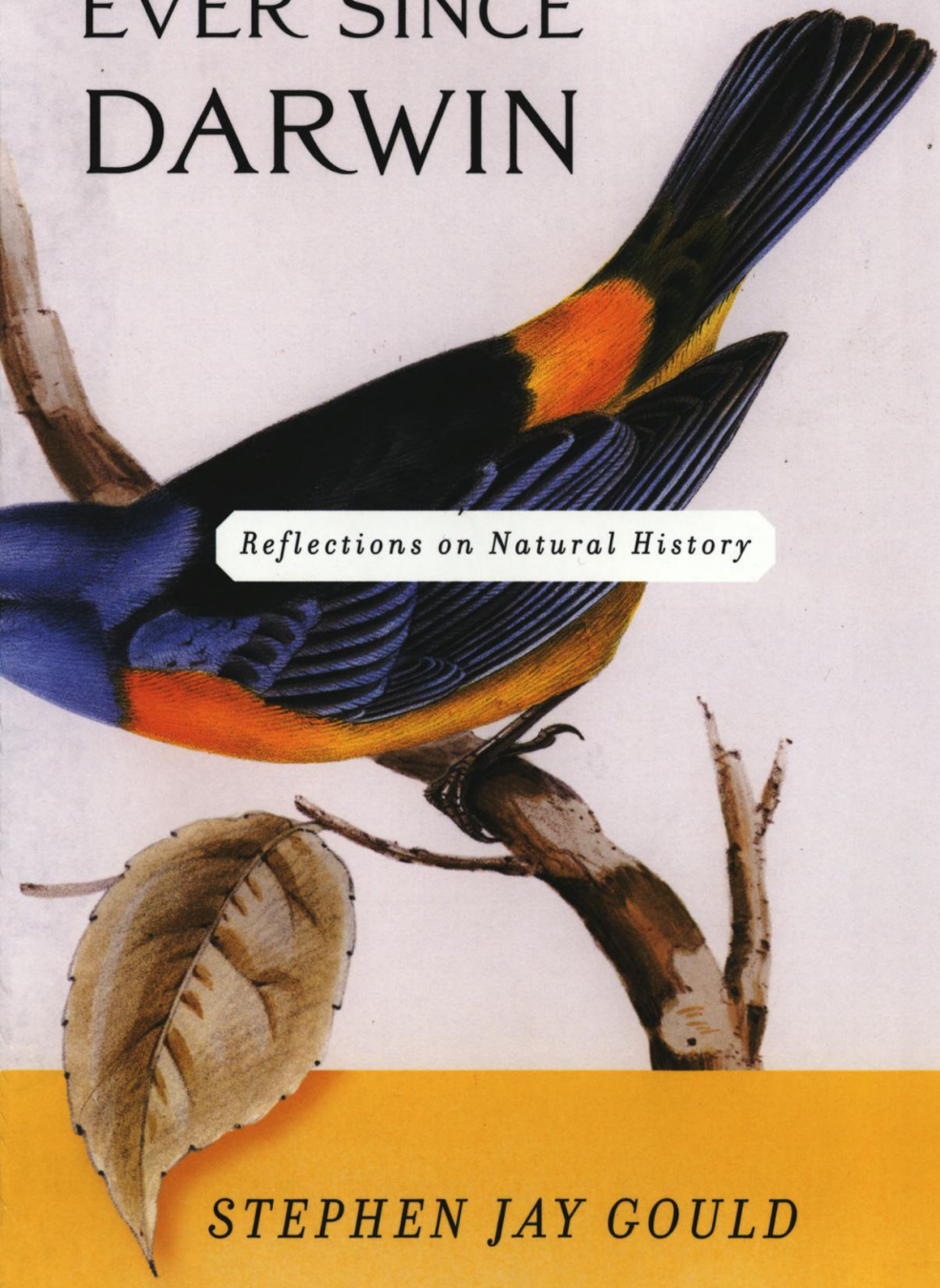
EVER SINCE DARWIN



Reflections on Natural History

STEPHEN JAY GOULD

Ever Since Darwin

Reflections in Natural History

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Prologue

"ONE HUNDRED YEARS without Darwin are enough," grumbled the noted American geneticist H. J. Muller in 1959. The remark struck many listeners as a singularly inauspicious way to greet the centenary of the *Origin of Species,* but no one could deny the truth expressed in its frustration.

