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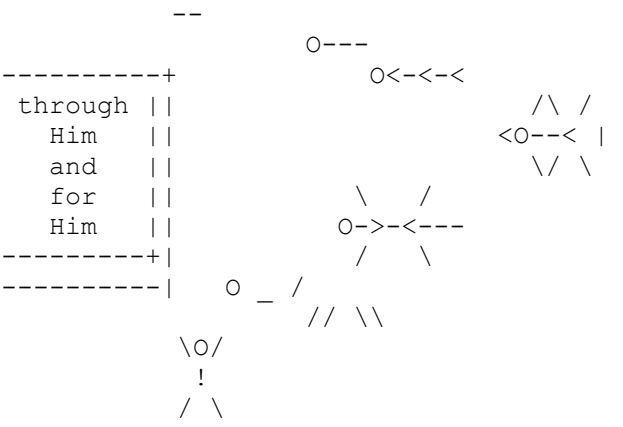

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FINDING DARWIN'S GOD..... (Kenneth R. Miller)
To creationists, an acceptance of evolution cannot coexist with belief in a created world. Not only are the creationists wrong, argues a professor of biology who is also a Christian, they deny the possibility of human beings created free to choose right from wrong. Darwin's theories, he says, can actually deepen our belief in a Creator.

Kenneth Miller is a professor of biology at Brown University. This article is adapted from _Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution_, published by Cliff
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Curious Creatures
GO TO THE ANT... Mike L Anderson

So said Solomon. He had a remedy for sloth in mind. What Solomon did not know was that each ant spends several of its waking hours each day slipping away to have a catnap - or should I say antnap. Ants have remarkable features besides their industry. It has been estimated that there are more individual ants in the world than all other terrestrial animals combined. Perhaps we could learn a thing or two from the success of ants. Here are some ant features that have contributed to their success.

Adaptability
Ants, like their wasp ancestors, are usually carnivorous. This fact led naturalists in the 19th century to doubt Solomon's veracity. Was the Bible wrong? Did Solomon's ants really harvest grain? In 1871, Traheme Moggerdige discovered that Solomon was right after all (3). Presumably, scarcity in their usual food sources led the ancestors of these ants to evolve seed-eating habits. However, two problems came with their new vocation. Some seeds were too tough for the small jaws of the workers and their soldiers were left with little to do. Solution: employ the soldiers in a new task - breaking open the husks of tough seeds. In a changing world, it is beneficial to be adaptable - to be prepared to use existing skills in new ways. The same applies in the human world of course. The principle is being taught to students in higher education (4).

Organisation
It has been said that the ant's greatest enemy, apart from humans, is other ants. In South Africa and elsewhere alien species have been driving out local species seemingly at will. The victims are often large, have big mandibles and

even stings. You might think the conqueror to be one impressively large ant. Actually, no. The victor, which has been called "the most pernicious ant in the world" is the tiny, stingless Argentine ant (5). It has dominated because of its superior organisation. What the ants lack as individuals is more than made up by their social characteristics. Instead of separate colonies fighting it out, they put aside their differences to form super-colonies. In 2002, researchers discovered a super-colony in Europe that stretches for more than 5000 kilometres (6)! Nature has discovered that there are conditions under which the best way to defeat potential enemies is to make friends with them. In a sense, this principle under girds the mission of Jesus. The good news is that God wants to convert his enemies into friends.

Division of labour
Ants have also learnt that they can be more efficient by giving individuals specialised tasks. Workers, freed from reproductive roles, are able to get stuck into ... well work. Reproductives on the other hand do nothing but eat and reproduce. Soldiers are big on defence. Perhaps one reason for burnout in humans is that we try too hard to be good at everything instead of being interdependent. I've found myself trying to be an expert theologian, car mechanic, administrator, physicist, political commentator, counsellor, mother and tax advisor - none of which is my gift.

One striking case of division of labour occurs among desert ants in Ethiopia (7). At night, the ants retreat into their underground nest except for one individual. It hides the nest opening so that predators do not find it. As a result, it remains outside to be eaten by the one of the many night predators. The well being of the colony is vitally dependent on this division of labour. If all tried to be saviour, none would be saved. This case reminds of a divine division of labour. God came to Bethlehem to be our Saviour. He left us behind to be his witnesses. We cannot save others. Christ does that. God does not disciple; we have to do that.

1. Morley, D.W. (1953) _The Ant World_. Penguin Books, (S.A.) Pty Ltd, Sea Point, p. 9.
2. _Ibid_., p. 123.
3. _Ibid_., p. 183.
4. http://www.learnntc.com/tools/GettingStarted/someIdeas.cfm
5. Skaife, S.H. (1961) _The Study of Ants_. Spottiswoode, Ballantyne and Company, Ltd., London, p. 5
6. http://www.freerepublic.com/focus/news/746044/posts
7. _Bugs!_ No. 5. Orbis Publishing Ltd., p. 119.

