

FINDING DARWIN'S GOD

*A Scientist's Search for
Common Ground
Between God and Evolution*

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HARPER  PERENNIAL

CONTENTS

PREFACE	Xi
1 DARWIN'S APPLE	
2 EDEN'S CHILDREN	18
3 GOD THE CHARLATAN	57
4 GOD THE MAGICIAN	81
5 GOD THE MECHANIC	129
6 THE GODS OF DISBELIEF	165
7 BEYOND MATERIALISM	192
8 THE ROAD BACK HOME	220
9 FINDING DARWIN'S GOD	260
NOTES	293
BIBLIOGRAPHY	317
INDEX	325

PREFACE

Introductions to Darwin's great work *On the Origin of Species* routinely tell readers that it belongs to a small group of books that have changed the face of the earth. As the distinguished biologist Ernst Mayr wrote for a 1974 reprint of the *Origin's* first edition, "Every modern discussion of man's future, the population explosion, the struggle for existence, the purpose of man and the universe, and man's place in nature rests on Darwin." Evolution remains the focal point, the organizing principle, the logical center of every discipline in biology today.

Yet evolution also remains a point of concern and controversy, because it deals with the greatest of all mysteries, our own origins, and our human place in nature. The institutions of religion had once claimed solutions to these mysteries as their own, and the notion that natural science might find its own answers to such questions stirred immediate conflict. Darwin felt the conflict clearly, and attached three quotations to serve as epigraphs to the later editions of *Origin*. Each tells us something about Darwin's view of the proper relationship between religion and natural science, but the third, from Francis Bacon's *Advancement of Learning*, is particularly revealing:

To conclude, therefore, let no man out of a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far or be too well-studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavor an endless progress or proficiency in both.

In no small way, my purpose in writing this book has been to argue that Darwin chose exceptionally well when he selected this quotation.

The common assumption, widely shared in academic and intellectual circles, is that Darwinism is a fatal poison to traditional religious belief. One may, of course, accept the scientific validity of evolution and profess belief in a supreme being, but not without diluting traditional religion almost beyond recognition, or so the thinking goes. Incredibly, all too many traditional believers accept this view, not realizing that it is based more on a humanistic culture of disbelief than on any finding of evolutionary science. In a curious way, this allows each side to validate the extremes of the other. Religion leads one side to reject the cornerstone of the life sciences, while the other delights in telling us that science can determine the meaning of life—which is, of course, that it does not have one.

Lost in the fury is the hope Darwin expressed in his epigraph—that true knowledge could be found as much in "the book of God's works" as in the book of his word. I have written this book to make exactly that point, and leave it to the reader to judge if I have made it well.

Like any person who has been lucky enough to have the chance to pursue a scientific career, I am especially indebted to the many remarkable people who opened the doors and showed me the way. They include gifted teachers and patient mentors such as Richard Ellis, Andrew Holowinsky, Richard Goss, and Elizabeth Leduc. I am grateful to Andrew Staehelin and Daniel Branton, who guided me through scientific apprenticeships, and especially to the late Keith Porter, who expertly introduced me to the art and craft of science teaching.

During the preparation of this manuscript, my colleagues at Brown University were exceptionally generous with their advice, criticism, and most notably with their time. Included in this wonderful group are David Rand, Kristi Wharton, Marjorie Thompson, Susan Gerbi, Peter Gromet, Christine Janis, Walter Quevedo, and Alan Flam. I owe a spe-

PREFACE

cial debt of thanks to a remarkable scientist, the late Jack Sepkoski, whom I came to know only over the past *few* years. Jack's patient studies of the fossil record set the standard for a new level of professionalism in paleontology, and his kind encouragement of my work on this book meant more to me than he could have known.

I am indebted to Robert Bloodgood for his thoughtful and careful reading of several sections of the manuscript, and also to my longstanding friend and colleague, Ursula Goodenough, a kindred spirit in the field of cell biology. I was also fortunate to have the kind assistance of Russell Doolittle to explain to me the intricacies of blood clotting, although I must assure the reader that any technical errors in my descriptions of these pathways are mine and mine alone.

A number of people were kind enough to supply material, figures, quotations, and ideas for this book from their own work, including Stephen Jay Gould, Hezy Shoshani, Phillip Johnson, Thomas M. Cronin, G. Brent Dalrymple, Harvey Lodish, and J. G. M. Thewissen.

