

CHAPTER 10

A much needed gap?

What can be more soul shaking than peering through a 100-inch telescope at a distant galaxy, holding a 100-million-year-old fossil or a 500,000-year-old stone tool in one's hand, standing before the immense chasm of space and time that is the Grand Canyon, or listening to a scientist who gazed upon the face of the universe's creation and did not blink? That is deep and sacred science.

MICHAEL SHERMER

'This book fills a much needed gap.' The jest works because we simultaneously understand the two opposite meanings. Incidentally, I thought it was an invented witticism but, to my surprise, I find that it has actually been used, in all innocence, by publishers. See <http://www.kcl.ac.uk/kis/schools/hums/french/pgr/tqr.html> for a book that 'fills a much needed gap in the literature available on the post-structuralist movement'. It seems deliciously appropriate that this avowedly superfluous book is all about Michel Foucault, Roland Barthes, Julia Kristeva and other icons of haute francophonyism.

Does religion fill a much needed gap? It is often said that there is a God-shaped gap in the brain which needs to be filled: we have a psychological need for God - imaginary friend, father, big brother, confessor, confidant - and the need has to be satisfied whether God really exists or not. But could it be that God clutters up a gap that we'd be better off filling with something else? Science, perhaps? Art? Human friendship? Humanism? Love of this life in the real world, giving no credence to other lives beyond the grave? A love of nature, or what the great entomologist E. O. Wilson has called *Biophilia*?

Religion has at one time or another been thought to fill four main roles in human life: explanation, exhortation, consolation and inspiration. Historically, religion aspired to *explain* our own existence and the nature of the universe in which we find ourselves. In this role it is now completely superseded by science, and I have dealt with it in Chapter 4. By *exhortation* I mean moral instruction on how we ought to behave, and I covered that in Chapters 6 and 7. I have not so far done justice to *consolation* and *inspiration*, and this final chapter will briefly deal with them. As a preliminary to consolation itself, I want to begin with the childhood phenomenon of the 'imaginary friend', which I believe has affinities with religious belief.

BINKER

Christopher Robin, I presume, did not believe that Piglet and Winnie the Pooh really spoke to him. But was Binker different?

Binker - what I call him - is a secret of my own,
 And Binker is the reason why I never feel alone.
 Playing in the nursery, sitting on the stair,
 Whatever I am busy at, Binker will be there.
 Oh, Daddy is clever, he's a clever sort of man,
 And Mummy is the best since the world began,
 And Nanny is Nanny, and I call her Nan -
 But they can't See Binker.
 Binker's always talking, 'cos I'm teaching him to speak
 He sometimes likes to do it in a funny sort of squeak,
 And he sometimes likes to do it in a hoodling sort of roar ...
 And I have to do it for him 'cos his throat is rather sore.
 Oh, Daddy is clever, he's a clever sort of man,
 And Mummy knows all that anybody can,
 And Nanny is Nanny, and I call her Nan -
 But they don't Know Binker.
 Binker's brave as lions when we're running in the park;
 Binker's brave as tigers when we're lying in the dark;
 Binker's brave as elephants. He never, never cries . . .
 Except (like other people) when the soap gets in his eyes.
 Oh, Daddy is Daddy, he's a Daddy sort of man,
 And Mummy is as Mummy as anybody can,
 And Nanny is Nanny, and I call her Nan ...
 But they're not Like Binker.
 Binker isn't greedy, but he does like things to eat,
 So I have to say to people when they're giving me a sweet,
 'Oh, Binker wants a chocolate, so could you give me two?'
 And then I eat it for him, 'cos his teeth are rather new.
 Well, I'm very fond of Daddy, but he hasn't time to play,
 And I'm very fond of Mummy, but she sometimes goes away,
 And I'm often cross with Nanny when she wants to brush my
 hair . . .
 But Binker's always Binker, and is certain to be there.

A. A. MILNE, *NOW We Are Six**

Is the imaginary-friend phenomenon a higher illusion, in a different category from ordinary childhood make-believe? My own experience is not much help here. Like many parents, my mother

kept a notebook of my childish sayings. In addition to simple pretendings (now I'm the man in the moon ... an accelerator ... a Babylonian) I was evidently fond of second-order pretendings (now I'm an owl pretending to be a waterwheel) which might be reflexive (now I'm a little boy pretending to be Richard). I never once believed I really was any of those things, and I think that is normally true of childhood make-believe games. But I didn't have a Binker. If the testimony of their adult selves is to be believed, at least some of those normal children who have imaginary friends really do believe they exist, and, in some cases, see them as clear and vivid hallucinations. I suspect that the Binker phenomenon of childhood may be a good model for understanding theistic belief in adults. I do not know whether psychologists have studied it from this point of view, but it would be a worthwhile piece of research. Companion and confidant, a Binker for life: that is surely one role that God plays - one gap that might be left if God were to go.

