

Voyaging with Charles Darwin on the *Beagle*

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I DID RESEARCH A LONG TIME AGO. Not because I wanted to do research, but because I wanted future residency program directors, years later during interview season, to ask me about expression of the CXCR3 receptor protein in multiple sclerosis. I planned to sit back, gaze intellectually into the near distance, and deliver a prepared speech on the promise of immunological markers towards “a treatment, and, we hope, a cure” that I had been involved with for maybe four weeks between ten in the morning and two in the afternoon.

During my research summer, I would look through a high-powered microscope and count cells. The cells I needed to count were stained a deep green—simultaneously dark and fluorescent, if you can imagine that. My immediate superiors were two brilliant twentysomething green-eyed blondes, one a Swede named Pia, another a German named Corinne. I had to count these dark green stars in one field of view, then ease the slide north until the topmost star was just below the margin, and count again. Eventually I’d make it through a whole slide and jot down a number.

This seemingly tedious task went very quickly, once I realized all the slides had counts that fell between 25 and 45 cells, except for the outlier slide that had under 5. Soon, I could just kind of sweep back and forth and get a feel for the count. “Thin-slicing,” Malcolm Gladwell might call it, though I think it’s 10,000 hours of experience before you’re supposed to do that.

As you can imagine, I made a serious mistake that first morning: I assumed that box of slides was my morning’s work. I made short work of the whole batch so I could read Nabokov. That was a rookie researcher’s mistake; the box had been meant to occupy me for a week.

Corinne and Pia were so impressed by my efficiency that they had a small conference with much enthusiastic nodding. I realized I had gotten myself assigned a whole new task in exchange for three chapters of *Pale Fire*. Fortunately, the next task was actually pretty cool: I was going to be the “runner,” fetching freshly tapped cerebrospinal fluid from the main Cleveland Clinic hospital and getting it back to the research facility.

I showed up at the main hospital that afternoon and received my package, a light styrofoam box about the size of a toaster oven. I secured it under my arm, took a deep breath, and started running. I ran through the lobby, into the summer traffic, through the line by the hot dog stall. I hurdled a stroller, punched a kid and stole his bike, ditched the bike and hopped over car roofs against the flow of traffic, and eventually burst through the door of the lab, holding the styrofoam box over my head like Charlton Heston holding the tablets on Sinai. "I've got it!" I shouted.

Pia turned to me. "How hot is it out there?"

I lowered the box, hiding the sweat blotches under my arms. "Seventy-two, seventy-three?" I felt my left earlobe drip.

Corinne rose and looked closely at me. "Are you okay? What happened?"

"I ran."

"Why?"

"I'm the runner." I regretted the tautological sound of this immediately. "And I, um, didn't want the heat to, uh, denature our cells."

Corinne took the lid off the box. "The CSF is on ice, ja? Look."

A test tube full of clear liquid nestled in about forty ice cubes.

"In fact," commented Pia, "the only thing that could damage the cells is if they were jarred about."

I walked after that. Once I realized that I had a lot of time before the ice melted, and that they *wanted* me to take my time on the errand, I went to the falafel place for a wrap on every trip. If I'd already had lunch, I'd treat myself to a baklava piece. The CSF would sit on the chair next to me, freshly drained from some unfortunate MS sufferer's spinal canal, and I would stare at it and think about how terrible it would be to grow old and have health problems, and on the other hand how shitty it would be to die young having sacrificed your twenties to memorizing the mechanism of insulin and the Krebs Cycle. I couldn't even enjoy my summer vacation without tainting it

with this mindless research. Well, I thought, maybe I'd get a publication out of this. That would look great on a resume. A real conversation-starter.

I actually *did* get a paper out of it (the coveted "fifth author" spot), and this is what I/we sounded like:

T-cell accumulation in the central nervous system (CNS) is considered crucial to the pathogenesis of multiple sclerosis (MS). We found that the majority of T cells within the cerebrospinal fluid (CSF) compartment expressed the CXC chemokine receptor 3 (CXCR3), independent of CNS inflammation. Quantitative immunohistochemistry revealed continuous accumulation of CXCR3+ T cells during MS lesion formation. The expression of one CXCR3 ligand, interferon (IFN)- γ -inducible protein of 10 kDa (IP-10)/CXC chemokine ligand (CXCL10) was elevated in MS CSF, spatially associated with demyelination in CNS tissue sections and correlated tightly with CXCR3 expression. These data suggest a critical role for CXCL10 and CXCR3 in the accumulation of T cells in the CNS of MS patients.

