strate for new lives.

Most of the heavier elements of which we are made were born in the stars, spread throughout the galaxy when stars exploded and accu- mulated when the infant Earth coalesced some 4.5 billion years ago, so, in a very real sense, each of us is made of stardust. Living things acquire the elements they need, package them in different ways and eventually release them, where they are taken up and transformed, recycled by biological, geological and chemical (biogeochemical) processes countless times. Some things are reused quickly, some are stored for long periods, but nothing is wasted and nothing really disappears. The very atoms that were part of Moses, Lao Tsu, Gautama Siddhartha, Jesus, Mohammed and Bahaullah are still with us and part of us. Every person in the world, every mushroom, leaf and bird, has carbon from King David, sulfur from Confucius and oxygen from Joan of Arc. And when enough time has passed for our elements to be redistributed, everyone in the future will carry elements from us. So, each of us is a new assem- blage of atoms that were part of those we most revere. And for as long as the Earth survives, something in each of us will be in everyone else.

In this sense, we are all immortal, and we are all one.

Is this the stuff of science or religion? The miracles of being are no more or less miraculous either way. But by rethinking our religions and lovingly reshaping them to reflect what we have learned about the world we inhabit and the forces that created us, each and every one of us can revere, protect and sustain Creation. Our religions gave us the direction we needed to sustain ourselves for millennia when the voice of science was quiet, indeed. Knowing what science now teaches, people are faced with the choice of holding on to beliefs that will bring a sorry end to Creation as we know it, or of renewing our faiths to sustain life on God's Green Earth. My fondest hope is that we will make the right choice.