

Chapter 10: In which I muse about final matters considered off-limits to polite scientific discourse: to wit, the relationship between science and religion, the existence of God, whether this God can intervene in the universe, the death of my mentor, and my recent tribulations

When I consider the short duration of my life, swallowed up in the eternity before and after, the little space which I fill, and even can see, engulfed in the infinite immensity of spaces of which I am ignorant, and which know me not, I am frightened, and am astonished at being here rather than there; for there is no reason why here rather than there, why now rather than then. Who has put me here? By whose order and direction have this place and time been allotted to me? . . . The eternal silence of these infinite spaces frightens me.

—Blaise Pascal, *Pensées* (1670)

Paul Gauguin's haunting masterpiece, *D'où venons nous? Que sommes nous? Où allons nous?*, painted in Tahiti in the closing years of his life, perfectly encapsulates the three questions I am obsessed with: Where do we—humans, dogs, and other sentient beings—come from? Who are we? Where are we going? I'm a natural scientist. I have a deep-seated desire to find answers to these questions and to understand the physical universe, as well as consciousness. I seek to comprehend the whole shebang—not as the mystic does, in the sort of ecstatic experience that I sometimes have when running for hours at high altitudes in the San Gabriel Mountains, but in a rational, intellectual manner.

These last pages present some personal ruminations on science and religion, a belated coming-of-age process that has compelled me to re-evaluate my childhood faith, and some autobiographical fragments that throw light on why I care about questions of free will. I know through encounters with students and colleagues that more than a few lie awake at night, wondering about these things. This final chapter is for you.

Dualism, the Soul, and Science

Plato, the patriarch of Western philosophy, conceived of the individual as an immaterial and immortal soul imprisoned in a material and mortal

body. This concept is the very embodiment (*sic*) of dualism, the belief that reality consists of two radically different sorts of things—the mental or spiritual, and the physical. Plato promulgated his ideas through the academy that he founded in 387 BCE. It was the first institution of higher learning in Western civilization. I call myself an academic after the Athenian hero *Akademios*, for whom the olive grove that hosted his school was named.

These platonic views were subsequently absorbed into the New Testament. They form the basis of the Christian doctrine of the soul, which will be resurrected at the end of time to live in everlasting communion with God. The belief in a transcendent, immortal soul that lies at the heart of consciousness recurs in the history of thought and is widely shared by many faiths throughout the world.

Many readers will not have much sympathy with such an overtly dualistic belief. Yet fundamentalism, the uncompromising rejection of a rational, humanistic, liberal world view in favor of a rigid adherence to doctrine and core beliefs about the body and the soul, is on the rise worldwide. This is as true of Christian fundamentalism as it is of extreme Islamic variants. And more than ever, young men are willing to kill others and themselves in the name of their particular god. Not quite what Nietzsche had in mind when he declared in delirious tones, “God is dead!”

Contemporary academic books dealing with the mind–body problem dispense with God and the soul in an aside—if they mention them at all. In a dismissive way, the author points to the obvious incompatibility of science and these antiquated modes of thinking. What a far cry from the situation three or four centuries ago, when books and buildings were dedicated *ad majorem dei gloriam*, to the greater glory of God!

Descartes, the Enlightenment philosopher, postulated that everything under the Sun is made out of one of two substances. The sort of stuff that you can touch and that has spatial extension is *res extensa*; this includes the bodies and brains of animals and people. The stuff that you can’t see, that has no length and width, and that animates the human brain is *res cogitans*, soul stuff.

The working of our brain is typically compared with the most advanced technology of the day. Today, it is the vast and tangled Internet. Yesterday, it was the digital computer. Yester-century, it was the moving statues of gods, satyrs, tritons, nymphs, and heroes in the fountains at the French court in Versailles. Descartes argued that, like the water that powered these simple machines, “animal spirits” flow through the arteries, cerebral cavities, and nervous tubules of all creatures, making them move. In a

radical break with the Medieval scholastic tradition and its endless speculations, Descartes sought mechanical explanations for perception and action. Informed by his dissections of brains and bodies, he argued that most behaviors are caused by the action of particles distinguished by their size, shape, and motion.

But Descartes was at a loss to conceive of mechanisms for intelligence, reasoning, and language. In the seventeenth century, nobody could envision how the mindless application of meticulously detailed, step-by-step instructions, what we today refer to as algorithms, makes computers play chess, recognize faces, and translate Web pages. Descartes had to appeal to his mysterious, ethereal substance, *res cogitans*, that in some nebulous manner did the thinking and reasoning. As a devout Catholic, he safeguarded the absolute distinction between humans and soulless animals by restricting *res cogitans* to the former. As he wrote quite unequivocally, a dog may howl pitifully when hit by a carriage, but it does not feel pain.