I thank Barney Karpfinger, who believed in this project, nurtured it through my first halting attempts to plan a book, and helped to see it to completion. I appreciate the patience and kindness of Joseph Levine, my coauthor on many textbooks, whose support and friendship have been constants over the years. I am grateful to my editor, Diane Reverand, to my secretary, Jennifer Turner, and to all of my students over the years who have helped to keep my eyes firmly focused on the best ideals of science and learning.

Finally, I must thank the people who are and will always be close to me, including Marion and Ray, Lauren and Tracy, and most especially Jody, whose love, understanding, and support make all things possible.

I

DARWIN'S APPLE

Where are you from?" It's the kind of question that strangers, trying to become friends, will often ask one another.

No one can begin to know another until he knows where that person is from. Not just his family, school, and town, but everything that has helped to bring him to this point in his life.

This book is about the ultimate "Where are you from?" question. As important as it may be to understand one's ethnic origin and cultural identity, the bigger question is one that every child, sooner or later, asks of his or her parents: "Where did people come from?" In each culture according to its fashion, every child gets an answer. For me, a little boy growing up in suburban New Jersey in the 1950s, the answer came in the form of the first couplet of my religious training:

Question: "Who made us?"

Answer: "God made us."

Every yea; that training reached deeper, demanded more, and grappled with more sophisticated questions of faith and virtue. But every yea; it began with exactly the same question: Who made us? And that question was always followed by exactly the same answer. God *made us*.

In a different building, only a few hundred yards away from the red brick walls of St. Mary's, I began to find another answer to that question. This other school did not always grapple with the same straightforward questions of right and wrong that were the weekly fare of our catechism,

but it taught its students to believe something at least as intoxicating as the divinity of their origins—the possibility that the world around us was constructed in such a way that we could actually make sense of it. That great secular faith drew strength from a culture in which science seemed to fuel not only the fires of imagination, but the fires of industry as well. And that faith extended to living things, which yielded, like everything else in the natural world, to the analysis of science.

Looking back on my youth, I am struck by how meticulously those two aspects of education were channeled to avoid conflict. Teachers on both sides, secular and religious, were careful to avoid pointing out the dramatic clash between the most fundamental aspects of their world views. No one ever suggested a catechism with a different beginning:

Question: "Who made us?"

Answer: "Evolution made us."

Nonetheless, the conflict between those two points of view is real. The traditional Western view of humanity as the children of God once had a direct, literal basis in the historical narrative of sacred scripture. Not only was God our spiritual father, He was also the direct agent of our creation. His actions were the immediate cause of our existence, and His planning and engineering skills were manifest in every aspect of our bodies. By extension, the splendor and diversity of the living world that surrounds us testified to the very same care and skill.

Charles Darwin himself recognized how profoundly scientific analysis had changed this view of life and humanity when he wrote the historical sketch that preceded his great work, *The Origin of Species by Means of Natural Selection*. Generously (and correctly) he gave credit for this transformation to the now much-maligned French naturalist Jean Baptiste Lamarck:

In these works, he [Lamarck] upholds the doctrine that all species, including man, are descended from other species. He first did the eminent service of arousing attention to the probability of all change in the organic, as well as in the inorganic world, being the result of law, and not of miraculous interposition.'

Today it is very clear that the line of reasoning Darwin attributed to Lamarck has emerged triumphant. Change in the inorganic and organic world is no longer attributed to "miraculous interposition." It once was

possible to point to a humble seed and invoke the attention of the Almighty as the only possible explanation for how such an ordinary object could grow into a mighty tree. Today we look into the seed itself, examine the program of gene expression that begins at germination, and seek our answers in the rich complexities of molecular biology and biochemistry. This does not mean that we have reduced the seedling to mere chemistry or physics. It means instead that we have elevated our understanding to appreciate the living plant in a way that lends wonder and delight to our view of nature.

My purpose in this book is to attempt something that is generally avoided. I want to ask a question that most of my colleagues shy away from, and to attack head-on the defenses that many of us have built up in our unwillingness to reconcile the two different answers to the question of "Who made us?" The question is whether or not God and evolution can coexist.