Another child, a girl, had a 'little purple man', who seemed to her a real and visible presence, and who would manifest himself, sparkling out of the air, with a gentle tinkling sound. He visited her regularly, especially when she felt lonely, but with decreasing frequency as she grew older. On a particular day just before she went to kindergarten, the little purple man came to her, heralded by his usual tinkling fanfare, and announced that he would not be visiting her any more. This saddened her, but the little purple man told her that she was getting bigger now and wouldn't need him in the future. He must leave her now, so that he could look after other children. He promised her that he would come back to her if ever she *really* needed him. He did return to her, many years later in a dream, when she had a personal crisis and was trying to decide what to do with her life. The door of her bedroom opened and a cartload of books appeared, pushed into the room by ... the little purple man. She interpreted this as advice that she should go to university - advice that she took and later judged to be good. The story makes me almost tearful, and it brings me as close as I shall probably come to understanding the consoling and counselling role of imaginary gods in people's lives. A being may exist only in the imagination, yet still seem completely real to the child, and still give real comfort and good advice. Perhaps even better: imaginary

friends - and imaginary gods - have the time and patience to devote all their attention to the sufferer. And they are much cheaper than psychiatrists or professional counsellors.

Did gods, in their role as consolers and counsellors, evolve from binkers, by a sort of psychological 'paedomorphosis'? Paedomorphosis is the retention into adulthood of childhood characteristics. Pekinese dogs have paedomorphic faces: the adults look like puppies. It is a well-known pattern in evolution, widely accepted as important for the development of such human characteristics as our bulbous forehead and short jaws. Evolutionists have described us as juvenile apes, and it is certainly true that juvenile chimpanzees and gorillas look more like humans than adult ones do. Could religions have evolved originally by gradual postponement, over generations, of the moment in life when children gave up their binkers - just as we slowed down, during evolution, the flattening of our foreheads and the protrusion of our jaws?

I suppose, for completeness, we should consider the reverse possibility. Rather than gods evolving from ancestral binkers, could binkers have evolved from ancestral gods? This seems to me less likely. I was led to think about it while reading the American psychologist Julian Jaynes's *The Origin of Consciousness in the Breakdown of the Bicameral Mind*, a book that is as strange as its title suggests. It is one of those books that is either complete rubbish or a work of consummate genius, nothing in between! Probably the former, but I'm hedging my bets.

Jaynes notes that many people perceive their own thought processes as a kind of dialogue between the 'self and another internal protagonist inside the head. Nowadays we understand that both 'voices' are our own - or if we don't we are treated as mentally ill. This happened, briefly, to Evelyn Waugh. Never one to mince words, Waugh remarked to a friend: 'I haven't seen you for a long time, but then I've seen so few people because - did you know? - I went mad.' After his recovery, Waugh wrote a novel, *The Ordeal of Gilbert Pinfold*, which described his hallucinatory period, and the voices that he heard.

Jaynes's suggestion is that some time before 1000 BC people in general were unaware that the second voice - the Gilbert

Pinfold voice - came from within themselves. They thought the Pinfold voice was a god: Apollo, say, or Astarte or Yahweh or, more probably, a minor household god, offering them advice or orders. Jaynes even located the voices of the gods in the opposite hemisphere of the brain from the one that controls audible speech. The 'breakdown of the bicameral' mind was, for Jaynes, a historical transition. It was the moment in history when it dawned on people that the external voices that they seemed to be hearing were really internal. Jaynes even goes so far as to define this historical transition as the dawning of human consciousness.

There is an ancient Egyptian inscription about the creator god Ptah, which describes the various other gods as variations of Ptah's 'voice' or 'tongue'. Modern translations reject the literal 'voice' and interpret the other gods as 'objectified conceptions of [Ptah's] mind'. Jaynes dismisses such educated readings, preferring to take the literal meaning seriously. The gods were hallucinated voices, speaking inside people's heads. Jaynes further suggests that such gods evolved from memories of dead kings, who still, in a manner of speaking, retained control over their subjects via imagined voices in their heads. Whether or not you find his thesis plausible, Jaynes's book is intriguing enough to earn its mention in a book on religion.

Now, to the possibility I raised of borrowing from Jaynes to construct a theory that gods and binkers are developmentally related, but the opposite way around from the paedomorphosis theory. It amounts to the suggestion that the breakdown of the bicameral mind didn't happen suddenly in history, but was a progressive pulling back into childhood of the moment when hallucinated voices and apparitions were rumbled as not real. In a kind of reversal of the paedomorphosis hypothesis, the hallucinated gods disappeared from adult minds first, then were pulled back earlier and earlier into childhood, until today they survive only in the Binker or little purple man phenomenon. The problem with this version of the theory is that it doesn't explain the persistence of gods into adulthood today.