In other words, our writing was

1. the work of a collective, not an individual
2. unbeautiful
3. uninteresting to a layperson
4. from a verbal perspective, overly Latinate and jargon-laden (see no. 2)
5. divorced from direct observation (unless counting cells through a microscope counts)
6. really, really "zoomed in" on one specific detail with no hint of a larger perspective.

You may think no. 6 only seemed the case to *me* because I was a medical student with no eagle's-eye perspective on MS research. Yet despite repeated attempts to find out—from Pia and Corinne and eventually the chief neurologist in charge of the whole lab—exactly what our paper meant from the standpoint of treatment, experimental therapies, or even our "understanding" of the (still-obscure) pathogenesis of MS lesions, there was no answer. The distances among act, interpretation, and application were just too great. Our paper was "another piece of evidence" that the immune system "played a

role” in ms. What we were doing was necessary to the furthering of neuroscience—but we were focused not on the forest, not on the trees, not on the leaves, but on a single segment of single vein of a single leaf, tracing it back and forth, going nowhere in particular.

What did I expect? Research isn’t visiting a faraway place and adumbrating a fundamental secret of biology while chasing bugs over the rocks. Or at least research isn’t that anymore. That ship has sailed, as they say.

Its name was the *Beagle*.

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The place it sailed for, as every biologist knows, was the Galapagos islands. Darwin’s research happened in an environment nothing like the stainless steel basins and glass panes and microscope-slide-nudging quiet of the modern laboratory. We have to imagine the father of evolutionary science clambering over volcanic landscapes, reeking of sweat, covered in dirt and beetles, like some kind of animistic shaman communing with the wilderness. Darwin got to evolutionary theory by traveling very far indeed—deep into the stubbornly prehistoric, pre-human rockscapes of these islands off the coast of nowhere.

I’ve never visited the Galapagos except through the eponymous BBC One documentary, which happened to be available for streaming on Netflix the same week I started reading *The Voyage of the Beagle*, No. 104 in the Everyman’s Library collection. Apparently are no resorts on these islands, no parasailing Missouri-based insurance agents with their freckled wives and daughters, no weed-smelling islanders offering to braid the wife’s hair into dreadlocks, no piña coladas with the little umbrellas: The Galapagos remain as pristine and forbidding as they were one hundred and fifty years ago.

As I watched these baroquely decked-out birds and weird insects, I thought about Darwin poking around on these islands—and how he never records a single bug bite, though he must have experienced his share. I thought about modern-day Darwinists—the slick academics and symposium atheists, Richard Dawkins and Sam Harris, and all the

self-certain undergraduate ramen-slurpers who scoff at traditional religion in his name. Darwin’s Darwinism feels *earned* in a way these campus Darwinisms don’t.

On the 13th the storm raged with its full fury: our horizon was narrowly limited by the sheets of spray borne by the wind. The sea looked ominous, like a dreary waving plain with patches of drifted snow: whilst the ship laboured heavily, the albatross glided with its expanded wings right up the wind. At noon a great sea broke over us, and filled one of the whale boats, which was obliged to be instantly cut away. The poor Beagle trembled at the shock, and for a few minutes would not obey her helm; but soon, like a good ship that she was, she righted and came up to the wind again. Had another sea followed the first, our fate would have been decided soon, and for ever. We had now been twenty-four days trying in vain to get westward; the men were worn out with fatigue, and they had not had for many nights or days a dry thing to put on. Captain Fitz Roy gave up the attempt to get westward by the outside coast. In the evening we ran in behind False Cape Horn, and dropped our anchor in forty-seven fathoms, fire flashing from the windlass as the chain rushed round it.

To go on a sea voyage in the early 1800s was to put yourself, literally, at mortal risk, particularly when the sea voyage was so far outside the usual trade routes. Darwin took on risk in a way even the most dedicated evolutionary biologists today don’t, or don’t have to. Challenging nearly two millennia of Christian dogma involved an intellectual fearlessness that mirrored the physical fearlessness involved in boarding the *Beagle*.