There is no need to break new scientific ground in approaching this question. The century and a half since Darwin has provided us with more than enough time to flesh out the details of his abstract outline on the process of biological change. To add to Darwin's ideas we have half a century of molecular biology, bold explorations of space and time provided by the physical sciences, an understanding of earth's history from geology, and even an appreciation of the limits of our most powerful reasoning tool—mathematics. We have to be willing to bring all these resources to bear in unfamiliar surroundings, to apply them in new ways, and to ask the sorts of questions that are not commonly heard in scientific circles.

We can by starting with the man himself, Charles Darwin, a writer of exceptional clarity whose words and ideas remain accessible, even today.

SUMMER READING

My first encounter with Charles Darwin cost me a buck ninety-five, the price of a Penguin paperback copy of *On the Origin of Species*. I picked the book up one July day in the summer of 1966 in a New Jersey mall. Suspended in that strange summer between high school and college, I had found just the place to spend twelve pleasant weeks converting my one marketable skill, lifeguarding, into enough spare cash to get through my first year at university. When the chance presented itself, I

supplemented my not-exactly-generous lifeguard's pay by giving private swimming lessons to the sons and daughters of club members.

Those swimming lessons helped to put enough extra change in my pocket to afford to buy a book like Darwin's. Reading "serious" books had become one of my most important projects that summer. For twenty minutes each hour, one of the three lifeguards on duty was rotated into a large booth at the club entrance where we were to check IDs and "greet club members with enthusiasm." After the morning rush on sunny days, there was plenty of time to socialize with kids my own age or just lean back and read.

Visible reading was part of my other important "project," a young lady at the swim club. Early in our mutual flirtation, she made it clear to me that she regarded reading serious books as a mark of "depth." From that moment on, in the parlance of the time, I wanted to be as "deep" as possible—at least while she was looking. My reading list that year included not just Darwin, but Augustine, Eliot, Marx, Durant, Shirer, Milton, and Dante. I must have been quite a sight, propped up in the corner of the check-in booth stumbling through the likes of *The Wasteland*, always making sure that the title was in plain view just in case my young love strolled past unexpectedly.

I remember that summer with something between amusement and embarrassment. I managed to stumble through those books, collect a tan on the lifeguard perches, survive love's heartbreak, and as the days began to shorten, pack myself off to my first year of college.

However impure my motives for tackling those volumes, something did sink in. Several books took hold so thoroughly that I wound up finishing them at home, sitting on our backyard porch listening to Mel Allen's fluid descriptions of New York Yankee night games in the background. Each book had its own life, and each carved out its own niche in my imagination. Shirer's descriptions of prewar Berlin enlivened my father's war stories; Durant convinced me that philosophy was a lively subject, despite the density of its language and thickness of its books; and Saint Augustine made me realize that even in the fifth century A.D. there lived people who had the same likes and dislikes, the same difficulties with authority, and the same weaknesses that I had. My personal favorite, unexpectedly, was Milton, whose *Paradise Lost* at first seemed to drone through line after line of pointless extrapolation exploding from the clar-

ity of the blessedly concise Book of Genesis. Then, just as I was about to put it down, I happened upon Milton's wonderful passage about God's decision to create Eve.

Surrounding Adam in the Garden were the other creatures of God's creation, the lion and the lamb, the snake and the hummingbird, all wrapped in the harmony of Eden. As Adam was quick to note, there was something special about him. Not his intellect, not his cleverness, not his likeness so close to God. No, the difference that came to the mind of Milton's Adam was his loneliness. He alone, among the creatures of Eden, was the solitary member of his kind. Boldly, Adam brought his complaint to the Almighty:

*Let not my words offend thee, Heav'nly Power,
My Maker, be propitious while I speak.
Hast thou not made me here thy substitute,
And these inferiour farr beneath me set?
Among unequals what societie
Can sort, what harmonie or true delight?'*

What society, indeed? Adam was quick to realize that Eden, however glorious, included little for him in the way of conversational possibility. Wandering alone in God's fair Garden might be a fine way to pass the time, but Adam, as it turned out, had a little more on his mind:

*Of fellowship I speak
Such as I seek, fit to participate
All rational delight, wherein the brute
Cannot be human consort; they rejoyce
Each with thir kinde, Lion with Lioness;
So fitly them in pairs thou hast combin'd . . .3*