If I have learned anything in my lifelong exploration of the mind-body nexus, it is this: Whatever consciousness is—however it relates to the brain—dogs, birds, and legions of other species have it. As I laid out in chapter 3 and reemphasize in the last chapter, canine consciousness is not the same as ours—for one thing, dogs are much less introspective and don't talk—but there is no question that they, too, experience life.

Two recent defenders of dualism, the philosopher Karl Popper and the neurophysiologist and Nobel laureate John Eccles, made an appearance in chapter 7. Let me repeat a point I made there when discussing their views on Libertarian free will. The dualism they advocate, in which the mind forces the brain to do its bidding, is unsatisfactory for the reason that the 25-year-old Princess Elisabeth of Bohemia had already pointed out to Descartes three centuries earlier—by what means does the immaterial soul direct the physical brain to accomplish its aim? If the soul is ineffable, how can it manipulate actual stuff such as synapses? It is easy to see causality flowing from the brain to the mind, but the reverse is difficult. Any mind-to-brain communication has to be compatible with natural laws, in particular with the principle of energy conservation. Making the brain do things, like messing with synapses, takes work that the soul would have to perform and that has to be accounted for.

The nature of the interaction between the two is not the only problem. How does the soul remember anything? Does it have its own memory? If so, where? What logic does it follow? What happens to the soul when the brain dies? Does it float around in some sort of hyperspace, like a ghost? And where was this soul before the body was born? These

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questions do not have answers that are compatible with what we know about the physical world.

If we honestly seek a single, rational, and intellectually consistent view of the cosmos and everything in it, we must abandon the classical view of the immortal soul. It is a view that is deeply embedded in our culture; it suffuses our songs, novels, movies, great buildings, public discourse, and our myths. Science has brought us to the end of our childhood. Growing up is unsettling to many people, and unbearable to a few, but we must learn to see the world as it is and not as we want it to be. Once we free ourselves of magical thinking we have a chance of comprehending how we fit into this unfolding universe.

The dominant intellectual position of our day and age is physicalism—at rock bottom all is reducible to physics. There is no need to appeal to anything but space, time, matter, and energy. Physicalism—a halftone away from materialism—is attractive because of its metaphysical sparseness. It makes no additional assumptions.

In contrast, such simplicity can also be viewed as poverty. This book makes the argument that physicalism by itself is too impoverished to explain the origin of mind. In the previous chapter, I sketched an alternative account that augments physicalism. It is a form of property dualism: The theory of integrated information postulates that conscious, phenomenal experience is distinct from its underlying physical carrier. Informationally speaking, the experience of being sad is a crystal, a fantastically complex shape in a space of a trillion dimensions that is qualitatively different from the brain state that gives rise to sadness. The conscious sensation arises from integrated information; the causality flows from the underlying physics of the brain, but not in any easy-to-understand manner. That is because consciousness depends on the system being more than the sum of its parts.

Think of this crystal as the twenty-first-century version of the soul. But, *hélas*, it is not immortal. Once the underlying physical system disintegrates, the crystal is extinguished. It returns to where it was before the system was constituted.

Before such a breakdown occurs, however, the causal relationships that make up this crystal could be uploaded onto a computer. This is the infamous *Singularity* that Ray Kurzweil and other technologists are hoping will render them immortal—rapture for nerds. And once the associated integrated information is reduced to patterns of electrons, it can be copied or edited, sold or pirated, bundled with other electronic minds, or deleted.

But without some carrier, integrated information can't exist. Put succinctly: no matter, never mind.

Religion, Reason, and Francis Crick

Francis Crick exemplified the historical animosity between religion and science. Nothing in his tolerant, middle-class British upbringing would suggest this, but from many discussions with him I know that he felt motivated to rid the world of God, replacing supernatural explanations of life and of consciousness with explanations based firmly on natural forces. He wanted to exile God permanently from the sphere of rational and educated discourse.

Francis succeeded spectacularly in his goal of understanding life. Although the origins of life in a prebiotic world remain murky, the conceptual scaffolding for its evolution is all there. It is too early to tell how many inroads he made toward his second goal.