It might be better not to treat gods as ancestral to binkers, or vice versa, but rather to see both as by-products of the same psychological predisposition. Gods and binkers have in common the power to comfort, and provide a vivid sounding board for

trying out ideas. We have not moved far from Chapter 5's psychological by-product theory of the evolution of religion.

CONSOLATION

It is time to face up to the important role that God plays in consoling us; and the humanitarian challenge, if he does not exist, to put something in his place. Many people who concede that God probably doesn't exist, and that he is not necessary for morality, still come back with what they often regard as a trump card: the alleged psychological or emotional *need* for a god. If you take religion away, people truculently ask, what are you going to put in its place? What have you to offer the dying patients, the weeping bereaved, the lonely Eleanor Rigbys for whom God is their only friend?

The first thing to say in response to this is something that should need no saying. Religion's power to console doesn't make it true. Even if we make a huge concession; even if it were conclusively demonstrated that belief in God's existence is completely essential to human psychological and emotional well-being; even if all atheists were despairing neurotics driven to suicide by relentless cosmic angst - none of this would contribute the tiniest jot or tittle of evidence that religious belief is true. It might be evidence in favour of the desirability of convincing yourself that God exists, even if he doesn't. As I've already mentioned, Dennett, in *Breaking the Spell*, makes the distinction between belief in God and belief in belief: the belief that it is desirable to believe, even if the belief itself is false: 'Lord, I believe; help thou mine unbelief (Mark 9: 24). The faithful are encouraged to *profess* belief, whether they are convinced by it or not. Maybe if you repeat something often enough, you will succeed in convincing yourself of its truth. I think we all know people who enjoy the idea of religious faith, and resent attacks on it, while reluctantly admitting that they don't have it themselves.

Since reading of Dennett's distinction, I have found occasion to use it again and again. It is scarcely an exaggeration to say that the

majority of atheists I know disguise their atheism behind a pious facade. They do not believe in anything supernatural themselves, but retain a vague soft spot for irrational belief. They believe in belief. It is amazing how many people seemingly cannot tell the difference between 'X is true' and 'It is desirable that people should believe that X is true'. Or maybe they don't really fall for this logical error, but simply rate truth as unimportant compared with human feelings. I don't want to decry human feelings. But let's be clear, in any particular conversation, what we are talking about: feelings, or truth. Both may be important, but they are not the same thing.

In any case, my hypothetical concession was extravagant and wrong. I know of no evidence that atheists have any general tendency towards unhappy, angst-ridden despond. Some atheists are happy. Others are miserable. Similarly, some Christians, Jews, Muslims, Hindus and Buddhists are miserable, while others are happy. There may be statistical evidence bearing on the relationship between happiness and belief (or unbelief), but I doubt if it is a strong effect, one way or the other. I find it more interesting to ask whether there is any good *reason* to feel depressed if we live without God. I shall end this book by arguing, on the contrary, that it is an understatement to say that one can lead a happy and fulfilled life without supernatural religion. First, though, I must examine the claims of religion to offer consolation.

Consolation, according to the *Shorter Oxford Dictionary*, is the alleviation of sorrow or mental distress. I shall divide consolation into two types.

1. *Direct physical consolation.* A man stuck for the night on a bare mountain may find comfort in a large, warm St Bernard dog, not forgetting, of course, the brandy barrel around its neck. A weeping child may be consoled by the embrace of strong arms wrapped around her and reassuring words whispered in her ear.
2. *Consolation by discovery of a previously unappreciated fact, or a previously undiscovered way of looking at existing facts.* A woman whose husband has been killed in war may be

consoled by the discovery that she is pregnant by him, or that he died a hero. We can also get consolation through discovering a new way of thinking about a situation. A philosopher points out that there is nothing special about the moment when an old man dies. The child that he once was 'died' long ago, not by suddenly ceasing to live but by growing up. Each of Shakespeare's seven ages of man 'dies' by slowly morphing into the next. From this point of view, the moment when the old man finally expires is no different from the slow 'deaths' throughout his life.¹⁵⁴ A man who does not relish the prospect of his own death may find this changed perspective consoling. Or maybe not, but it is an example of consolation through reflection. Mark Twain's dismissal of the fear of death is another: 'I do not fear death. I had been dead for billions and billions of years before I was born, and had not suffered the slightest inconvenience from it.' The *apercu* changes nothing about the fact of our inevitable death. But we have been offered a different way of looking at that inevitability and we may find it consoling. Thomas Jefferson, too, had no fear of death and he seems to have believed in no kind of afterlife. By Christopher Hitchens's account, 'As his days began to wane, Jefferson more than once wrote to friends that he faced the approaching end without either hope or fear. This was as much as to say, in the most unmistakable terms, that he was not a Christian.'