Why has Darwin been so hard to grasp? Within a decade, he convinced the thinking world that evolution had occurred, but his own theory of natural selection never achieved much popularity during his lifetime. It did not prevail until the 1940s, and even today, though it forms the core of our evolutionary theory, it is widely misunderstood, misquoted, and misapplied. The difficulty cannot lie in complexity of logical structure, for the basis of natural selection is simplicity itself —two undeniable facts and an inescapable conclusion:

1. Organisms vary, and these variations are inherited (at least in part) by their offspring.

2. Organisms produce more offspring than can possibly survive.

3. On average, offspring that vary most strongly in directions favored by the environment will survive and propagate. Favorable variation will therefore accumulate in populations by natural selection.

These three statements do ensure that natural selection will operate, but they do not (by themselves) guarantee for it the fundamental role that Darwin assigned. The essence of

Darwin's theory lies in his contention that natural selection is the creative force of evolution—not just the executioner of the unfit. Natural selection must construct the fit as well; it must build adaptation in stages by preserving, generation after generation, the favorable part of a random spectrum of variation. If natural selection is creative, then our first statement on variation must be amplified by two additional constraints.

First, variation must be random, or at least not preferentially inclined toward adaptation. For, if variation comes prepackaged in the right direction, then selection plays no creative role, but merely eliminates the unlucky individuals who do not vary in the appropriate way. Lamarckism, with its insistence that animals respond creatively to their needs and pass acquired traits to offspring, is a non-Darwinian theory on this account. Our understanding of genetic mutation suggests that Darwin was right in maintaining that variation is not predirected in favorable ways. Evolution is a mixture of chance and necessity—chance at the level of variation, necessity in the working of selection.

Secondly, variation must be small relative to the extent of evolutionary change in the foundation of new species. For if new species arise all at once, then selection only has to remove former occupants to make way for an improvement that it did not manufacture. Again, our understanding of genetics encourages Darwin's view that small mutations are the stuff of evolutionary change.

Thus, Darwin's apparently simple theory is not without its subtle complexities and additional requirements. Nonetheless, I believe that the stumbling block to its acceptance does not lie in any scientific difficulty, but rather in the radical philosophical content of Darwin's message—in its challenge to a set of entrenched Western attitudes that we are not yet ready to abandon. First, Darwin argues that evolution has no purpose. Individuals struggle to increase the representation of their genes in future generations, and that is all. If the world displays any harmony and order, it arises only as an incidental result of individuals seeking their own advantage —the economy of Adam Smith transferred to nature. Sec-

ond, Darwin maintained that evolution has no direction; it does not lead inevitably to higher things. Organisms become better adapted to their local environments, and that is all. The "degeneracy" of a parasite is as perfect as the gait of a gazelle. Third, Darwin applied a consistent philosophy of materialism to his interpretation of nature. Matter is the ground of all existence; mind, spirit, and God as well, are just words that express the wondrous results of neuronal complexity. Thomas Hardy, speaking for nature, expressed his distress at the claim that purpose, direction, and spirit had been banished:

> When I took forth at dawning, pool,
> Field, flock, and lonely tree,
> All seem to gaze at me
> Like chastened children sitting silent in a school;
>
> Upon them stirs in lippings mere
> (As if once clear in call,
> But now scarce breathed at all)—
> "We wonder, ever wonder, why we find us here!"

Yes, the world has been different ever since Darwin. But no less exciting, instructing, or uplifting; for if we cannot find purpose in nature, we will have to define it for ourselves. Darwin was not a moral dolt; he just didn't care to fob off upon nature all the deep prejudices of Western thought. Indeed, I suggest that the true Darwinian spirit might salvage our depleted world by denying a favorite theme of Western arrogance—that we are meant to have control and dominion over the earth and its life because we are the loftiest product of a preordained process.

In any case, we must come to terms with Darwin. And to do this, we must understand both his beliefs and their implications. All the disparate essays of this book are devoted to the exploration of "this view of life"—Darwin's own term for his new evolutionary world.

These essays, written from 1974–77, originally appeared in my monthly column for *Natural History Magazine*, entitled "This View of Life." They range broadly from planetary and geological to social and political history, but they are united

(in my mind at least) by the common thread of evolutionary theory—Darwin's version. I am a tradesman, not a polymath; what I know of planets and politics lies at their intersection with biological evolution.