To my amazement, Milton's God acceded to Adam's request, and agreed to heal his loneliness with a new creation—Eve. Things then got complicated, we might say, in ways that most of us know all too well. John Milton described the mother of mankind in terms quite different from the modest prose of Genesis:

*Shee as a vail down to the slender waste
Her unadorned golden tresses wore*

*Dissheveld, but in wanton ringlets wav'd
 As the Vine curls her tendrils, which impli'd
 Subjection, but requir'd with gentle sway,
 And by her yielded, by him best receivd,
 Yielded with coy submission, modest pride,
 And sweet reluctant amorous delay.
 Nor those mysterious parts were then conceald,
 Then was not guiltie shame, dishonest shame
 Of natures works, honor dishonorable . . . °*

To an eighteen-year-old whose personal discoveries that summer were taking a pathway in the imagination remarkably similar to those of the fictional Adam, John Milton's verse had all but burst into flame. I began to think that packed in the midst of this epic work, so respected and admired by a dusty educational establishment, there just might be the forbidden fruit of desire, passion, and that most unscholarly of all qualities—humor—stunning, memorable, ironic. Maybe, just maybe, if you read through these great, gray books you eventually got to the good parts.

MISSING THE POINT

The only scientific book I read that summer was Charles Darwin's *The Origin of Species*. Because I am a biologist, one might expect me to say that the power and subtlety of this great work drew me into the life of an experimental scientist. Nothing could be further from the truth. I found Darwin *boring*. You might say that I kept looking for the good part, something that would match those sensual passages from Milton, and I never found it. At least not that summer.

It was clear to me after the first few pages that the book by this nineteenth century naturalist was not in the same rhetorical league as the rest of my poolside syllabus. In its own way, that made perfect sense. What book of science was? Ordinary people, after all, no longer read Newton's *Principia* or Lyell's *Principles of Geology*, even though we continue to delight in the craft of their literary contemporaries, Swift and Dickens. But we do still read Darwin. That must mean, to draw the obvious conclusion, there was something important in the *ideas* between the covers of this classic.

I remember reading the first three chapters of *The Origin* page by page before I lost patience with the author. Mercifully, I discovered the careful summaries tucked away at the end of each chapter. I charged to the end of each chapter of the work, where every student's dream, a summary of the summaries, awaited me. Dutifully I worked through them, and finally, one rainy afternoon, surveying an empty pool and an abandoned parking lot, I decided that I was finished with Charles Darwin. Everything in *The Origin of Species* had seemed just too ordinary.

Nothing in my adolescent reading of *The Origin* could match the sensual poetry of Milton, the brooding darkness of Eliot, or the chilling spell of Dante's admonition above the gates of hell: "Abandon all hope, O ye who enter here!" Pitted against these masterpieces, all that Darwin had to offer was a common-sense rendition of one obvious observation after another on the nature of living things.

The man's arguments—and he called his book "one long argument," went something like this:

Domesticated plants and animals show a tremendous range of variation. This was obviously true. After all, variation is the raw material upon which the breeders of animals and plants are able to work. By selecting, consciously or unconsciously, the individuals who will give rise to the next generation, they gradually form new and distinct varieties, which can differ so greatly from one another that they are barely recognizable as members of the same species.

Take, for example, two common breeds of dog: the Great Dane and the Chihuahua. There isn't the slightest doubt that they are both dogs (*Canis familiaris*) or that they are both descended from common ancestors. Yet think how a naturalist who had never seen a dog would respond to these two creatures! Without a doubt, he would quickly conclude that they were different species. That's variation!

A similar range of variation exists in nature among wild species. I wondered about this, and was ready to "challenge" Darwin, but he summed it up in a convincing way—by pointing out that the variation was so great that naturalists argued endlessly among themselves as to whether the individuals of a widely dispersed type were one species or two.

Compare the several floras of Great Britain, of France or of the United States, drawn up by different botanists, and see what a surprising number of forms have been ranked by one botanist as good species, and by another as mere varieties.