Robust intellects may be ready for the strong meat of Bertrand Russell's declaration, in his 1925 essay 'What I Believe':

I believe that when I die I shall rot, and nothing of my ego will survive. I am not young and I love life. But I should scorn to shiver with terror at the thought of annihilation. Happiness is nonetheless true happiness because it must come to an end, nor do thought and love lose their value because they are not everlasting. Many a man has borne himself proudly on the scaffold; surely the same pride should teach us to think truly about man's place in the world. Even if the open windows of science at first make

us shiver after the cosy indoor warmth of traditional humanizing myths, in the end the fresh air brings vigour, and the great spaces have a splendour of their own.

I was inspired by this essay of Russell's when I read it in my school library at the age of about sixteen, but I had forgotten it. It is possible that I was paying unconscious homage to it when I wrote, in *A Devil's Chaplain* in 2003,

There is more than just grandeur in this view of life, bleak and cold though it can seem from under the security blanket of ignorance. There is deep refreshment to be had from standing up and facing straight into the strong keen wind of understanding: Yeats's 'Winds that blow through the starry ways'.

How does religion compare with, say, science in providing these two types of consolation? Looking at Type 1 consolation first, it is entirely plausible that the strong arms of God, even if they are purely imaginary, could console in just the same kind of way as the real arms of a friend, or a St Bernard dog with a brandy cask around its neck. But of course scientific medicine can also offer comfort - usually more effectively than brandy.

Turning now to Type 2 consolation, it is easy to believe that religion could be extremely effective. People caught up in a terrible disaster, such as an earthquake, frequently report that they derive consolation from the reflection that it is all part of God's inscrutable plan: no doubt good shall come of it in the fullness of time. If someone fears death, sincere belief that he has an immortal soul can be consoling - unless, of course, he thinks he is going to hell or purgatory. False beliefs can be every bit as consoling as true ones, right up until the moment of disillusionment. This applies to non-religious beliefs too. A man with terminal cancer may be consoled by a doctor who lies to him that he is cured, just as effectively as another man who is told truthfully that he is cured. Sincere and wholehearted belief in life after death is even more immune to disillusionment than belief in a lying doctor. The

doctor's lie remains effective only until the symptoms become unmistakable. A believer in life after death can never be ultimately disillusioned.

Polls suggest that approximately 95 per cent of the population of the United States believe they will survive their own death. I can't help wondering how many people who claim such belief really, in their heart of hearts, hold it. If they were truly sincere, shouldn't they all behave like the Abbot of Ampleforth? When Cardinal Basil Hume told him that he was dying, the abbot was delighted for him: 'Congratulations! That's brilliant news. I wish I was coming with you.'¹⁵⁵ The abbot, it seems, really was a sincere believer. But it is precisely because it is so rare and unexpected that his story catches our attention, almost provokes our amusement - in a fashion reminiscent of the cartoon of a young woman carrying a 'Make love not war' banner, stark naked, and with a bystander exclaiming, 'Now that's what I call sincerity!' Why don't all Christians and Muslims say something like the abbot when they hear that a friend is dying? When a devout woman is told by the doctor that she has only months to live, why doesn't she beam with excited anticipation, as if she has just won a holiday in the Seychelles? 'I can't wait!' Why don't faithful visitors at her bedside shower her with messages for those that have gone before? 'Do give my love to Uncle Robert when you see him . . .'

Why don't religious people talk like that when in the presence of the dying? Could it be that they don't really believe all that stuff they pretend to believe? Or perhaps they do believe it but fear the *process* of dying. With good reason, given that our species is the only one not allowed to go to the vet to be painlessly put out of our misery. But in that case, why does the most vocal opposition to euthanasia and assisted suicide come from the religious? On the 'Abbot of Ampleforth' or 'Holiday in the Seychelles' model of death, wouldn't you expect that religious people would be the least likely to cling unbecomingly to earthly life? Yet it is a striking fact that, if you meet somebody who is passionately opposed to mercy killing, or passionately against assisted suicide, you can bet a good sum that they will turn out to be religious. The official reason may be that all killing is a sin. But why deem it to be a sin if you sincerely believe you are accelerating a journey to heaven?

My attitude to assisted suicide, by contrast, takes off from Mark Twain's observation, already quoted. Being dead will be no different from being unborn - I shall be just as I was in the time of William the Conqueror or the dinosaurs or the trilobites. There is nothing to fear in that. But the process of dying could well be, depending on our luck, painful and unpleasant - the sort of experience from which we have become accustomed to being protected by a general anaesthetic, like having your appendix out. If your pet is dying in pain, you will be condemned for cruelty if you do not summon the vet to give him a general anaesthetic from which he will not come round. But if your doctor performs exactly the same merciful service for you when you are dying in pain, he runs the risk of being prosecuted for murder. When I am dying, I should like my life to be taken out under a general anaesthetic, exactly as if it were a diseased appendix. But I shall not be allowed that privilege, because I have the ill-luck to be born a member of *Homo sapiens* rather than, for example, *Canis familiaris* or *Felis catus*. At least, that will be the case unless I move to a more enlightened place like Switzerland, the Netherlands or Oregon. Why are such enlightened places so rare? Mostly because of the influence of religion.