I am not unmindful of the journalist's quip that yesterday's paper wraps today's garbage. I am also not unmindful of the outrages visited upon our forests to publish redundant and incoherent collections of essays; for, like Dr. Seuss' Lorax, I like to think that I speak for the trees. Beyond vanity, my only excuses for a collection of these essays lie in the observation that many people like (and as many people despise) them, and that they seem to cohere about a common theme—Darwin's evolutionary perspective as an antidote to our cosmic arrogance.

The first section explores Darwin's theory itself, especially the radical philosophy that inspired H. J. Muller's complaint. Evolution is purposeless, nonprogressive, and materialistic. I approach the heavy message through some entertaining riddles: who was the Beagle's naturalist (not Darwin); why didn't Darwin use the word "evolution"; and why did he wait twenty-one years to publish his theory?

The application of Darwinism to human evolution forms the second section. I try to stress both our uniqueness and our unity with other creatures. Our uniqueness arises from the operation of ordinary evolutionary processes, not from any predisposition toward higher things.

In the third section, I explore some complex issues in evolutionary theory through their application to peculiar organisms. On one level, these essays are about deer with giant antlers, flies that eat their mother from inside, clams that evolve a decoy fish on their rear end, and bamboos that only flower every 120 years. On another level, they treat the issues of adaptation, perfection, and apparent senselessness.

The fourth section extends evolutionary theory to an exploration of patterns in the history of life. We find no story of stately progress, but a world punctuated with periods of mass extinction and rapid origination among long stretches of relative tranquility. I focus upon the two greatest punctuations—the Cambrian "explosion" that ushered in most com-

plex animal life about 600 million years ago, and the Permian extinction that wiped out half the families of marine invertebrates 225 million years ago.

From the history of life, I move to the history of its abode, our earth (fifth section). I discuss both the ancient heros (Lyell) and the modern heretics (Velikovsky) who wrestled with the most general questions of all—does geological history have a direction; is change slow and stately, or rapid and cataclysmic; how does the history of life map the history of the earth? I find a potential resolution to some of these questions in the "new geology" of plate tectonics and continental drift.

The sixth section attempts to be comprehensive by looking in the small. I take a single, simple principle—the influence of size itself upon the shapes of objects—and argue that it applies to an astonishingly broad range of developmental phenomena. I include the evolution of planetary surfaces, the brains of vertebrates and the characteristic differences in shape between small and large medieval churches.

The seventh section may strike some readers as a break in the sequence. I have built laboriously from general principles down to their specific applications, and up again to their working in major patterns for life and the earth. Now I move to the history of evolutionary thought, particularly to the impact of social and political views upon supposedly "objective" science. But I see it as more of the same—another needle in scientific arrogance, with an added political message. Science is no inexorable march to truth, mediated by the collection of objective information and the destruction of ancient superstition. Scientists, as ordinary human beings, unconsciously reflect in their theories the social and political constraints of their times. As privileged members of society, more often than not they end up defending existing social arrangements as biologically foreordained. I discuss the general message in an obscure debate within eighteenth century embryology, Engels's views on human evolution, Lombroso's theory of innate criminality, and a twisted tale from the catacombs of scientific racism.

The final section pursues the same theme, but applies it to

contemporary discussions of "human nature"—the major impact of misused evolutionary theory upon current social policy. The first subsection criticizes as political prejudice the biological determinism that has recently deluged us with killer apes as ancestors, innate aggression and territoriality, female passivity as the dictate of nature, racial differences in IQ, etc. I argue that no evidence supports any of these claims, and that they represent just the latest incarnation of a long and sad story in Western history—blaming the victim with a stamp of biological inferiority, or using "biology as an accomplice," as Condorcet put it. The second subsection treats both my pleasure and unhappiness with the recently christened study of "Sociobiology," and its promise of a new, Darwinian account of human nature. I suggest that many of its specific claims are unsupported speculations in the determinist mode, but I find great value in its Darwinian explanation of altruism—as support for my alternate preference that inheritance has given us flexibility, not a rigid social structure ordained by natural selection.

These essays have suffered only minor alteration from their original status as columns in *Natural History Magazine*—errors corrected, parochialisms eliminated, and information updated. I have tried to attack the bugbear of essay collections, redundancy, but have retreated when my editorial knife threatened the coherence of any individual piece. At least I never use the same quote twice. Finally, my thanks and affection for editor-in-chief Alan Ternes, and for his copy editors Florence Edelstein and Gordon Beckhorn. They have supported me through a rash of cranky letters, and have shown the finest forebearance and discretion by using the lightest of editorial hands. Blame Alan, however, for all the really catchy titles—particularly for the sigmoid fraud of essay 15.