At that point in my life, I had had only the slightest glimpse of academic science, but even this was enough to support Darwin's view. Arguments over exactly how different two populations had to be to constitute separate species were common. As it turned out, these natural variations were more than just a little important to Darwin. To make sure that we would not mistake what he was driving at, in Chapter 2, titled "Variation in Nature," he wrote:

These differences blend into each other in an insensible series; and a series impresses the mind with the idea of an actual passage.'

An *actual passage*. How about that? But let's not get ahead of ourselves.

All living things are engaged in a struggle for existence. Like anyone who has ever tended a small garden, I immediately knew that Darwin was right about this. I might have been only eighteen, but I had already watched tomatoes die under an onslaught of cutworms, red ants dismember a hapless beetle under my magnifying lens, and scores of weeds and grass seedlings sprout only to wither and vanish under the sharp August sunlight. Despite all this carnage, our small yard teemed with life.

Darwin explained it all succinctly. First, living things can produce more of themselves.

There is no exception to the rule that every organic being naturally increases at so high a rate, that, if not destroyed, the earth would soon be covered by the progeny of a single pair.'

Because only a few of those progeny can survive, there is a struggle for existence among them—the same struggle I had seen daily in the garden. And finally, a key insight: The struggle is most severe among individuals of the same species. Why? Because the members of your own species are the very ones who need *exactly* the same resources you do to survive. In short, to know what your number one competitor is like, take a look in the mirror—he's going to look a lot like you.

This struggle, combined with variation, results in natural selection. Darwin began the fourth chapter of *The Origin*, "Natural Selection," with a rhetorical question: "How will the struggle for existence, briefly discussed in the last chapter, act in regard to variation?"

Darwin's answer was that it would act automatically. Those individuals that lose in the struggle for existence generally do not get to produce the next generation, but those individuals that do succeed get the greatest of all possible rewards—they get to pass their winning traits along to their offspring.

This means that the conditions of nature, whether acting in my backyard, on the Galapagos Islands, or atop Mount Fuji, are constantly acting on natural variation, selecting out unsuccessful variations and rewarding successful ones. When forces divide a single species into two populations, natural selection will act on each separately, until they have accumulated enough differences that each becomes a separate (and new) species.

Incredibly, that's all there was to it. In those principles you have all of Darwin's theory. Being a long-winded Englishman, Darwin wasn't going to end with just four chapters and a hundred pages. He went on for eleven more chapters, explaining in numbing detail the implications of his theory for biogeography, paleontology, classification, instinctive behavior, and embryology. He even considered objections to his theory, and, just in case you had missed something important, fashioned a concluding chapter to recapitulate his arguments.

I did have to admit that each of the four building blocks of this theory was obviously true. Breeders did draw upon the range of variation in domestic animals and plants to make new varieties. A similar range of variation did exist in nature. The conditions of life did place each individual in competition with others. And this competition clearly affected the range of variation that survived.

Thomas Henry Huxley, soon to be called "Darwin's Bulldog" for his determined advocacy of Darwinism, is said to have read *The Origin* and then to have remarked, "How foolish of me not to have thought of it!" I would love to say I felt the same way, but I can do nothing of the sort. Darwin's observations seemed tediously obvious. They also led to an obvious conclusion—that all life was interrelated, which hardly seemed earth-shattering to me at the time.

American scientific education, particularly during my youth in the

fifties and sixties, is often assumed to have been so timid on the issue of evolution that a whole generation grew up knowing next to nothing about the subject. There may have been some truth to that, but like most kids my age, I still had a pretty good understanding of earth history. That understanding had been reinforced by a handful of visits to fossil collections at the American Museum of Natural History in New York. The bones and shells and especially the great dinosaur reconstructions left very little doubt that life on earth had once been very different from today. Before long we all were convinced that evolution was the process that had produced the dramatic changes the museum documented in such spectacular fashion.

My encounter with Darwin's detailed, careful, exhausting nineteenth century prose was less than memorable the first time around. At best, it gave me a sense of where these rich and wonderful ideas of our past had come from. But like most of my contemporaries at the time, I placed little value on historical context. I found nothing in *The Origin* worth reading to my love, which, for me, made it the single most boring book of an otherwise memorable summer.

A DANGEROUS MIND

In retrospect, there was just one thing that made me reluctant to put down Darwin's book, something extraordinary that kept me going until I had read at least a bit of each chapter, all of the conclusion, and then revisited each of the summaries. This motivating force was something I had not encountered in all the rest of my reading. People were *afraid* of the book.