Francis's opposition to organized religion became legendary when he resigned from Churchill College at Cambridge University in 1961 to protest plans to add a chapel to the college grounds. Francis was of the opinion that religion had no place in a modern college with an emphasis on science, mathematics, and engineering. Sir Winston Churchill—in whose name the college had been founded—tried to appease him by pointing out that the money for the construction of the chapel was being raised privately and that nobody would be forced to attend services there. Francis replied by proposing a fund for the construction of a brothel associated with the college: nobody would be forced to take advantage of its services, and it would accept men no matter what their religious beliefs. Included in his letter was a down payment of ten guineas. Understandably, this put an end to any further correspondence between the two men.

By the time I knew Francis, his strident opposition to any sort of religious thinking had become muted. At dinner with him and Odile in their hilltop home, we occasionally discussed the Roman Catholic Church and its position on evolution, celibacy, and so on. He knew that I was raised as a Catholic and continued sporadically to attend mass. He never delved into the basis of my faith, as he was a kind man and wanted to spare me the embarrassment of groping for an explanation—particularly as my faith did not interfere with our quest to understand consciousness within a strictly empirical framework.

Remarkably, in his 1994 book *The Astonishing Hypothesis*, in which he outlines his views on the mind–body problem, he admits, “Alternatively,

some view closer to the religious one may become more plausible.” This startling concession was immediately neutralized by, “There is always a third possibility; that the facts support a new, alternative way of looking at the mind-brain problem that is significantly different from the rather crude materialistic view many neuroscientists hold today and also from the religious point of view.” This was not an expression of political correctness—far from it. More than anybody else I know, Francis was open to new, alternative, and even radical explanations, provided they were consistent with most of the established facts, verifiable, and opened up new avenues of thought and experimentation.

Deism, or God as the Divine Architect

The greatest of all existentialist puzzles is why there is anything rather than nothing. Surely, the most natural state of being—in the sense of assuming as little as possible—is emptiness. I don’t mean the empty space that has proved so fecund in the hands of physicists. I am referring to the absence of anything: space, time, matter, and energy. Nothing, *rien, nada, nichts*. But we are here and that is the mystery.

Writing in the trenches of World War I and as a prisoner of war, the young Ludwig Wittgenstein expressed the wonder of it in his *Tractatus logico-philosophicus*: “It is not *how* things are in the world that is mystical, but *that* it exists.”

Cosmology has tracked this question down to the point of creation itself, the unimaginably fiery Big Bang. It took place 13.7 billion years ago, in truly deep time, utterly beyond any human experience. And it is there—despite the best efforts of Stephen Hawking and others—that physics meets metaphysics.

Who or what set the conditions for the initial singularity, when everything was compressed into a single point of infinite density? Where did it come from? Doesn’t the principle “from nothing comes nothing” hold for the universe as a whole as much as for anything in it? And where do the laws governing this universe originate? Who or what set up quantum mechanics and general relativity? Are these laws necessary? Could the universe obey other laws and still remain self-consistent? Is a universe that does not obey quantum mechanics viable, or even conceivable?

One rational explanation is a demiurge, a Supreme Being who always was, is, and will be. Outside of time, this entity created the natural laws and willed the Big Bang into existence. Physics then begat a stable space-time fabric and our universe. After this initial act of creation, the Divine

Architect left the cosmos to its own devices, free to evolve by chance and necessity. Eventually, creatures arose from the primeval slime and built temples to praise this Supreme Being. This is the *Creator* or *Divine Providence* that the American Declaration of Independence speaks of. Thomas Jefferson and Benjamin Franklin were deists, as a belief in such a naturalistic God is called.

Science gives a valid description of the way things interact with each other and how they change from one form into another. That galaxies, cars, billiard balls, and subatomic particles act in a regular manner that can be captured by mathematics, and that can therefore be predicted, is nothing short of amazing. Indeed, some physicists and mathematicians—most famously Albert Einstein—believe in such a creator precisely because of this “miraculous” state of affairs. It is not difficult to imagine a universe so complex that it is incomprehensible. But the deist’s God created a universe that is not only hospitable to life, but also so predictable that its regularity can be apprehended by the human mind.

Yet we search in vain for direct empirical evidence for such an eternal being above and beyond natural forces. God leaves no residue in our test tubes nor tracks in our bubble chambers. God does not reveal himself through logic, either. As the astronomer-philosopher Immanuel Kant argued, all proofs of the existence of God are flawed. No chain of bullet-proof arguments leads from unassailable propositions to the firm conclusion that God must, of necessity, exist. (The opposite is also true—it can’t be proved that there is no God.) Again, Wittgenstein puts it sparingly: “God does not reveal himself *in* the world.”