NEWS BRIEFS ..... (From the Internet)

* This old geyser may have signs of life
Last year a giant geyser was found spewing from Enceladus, a 500 km wide moon of Saturn. The plume contained water vapour, ice, hydrocarbons and dust, suggesting that a heat source and organic soup may lie beneath the moon's surface - just the sort of conditions needed for life. Europa and Titan are also potential sources for life, but Enceladus is beginning to look the most promising.
http://www.sciencenews.org/articles/20060506/bob9.asp

* Light bothers creatures of the night
For species that require darkness such the California glossy snake, light pollution may be the culprit in their decline. Researchers are taking the first steps in understanding the ecological effects of light pollution. Using sophisticated photography ecologists can now pinpoint areas that are most likely to be ecologically sensitive. It has been found that light pollution in Death Valley National Park is predominantly caused by the city lights of Las Vegas, 150 kilometres away.

http://www.sciencenews.org/articles/20060318/bob10.asp

* Yes, death and taxes might be the only constants
The so-called constants of nature such as the speed of light and the gravitational constant are constant, right? Some might not be after all. Take the constant mu - the ratio between the mass of the proton and that of the electron. It has a value of 1836.153. Researchers believe this is down by two thousands of a percent since the early universe. The evidence comes from examining light-absorption patterns of hydrogen molecules.
http://www.sciencenews.org/articles/20060429/fob1.asp

* Xena is brighter than most
Xena, the unofficial tenth planet in our solar system, has a reflectivity of 85%. It is only beaten by Enceladus, the moon of Jupiter. Pluto has a reflectivity of 60%. Scientists are not sure of the reason, but they suspect that the planet is covered in a blanket of methane snow.
http://www.sciencenews.org/articles/20060415/fob8.asp

* Nagging could have been around for 1.8 million years
Excavations last year have revealed 1.8 million year old Homo erectus vertebrae fossils. The dimensions of the vertebrae fall within the human range and would have easily held a modern human spinal cord. Furthermore, there would have been sufficient support for the respiratory muscles needed in speech. Speech does not fossilise, of course, so we have no indication what these hominids would have spoken about. We can only extrapolate back from studying modern humans.
http://www.sciencenews.org/articles/20060506/fob2.asp

* The bang was big!
Data from a NASA satellite has lead researchers to a clearer picture of the early universe. They examined polarization in the cosmic micro-wave background radiation left over from the Big Bang. The bang was big. In less than a trillionth of a second the universe went from less than the size of an atom to the size of a grapefruit. This is many times faster than the speed of light. In 300 to 400 million years the first stars formed. This is a little later than previously thought. The data also confirm with greater accuracy the ingredients of the universe: 4.4% matter, 22% dark matter and 74% dark energy and the age of the universe - 13.7 billion years.
http://www.sciencenews.org/articles/20060318/fob1.asp

* South African bug wallops drug-resistant bacteria
A bacterium living in South African soil has been found to produce a compound that annihilates antibiotic resistant bacterium. Researchers have been targeting bacteria for such compounds because bacteria have been at war with each other billions of years. Natural selection
can be expected to have arrived at clever biochemical ploys. The compound is called platensimycin and works by disrupting the mechanism bacteria use to make fatty acids.
http://www.sciencenews.org/articles/20060520/fob1.asp

* A long evolutionary good-bye
The ancestors of humans and chimps may have taken as much as 4 million years to finally say good-bye and follow separate evolutionary pathways. During that time they interbred according to new evidence. The final split happened between 6.3 million and 5.4 million years, later than the 7 million years previously thought. The evidence that prompted these claims comes from a comparison of the DNA of humans, apes and macaque monkeys. Researchers found that genetic similarity of chromosomes is not uniform. There is greater similarity between chimps and humans in their X chromosome than other chromosomes.
http://www.sciencenews.org/articles/20060520/fob4.asp

* Yep, there is such a thing as brain food

It might sound like the utterance of a snake-oil merchant but researchers are saying that fish-oil could make you smarter. Research on brain-injured rats has found that those fed on a diet supplemented with omega-3 fatty acids out performed those that did not in a cognitive task involving a maze. On the other hand, work on rats has also revealed that a high-fat, sugary diet could lower brain health.
http://www.sciencenews.org/articles/20060304/bob8.asp