My dad, whose chance at college came only when the end of World War II allowed him to lay down a rifle and pick up the GI bill, had ignored most of my attempts to act like an intellectual that summer. When he saw me reading Darwin, he thoughtfully told me that I was reading a dangerous book, and I should be careful. I wondered about that. A few people at the swim club made the same comment. "Be sure you talk to someone about that book," a member solemnly warned, "and be careful not to lose your values." These warnings made the book seem more interesting at first, and kept me pumping through the first few chapters searching for scandal. I never found the good parts that would have justified such concerns. The scandal, no matter how carefully I read, escaped my notice.

This was quite a disappointment, but my father's warning did have a certain ring of truth to it. I had taken two public high school courses in biology. My first biology teacher, Paul Zong, was in love with life, and wanted to draw us into his kind of biology—a fellowship of systematic exploration, classification, and nomenclature. I am positive, even after I have earned two university degrees and accumulated years of specialized training, that my knowledge of classification and scientific names reached its high-water mark on the morning of my final exam in ninth grade biology. By the time I had ended Paul Zong's class, I knew exactly what I wanted to be—a biologist. And I never changed my mind.

I took my second course in biology, an advanced course, as a senior from an uninspiring instructor whose name is best not mentioned. This awful class would pass unmentioned except for one striking similarity it shared with my wonderful year under Mr. Zong. Neither teacher mentioned evolution.

Many years later, wondering if that recollection had been correct, I retrieved the exact edition of the biology textbook we used for the first of these courses. The word "evolution" did not appear in the index. Charles Darwin was mentioned, but only in a chapter strangely titled "Organic Variation through Time." The facts of natural history were too compelling to skip completely, but the mention of evolution was carefully avoided. This was essentially the strategy followed by both of my teachers. I did indeed learn about natural selection, the human fossil record, and the age of the dinosaurs. I simply had not learned *evolution* as a specific subject.

This was hardly a unique experience. Historians of American scientific education would later document the great retreat from evolution that swept over public education at midcentury. I suspect that at one time or another in their careers, my teachers had discovered that teaching evolution and calling it such brought concern and discomfort to an otherwise quiet and respectable profession. Like most of us, they found an easier way through the woods, and then trod that path year after year.

The dearth of apparent scandal in *The Origin* made all of this a little puzzling, and it took me a few years to understand what all the fuss was about.

During my second year of graduate school at the University of Colorado, trying to make ends meet, I was teaching a regular tutorial session of freshman biology students in the dorm lounge several nights a week.

One day, two of my students wandered into my advisor's lab holding a tiny newsprint pamphlet. I have long since forgotten the specifics it contained, but the cover illustration is plain as day in my recollection. "Evolution—The **LIE**" was emblazoned on the surface of an apple, while a snake coiled about it with obvious menace.

Not only was evolution linked with the Father of Lies himself, it was "exposed" as a massive conspiracy foisted on an unsuspecting public. In case I had been thick enough to wonder how a specialized biological theory might play such a crucial role in society, the back cover of the pamphlet spelled it all out for me. Evolution, it seemed, was responsible for such evils as theft, murder, drug abuse, prostitution, war, and even adultery. I dismissed the pamphlet with a sneer, cleverly pointing out to my younger friends that the Old Testament documented nearly all of these sins long before *The Origin*, and it seemed a bit much to blame Darwin for all of them.

The pamphlet jarred a nerve within me, however, put there no doubt by years of careful study of the catechism. The dangers sensed by the pamphleteers, by my Dad, and by my teachers all had the same source. The danger in evolution was that it struck directly at the fundamental assumptions of religion about the relationship between God and man. Evolution threatened the soul itself.

THE APPLE DROPS

Darwin's "dangerous idea," as philosopher Daniel Dennett called it in his recent book by that name, is surely one of the most influential and far-reaching ideas of all time.