Sigmund Freud expressed as well as anyone the ineradicable impact of evolution upon human life and thought when he wrote:

> Humanity has in course of time had to endure from the hands of science two great outrages upon its naive self-

> love. The first was when it realized that our earth was not the center of the universe, but only a speck in a world-system of a magnitude hardly conceivable. . . . The second was when biological research robbed man of his particular privilege of having been specially created, and relegated him to a descent from the animal world.

I submit that the knowledge of this relegation is also our greatest hope for continuity on a fragile earth. May "this view of life" flower during its second century and help us to comprehend both the limits and the lessons of scientific understanding—as we, like Hardy's fields and trees, continue to wonder why we find us here.

1 Darwiniana

1 | Darwin's Delay

FEW EVENTS INSPIRE more speculation than long and unexplained pauses in the activities of famous people. Rossini crowned a brilliant operatic career with *William Tell* and then wrote almost nothing for the next thirty-five years. Dorothy Sayers abandoned Lord Peter Wimsey at the height of his popularity and turned instead to God. Charles Darwin developed a radical theory of evolution in 1838 and published it twenty-one years later only because A. R. Wallace was about to scoop him.

Five years with nature aboard the *Beagle* destroyed Darwin's faith in the fixity of species. In July, 1837, shortly after the voyage, he started his first notebook on "transmutation." Already convinced that evolution had occurred, Darwin sought a theory to explain its mechanism. After much preliminary speculation and a few unsuccessful hypotheses, he achieved his central insight while reading an apparently unrelated work for recreation. Darwin later wrote in his autobiography:

> In October 1838 . . . I happened to read for amusement Malthus on *Population,* and being well prepared to appreciate the struggle for existence which everywhere goes on from long continued observation of the habits of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved and unfavorable ones to be destroyed. The result of this would be the formation of new species.

Darwin had long appreciated the importance of artificial selection practiced by animal breeders. But until Malthus's vision of struggle and crowding catalyzed his thoughts, he had not been able to identify an agent for natural selection. If all creatures produced far more offspring than could possibly survive, then natural selection would direct evolution under the simple assumption that survivors, on the average, are better adapted to prevailing conditions of life.

Darwin knew what he had achieved. We cannot attribute his delay to any lack of appreciation for the magnitude of his accomplishment. In 1842 and again in 1844 he wrote out preliminary sketches of his theory and its implications. He also left strict instructions with his wife to publish these alone of his manuscripts if he should die before writing his major work.

Why then did he wait for more than twenty years to publish his theory? True, the pace of our lives today has accelerated so rapidly—leaving among its victims the art of conversation and the game of baseball—that we may mistake a normal period of the past for a large slice of eternity. But the span of a man's life is a constant measuring stick; twenty years is still half a normal career—a large chunk of life even by the most deliberate Victorian standards.

Conventional scientific biography is a remarkably misleading source of information about great thinkers. It tends to depict them as simple, rational machines pursuing their insights with steadfast devotion, under the drive of an internal mechanism subject to no influence but the constraints of objective data. Thus, Darwin waited twenty years—so the usual argument runs—simply because he had not completed his work. He was satisfied with his theory, but theory is cheap. He was determined not to publish until he had amassed an overwhelming dossier of data in its support, and this took time.

But Darwin's activities during the twenty years in question display the inadequacy of this traditional view. In particular, he devoted eight full years to writing four large volumes on the taxonomy and natural history of barnacles. Before this single fact, the traditionalists can only offer pap—some-

thing like: Darwin felt that he had to understand species thoroughly before proclaiming how they change; this he could do only by working out for himself the classification of a difficult group of organisms—but not for eight years, and not while he sat on the most revolutionary notion in the history of biology. Darwin's own assessment of the four volumes stands in his autobiography.

> Besides discovering several new and remarkable forms, I made out the homologies of the various parts . . . and I proved the existence in certain genera of minute males complemental to and parasitic on the hermaphrodites. . . . Nevertheless, I doubt whether the work was worth the consumption of so much time.

So complex an issue as the motivation for Darwin's delay has no simple resolution, but I feel sure of one thing: the negative effect of fear must have played at least as great a role as the positive need for additional documentation. Of what, then, was Darwin afraid?