Because the *Beagle*, by sailing into the history of science, sailed through the history of religion as well. That is an inextricable part of Darwin's history as it is of Darwinism's. He chased butterflies like *Papilio feronia* directly into the sanctum of theology. This had happened before with astronomy (Galileo) and history (David Strauss's 1835 *The Life of Jesus, Critically Examined*). In 1859, with *On the Origin of Species*, another investigation into Nature would prove an accidental investigation into God.

The traditional sense is that evolutionary theory contradicted the parts in Genesis about God creating Adam and the animals and so on—Genesis 1:25.

And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.

But that's just the literal contradiction. Darwinism calls out Brahma and Pangu just as it does the Old Testament God, but it's only in the Abrahamic monotheisms that this truly bitter resistance to evolutionary theory shows up. (Every Hindu I know, for example, seems quite at ease with the idea.) This is because the source of the revulsion resides in the verse immediately *after* the one where it's God creating all the animals.

And God said, Let us make man in our image, after our likeness: and let them have dominion over the fish of the sea, and over the fowl of the air, and over the cattle, and over all the earth, and over every creeping thing that creepeth upon the earth.

And let them have dominion. In Abrahamic religions, we human beings are set apart because we are made in God's image, and we sit imperiously at the top of a hierarchy. In the Eastern religions that believe in rebirth, the hierarchy exists—it's better to be born a human being than to be born a monkey—but human beings are always risking slippage. The Jataka

tales tell of the prior incarnations of the Buddha. It turns out he had appeared in the past as a rabbit, a deer, a mallard.... Of the ten incarnations of Vishnu, the first three are animals, a Fish, a Tortoise, a Boar, while the fourth is a man with a lion's head and claws, as if transitioning to the human avatars to follow. There is no sharp boundary between the animal world and the human world, and the animal can "lord it" (literally) over mankind: Lord Ganesha has an elephant's head. The Scopes Monkey Trial is unthinkable in a civilization where there are temples and hymns to Hanuman.

That is why the *Voyage of the Beagle* is so crucial a counterpart to Darwin's later scientific work. It shows us the image of this biologist—this biological philosopher—seeking out nature at its harshest and most indifferent and most beautiful.

The day was glowing hot, and the scrambling over the rough surface and through the intricate thickets, was very fatiguing; but I was well repaid by the strange Cyclopean scene. As I was walking along I met two large tortoises, each of which must have weighed at least two hundred pounds: one was eating a piece of cactus, and as I approached, it stared at me and slowly walked away; the other gave a deep hiss, and drew in its head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, seemed to my fancy like some antediluvian animals. The few dull-coloured birds cared no more for me than they did for the great tortoises.

There is something proud and unconquerable in these tortoises, both the one that hisses and the one that turns away. They can be caged or killed or driven to extinction. But no human being can have dominion over them. Darwin came face to face with nature radically unbowed, and eventually, he placed himself (and the human species) in a continuum with it: After millennia of Abrahamic hubris, a scientific humbling.

Darwin got where he got intellectually by sailing there and hoofing it, all for the sake of knowledge. The Everyman in my edition's logo was a powerfully striding fellow, too. I used to think he looked jaunty, but now I know he looks determined. (And if he's going to get through *The Tale of Genji*, he'd better be.) If I could pencil in a detail, I'd draw in a headphone cord leading to his ears, since I do most of my "reading" in audiobook form. (Audiobooks allow me to lead my other life as a diagnostic radiologist and still blaze through a small library's worth of literature a year.)

Diagnostic radiologists, incidentally, are the most hands-off of medical specialists. Never do we venture onto the tectonic and sulfurous Galapagos of patients' social histories. We avoid boarding the *Beagle* and coming face to face with the species we study. I myself "see" about 16,000 patients a year without ever actually *seeing* them, except in pixelated form, on a set of computer screens. After my summer of research, I ditched neurology and set my sights on radiology instead, precisely because

it would keep me from having to see, and smell, and touch patients. I go through whole workdays without meeting a single patient. I spend my day delivering catastrophic diagnoses...into a voice recognition software that asks me no heart-rending follow-up questions.

I chose radiology because I wanted to be a writer and I didn't want my day job to bleed into my time outside the hospital. It's hard to take the CT appearance of Stage IV cancer home with you; it's natural to remember the face of the 36-year-old woman who got the news from you. I chose radiology to insulate myself from the realities of medicine—from life and death and human suffering, basically—so that I could create art about...life and death and human suffering. It's paradoxical, I know. I chose detachment over compassion, sterile lab work (office work, technically) over the messy surgical "field." I preferred to be Siddhartha in the climate-controlled palace, not Buddha in the mosquito-ridden forest. Much less Darwin on Tierra del Fuego.