But, it might be said, isn't there an important difference between having your appendix removed and having your life removed? Not really; not if you are about to die anyway. And not if you have a sincere religious belief in life after death. If you have that belief, dying is just a transition from one life to another. If the transition is painful, you should no more wish to undergo it without anaesthetic than you would wish to have your appendix removed without anaesthetic. It is those of us who see death as terminal rather than transitional who might naively be expected to resist euthanasia or assisted suicide. Yet we are the ones who support it.*

In the same vein, what are we to make of the observation of a senior nurse of my acquaintance, with a lifetime's experience in running a home for old people, where death is a regular occurrence? She has noticed over the years that the individuals who

* One study of attitudes to death among American atheists found the following: 50 per cent wanted a memorial celebration of their life; 99 per cent supported physician-assisted suicide for those who want it, and 75 per cent wanted it for themselves; 100 per cent wanted no contact with hospital staff who promote religion. See <http://nursestoner.com/myresearch.html>.

are most afraid of death are the religious ones. Her observation would need to be substantiated statistically but, assuming she is right, what is going on here? Whatever it is, it doesn't, on the face of it, speak strongly of religion's power to comfort the dying.* In the case of Catholics, maybe they are afraid of purgatory? The saintly Cardinal Hume said farewell to a friend in these words: 'Well, goodbye then. See you in purgatory, I suppose.' What / suppose is that there was a sceptical twinkle in those kind old eyes.

The doctrine of purgatory offers a preposterous revelation of the way the theological mind works. Purgatory is a sort of divine Ellis Island, a Hadean waiting room where dead souls go if their sins aren't bad enough to send them to hell, but they still need a bit of remedial checking out and purifying before they can be admitted to the sin-free-zone of heaven. In medieval times, the Church used to sell 'indulgences' for money. This amounted to paying for some number of days' remission from purgatory, and the Church literally (and with breathtaking presumption) issued signed certificates specifying the number of days off that had been purchased. The Roman Catholic Church is an institution for whose gains the phrase 'ill-gotten' might have been specially invented. And of all its money-making rip-offs, the selling of indulgences must surely rank among the greatest con tricks in history, the medieval equivalent of the Nigerian Internet scam but far more successful.

As recently as 1903, Pope Pius X was still able to tabulate the number of days' remission from purgatory that each rank in the hierarchy was entitled to grant: cardinals two hundred days, archbishops a hundred days, bishops a mere fifty days. By his time, however, indulgences were no longer sold directly for money. Even in the Middle Ages, money was not the only currency in which you could buy parole from purgatory. You could pay in prayers too, either your own before death or the prayers of others on your behalf, after your death. And money could buy prayers. If you were rich, you could lay down provision for your soul in perpetuity. My own Oxford College, New College, was founded in 1379 (it was new then) by one of that century's great philanthropists, William of Wykeham, Bishop of Winchester. A medieval bishop could become

* An Australian friend coined a wonderful phrase to describe the tendency for religiosity to increase in old age. Say it with an Australian intonation, going up at the end like a question: 'Cramming for the final?'

the Bill Gates of the age, controlling the equivalent of the information highway (to God), and amassing huge riches. His diocese was exceptionally large, and Wykeham used his wealth and influence to found two great educational establishments, one in Winchester and one in Oxford. Education was important to Wykeham, but, in the words of the official New College history, published in 1979 to mark the sixth centenary, the fundamental purpose of the college was 'as a great chantry to make intercession for the repose of his soul. He provided for the service of the chapel by ten chaplains, three clerks and sixteen choristers, and he ordered that they alone were to be retained if the college's income failed.' Wykeham left New College in the hands of the Fellowship, a self-electing body which has been continuously in existence like a single organism for more than six hundred years. Presumably he trusted us to continue to pray for his soul through the centuries.

Today the college has only one chaplain* and no clerks, and the steady century-by-century torrent of prayers for Wykeham in purgatory has dwindled to a trickle of two prayers per year. The choristers alone go from strength to strength and their music is, indeed, magical. Even I feel a twinge of guilt, as a member of that Fellowship, for a trust betrayed. In the understanding of his own time, Wykeham was doing the equivalent of a rich man today making a large down payment to a cryogenics company which guarantees to freeze your body and keep it insulated from earthquakes, civil disorder, nuclear war and other hazards, until some future time when medical science has learned how to unfreeze it and cure whatever disease it was dying of. Are we later Fellows of New College reneging on a contract with our Founder? If so, we are in good company. Hundreds of medieval benefactors died trusting that their heirs, well paid to do so, would pray for them in purgatory. I can't help wondering what proportion of Europe's medieval treasures of art and architecture started out as down payments on eternity, in trusts now betrayed.