The early 1970s saw a new twist to this debate—namely, the *anthropic principle*, the observation that the universe is ever so friendly to stable, self-replicating biochemical systems. If the physical constants and parameters that govern the cosmos were slightly different, complex molecules, and therefore life, could not exist. In that sense, “anthropic” is a misnomer, for the principle does not refer to human life; rather, it should be called the “biotropic” or, perhaps, the “biophilic” principle.

Take Newton’s law of gravity and Coulomb’s law, which governs the way electrically charged particles attract and repel each other. Both laws have the same form, stating that the forces decay with the square of the distance between any two particles. Only the constant in front of the quadratic decay term differs. Intriguingly, the attraction between two opposite charges must be exactly 10,000 trillion, trillion, trillion times stronger than their mutual gravitational attraction in order for life as we know it to form. A itsy-bitsy more or less and we would not be around.

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Another cosmic constraint is that the sum of all positively charged particles in the universe must equal the sum of all negatively charged particles; otherwise, electromagnetism would dominate gravity, and stars, galaxies, and planets couldn't form. The number of electrons must equal the number of protons to within one part in a trillion, trillion, trillion. If the strong nuclear force were slightly stronger or weaker than it actually is, either nothing but hydrogen or no elements heavier than iron would exist. If the universe had expanded too rapidly, protons and neutrons couldn't have bonded into atomic nuclei. If the initial expansion of the universe had been ever so slightly slower, the fiery brew that made up the early universe would have been too hot for nuclei to have formed. In short, an amazing number of "coincidences" had to occur to give rise to a universe that was stable for a sufficiently long time and diverse enough in chemical elements to support complex, carbon-based life forms.

Some argue that the anthropic principle is tautological: If the universe had not been friendly to life, we wouldn't be around to ponder its existence. This assumes that there is an uncountable number—in time or in space—of parallel universes that are inhospitable to life and that we happen to be in the one that is conducive to life. The trouble is that we don't know about these other universes—they have never been observed. Maybe we live in a multiverse, containing an infinite number of noninteracting and nonobservable universes. Possibly. But assuming an uncountable number of worlds is a very strong assumption and is as *ad hoc* as the hypothesis of a Supreme Architect who rigged the laws of physics to facilitate the formation of life.

The lively debate triggered by the anthropic principle shows no signs of settling down.

What remains is neither empirical knowledge nor logical certainty, but faith. Some, such as the physicists Stephen Hawking and Leonard Mlodinow, express their faith that a yet-to-be-proven theory of physics called M-theory will demonstrate why the universe has to exist the way it does. Others find this a questionable promissory note at best and have faith in different principles.

Theism, or God as the Interventionist

What power does God have? Can the Supreme Being influence the course of events in his creation? After all, people pray in the expectation that God will listen to them—provided that their intentions are pure and

their belief sincere—and will intercede on their behalf to cure a sick child, steady a rocky marriage, or bless a new business. If God is unable to do any of these things, why bother? (I'm not concerned here with the possible beneficial psychological effects of praying, such as relief from anxiety. I'm after bigger game.)

Theism is the belief in an activist God who intervenes in the universe. Is Theism compatible with science? When something outside the universe, not subject to natural law, causes something inside the universe to happen, people speak of a miracle. So, the question needs to be rephrased as, are miracles compatible with science? The answer is an unambiguous no.

Take Jesus' first public action (according to the New Testament), turning water into wine at a wedding in Canaan. This runs counter to a fundamental principle, the conservation of mass–energy. The aromatic and ether molecules making up the wine had to come from somewhere. Water molecules can be converted into carbon and the other elements and molecules that constitute wine, but this is a feat of nuclear synthesis that requires prodigious amounts of energy. Nothing like that was reported.

Every time this conservation principle is tested, it is found to be sound, from the infinitesimally small to the unimaginably large. It is, therefore, extremely unlikely that the miracle in Canaan took place.

Scientists are guided by a heuristic principle of deductive reasoning called *Occam's razor*. Named after the fourteenth-century English friar and logician William of Ockham, it states that of two equally good explanations for a phenomenon, the simpler one is more likely to be true. A more convoluted explanation is less likely than a more parsimonious one. It is not a logical principle but a working rule.

When reconstructing an anomalous event, a murder or an airplane crash, investigators can never determine with absolute certainty what happened. But Occam's principle narrows the options. Occam's razor slashes hither, eliminating the unknown assailant with no apparent motive who left no physical trace but who, so claims the defense attorney, was responsible for the murder. Occam's razor slashes thither, decimating the theory of a secret government conspiracy that brought down the airplane but that necessitates an unlikely chain of events and the active participation of many people. Occam's razor is an invaluable tool, eliminating superfluous entities from consideration.