* Nectar: Nature's cold-drink
Is nectar essentially just sugar-water? No. Researchers have discovered that plants have evolved surprisingly selective nectar cocktails in a bid to entice particular pollinators. For instance, some Australian flowers have added extra calcium to their nectar. The niche market? Lactating female nectar-feeding bats! Others add the amino acid proline. Insects burn up a lot of proline during flight. Unsurprisingly, bees have a taste for proline. Plants have also discovered preservatives - they use a suite of proteins to produce a hydrogen peroxide based disinfectant. They even add stimulants! Some citrus nectars contain a shot of caffeine that bees seem to like. Some add alcohol or other intoxicants. There seems to be a great opportunity here to get funding for research from Coca-Cola or South African Breweries.
http://www.sciencenews.org/articles/20060513/bob10.asp

Humour from the web
TALL ANIMAL TALES

Neil Simmons and Fred Cornes were neighbours. They did not know that each of them were amateur ornithologists. So, when Neil made a tawny owl call one evening, Fred assumed that it was real owl. He hooted back. Every night for a year they hooted at each other, dutifully recording the incidents in their notebooks. Only when the wives got talking to each did they realise what had been happening.

Koalas are cute cuddly creatures to everyone but the Australian Minister for Tourism, John Brown. In a scurrilous attack he called them flea-ridden, stinky animals that pee on people. There was an outrage among koala lovers including opposition politicians and the Prime Minister. Some time later John Brown made a public apology and to authenticate his sentiments cuddled a koala in front of the cameras. It bit him on the stomach.

Source: Harris, Rolf (2000) _Tall Animal Tales_ Chivers Press, Bath, United Kingdom

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Spot the Fallacy
DISCIPLINARY CHAUVINISM OR HOW TO MAKE LIGHT OF GOD'S WORLD
Mike L Anderson

I like to think of myself as a logical animal. When my tax advisor suggested ways that I could avoid tax it looked to me like tax evasion. I want to be conservative about tax. I prefer to pay more then end up paying penalties. I refuted his argument. I thought my logic was unassailable. It was. The problem, besides arrogance, was that I was ignorant of certain tax facts. My wife saw me less as a logical animal, and more as someone who lost the family a pile of money. The trouble was that I thought that knowing something about logic put me in a satisfactory position to evaluate tax matters. In short, I was being a disciplinary chauvinist.

Jesus did not have this problem. You might think that as the Son of God, he was in the prime position to arbitrate in all matters. Jesus did not. Someone from

the crowd asks him to tell his brother to divide up the inheritance with him. Jesus replies, "Man, who appointed me a judge or an arbiter between you?"(1) . God incarnate accepted the limits of his mission (2). It seems ironical that Jesus, who might be excused for having something of a God-complex, did not, whereas the rest of us sometimes do.

Some time ago I got talking with a gentleman, let's call him Billy, who has degrees in physics and theology and who is pursuing post-graduate studies in philosophy. Billy has also been outspoken in his rejection of the theory of evolution. He said to me that evolution is "ultimately a matter of metaphysics not biology." He was trying to make evolution a sub-discipline of his field of study. This would put him in the ultimate position to evaluate it! Billy was falling into disciplinary chauvinism.

My favourite example is the story Dr Fleiss (3), a friend of the founder of psychology, Sigmund Freud. They had a falling out partly because Fleiss insisted that the nose was the centre of all kinds of neurotic ailments! Guess Fleiss's occupation. He was an Ear, Nose and Throat surgeon! His is a particularly extreme, even comical example, but the fallacy is prevalent.

Physicist Alan Sokal submitted a spoof paper to the journal Social Text that was dense with allusions to quantum mechanics, topology and other scientific and mathematical fields. It was, he said, so full of nonsense that any competent physicist or mathematician would have realised it was a parody. He wanted to see whether his paper would be published. It was. He writes, "Social Text's acceptance of my article exemplifies the intellectual arrogance of Theory -- meaning postmodernist literary theory -- carried to its logical extreme. No wonder they didn't bother to consult a physicist. If all is discourse and ``text,'' then knowledge of the real world is superfluous; even physics becomes just another branch of Cultural Studies" (4).

Illusionist James Randi recounts an example of two physicists who refused to consult him in the execution of experiments to detect psychic ability (5). They got funding, set up a research institute and within a short time claimed to have demonstrated genuine psychic ability in two subjects. At a press conference, their subjects announced that they did _not_have this ability, that they cheated and that they were students of none other than James Randi! Evidently the physicists felt that their education in physics provided them with sufficient training to pick up deception.