But what really fascinates me about the doctrine of purgatory is the *evidence* that theologians have advanced for it: evidence so spectacularly weak that it renders even more comical the airy confidence with which it is asserted. The entry on purgatory in the *Catholic Encyclopedia* has a section called 'proofs'. The essential

* Female - what would Bishop William have made of that?

evidence for the existence of purgatory is this. If the dead simply went to heaven or hell on the basis of their sins while on Earth, there would be no point in praying for them. 'For why pray for the dead, if there be no belief in the power of prayer to afford solace to those who as yet are excluded from the sight of God.' And we do pray for the dead, don't we? Therefore purgatory must exist, otherwise our prayers would be pointless! Q.E.D. This seriously is an example of what passes for reasoning in the theological mind.

That remarkable *non sequitur* is mirrored, on a larger scale, in another common deployment of the Argument from Consolation. There must be a God, the argument goes, because, if there were not, life would be empty, pointless, futile, a desert of meaninglessness and insignificance. How can it be necessary to point out that the logic falls at the first fence? Maybe life *is* empty. Maybe our prayers for the dead really *are* pointless. To presume the opposite is to presume the truth of the very conclusion we seek to prove. The alleged syllogism is transparently circular. Life without your wife may very well be intolerable, barren and empty, but this unfortunately doesn't stop her being dead. There is something infantile in the presumption that somebody else (parents in the case of children, God in the case of adults) has a responsibility to give your life meaning and point. It is all of a piece with the infantilism of those who, the moment they twist their ankle, look around for someone to sue. Somebody else must be responsible for my well-being, and somebody else must be to blame if I am hurt. Is it a similar infantilism that really lies behind the 'need' for a God? Are we back to Binker again?

The truly adult view, by contrast, is that our life is as meaningful, as full and as wonderful as we choose to make it. And we can make it very wonderful indeed. If science gives consolation of a non-material kind, it merges into my final topic, inspiration.

INSPIRATION

This is a matter of taste or private judgement, which has the slightly unfortunate effect that the method of argument I must employ is

rhetoric rather than logic. I've done it before, and so have many others including, to name only recent examples, Carl Sagan in *Pale Blue Dot*, E. O. Wilson in *Biophilia*, Michael Shermer in *The Soul of Science* and Paul Kurtz in *Affirmations*. In *Unweaving the Rainbow* I tried to convey how lucky we are to be alive, given that the vast majority of people who could potentially be thrown up by the combinatorial lottery of DNA will in fact never be born. For those of us lucky enough to be here, I pictured the relative brevity of life by imagining a laser-thin spotlight creeping along a gigantic ruler of time. Everything before or after the spotlight is shrouded in the darkness of the dead past, or the darkness of the unknown future. We are staggeringly lucky to find ourselves in the spotlight. However brief our time in the sun, if we waste a second of it, or complain that it is dull or barren or (like a child) boring, couldn't this be seen as a callous insult to those unborn trillions who will never even be offered life in the first place? As many atheists have said better than me, the knowledge that we have only one life should make it all the more precious. The atheist view is correspondingly life-affirming and life-enhancing, while at the same time never being tainted with self-delusion, wishful thinking, or the whingeing self-pity of those who feel that life owes them something. Emily Dickinson said,

That it will never come again
Is what makes life so sweet.

If the demise of God will leave a gap, different people will fill it in different ways. My way includes a good dose of science, the honest and systematic endeavour to find out the truth about the real world. I see the human effort to understand the universe as a model-building enterprise. Each of us builds, inside our head, a model of the world in which we find ourselves. The minimal model of the world is the model our ancestors needed in order to survive in it. The simulation software was constructed and debugged by natural selection, and it is most adept in the world familiar to our ancestors on the African savannah: a three-dimensional world of medium-sized material objects, moving at medium speeds relative to one another. As an unexpected bonus, our brains turn out to be

powerful enough to accommodate a much richer world model than the mediocre utilitarian one that our ancestors needed in order to survive. Art and science are runaway manifestations of this bonus. Let me paint one final picture, to convey the power of science to open the mind and satisfy the psyche.

THE MOTHER OF ALL BURKAS

One of the unhappiest spectacles to be seen on our streets today is the image of a woman swathed in shapeless black from head to toe, peering out at the world through a tiny slit. The burka is not just an instrument of oppression of women and claustal repression of their liberty and their beauty; not just a token of egregious male cruelty and tragically cowed female submission. I want to use the narrow slit in the veil as a symbol of something else.