The possibility of a Supreme Being turning water into wine is so outlandish that it can be rejected using Occam's razor. It is far more likely

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that something else, obeying the laws of physics, was the cause. Maybe the wedding organizers discovered long-forgotten flasks of wine in the basement. Or a guest brought the wine as a gift. Or the story was made up to cement Jesus' reputation as the true Messiah. Remember Sherlock Holmes' advice: "When you have eliminated the impossible, whatever remains, however improbable, must be the truth."

Miracles are not in the cards. The fabric of everyday reality is woven too tightly for it to be pulled asunder by extranatural forces. I'm afraid that God is an absentee cosmic landlord. If we want things to happen down here, we had better take care of them ourselves. Nobody else is going to do it for us.

Can Revelation and Scripture Be Helpful?

Traditionally, the most important source of knowledge about the transcendental is revelation—the direct, first-hand experience of God. Saul's encounter with the living God on the road to Damascus turned him from a persecutor of the early acolytes of Jesus into the apostle Paul, Christianity's greatest missionary. The seventeenth-century French mathematician, physicist, and philosopher Blaise Pascal likewise experienced God in this manner: A description of his searing experience was found on a parchment sewn into the lining of his coat. The writings of saints and mystics from all religious traditions contain encounters with the Absolute and the feeling of oneness with the universe.

If I had experienced God in this manner, if I would have seen the burning bush and felt some manifestation of the *Mysterium tremendum*, I would not be writing these lines. I wouldn't have to resort to inadequate reason to figure things out.

Because I only have reason to fall back on, I admit to skepticism when considering the ontological (but not the psychological) validity of such life-changing experiences. As a husband, father, son, brother, friend, lover, colleague, scientist, citizen, and avid reader of history, I continue to be amazed by the ability of highly educated and intelligent people to fool themselves. You and I are convinced that our motives are noble, that we are smarter than most, that the opposite sex finds us attractive.

Nobody is immune from self-deception and self-delusion. We all have intricate, subliminal defense mechanisms that allow us to retain beliefs that are dear to us, despite contravening facts. September 11, the Iraq debacle, and the Lehman Brothers' bankruptcy vividly demonstrate that the "elite" suffer from these failures of common sense as much as

anybody else. A Caltech colleague, the physicist Richard Feynman, said “The first principle is that you must not fool yourself, and you are the easiest person to fool.” Our pathological propensity for interpreting any event in the light of what we want to believe is exactly why double-blind experimental protocols are so essential in science and medicine. They root out the experimentalist’s hidden biases, which otherwise contaminate the results.

Given these uncomfortable facts about human nature, I am doubtful that intense religious experience, although no doubt genuinely felt, reveals anything about the actual existence of God. Too much is at stake for people to be objective. I do not deny such experiences, but I am wary of their interpretation. I stand ready with sodden blankets and the cold water of reason.

I am equally skeptical when turning to Holy Scripture, another traditional source of religious thought and teaching. The idea that the experiences and thoughts of men who lived thousands of years ago are relevant to our understanding of the universe and our place in it strikes me as quaint. The books of the Bible were written before the true age and extent of the cosmos were even remotely imagined, before the evolutionary bonds between humans and animals were understood, before the brain was identified as the seat of the mind (neither the Old nor the New Testament mentions the brain a single time).

Moreover, the observation that different societies and cultures have foundational texts and traditions that are quite at odds with each other, differences that some followers are willing to kill and to die for, does not increase my confidence in these received “truths.” (What strange gods, rituals, and beliefs will join this pantheon if we ever find civilizations on distant stars? Can they, too, attain salvation? Did Jesus die for them as well?) Given this marketplace of religions, on what basis should I choose one over the others? For many years I, like the vast majority of people, believed what my parents believed. But that is not a truly informed choice.

The Old and New Testaments, the Koran, and other religious texts are poetic, inspirational, and insightful about enduring human needs and desires. They provide the ethical foundations that have guided the faithful for millennia. Holy writ reminds us, again and again, that each individual is part of something larger, part of a larger community of believers, and part of creation. Contemporary cultural, political, and social life revolves around the golden calf of greed and consumption. Wars and conflicts, stock market crashes, and environmental degradation and shortages of water and oil remind us that we neglect these essential

truths at our peril. But as we learn more about the universe, the relevance of these sacred texts to the contemporary world lessens.