Although Darwin was careful to note the contributions of those who preceded him, the publication of *The Origin* was a public event unprecedented in the history of science. He may have hoped to write a book to be read and appreciated by specialists, but it immediately became a widely discussed best-seller. Evolution turned out to be hot stuff. Its influence has been felt in fields as disparate as immunology and sociology, and it has revolutionized the way in which we view the world, natural and man-made. Detmett accurately described the impact of Darwin's theories:

Let me lay my cards on the table. If I were to give an award for the single best idea anyone has ever had, I'd give it to Darwin, ahead of Newton

and Einstein and everyone else. In a single stroke, the idea of evolution by natural selection unifies the realm of life, meaning, and purpose with the realm of space and time, cause and effect, mechanism and physical law. But it is not just a wonderful scientific idea. It is a dangerous idea.'

We'll return to visit some of Dennett's ideas on the "danger" represented by the theory of evolution in Chapter 6, but here we will consider some of the undeniable power and scientific fruitfulness that evolutionary thought offers.

One of the great beauties of evolution is that it is automatic. The combination of random variation and natural selection automatically selects the organisms that do best in a particular environment, and then rewards them by forming the next generation from the winners in the game of natural selection. The power of this simple idea extends well beyond biology.

When I first began university teaching, I was unexpectedly impressed by the skill of my students at taking tests. Test-taking is an ability distinct from actual knowledge, which is not to say that knowledge is unimportant to success on a well-constructed exam. There is a strategic component to doing well, and all of my students seemed to excel at this. They asked the right questions: "Is there a correction [on the multiple choice questions] for guessing?" "Should I write a literal answer, or do you want us to extrapolate?" "Do you want all possible solutions? Or just the most obvious one?" They paced themselves intelligently, quickly identifying the most time-consuming questions, making sure that they left them for last, scoring as many points as they could on questions that could be quickly answered.

Did we have a course where they are taught how to take tests, I wondered. I asked this out loud to a colleague, who laughed. "Don't have to. It's natural selection," he said with a grin.

Why natural selection? Student admissions at the university where I teach are extremely competitive. Our students are products of an educational system in which those who are proficient at test-taking are moved towards the honors tracks in middle school and high school. Once there, they can earn the best grades only by excellent exam work—test-taking again. If that were not enough, nearly all of our students, number two pencils in hand, take a nationwide aptitude test as the capstone of their

preparation. Students who are not proficient at test-taking are gradually weeded out. By the time they reach my classroom, only the adept test-takers are left. It works automatically, just like natural selection.

Biologist and author Richard Dawkins once allowed his readers to consider how powerful natural selection was by asking them how many of their direct ancestors had died in childhood.⁹ When I pose this question to my own students, they take it seriously at first, and I can almost see the mental wheels spinning as they silently reconsider the lives of their parents and grandparents. Within a few seconds, most of them are grinning or laughing out loud as they realize how ridiculous such a question is. *None* of anyone's immediate ancestors died in childhood. If they had, they wouldn't be your ancestors!

Putting it another way, each of us is descended from a long line of winners. The near-perfection our bodies display as they grow, processing food, regulating temperature, and resisting disease, has been honed at a price. Unsuccessful experiments in metabolism or design, like poor test-takers, are weeded out by natural selection.

Darwin's powerful idea, a biological explanation for the origins of living species, has exerted a transfixing hold on human thinking in the century and a half since it first kicked in the doors of Western intellectual life. Once Darwin's apple had fallen from the tree, there was no stopping the ways in which eager scholars would apply it to one problem after another. Like a tide sweeping away old explanations of natural philosophy, Darwinian thought made scientists everywhere demand naturalistic, materialist explanations for the way things are. The intellectual dominance of these ideas led to a new set of cultural assumptions about science, about the world, and even about the nature of reality.

Was this because Darwin provided the first workable explanation for the remarkable adaptations of living things? I suspect not. I also do not believe that Darwin's wide influence comes from his patient and groundbreaking observations on orchids or barnacles. Rather, it comes from one simple fact. Evolution displaced the Creator from His central position as the primary explanation for every aspect of the living world. In so doing, Darwin lent intellectual aid and comfort to anti-religionists everywhere. As Dawkins accurately observed:

Although atheism might have been *logically* tenable before Darwin, Darwin made it possible to be an intellectually fulfilled atheist."

For nonbelievers like Richard Dawkins, Darwin provided the first complete, rational basis for rejecting the spiritual and the supernatural. In a Copernican universe where Newtonian laws, not the chariots of gods, moved the heavens around, evolution disposed of the last remaining mystery—the source of life itself. With that taken care of, surely there was no longer any room left for religion in the life of the mind. The world had at last been made safe for "intellectually fulfilled" atheists. That is what was dangerous about *The Origin*.