When Darwin achieved his Malthusian insight, he was twenty-nine years old. He held no professional position, but he had acquired the admiration of his colleagues for his astute work aboard the *Beagle.* He was not about to compromise a promising career by promulgating a heresy that he could not prove.

What then was his heresy? A belief in evolution itself is the obvious answer. Yet this cannot be a major part of the solution; for, contrary to popular belief, evolution was a very common heresy during the first half of the nineteenth century. It was widely and openly discussed, opposed, to be sure, by a large majority, but admitted or at least considered by most of the great naturalists.

An extraordinary pair of Darwin's early notebooks may contain the answer (see H. E. Gruber and P. H. Barrett, *Darwin on Man,* for text and extensive commentary). These so-called M and N notebooks were written in 1838 and 1839, while Darwin was compiling the transmutation notebooks that formed the basis for his sketches of 1842 and 1844. They contain his thoughts on philosophy, esthetics, psychology,

and anthropology. On rereading them in 1856, Darwin described them as "full of metaphysics on morals." They include many statements showing that he espoused but feared to expose something he perceived as far more heretical than evolution itself: philosophical materialism—the postulate that matter is the stuff of all existence and that all mental and spiritual phenomena are its by-products. No notion could be more upsetting to the deepest traditions of Western thought than the statement that mind—however complex and powerful—is simply a product of brain. Consider, for example, John Milton's vision of mind as separate from and superior to the body that it inhabits for a time (*Il Penseroso,* 1633).

> Or let my lamp, at midnight hour,
> Be seen in some high lonely tower,
> Where I may oft outwatch the Bear,
> With thrice-great Hermes,[1] or unsphere
> The spirit of Plato, to unfold
> What worlds or what vast regions hold
> The immortal mind that hath forsook
> Her mansion in this fleshly nook.

The notebooks prove that Darwin was interested in philosophy and aware of its implications. He knew that the primary feature distinguishing his theory from all other evolutionary doctrines was its uncompromising philosophical materialism. Other evolutionists spoke of vital forces, directed history, organic striving, and the essential irreducibil-

1 | "The Bear" refers to the constellation of Ursa major (the Great Bear), better known to us by its tail and hindquarters—the big dipper. "Thrice great Hermes" is Hermes Trismegistus (a Greek name for Thoth, Egyptian god of wisdom). The "hermetic books," supposedly authored by Thoth, are a collection of metaphysical and magical works that exerted great influence in seventeenth century England. They were equated by some with the Old Testament as a parallel source of pre-Christian wisdom. They waned in importance when exposed as a product of Alexandrian Greece, but survive in various doctrines of the Rosicrucians, and in our phrase "hermetic seal."

ity of mind—a panoply of concepts that traditional Christianity could accept in compromise, for they permitted a Christian God to work by evolution instead of creation. Darwin spoke only of random variation and natural selection.

In the notebooks Darwin resolutely applied his materialistic theory of evolution to all phenomena of life, including what he termed "the citadel itself"—the human mind. And if mind has no real existence beyond the brain, can God be anything more than an illusion invented by an illusion? In one of his transmutation notebooks, he wrote:

> Love of the deity effect of organization, oh you materialist! . . . Why is thought being a secretion of brain, more wonderful than gravity a property of matter? It is our arrogance, our admiration of ourselves.

This belief was so heretical that Darwin even sidestepped it in *The Origin of Species* (1859), where he ventured only the cryptic comment that "light will be thrown on the origin of man and his history." He gave vent to his beliefs, only when he could hide them no longer, in the *Descent of Man* (1871) and *The Expression of the Emotions in Man and Animals* (1872). A. R. Wallace, the codiscoverer of natural selection, could never bring himself to apply it to the human mind, which he viewed as the only divine contribution to the history of life. Yet Darwin cut through 2,000 years of philosophy and religion in the most remarkable epigram of the M notebook:

> Plato says in *Phaedo* that our "imaginary ideas" arise from the preexistence of the soul, are not derivable from experience—read monkeys for preexistence.

In his commentary on the M and N notebooks, Gruber labels materialism as "at that time more outrageous than evolution." He documents the persecution of materialistic beliefs during the late eighteenth and early nineteenth century and concludes:

> In virtually every branch of knowledge, repressive methods were used: lectures were proscribed, publication was hampered, professorships were denied, fierce invective and ridicule appeared in the press. Scholars and scien-

> tists learned the lesson and responded to the pressures on them. The ones with unpopular ideas sometimes recanted, published anonymously, presented their ideas in weakened forms, or delayed publication for many years.