Let me give you a personal example of how the scientific insights discussed in this book have made a concrete difference in my life. As I explained earlier, many—and possibly all—animal species have subjective, phenomenal feelings. They experience pleasure and pain, are happy and sad. In light of this knowledge, how can we justify raising animals under atrocious, industrial conditions, far removed from their natural habitats, in order to eat them? How can we breed sentient beings for their flesh? How can we justify locking up young calves in tight, closed boxes where they can't turn around or lie down and deprive them of any social contact for the duration of their short life just so we can eat their white and tender flesh? This is particularly barbaric today, when nutritious, good-tasting, cheap—and more healthful—alternatives to meat are readily available. Yet, it was difficult for me to follow through on this intellectual insight with action—the taste of flesh is very deeply ingrained in our cuisine and palates. Then, in 2004, Susan Blackmore, an intrepid British psychologist with rainbow-colored hair, interviewed me for a book of hers. I had just concluded a riff on mouse consciousness with a plea to not kill mice thoughtlessly, as many researchers who work with them do, when Susan asked me, out of the blue, whether I ate meat. We looked at each other for a while, silently, until I sighed to cover up my embarrassment at having been revealed a hypocrite. This incident really bothered me.

When a year later my beloved Nosy died, I was moved to act. Of the six dogs I have lived with, I grew fondest of this ever-so-savvy, playful, and intensely curious black German shepherd. When she passed away, I was distraught; I still dream about her today. I asked myself that night, as she lay dying in my arms, how could I cry over her but happily eat the flesh of lambs and pigs? Their intelligence and brains are not that different from those of dogs. From that night on, I stopped eating mammals and birds, though somewhat inconsistently, I still consume fish.

None of the Ten Commandments teaches us to avoid eating the flesh of sentient creatures. None of them instructs us to take care of planet Earth. The Decalogue is not helpful in making end-of-life decisions or dealing with reproductive cloning. We need a new set of commandments, one appropriate for our times, as is forcefully advocated by the philosopher and ethicist Peter Singer, one of the founders of the modern animal rights movement.

Et in Arcadia Ego

My upbringing left me with a yearning for the absolute and with the recognition that the numinous can be found in all things—the howling of a dog, the sight of the star-studded heavens, the contemplation of the periodic table, or the pain of ice-cold hands during a windy climb.

On occasion, I have encountered a dark side to such musings. As a teenager lying in bed at night, I would strive to grasp eternity. What does it feel like for time to be going on forever? What does it mean to be dead forever? Not just dead for a century, or a millennium, not just for a long time or a really long time, but forever and ever. The conceptual artist Roman Opalka sought to plumb infinity, to capture it—the steady, incomprehensible progression of one number after another, from one to infinity, on and on. Painting this endless stream of numbers that occupied Opalka during the last forty-five years of his life was his way of dealing with the dizzying and terrifying notion of the infinity stretching in front of us.

Yet, I never worried about my own demise. Like many young men in pursuit of the extreme—whether it be climbing, motorcycle racing, finance, or war—I didn't think about the end. It wasn't really going to happen to me. Not even the death of my daughter Elisabeth shocked me out of this blessed complacency.

It was only in my early forties that I truly realized death was going to come for me, too. I have told the story in the opening pages of chapter 6. One night, my unconscious rebelled. I woke up, and abstract knowledge had turned to gut-wrenching certainty: I was actually going to die!

I pondered the significance of my personal annihilation for the next several months, facing down an existentialist abyss of oblivion and meaninglessness within me. Eventually, through some unconscious process of recalibration, I returned to my basic attitude that all is as it should be. There is no other way I can describe it: no mountaintop conversion or flash of deep insight, but a sentiment that suffuses my life. I wake up each morning to find myself in a world full of mystery and beauty. And I am profoundly thankful for the wonder of it all.

Here I am, a highly organized pattern of mass and energy, one of seven billion, insignificant in any objective accounting of the world. And in a short while I will cease to exist. What am I to the universe? Practically nothing. Yet the certainty of my death makes my life more significant. My joy in life, in my children, my love of dogs, running and climbing, books and music, the cobalt blue sky, are meaningful *because* I will come

to an end. And that is as it should be. I do not know what will come afterward, if there is an afterward in the usual sense of the word, but whatever it is, I know in my bones that everything is for the best.

This sentiment is tied in with my overall sunny and optimistic disposition, which is largely determined by genetic factors and was amplified by the benign circumstances in which I grew up. I can't take credit for either.

Edith is the strong, centered, and responsible woman who kept me grounded for close to three decades. She enabled me to develop fully as a professor and a scientist. She put her career on hold for many years to raise our children into the healthy, smart, resourceful, responsible, and beautiful adults that they are today. This meant that I could read and sing them to sleep, travel to foreign countries and hike, camp, and river raft with them, help with their homework and school projects, and indulge in all the other pleasures of fatherhood without any significant sacrifices to my professional life.