The trouble with disciplinary chauvinism is that it makes light of the world that God has created and light of the work of professionals in their fields. Why should God have made the universe such that ability in one department invariably grants us ability in quite another? Would this not be trivialising this grand, intricate, diverse, rich, multifaceted world? Why, if the world is so simple, does God give wisdom to one and knowledge to another (6) ? Why does He tell us to consult the wise (7) and seek out many advisers (8)? Paul asks rhetorically, "Are all apostles? Are all prophets? Are all teachers? Do all work miracles (9)?" Let us not be too wooden in applying this passage. Are all tax brokers? Are all philosophers? Are all physicists? Are all plumbers? Are all evolutionary biologists? Are all illusionists?

To recognise our need for professionals in other fields is not only humble; it also acknowledges the greatness of God's creation and thereby the even greater greatness of the Creator behind it. Disciplinary chauvinism, on the other hand, is an affront both to the greatness of God and to the humility of His Son.

Notes

1. Luke 12:14
2. He says, "For I did not come to judge the world, but to save it" (Luke

12:47).
3. Gardner, M. (1989) _Mathematical Carnival_. The Mathematical Association of America, p. 152.
4. <http://www.physics.nyu.edu/faculty/sokal/lingua_franca_v4/lingua_franca_v4.html>.
5. Randi, J. (1983) The Project Alpha Experiment: Part 1. The First Two Years. _The Skeptical Inquirer_ 8:24-33, Randi, J. (1983) The Project Alpha Experiment: Part 2. Beyond the Laboratory. _The Skeptical Inquirer_ 8:36-45.
6. 1 Corinthians 12:8
7. Proverbs 15:12
8. Proverbs 15:22
9. 1 Corinthians 12:29

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* Feature article *

FINDING DARWIN'S GOD

Kenneth R. Miller

The great hall of the Hynes Convention Center in Boston looks nothing like a church. And yet I sat there, smiling amid an audience of scientists, shaking my head and laughing to myself as I remembered another talk, given long ago, inside a church to an audience of children.

Without warning, I had experienced one of those moments in the present that connects with the scattered recollections of our past. Psychologists tell us that things happen all the time. Five thousand days of childhood are filed, not in chronological order, but as bits and pieces linked by words, or sounds, or even smells that cause us to retrieve them for no apparent reason when something "refreshes" our memory. And just like that, a few words in a symposium on developmental biology had brought me back to the day before my first communion. I was eight years old, sitting with the boys on the right side of our little church (the girls sat on the left), and our pastor was speaking.

Putting the finishing touches on a year of preparation for the sacrament, Father Murphy sought to impress us with the reality of God's power in the world. He pointed to the altar railing, its polished marble gleaming in sunlight, and firmly assured us that God himself had fashioned it. "Yeah, right," whispered the kid next to me. Worried that there might be the son or daughter of a stonecutter in the crowd, the good Father retreated a bit. "Now, he didn't carve the railing or bring it here or cement it in place. . . but God himself _made_ the marble, long ago, and left it for someone to find and make into part of our church."

I don't know if our pastor sensed that his description of God as craftsman was meeting a certain tide of skepticism, but no matter. He had another trick up his sleeve, a can't-miss, sure-thing argument that, no doubt, had never failed him. He walked over to the altar and picked a flower from the vase.

"Look at the beauty of a flower," he began. "The Bible tells us that even Solomon in all his glory was never arrayed as one of these. And do you know what? Not a single person in the world can tell us what makes a flower bloom. All those scientists in their laboratories, the ones who can split the atom and build jet planes and televisions, well, not one of them can tell you how a plant makes flowers." And why should they be able to? "Flowers, just like you, are the work of God."

I was impressed. No one argued, no one wisecracked. We filed out of the church like good little boys and girls, ready for our first communion the next day. And I never thought of it again, until this symposium on developmental biology. Sandwiched between two speakers working on more fashionable topics in animal development was Elliot M. Meyerowitz, a plant scientist at Caltech. A few of my colleagues, uninterested in research dealing with plants, got up to stretch their legs before the final talk, but I sat there with an ear-to-ear grin on my face. I jotted notes furiously; I sketched the diagrams he projected on the screen and wrote additional speculations of my own in the margins. Meyerowitz, you see, had explained how plants make flowers.

The four principal parts of a flower - sepals, petals, stamens, and pistils - are actually modified leaves. This is one of the reasons why plants can produce reproductive cells just about anywhere, while animals are limited to a very specific set of reproductive organs. Your little finger isn't going to start shedding reproductive cells anytime soon. But in springtime, the tip of any branch on an apple tree may very well blossom and begin scattering pollen. Plants can produce new flowers anywhere they can grow new leaves. Somehow, however, the plant must find a way to "tell" an ordinary cluster of leaves that they should develop into floral parts. That's where Meyerowitz's lab took over.