Darwin had experienced a direct example as an undergraduate at the University of Edinburgh in 1827. His friend W. A. Browne read a paper with a materialistic perspective on life and mind before the Plinian Society. After much debate, all references to Browne's paper, including the record (from the previous meeting) of his intention to deliver it, were expunged from the minutes. Darwin learned his lesson, for he wrote in the M notebook:

> To avoid stating how far, I believe, in Materialism, say only that emotions, instincts, degrees of talent, which are hereditary are so because brain of child resembles parent stock.

The most ardent materialists of the nineteenth century, Marx and Engels, were quick to recognize what Darwin had accomplished and to exploit its radical content. In 1869, Marx wrote to Engels about Darwin's *Origin:*

> Although it is developed in the crude English style, this is the book which contains the basis in natural history for our view.

A common bit of folklore—that Marx offered to dedicate volume 2 of *Das Kapital* to Darwin (and that Darwin refused)—turns out to be false. But Marx and Darwin did correspond, and Marx held Darwin in very high regard. (I have seen Darwin's copy of *Das Kapital* in his library at Down House. It is inscribed by Marx who calls himself a "sincere admirer" of Darwin. Its pages are uncut. Darwin was no devotee of the German language.)

Darwin was, indeed, a gentle revolutionary. Not only did he delay his work for so long, but he also assiduously avoided any public statement about the philosophical implications of his theory. In 1880, he wrote:

> It seems to me (rightly or wrongly) that direct arguments against Christianity and Theism hardly have any effect

> on the public; and that freedom of thought will best be promoted by that gradual enlightening of human understanding which follows the progress of science. I have therefore always avoided writing about religion and have confined myself to science.

Yet the content of his work was so disruptive to traditional Western thought that we have yet to encompass it all. Arthur Koestler's campaign against Darwin, for example, rests upon a reluctance to accept Darwin's materialism and an ardent desire once again to invest living matter with some special property (see *The Ghost in the Machine* or *The Case of the Midwife Toad*). This, I confess, I do not understand. Wonder and knowledge are both to be cherished. Shall we appreciate any less the beauty of nature because its harmony is unplanned? And shall the potential of mind cease to inspire our awe and fear because several billion neurons reside in our skulls?

2 Darwin's Sea Change, or Five Years at the Captain's Table

GROUCHO MARX ALWAYS delighted audiences with such outrageously obvious questions as "Who's buried in Grant's tomb?" But the apparently obvious can often be deceptive. If I remember correctly, the answer to who framed the Monroe Doctrine? is John Quincy Adams. Most biologists would answer "Charles Darwin" when asked, "Who was the naturalist aboard the H.M.S. *Beagle?*" And they would all be wrong. Let me not sound too shocking at the outset. Darwin was on the *Beagle* and he did devote his attention to natural history. But he was brought on board for another purpose, and the ship's surgeon, Robert McKormick, originally held the official position of naturalist. Herein lies a tale; not just a nit-picking footnote to academic history, but a discovery of some significance. Anthropologist J. W. Gruber reported the evidence in "Who Was the *Beagle*'s Naturalist?" written in 1969 for the *British Journal for the History of Science.* In 1975, historian of science H. L. Burstyn attempted to answer the obvious corollary: If Darwin wasn't the *Beagle*'s naturalist, why was he on board?

No document specifically identifies McKormick as an official naturalist, but the circumstantial evidence is overwhelming. The British navy, at the time, had a well-established tradition of surgeon-naturalists, and McKormick had deliberately educated himself for such a role. He was an adequate, if not brilliant, naturalist and performed his tasks with distinction on other voyages, including Ross's Antarctic expedi-

tion (1839–1843) to locate the position of the South Magnetic Pole. Moreover, Gruber has found a letter from the Edinburgh naturalist Robert Jameson addressed to "My dear Sir" and full of advice to the *Beagle*'s naturalist on collection and preservation of specimens. In the traditional view, no one but Darwin himself could have been the recipient. Fortunately, the name of the addressee is on the original folio. It was written to McKormick.

Darwin, to cut the suspense, sailed on the *Beagle* as a companion to Captain Fitzroy. But why would a British captain want to take as a companion for a five-year journey a man he had only met the previous month? Two features of naval voyages during the 1830s must have set Fitzroy's decision. First of all, voyages lasted for many years, with long stretches between ports and very limited contact by mail with friends and family at home. Secondly (and however strange it may seem to our psychologically more enlightened century), British naval tradition dictated that a captain have virtually no social contact with anyone down the chain of command. He usually dined alone and met with his officers primarily to discuss ship's business and to converse in the most formal and "correct" manner.