Dante went down to the Inferno; Darwin's descent was latitudinal, but both of them, one below sea level, the other by traversing the sea, ended up exploring a "Land of Fire."

The theme of the Descent is the one of the oldest in all literature. Gilgamesh, Odysseus, Aeneas, Dante—and those are just the poetic examples, where it's out there in the open. You see the theme crop up again, in a masked form, wherever a mythopoetic talent wanders into the novel. Quixote gets lowered into the dreamlike Cave of Montesinos. *Les Misérables*

has an extended discussion of the catacombs under Paris, and at one point, Jean Valjean is actually fake-buried. Melville, like Hugo, was a poet working the prose beat—and sure enough, the voyage of the *Pequod* around the horn of Africa, mapped out, graphs the descent-and-rise we find in the old poetic epics. You have to go down to the Underworld in order to rise again, enlightened and ready to save the world. Jesus was said to have visited the Underworld, too, during the period between the crucifixion and resurrection—the so-called Harrowing of Hell. This event shook hell with an earthquake,

and Dante (in that journal of his own transformative Voyage) documented a collapsed bridge in Hell that dated back to it.

The ground in many parts was fissured in north and south lines, perhaps caused by the yielding of the parallel and steep sides of this narrow island. Some of the fissures near the cliffs were a yard wide. Many enormous masses had already fallen on the beach; and the inhabitants thought that when the rains commenced far greater slips would happen. The effect of the vibration on the hard primary slate, which composes the foundation of the island, was still more curious: the superficial parts of some narrow ridges were as completely shivered as if they had been blasted by gunpowder.

That's Darwin, on Quiriquina Island, off the coast of Chile. He, too, descended to a Land of Fire and came back up, in his case, to England. He wasn't quite the enlightened Teacher yet, but in time, he would end up

changing the human self-conception as profoundly as the founder of any religion.

More profoundly, that is, than any poet or other scientist. This is the other reason Darwin ends up in theological discussions while Galileo, who also ran afoul of Christian dogma, doesn't anymore. Galileo, Kepler, and Copernicus all challenged the Mother Church on the organization and mechanics of the heavens. Because they challenged it on astronomy, they challenged the old story about *where* we are. Darwin was the first scientific teacher to challenge the old story about *what* we are. The two challenges point different ways: One at the sky, the other at your heart. That's why the astronomical challenge has been successful. Today, even the most conservative cardinals in the Vatican subscribe to the heliocentric model. Evolution is another story.

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And a story *The Voyage of the Beagle* is, one in a genre. (Incidentally, David Mitchell imitated it in one of the sections of his novel *Cloud Atlas*.) Darwin worked before the development of academic science writing as we know it; he also came before serious scientific research itself completed its divorce from the literary culture. Galileo wrote dialogues about astronomy that were modeled on Plato's. For that matter, the central figure in Western science, Aristotle, was famed in his own day for a literary style that Cicero, no mean stylist himself, called "a river of gold." Aristotle's surviving books are, apparently, mere lecture notes.

Darwin's journal was part of a now-defunct branch of scientific literature: the literature of exploration. The greatest practitioner of this, and Darwin's inspiration, was the German explorer-scientist Alexander von Humboldt, who

also wrote about his visits to South America. Humboldt, the most famous scientist of his day (in 1842, Darwin made a pilgrimage to see him in London), has enjoyed something of a revival recently with Andrea Wulf's *The Invention of Nature: Alexander von Humboldt's New World* (Knopf, 2015). Humboldt didn't accompany Darwin on the *Beagle*, but the predecessor was never far from Darwin's thoughts:

*On a point not far from the city,
where a rivulet entered the sea,
I observed a fact connected with a
subject discussed by Humboldt.*

*Travelling onwards we passed through
tracts of pasturage, much injured by the
enormous conical ants' nests, which were
nearly twelve feet high. They gave to the
plain exactly the appearance of the mud
volcanos at Jorullo, as figured by Humboldt.*

The house in which I lived was seated close beneath the well-known mountain of the Corcovado. It has been remarked, with much truth, that abruptly conical hills are characteristic of the formation which Humboldt designates as gneiss-granite.