Several years of patient genetic study had isolated a set of mutants that could only form two or three of the four parts. By crossing the various mutants, his team was able to identify four genes that had to be turned on or off in a specific pattern to produce a normal flower. Each of these genes, in turn, sets off a series of signals that "tell" the cells of a brand new bud to develop as sepals or petals rather than ordinary leaves. The details are remarkable, and the interactions between the genes are fascinating. To me, sitting in the crowd thirty-seven years after my first communion, the scientific details were just the icing on the cake. The real message was "Father Murphy, you were wrong." God doesn't make a flower. The floral induction genes do.

Our pastor's error, common and widely repeated, was to seek God in what science has not yet explained. His assumption was that God is best found in territory unknown, in the corners of darkness that have not yet seen the light of understanding. These, as it turns out, are exactly the wrong places to look.

Searching the Shadows

By pointing to the process of making a flower as proof of the reality of God, Father Murphy was embracing the idea that God finds it necessary to cripple nature. In his view, the blooming of a daffodil requires not a self-sufficient material universe, but direct intervention by God. We can find God, therefore, in the things around us that lack material, scientific explanations. In nature, elusive and unexplored, we will find the Creator at work.

The creationist opponents of evolution make similar arguments. They claim that the existence of life, the appearance of new species, and, most especially, the origins of mankind have not and cannot be explained by evolution or any other natural process. By denying the self-sufficiency of nature, they look for God (or at least a "designer") in the deficiencies of science. The trouble is that science, given enough time, generally explains even the most baffling things. As a matter of strategy, creationists would be well-advised to avoid telling

scientists what they will never be able to figure out. History is against them. In a general way, we really do understand how nature works.

And evolution forms a critical part of that understanding. Evolution really does explain the very things that its critics say it does not. Claims disputing the antiquity of the earth, the validity of the fossil record, and the sufficiency of evolutionary mechanisms vanish upon close inspection. Even to the most fervent anti-evolutionists, the pattern should be clear - their favorite "gaps" are filling up: the molecular mechanisms of evolution are now well-understood, and the historical record of evolution becomes more compelling with each passing season. This means that science can answer their challenges to evolution in an obvious way. Show the historical record, provide the data, reveal the mechanism, and highlight the convergence of theory and fact.

There is, however, a deeper problem caused by the opponents of evolution, a problem for religion. Like our priest, they have based their search for God on the premise that nature is _not_ self-sufficient. By such logic, only God can make a species, just as Father Murphy believed only God could make a flower. Both assertions support the existence of God _only_ so long as these assertions are true, but serious problems for religion emerge when they are shown to be false.

If we accept a _lack_ of scientific explanation as proof for God's existence, simple logic would dictate that we would have to regard a successful scientific explanation as an argument _against_ God. That's why creationist reasoning, ultimately, is much more dangerous to religion than to science. Elliot Meyerowitz's fine work on floral induction suddenly becomes a threat to the divine, even though common sense tells us it should be nothing of the sort. By arguing, as creationists do, that nature cannot be self-sufficient in the formation of new species, the creationists forge a logical link between the limits of natural processes to accomplish biological change and the existence of a designer (God). In other words, they show the proponents of atheism exactly how to disprove the existence of God - show that evolution works, and it's time to tear down the temple. This is an offer that the enemies of religion are all too happy to accept.

Putting it bluntly, the creationists have sought God in darkness. What we have not found and do not yet understand becomes their best - indeed their only - evidence for the divine. As a Christian, I find the flow of this logic particularly depressing. Not only does it teach us to fear the acquisition of knowledge (which might at any time disprove belief), but it suggests that God dwells only in the shadows of our understanding. I suggest that, if God is real, we should be able to find him somewhere else - in the bright light of human knowledge, spiritual and scientific.

Faith and Reason

Each of the great Western monotheistic traditions sees God as truth, love, and knowledge. This should mean that each and every increase in our understanding of the natural world is a step toward God and not, as many people assume, a step away. If faith and reason are both gifts from God, then they should play complementary, not conflicting, roles in our struggle to understand the world around us. As a scientist and as a Christian, that is exactly what I believe. True knowledge comes only from a combination of faith and reason.

A nonbeliever, of course, puts his or her trust in science and finds no value in faith. And I certainly agree that science allows believer and nonbeliever alike to investigate the natural world through a common lens of observation, experiment, and theory. The ability of science to transcend cultural, political, and even religious differences is part of its genius, part of its value as a way of knowing. What science cannot do is assign either meaning or purpose to the world it explores. This leads some to conclude that the world as seen by science is devoid of meaning and absent of purpose. It is not. What it does mean, I would suggest, is that our human tendency to assign meaning and value must transcend science and, ultimately, must come from outside it. The science that results can thus be enriched and informed from its contact with the values and principles of faith. The God of Abraham does not tell us which proteins control the cell cycle. But he does give us a reason to care, a reason to cherish that understanding, and above all, a reason to prefer the light of knowledge to the darkness of ignorance.