THE FIRST CHURCH OF CHARLES THE NATURALIST

My particular religious beliefs or yours notwithstanding, it is a fact that in the scientific world of the late twentieth century, the displacement of God by Darwinian forces is almost complete. This view is not always articulated openly, perhaps for fear of offending the faithful, but the literature of science is not a good place to keep secrets. Scientific writing, especially on evolution, shows this displacement clearly.

In 1978, Edward O. Wilson won a Pulitzer Prize for his influential book, *On Human Nature*. Wilson's widely admired pioneering work on social behavior in insects led directly to his founding contributions to a new field which he called "sociobiology"—the study of the biological basis of social behavior. *On Human Nature* was a bold attempt to apply sociobiological principles to human behavior and human institutions. Right up front, on the very first page of the book, Wilson put his finger on the crux of the matter:

If humankind evolved by Darwinian natural selection, genetic chance and environmental necessity, not God, made the species."

For thousands of years, human beings thought of themselves as the children of God. After Darwin, they were the children of "genetic chance and environmental necessity." Wilson's sentiment that Darwinian natural selection rules out God is widely shared. Richard Dawkins leaves no doubt about his own view of a Darwinian universe. It is not a place of real values, of genuine good and evil. As Dawkins admits:

This is one of the hardest lessons for humans to learn. We cannot admit that things might be neither good nor evil, neither cruel nor kind, but simply callous—indifferent to all suffering, lacking all purpose."

The writings of scientists like Wilson and Dawkins present a viewpoint in which the need for God as an explanation for the nature of things is a relic of humanity's intellectual childhood, and nothing more.

A few years ago, an opinion column in *The Scientist*, a trade weekly for scientific professionals, had maintained that any scientist who entered a house of worship had better "check his brain on the way in." Although many readers of this publication stated views to the contrary, there was strong, well-argued support for the position that no educated scientific professional could possibly profess a belief in the supernatural. The readers of *The Scientist* are no fools—they knew exactly what had happened in recent scientific history. First Galileo and Copernicus displaced man as the center of the universe. Then Darwinism set aside God as the author of creation. And finally the rise of biochemistry and molecular biology removed any doubt as to whether or not the properties of living things, humanity included, could be explained in terms of the physics and chemistry of ordinary matter. The word is out—we are mere molecules.

So complete is the absence of the spiritual from modern science that a few writers even take withering potshots at God Himself. George C. Williams, a scientist who has made important contributions towards understanding the complexities of natural selection, did so in his book *The Pony Fish's Glow*:

She [anthropologist Sarah Hrdy] studied a population of monkeys, Hanuman langurs, in Northern India. Their mating system is what biologists call harem polygyny: Dominant males have exclusive sexual access to a group of adult females, as long as they can keep other males away. Sooner or later, a stronger male usurps the harem and the defeated one must join the ranks of celibate outcasts. The new male shows his love for his new wives by trying to kill their unweaned infants. For each successful killing, a mother stops lactating and goes into estrous.... Deprived of her nursing baby, a female soon starts ovulating. She accepts the advances of her baby's murderer, and he becomes the father of her next child.

Do you still think God is good?"

The terrifying infanticide practiced within the langur harem, as Williams explains, is a straightforward prediction of evolutionary theory. If it is genetically programmed, then it is an adaptive behavior

because it increases the proportion of the new harem-master's genes in the next generation.'⁴

A nonscientist reading the popular books of writers like these might be forgiven for jumping to the conclusion that modern evolutionary science has ruled out the existence of God. According to Williams, science *certainly* has ruled out the existence of a benign one.

Is this indeed the case? Is it time to replace existing religions with a scientifically responsible, attractively sentimental, ethically driven Darwinism—a First Church of Charles the Naturalist? Does evolution really nullify all world views that depend upon the spiritual? Does it demand logical agnosticism as the price of scientific consistency? And does it rigorously exclude belief in God?

These are the questions that I will explore in the pages that follow. My answer, in each and every case, is a resounding *no*. I do not say this, as you will see, because evolution is *wrong*. Far from it. The reason, as I hope to show, is because evolution is *right*.