And we enjoyed the company of a fluctuating number of big, hairy, boisterous dogs—Trixie, Nosy, Bella, and Falko. Next to children, they are the best things in life.

Together with a handful of colleagues, I inaugurated and directed two science summer schools: one on computational neuroscience at the Marine Biological Laboratory at Woods Hole, Massachusetts, on the Atlantic shore, and another one on neuromorphic engineering (what engineers can learn from neurobiology) in Telluride, Colorado, in the Rocky Mountains. Both remain popular. Each summer, our family spent four intense weeks in these glorious places. This was the happiest period of my life.

Those halcyon days came to an end when my son and daughter left for college. I missed them more than anything else. To fill that enormous void and to keep my energy channeled, I took up rock climbing in the Sierra Nevada and Yosemite Valley, long-distance trail running in the local mountains, marathons in Death Valley, and so on—anything challenging to combat my growing restlessness. I was suffering from acute empty nest syndrome.

Then Francis left my life. I was with him in his home study when his oncologist called, confirming that his colon cancer had returned with a vengeance. He stared off into the distance for a minute or two, and then returned to our reading. This diagnosis was discussed with Odile during lunch, but that was the extent of it for that day. Of course, I wasn't reading his dark thoughts during that night. But I did recall an earlier conversation in which he confessed to me that his own, not too distant, end made

him sad but that he was resolved to not waste any remaining time by fruitless ruminations and ponderings nor by chasing high-risk experimental therapies. Here I saw him practice this resolution. What mind control! What composure!

A few months later, suffering from the nauseating effects of chemotherapy that failed to stop the spread of the cancer, he put down the telephone in the neighboring room and shuffled past me on the way to the bathroom. When he returned to resume the phone conversation, he dryly remarked in passing, “Now I can truly tell them that their idea made me throw up.” (Somebody was trying to convince Francis to sign off on the creation of a bobblehead of him.) With a view of the inevitable, Francis gave me a life-sized, black-and-white photograph of him, as I knew him. Sitting in a wicker chair, he ironically gazes at the viewer with a twinkle in his eyes. Signed “For Christof—Francis—Keeping an eye on you,” it watches over me in my office.

In summer 2004, Francis phoned me on the way to the hospital to tell me that his emendations to our last manuscript, on the function of the claustrum, a sheet-like structure beneath the cortex, would be delayed. Yet he kept on working, dictating corrections to his secretary from the clinic. Two days later he died. Odile recounted how on his deathbed, Francis hallucinated arguing with me about rapidly firing claustrum neurons and their connection to consciousness, a scientist to the bitter end. He was my mentor, my close intellectual companion, and my hero for the unflinching manner in which he dealt with aging and mortality. His absence left a gaping hole in my life.

My father had passed away in the opening weeks of the third millennium, leaving me without an elder mentor to turn to for guidance and support. My disquiet was compounded, paradoxically, by the successful publication of *The Quest for Consciousness*. I had worked hard over many years toward that goal, which at times appeared very distant. Now that the race was run, I felt listless, bereft of a clear mission. I needed the challenge of an Annapurna in my life.

Precipitated by these cumulative departures, I grew estranged from my wife and left. It is easy enough to state this matter-of-factly, but these few words encompass a degree of misery, distress, pain, and anger over a protracted period that is impossible to put to paper. (Watch Ingmar Bergman’s cimmerician masterpiece *Scenes from a Marriage* to understand what I mean.) I went through a searing crisis, experiencing first-hand the power of the unconscious to shape feelings and actions in a way that escapes conscious insight. Once those forces were unleashed, I was

unable to master them. Or perhaps I was unwilling to master them. There is a reason that Dante consigns sinners who “made reason subject to desire” to the Second Circle of Hell. It was, without a doubt, the grim, low point of my life. Yet something was compelling me onward.

Spinoza coined a beautiful expression, *sub specie aeternitatis* literally, “under the form of eternity.” This is the remote viewpoint. Look down onto the Milky Way from far above its central black hole. You see a swirling disk of hundreds of billion of stars, many of them surrounded by tiny, dark associates. Some of these planets harbor life. On one of them, semi-intelligent, violent, and social primates furiously couple and uncouple. They endow this frenetic, anthill activity with great cosmic importance. These pairings last but the blink of an eye, the flash of a firefly, the flight of an arrow, compared with the time it takes the majestic galactic wheel to complete one rotation.