As more than one scientist has said, the truly remarkable thing about the world is that it actually does make sense. The parts fit, the molecules interact, the darn thing works. To people of faith, what evolution says is that nature is complete. Their God fashioned a material world in which truly free and independent beings could evolve. He got it right the very first time.

To some, the murderous reality of human nature is proof that God is absent or dead. The same reasoning would find God missing from the unpredictable branchings of an evolutionary tree. But the truth is deeper. In each case, a deity determined to establish a world that was truly independent of his whims, a world in which intelligent creatures would face authentic choices between good and evil, would have to fashion a distinct, material reality and then let his creation run. Neither the self-sufficiency of nature nor the reality of evil in the world mean God is absent. To a religious person, both signify something quite different - the strength of God's love and the reality of our freedom as his creatures.

The Weapons of Disbelief

As a species, we like to see ourselves as the best and brightest. We are the intended, special, primary creatures of creation. We sit at the apex of the evolutionary tree as the ultimate products of nature, self-proclaimed and self-aware. We like to think that evolution's goal was to produce us.

In a purely biological sense, this comforting view of our own position in nature is false, a product of self-inflating distortion induced by the imperfect mirrors we hold up to life. Yes, we are objectively among the most complex of animals, but not in every sense. Among the systems of the body, we are the hands-down winners for physiological complexity in just one place - the nervous system - and even there, a nonprimate (the dolphin) can lay down a claim that rivals our own.

More to the point, any accurate assessment of the evolutionary process shows that the notion of one form of life being more highly evolved than another is incorrect. Every organism, every cell that lives today, is the descendant of a long line of winners, of ancestors who used successful evolutionary strategies time and time again, and therefore lived to tell about it - or, at least, to reproduce. The bacterium perched on the lip of my coffee cup has been through as much evolution as I have. I've got the advantage of size and consciousness, which

matter when I write about evolution, but the bacterium has the advantage of numbers, of flexibility, and most especially, of reproductive speed. That single bacterium, given the right conditions, could literally fill the world with its descendants in a matter of days. No human, no vertebrate, no animal could boast of anything remotely as impressive.

What evolution tells us is that life spreads out along endless branching pathways from any starting point. One of those tiny branches eventually led to us. We think it remarkable and wonder how it could have happened, but any fair assessment of the tree of life shows that our tiny branch is crowded into insignificance by those that bolted off in a thousand different directions. Our species, _Homo sapiens_, has not "triumphed" in the evolutionary struggle any more than has a squirrel, a dandelion, or a mosquito. We are all here, now, and that's what matters. We have all followed different pathways to find ourselves in the present. We are all winners in the game of natural selection. _Current_ winners, we should be careful to say.

That, in the minds of many, is exactly the problem. In a thousand branching pathways, how can we be sure that one of them, historically and unavoidably, would lead for sure to us? Consider this: we mammals now occupy, in most ecosystems, the roles of large, dominant land animals. But for much of their history, mammals were restricted to habitats in which only very small creatures could survive. Why? Because another group of vertebrates dominated the earth - until, as Stephen Jay Gould has pointed out, the cataclysmic impact of a comet or asteroid drove those giants to extinction. "In an entirely literal sense," Gould has written, "we owe our existence, as large and reasoning animals, to our lucky stars."

So, what if the comet had missed? What if our ancestors, and not dinosaurs, had been the ones driven to extinction? What if, during the Devonian period, the small tribe of fish known as rhipidistians had been obliterated? Vanishing with them would have been the possibility of life for the first tetrapods. Vertebrates might never have struggled onto the land, leaving it, in Gould's words, forever "the unchallenged domain of insects and flowers."

Surely this means that mankind's appearance on this planet was _not_ pre-ordained, that we are here not as the products of an inevitable procession of evolutionary success, but as an afterthought, a minor detail, a happenstance in a history that might just as well have left us out. What follows from this, to skeptic and true believer alike, is a conclusion whose logic is rarely challenged - that no God would ever have used such a process to fashion his prize creatures. How could he have been sure that leaving the job to evolution would lead things to working out the "right" way? If it was God's will to produce us, then by showing that we are the products of evolution, we would rule God out as Creator. Therein lies the value or the danger of evolution.

Not so fast. The biological account of lucky historical contingencies that led to our own appearance on this planet is surely accurate. What does not follow is that a perceived lack of inevitability translates into something that we should regard as incompatibility with a divine will. To do so seriously underestimates God, even as this God is understood by the most conventional of Western religions.