Now Fitzroy, when he set sail with Darwin, was only 26 years old. He knew the psychological toll that prolonged lack of human contact could take from captains. The *Beagle*'s previous skipper had broken down and shot himself to death during the Southern Hemisphere winter of 1828, his third year away from home. Moreover, as Darwin himself affirmed in a letter to his sister, Fitzroy was worried about "his hereditary predisposition" to mental derangement. His illustrious uncle, the Viscount Castlereagh (suppressor of the Irish rebellion of 1798 and Foreign Secretary during the defeat of Napoleon), had slit his own throat in 1822. In fact, Fitzroy did break down and temporarily relinquish his command during the *Beagle*'s voyage—while Darwin was laid up with illness in Valparaiso.

Since Fitzroy had so little social contact with any of the ship's official personnel, he could gain it only by taking along a "supernumerary" passenger by his own arrangement. But

the Admiralty frowned upon private passengers, even captains' wives; a gentleman companion brought for no other stated purpose would never do. Fitzroy had taken other supernumeraries aboard—a draftsman and an instrument-maker among others—but neither could serve as a companion because they were not of the right social class. Fitzroy was an aristocrat, and he traced his ancestry directly to King Charles II. Only a gentleman could share his meals, and a gentleman Darwin surely was.

But how could Fitzroy entice a gentleman to accompany him on a voyage of five years' duration? Only by providing an opportunity for some justifying activity that could not be pursued elsewhere. And what else but natural history?—even though the *Beagle* had an official naturalist. Hence, Fitzroy advertised among his aristocratic friends for a gentleman naturalist. It was, as Burstyn argues, "A polite fiction to explain his guest's presence and an activity attractive enough to lure a gentleman on board for a long voyage." Darwin's sponsor, J. S. Henslow, understood perfectly. He wrote to Darwin: "Capt. F. wants a man (I understand) more as a companion than a mere collector." Darwin and Fitzroy met, they hit it off, and the pact was sealed. Darwin sailed as Fitzroy's companion, primarily to share his table at mealtime for every shipboard dinner during five long years. Fitzroy, in addition, was an ambitious young man. He wished to make his mark by setting a new standard for excellence in exploratory voyages. ("The object of the expedition," Darwin wrote, "was to complete the survey of Patagonia and Tierra del Fuego . . . to survey the shores of Chile, Peru, and of some islands in the Pacific—and to carry a chain of chronometrical measurements round the world.") By augmenting the official crew with technicians and engineers brought at his own expense, Fitzroy used his wealth and prestige to reach his goal. A "supernumerary" naturalist meshed well with Fitzroy's scheme to beef up the *Beagle*'s scientific mettle.

Poor McKormick's fate was sealed. Initially, he and Darwin cooperated, but their ways inevitably parted. Darwin had all the advantages. He had the captain's ear. He had a servant. At ports of call, he had the money to move ashore and hire

native collectors, while McKormick was bound to the ship and his official duties. Darwin's private efforts began to outstrip McKormick's official collections, and McKormick, in disgust, decided to go home. In April 1832, at Rio de Janeiro, he was "invalided out" and sent home to England aboard H.M.S. *Tyne.* Darwin understood the euphemism and wrote to his sister of McKormick's "being invalided, i.e. being disagreeable to the Captain. . . . He is no loss."

Darwin did not care for McKormick's brand of science. He wrote to Henslow in May 1832: "He was a philosopher of rather antient [*sic*] date; at St. Jago by his own account he made general remarks during the first fortnight and collected particular facts during the last." In fact, Darwin didn't seem to care for McKormick at all. "My friend the doctor is an ass, but we jog on very amicably; at present he is in great tribulation, whether his cabin shall be painted french gray or dead white—I hear little except this subject from him."

If nothing else, this story illustrates the importance of social class as a consideration in the history of science. How different would the science of biology be today if Darwin had been the offspring of a tradesman and not the son of a very wealthy physician. Darwin's personal riches gave him the freedom to pursue research without encumbrance. Since his various illnesses often permitted only two to three hours of fruitful work per day, any need to make an honest living would probably have shut him off from research entirely. We now learn that Darwin's social standing also played a crucial role at a turning point in his career. Fitzroy was more interested in his mealtime companion's social graces than his competence in natural history.