My anguish begins to recede in significance when viewed in this celestial light of deep time. My tribulations are not meaningless—I am no nihilist—but they should not, and will not, overwhelm my life. Having lost my central sun, I am a solitary planet now, wandering in the silent spaces between the stars. I am slowly regaining some measure of that inner peace, the equanimity, what the epicureans called ataraxia that I had for so long.

To come to terms with my actions, I studied what science knows about voluntary acts and free will, which explains the genesis of chapter 7. What I took from my readings is that I am less free than I feel I am. Myriad events and predispositions influence me. Yet I can’t hide behind biological urges or anonymous social forces. I must act as if “I” am fully responsible, for otherwise all meaning would be leached from this word and from the notions of good and bad actions.

One night, in the midst of my crisis, I emptied a bottle of Barolo while watching the fantasy action movie *The Highlander* and felt in need of some symbolic gesture. At midnight I decided to run to the top of Mount Wilson, which rises more than five thousand feet above Pasadena. After an hour stumbling around with my headlamp and becoming nauseated, I realized that I was being stupid and turned back—but not before shouting into the dark the closing line of the poem *Invictus*: “I am the master of my fate, I am the captain of my soul.” This is a perhaps overenthusiastic expression of my position on the question of free will: For better or worse, I am the principal actor of my life.

Now that you’ve arrived at the coda of this autobiographical chapter, I can confess what has become obvious by this point. I was driven to

write this book for a trifecta of reasons—to describe my quest for the material roots of consciousness, to come to terms with my personal failings, and to bring my search for a unifying view of the universe and my role in it that does justice to both chance and necessity to a satisfactory conclusion.

Nailing My Colors to the Mast

This is the end of my story. I'm optimistic that science is poised fully to comprehend the mind–body problem. To paraphrase language from Corinthians, “For now we see through a laboratory, darkly, but then shall we know.”

I do believe that some deep and elemental organizing principle created the universe and set it in motion for a purpose I cannot comprehend. I grew up calling this entity God. It is much closer to Spinoza's God than to the God of Michelangelo's painting. The mystic Angelus Silesius, a contemporary of Descartes, captures the paradoxical essence of the self-caused Prime Mover as “*Gott ist ein lauter Nichts, ihn rührt kein Nun noch Hier*” (God is a lucent nothing, no Now nor Here can touch him).

The pioneering generation of stars had to die in spectacular supernova fashion to seed space with the heavier elements necessary for the second act of creation—the rise of self-replicating bags of chemicals on a rocky planet orbiting a young star at just the right distance. The competitive pressures of natural selection triggered the third act of creation—the accession of creatures endowed with sentience, with subjective states. As the complexity of their nervous systems grew to staggering proportions, some of these creatures evolved the ability to think about themselves and to contemplate the splendidly beautiful and terrifyingly cruel world around them.

The rise of sentient life within time's wide circuit was inevitable. Teilhard de Chardin is correct in his view that islands within the universe—if not the whole cosmos—are evolving toward ever-greater complexity and self-knowledge. I am not saying that Earth had to bear life or that bipedal, big-brained primates had to walk the African grasslands. But I do believe that the laws of physics overwhelmingly favored the emergence of consciousness. The universe is a work in progress. Such a belief evokes jeremiads from many biologists and philosophers, but the evidence from cosmology, biology, and history is compelling.

Spiritual traditions encourage us to reach out to our fellow travelers on the river of time. More than most secular ideologies, religions

emphasize the common bond among people: love thy neighbor as thyself. Religious sentiments, as expressed through music, literature, architecture, and the visual arts, bring out some of what is best in humankind. Yet collectively, they are only of limited use in making sense of the puzzle of our existence. The only certain answers come from science. What I find most appealing from an intellectual and ethical point of view are certain strands of Buddhism. But that is a topic for another book.

I am saddened by the loss of my religious belief, like leaving forever the comfort of my childhood home, suffused with a warm glow and fond memories. I still have feelings of awe when entering a high-vaulted cathedral or listening to Bach's *St. Matthew Passion*. Nor can I escape the emotional thrall, the splendor and pageantry, of high Mass. But my loss of faith is an inescapable part of growing up, of maturing and seeing the world as it is.

I'm cast out into the universe, a glorious strange, scary, and often lonely place. I strive to discern through its noisy manifestations—its people, dogs, trees, mountains, and stars—the eternal Music of the Spheres.

When all is said and done, I am left with a deep and abiding sense of wonder. Echoing across more than two thousand years, the unknown scribe of the Dead Sea Scrolls, living in a tiny community in the Judean desert, expressed it well. Let his psalm close my book:

So walk I on uplands unbounded
and know that there is hope
for that which thou didst mold out of dust
to have consort with things eternal.