Our eyes see the world through a narrow slit in the electromagnetic spectrum. Visible light is a chink of brightness in the vast dark spectrum, from radio waves at the long end to gamma rays at the short end. Quite *how* narrow is hard to appreciate and a challenge to convey. Imagine a gigantic black burka, with a vision slit of approximately the standard width, say about one inch. If the length of black cloth above the slit represents the short-wave end of the invisible spectrum, and if the length of black cloth below the slit represents the long-wave portion of the invisible spectrum, how long would the burka have to be in order to accommodate a one-inch slit to the same scale? It is hard to represent it sensibly without invoking logarithmic scales, so huge are the lengths we are dealing with. The last chapter of a book like this is no place to start tossing logarithms around, but you can take it from me that it would be the mother of all burkas. The one-inch window of visible light is derisively tiny compared with the miles and miles of black cloth representing the invisible part of the spectrum, from radio waves at the hem of the skirt to gamma rays at the top of the head. What science does for us is widen the window. It opens up so wide that the imprisoning black garment drops away almost completely, exposing our senses to airy and exhilarating freedom.

Optical telescopes use glass lenses and mirrors to scan the heavens, and what they see is stars that happen to be radiating in the narrow band of wavelengths that we call visible light. But other telescopes 'see' in the X-ray or radio wavelengths, and present to us a cornucopia of alternative night skies. On a smaller scale, cameras with appropriate filters can 'see' in the ultraviolet and take photographs of flowers that show an alien range of stripes and spots that are visible to, and seemingly 'designed' for, insect eyes but which our unaided eyes can't see at all. Insect eyes have a spectral window of similar width to ours, but slightly shifted up the burka: they are blind to red and they see further into the ultraviolet than we do - into the 'ultraviolet garden'.*

The metaphor of the narrow window of light, broadening out into a spectacularly wide spectrum, serves us in other areas of science. We live near the centre of a cavernous museum of magnitudes, viewing the world with sense organs and nervous systems that are equipped to perceive and understand only a small middle range of sizes, moving at a middle range of speeds. We are at home with objects ranging in size from a few kilometres (the view from a mountaintop) to about a tenth of a millimetre (the point of a pin). Outside this range even our imagination is handicapped, and we need the help of instruments and of mathematics - which, fortunately, we can learn to deploy. The range of sizes, distances or speeds with which our imaginations are comfortable is a tiny band, set in the midst of a gigantic range of the possible, from the scale of quantum strangeness at the smaller end to the scale of Einsteinian cosmology at the larger.

Our imaginations are forlornly under-equipped to cope with distances outside the narrow middle range of the ancestrally familiar. We try to visualize an electron as a tiny ball, in orbit around a larger cluster of balls representing protons and neutrons. That isn't what it is like at all. Electrons are not like little balls. They are not like anything we recognize. It isn't clear that 'like' even means anything when we try to fly too close to reality's further horizons. Our imaginations are not yet tooled-up to penetrate the neighbourhood of the quantum. Nothing at that scale behaves in

* 'The Ultraviolet Garden' was the title of one of my five Royal Institution Christmas Lectures, originally televised by the BBC under the general title 'Growing Up in the Universe'. The whole series of five lectures will be made available at www.richarddawkins.net, the website of the Richard Dawkins Foundation.

the way matter - as we are evolved to think - ought to behave. Nor can we cope with the behaviour of objects that move at some appreciable fraction of the speed of light. Common sense lets us down, because common sense evolved in a world where nothing moves very fast, and nothing is very small or very large.

At the end of a famous essay on 'Possible Worlds', the great biologist J. B. S. Haldane wrote, 'Now, my own suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose ... I suspect that there are more things in heaven and earth than are dreamed of, or can be dreamed of, in any philosophy.' By the way, I am intrigued by the suggestion that the famous Hamlet speech invoked by Haldane is conventionally mis-spoken. The normal stress is on 'your':

There are more things in heaven and earth, Horatio,
Than are dreamt of in *your* philosophy.

Indeed, the line is often plonkingly quoted with the implication that Horatio stands for shallow rationalists and sceptics everywhere. But some scholars place the stress on 'philosophy', with 'your' almost vanishing: '. . . than are dreamt of in *any* philosophy.' The difference doesn't really matter for present purposes, except that the second interpretation already takes care of Haldane's 'any' philosophy.