During this day I was particularly struck with a remark of Humboldt's, who often alludes to "the thin vapour which, without changing the transparency of the air, renders its tints more harmonious, and softens its effects."

Humboldt has related the strange accident of a hovel having been erected over a spot where a young crocodile lay buried in the hardened mud. He adds, "The Indians often find enormous boas, which they call Uji or water serpents, in the same lethargic state. To reanimate them, they must be irritated or wetted with water."

I could go on—*The Voyage of the Beagle* converses with Humboldt's work in almost two dozen places.

Today, it's only popular "science writing" that uses sustained narrative, descriptive passages, jargon-free language, and the first person. Such writing summarizes the findings of "serious" scientific studies for consumption by laypeople. In Darwin's day, important scientific work was still being done by inspired amateurs. You didn't need to learn a discipline-specific jargon and get a university degree to be taken seriously. The sciences were like poetry and fiction today: Credentials *helped* (in those days, from the Royal Geographic Society or whatever), but they weren't *necessary*.

Even better, the scientific disciplines themselves were indistinct. I notice how both Humboldt and Darwin observe rock formations, insects, flora, fauna, weather patterns, tribes, and troubled histories with equal interest.

As it was growing dark we passed under one of the massive, bare, and steep hills of granite which are so common in this country. This spot is notorious from having been, for a long

time, the residence of some runaway slaves, who, by cultivating a little ground near the top, contrived to eke out a subsistence. At length they were discovered, and a party of soldiers being sent, the whole were seized with the exception of one old woman, who, sooner than again be led into slavery, dashed herself to pieces from the summit of the mountain. In a Roman matron this would have been called the noble love of freedom: in a poor negress it is mere brutal obstinacy.

Today, a geologist, an entomologist, a botanist, a zoologist, a meteorologist, an anthropologist, and a historian would each board a hypothetical *Beagle* with his or her separate agenda. Their eyes would zero in on what related to their disciplines.

I thought about Darwin poking around on these islands—and how he never records a single bug bite, though he must have experienced his share.

Darwin's scientific bombshell was probably the last readable one in scientific history. We've come a long way from the pre-Socratic speculations on the natural world in Heraclitus and Parmenides. Today the great advances require mathematics, and where they require words, the words require abbreviations; a word like "deoxyribonucleic" uglifies every sentence it enters. Crick and Watson's original April 1953 paper in *Nature* positing the structure of DNA may well, over the next 100 years, transfigure us (literally) far more than our intrepid Victorian's speculations on apes and men. But the Everyman Library would be hard pressed to justify, on literary grounds, the inclusion of paragraphs like these:

If it is assumed that the bases only occur in the structure in the most plausible tautomeric forms (that is, with the keto rather than the enol configurations) it is found that only specific pairs of bases can bond together. These pairs are: adenine (purine) with thymine (pyrimidine), and guanine (pyrine) with cytosine (pyrimidine).

This is why I like Darwin's *Journal* so much: It takes me back to an era when doing good science and writing well, my own two ideals, were at one. I write far more pages professionally as a radiologist than I do as a poet or novelist, but when I write that stuff, I am always trying to imitate a computer:

2.3 x 2.1 cm left renal superior pole hypodensity has a Hounsfield unit value of 7 consistent with a simple cyst.

I dictate these sentences into a voice recognition microphone, and to make sure the software picks up and transcribes the words accurately, I actually flatten my voice into a computer's monotone. I never wax poetic; the radiology report is part of

the medical record, and using poetic license could get my medical one revoked.

The scientist's eye is not so different from the poet's or novelist's—observation is all-important—but their voices, in the modern world, have nothing in common. Best to end with a passage from Darwin—like this one, where he describes rubbing a zoophyte. It responds by glowing.

Having kept a large tuft of it in a basin of salt-water, when it was dark I found that as often as I rubbed any part of a branch, the whole became strongly phosphorescent with a green light: I do not think I ever saw any object more beautifully so. But the remarkable circumstance was, that the flashes of light always proceeded up the branches, from the base towards the extremities.

This is the responsiveness of the natural world to his curiosity, growing luminous at his touch, "from the base toward the extremities," welling up with the color of life. Darwin's image hybridizes the precise and the magical. So does his book. ♪