Yes, the explosive diversification of life on this planet was an unpredictable process. But so were the rise of Western civilization, the collapse of the Roman Empire, and the winning number in last night's lottery. We do not regard the indeterminate nature of any of these

events in human history as antithetical to the existence of a Creator; why should we regard similar events in natural history any differently? There is, I would submit, no reason at all. If we can view the contingent events in the families that produced our individual lives as consistent with a Creator, then certainly we can do the same for the chain of circumstances that produced our species.

The alternative is a world where all events have predictable outcomes, where the future is open neither to chance nor to independent human action. A world in which we would always evolve is a world in which we would never be free. To a believer, the particular history leading to us shows how truly remarkable we are, how rare is the gift of consciousness, and how precious is the chance to understand.

Certainty and Faith

One would like to think that all scientific ideas, including evolution, would rise or fall purely on the basis of the evidence. If that were true, evolution would long since have passed, in the public mind, from controversy into common sense, which is exactly what has happened within the scientific community. This is, unfortunately, not the case - evolution remains, in the minds of much of the American public, a dangerous idea, and for biology educators, a source of never-ending strife.

I believe much of the problem is the fault of those in the scientific community who routinely enlist the findings of evolutionary biology in support of their own philosophical pronouncements. Sometimes these take the form of stern, dispassionate pronouncements about the meaninglessness of life. Other times we are lectured that the contingency of our presence on this planet invalidates any sense of human purpose. And very often we are told that the raw reality of nature strips the authority from any human system of morality.

As creatures fashioned by evolution, we are filled, as the biologist E. O. Wilson has said, with instinctive behaviors important to the survival of our genes. Some of these behaviors, though favored by natural selection, can get us into trouble. Our desires for food, water, reproduction, and status, our willingness to fight, and our tendencies to band together into social groups, can all be seen as behaviors that help ensure evolutionary success. Sociobiology, which studies the biological basis of social behaviors, tells us that in some circumstances natural selection will favor cooperative and nurturing instincts - "nice" genes that help us get along together. Some circumstances, on the other had, will favor aggressive self-centered behaviors, ranging all the way from friendly competition to outright homicide. Could such Darwinian ruthlessness be part of the plan of a loving God?

Yes, it could. To survive on this planet, the genes of our ancestors, like those of any other organism, had to produce behaviors that protected, nurtured, defended, and ensured the reproductive successes of the individuals that bore them. It should be no surprise that we carry such passions within us, and Darwinian biology cannot be faulted for giving their presence a biological explanation. Indeed, the Bible itself gives ample documentation of such human tendencies, including pride, selfishness, lust, anger, aggression, and murder.

Darwin can hardly be criticized for pinpointing the biological origins of these drives. All too often, in finding the sources of our "original

sins," in fixing the reasons why our species displays the tendencies it does, evolution is misconstrued as providing a kind of justification for the worst aspects of human nature. At best, this is a misreading of the scientific lessons of sociobiology. At worst, it is an attempt to misuse biology to abolish any meaningful system of morality. Evolution may explain the existence of our most basic biological drives and desires, but that does not tell us that it is always proper to act on them. Evolution has provided me with a sense of hunger when my nutritional resources are running low, but evolution does not justify my clubbing you over the head to swipe your lunch. Evolution explains our biology, but it does not tell us what is good, or right, or moral. For those answers, however informed we may be by biology, we must look somewhere else.

What Kind of World?

Like it or not, the values that any of us apply to our daily lives have been affected by the work of Charles Darwin. Religious people, however, have a special question to put to the reclusive naturalist of Down House. Did his work ultimately contribute to the greater glory of God, or did he deliver human nature and destiny into the hands of a professional scientific class, one profoundly hostile to religion? Does Darwin's work strengthen or weaken the idea of God?

The conventional wisdom is that whatever one may think of his science, having Mr. Darwin around certainly hasn't helped religion very much. The general thinking is that religion has been weakened by Darwinism and has been constrained to modify its view of the Creator in order to twist doctrine into conformity with the demands of evolution. As Stephen Jay Gould puts it, with obvious delight,"Now the conclusions of science must be accepted _a priori_, and religious interpretations must be finessed and adjusted to match unimpeachable results from the magisterium of natural knowledge!" Science calls the tune, and religion dances to its music.

This sad specter of a weakened and marginalized God drives the continuing opposition to evolution. This is why the God of the creationists requires, above all, that evolution be shown not to have functioned in the past and not to be working now. To free religion from the tyranny of Darwinism, creationists need a science that shows nature to be incomplete; they need a history of life whose events can only be explained as the result of supernatural processes. Put bluntly, the creationists are committed to finding permanent, intractable mystery in nature. To such minds, even the most perfect being we can imagine would not have been perfect enough to fashion a creation in which life would originate and evolve on its own. Nature must be flawed, static, and forever inadequate.