Might something deeper be hidden in the unrecorded mealtime conversations of Darwin and Fitzroy? Scientists have a strong bias for attributing creative insights to the constraints of empirical evidence. Hence, tortoises and finches have always received the nod as primary agents in the transformation of Darwin's world view, for he joined the *Beagle* as a naïvely pious student for the ministry, but opened his first notebook on the transmutation of species less than a year after his return. I suggest that Fitzroy himself might

have been an even more important catalyst.

Darwin and Fitzroy maintained a tense relationship at best. Only the severe constraints of gentlemanly cordiality and pre-Victorian suppression of emotion kept the two men on decent terms with each other. Fitzroy was a martinet and an ardent Tory. Darwin was an equally committed Whig. Darwin scrupulously avoided any discussion with Fitzroy of the great Reform Bill then pending in Parliament. But slavery brought them into open conflict. One evening, Fitzroy told Darwin that he had witnessed proof of slavery's benevolence. One of Brazil's largest slaveholders had assembled his captives and asked them whether they wished to be freed. Unanimously, they had responded "no." When Darwin had the temerity to wonder what a response made in the owner's presence was worth, Fitzroy exploded and informed Darwin that anyone who doubted his word was not fit to eat with him. Darwin moved out and joined the mates, but Fitzroy backed down and sent a formal apology a few days later.

We know that Darwin bristled in the face of Fitzroy's strong opinions. But he was Fitzroy's guest and, in one peculiar sense, his subordinate, for a captain at sea was an absolute and unquestioned tyrant in Fitzroy's time. Darwin could not express his dissent. For five long years, one of the most brilliant men in recorded history kept his peace. Late in life, Darwin recalled in his autobiography that "the difficulty of living on good terms with a Captain of a Man-of-War is much increased by its being almost mutinous to answer him as one would answer anyone else; and by the awe in which he is held —or was held in my time, by all on board."

Now Tory politics was not Fitzroy's only ideological passion. The other was religion. Fitzroy had some moments of doubt about the Bible's literal truth, but he tended to view Moses as an accurate historian and geologist and even spent considerable time trying to calculate the dimensions of Noah's Ark. Fitzroy's *idée fixe,* at least in later life, was the "argument from design," the belief that God's benevolence (indeed his very existence) can be inferred from the perfection of organic structure. Darwin, on the other hand, accepted the idea of excellent design but proposed a natural

explanation that could not have been more contrary to Fitzroy's conviction. Darwin developed an evolutionary theory based on chance variation and natural selection imposed by an external environment: a rigidly materialistic (and basically atheistic) version of evolution (see essay 1). Many other evolutionary theories of the nineteenth century were far more congenial to Fitzroy's type of Christianity. Religious leaders, for example, had far less trouble with common proposals for innate perfecting tendencies than with Darwin's uncompromisingly mechanical view.

Was Darwin led to his philosophical outlook partly as a response to Fitzroy's dogmatic insistence upon the argument from design? We have no evidence that Darwin, aboard the *Beagle,* was anything but a good Christian. The doubts and rejection came later. Midway through the voyage, he wrote to a friend: "I often conjecture what will become of me; my wishes certainly would make me a country clergyman." And he even coauthored with Fitzroy an appeal for the support of Pacific missionary work entitled, "The Moral State of Tahiti." But the seeds of doubt must have been sown in quiet hours of contemplation aboard the *Beagle.* And think of Darwin's position on board—dining every day for five years with an authoritarian captain whom he could not rebuke, whose politics and bearing stood against all his beliefs, and whom, basically, he did not like. Who knows what "silent alchemy" might have worked upon Darwin's brain during five years of insistent harangue. Fitzroy may well have been far more important than finches, at least for inspiring the materialistic and antitheistic tone of Darwin's philosophy and evolutionary theory.

Fitzroy, at least, blamed himself as his mind became unhinged in later life. He began to see himself as the unwitting agent of Darwin's heresy (indeed, I am suggesting that this may be true in a more literal sense than Fitzroy ever imagined). He developed a burning desire to expiate his guilt and to reassert the Bible's supremacy. At the famous British Association Meeting of 1860 (where Huxley creamed Bishop "Soapy Sam" Wilberforce), the unbalanced Fitzroy stalked about, holding a Bible above his head and shouting, "The Book, The Book." Five years later, he slit his throat.


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