Science in general, and evolutionary science in particular, gives us something quite different. It reveals a universe that is dynamic, flexible, and logically complete. It presents a vision of life that spreads across the planet with endless variety and intricate beauty. It suggests a world in which our material existence is not an impossible illusion propped up by magic, but the genuine article, a world in which things are exactly what they seem. A world in which we were formed, as the Creator once told us, from the dust of the earth itself.

It is often said that a Darwinian universe is one whose randomness cannot be reconciled with meaning. I disagree. A world truly without meaning would be one in which a deity pulled the string of every human

puppet, indeed of every material particle. In such a world, physical and biological events would be carefully controlled, evil and suffering could be minimized, and the outcome of historical processes strictly regulated. All things would move toward the Creator's clear, distinct, established goals. Such control and predictability, however, comes at the price of independence. Always in control, such a Creator would deny his creatures any real opportunity to know and worship him - authentic love requires freedom, not manipulation. Such freedom is best supplied by the open contingency of evolution.

One hundred and fifty years ago it might have been impossible not to couple Darwin to a grim and pointless determinism, but things look different today. Darwin's vision has expanded to encompass a new world of biology in which the links from molecule to cell and from cell to organism are becoming clear. Evolution prevails, but it does so with a richness and subtlety its original theorist may have found surprising and could not have anticipated.

We know from astronomy, for example, that the universe had a beginning, from physics that the future is both open and unpredictable, from geology and paleontology that the whole of life has been a process of change and transformation. From biology we know that our tissues are not impenetrable reservoirs of vital magic, but a stunning matrix of complex wonders, ultimately explicable in terms of biochemistry and molecular biology. With such knowledge we can see, perhaps for the first time, why a Creator would have allowed our species to be fashioned by the process of evolution.

If he so chose, the God whose presence is taught by most Western religions could have fashioned anything, ourselves included, _ex nihilo_, from his wish alone. In our childhood as a species, that might have been the only way in which we could imagine the fulfillment of a divine will. But we've grown up, and something remarkable has happened: we have begun to understand the physical basis of life itself. If a string of constant miracles were needed for each turn of the cell cycle or each flicker of a cilium, the hand of God would be written directly into every living thing - his presence at the edge of the human sandbox would be unmistakable. Such findings might confirm our faith, but they would also undermine our independence. How could we fairly choose between God and man when the presence and the power of the divine so obviously and so literally controlled our every breath? Our freedom as his creatures requires a little space and integrity. In the material world, it requires self-sufficiency and consistency with the laws of nature.

Evolution is neither more nor less than the result of respecting the reality and consistency of the physical world over time. To fashion material beings with an independent physical existence, any Creator would have had to produce an independent material universe in which our evolution over time was a contingent possibility. A believer in the divine accepts that God's love and gift of freedom are genuine - so genuine that they include the power to choose evil and, if we wish, to freely send ourselves to Hell. Not all believers will accept the stark conditions of that bargain, but our freedom to act has to have a physical and biological basis. Evolution and its sister sciences of genetics and molecular biology provide that basis. In biological terms, evolution is the only way a Creator could have made us the creatures we are - free beings in a world of authentic and meaningful moral and spiritual choices.

Those who ask from science a final argument, an ultimate proof, an unassailable position from which the issue of God may be decided will

always be disappointed. As a scientist I claim no new proofs, no revolutionary data, no stunning insight into nature that can tip the balance in one direction or another. But I do claim that to a believer, even in the most traditional sense, evolutionary biology is not at all the obstacle we often believe it to be. In many respects, evolution is the key to understanding our relationship with God.

When I have the privilege of giving a series of lectures on evolutionary biology to my freshman students, I usually conclude those lectures with a few remarks about the impact of evolutionary theory on other fields, from economics to politics to religion. I find a way to make clear that I do not regard evolution, properly understood, as either antireligious or antispiritual. Most students seem to appreciate those sentiments. They probably figure that Professor Miller, trying to be a nice guy and doubtlessly an agnostic, is trying to find a way to be unequivocal about evolution without offending the University chaplain.

There are always a few who find me after class and want to pin me down. They ask me point-blank: "Do you believe in God?"

And I tell each of them, "Yes."

Puzzled, they ask: "What kind of God?"

Over the years I have struggled to come up with a simple but precise answer to that question. And, eventually I found it. I believe in Darwin's God.

Kenneth Miller is a professor of biology at Brown University. This article is adapted from _Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution_, published by Cliff Street Books (1999). Used with permission.
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