The dedicatee of this book made a living from the strangeness of science, pushing it to the point of comedy. The following is taken from the same extempore speech in Cambridge in 1998 from which I have already quoted: 'The fact that we live at the bottom of a deep gravity well, on the surface of a gas-covered planet going around a nuclear fireball ninety million miles away and think this to be *normal* is obviously some indication of how skewed our perspective tends to be.' Where other science-fiction writers played on the oddness of science to arouse our sense of the mysterious, Douglas Adams used it to make us laugh (those who have read *The Hitchhiker's Guide to the Galaxy* might think of the 'infinite improbability drive', for instance). Laughter is arguably the best response to some of the stranger paradoxes of modern physics. The alternative, I sometimes think, is to cry.

Quantum mechanics, that rarefied pinnacle of twentieth-century

scientific achievement, makes brilliantly successful predictions about the real world. Richard Feynman compared its precision to predicting a distance as great as the width of North America to an accuracy of one human hair's breadth. This predictive success seems to mean that quantum theory has got to be true in some sense; as true as anything we know, even including the most down-to-earth common-sense facts. Yet the *assumptions* that quantum theory needs to make, in order to deliver those predictions, are so mysterious that even the great Feynman himself was moved to remark (there are various versions of this quotation, of which the following seems to me the neatest): 'If you think you understand quantum theory . . . you don't understand quantum theory.'^{*}

Quantum theory is so queer that physicists resort to one or another paradoxical 'interpretation' of it. Resort is the right word. David Deutsch, in *The Fabric of Reality*, embraces the 'many worlds' interpretation of quantum theory, perhaps because the worst that you can say of it is that it is preposterously *wasteful*. It postulates a vast and rapidly growing number of universes, existing in parallel and mutually undetectable except through the narrow porthole of quantum-mechanical experiments. In some of these universes I am already dead. In a small minority of them, you have a green moustache. And so on.

The alternative 'Copenhagen interpretation' is equally preposterous - not wasteful, just shatteringly paradoxical. Erwin Schrödinger satirized it with his parable of the cat. Schrödinger's cat is shut up in a box with a killing mechanism triggered by a quantum-mechanical event. Before we open the lid of the box, we don't know whether the cat is dead. Common sense tells us that, nevertheless, the cat must be either alive or dead inside the box. The Copenhagen interpretation contradicts common sense: all that exists before we open the box is a probability. As soon as we open the box, the wave function collapses and we are left with the single event: the cat is dead, or the cat is alive. Until we opened the box, it was neither dead nor alive.

The 'many worlds' interpretation of the same events is that in some universes the cat is dead; in other universes the cat is alive. Neither interpretation satisfies human common sense or intuition. The more macho physicists don't care. What matters is that the

* A similar remark is attributed to Niels Bohr: 'Anyone who is not shocked by quantum theory has not understood it.'

mathematics work, and the predictions are experimentally fulfilled. Most of us are too wimpish to follow them. We seem to *need* some sort of visualization of what is 'really' going on. I understand, by the way, that Schrodinger originally proposed his cat thought-experiment in order to expose what he saw as the absurdity of the Copenhagen interpretation.

The biologist Lewis Wolpert believes that the queerness of modern physics is just the tip of the iceberg. Science in general, as opposed to technology, does violence to common sense.¹⁵⁶ Here's a favourite example: every time you drink a glass of water, the odds are good that you will imbibe at least one molecule that passed through the bladder of Oliver Cromwell. It's just elementary probability theory. The number of molecules per glassful is hugely greater than the number of glassfuls in the world. So every time we have a full glass, we are looking at a rather high proportion of the molecules of water that exist in the world. There is, of course, nothing special about Cromwell, or bladders. Haven't you just breathed in a nitrogen atom that was once breathed out by the third iguanodon to the left of the tall cycad tree? Aren't you glad to be alive in a world where not only is such a conjecture possible but you are privileged to understand why? And publicly explain it to somebody else, not as your opinion or belief but as something that they, when they have understood your reasoning, will feel compelled to accept? Maybe this is an aspect of what Carl Sagan meant when he explained his motive in writing *The Demon-Haunted World: Science as a Candle in the Dark*: "Not explaining science seems to me perverse. When you're in love, you want to tell the world. This book is a personal statement, reflecting my lifelong love affair with science."

The evolution of complex life, indeed its very existence in a universe obeying physical laws, is wonderfully surprising - or would be but for the fact that surprise is an emotion that can exist only in a brain which is the product of that very surprising process. There is an anthropic sense, then, in which our existence should not be surprising. I'd like to think that I speak for my fellow humans in insisting, nevertheless, that it is desperately surprising.

Think about it. On one planet, and possibly only one planet in the entire universe, molecules that would normally make nothing

more complicated than a chunk of rock, gather themselves together into chunks of rock-sized matter of such staggering complexity that they are capable of running, jumping, swimming, flying, seeing, hearing, capturing and eating other such animated chunks of complexity; capable in some cases of thinking and feeling, and falling in love with yet other chunks of complex matter. We now understand essentially how the trick is done, but only since 1859. Before 1859 it would have seemed very very odd indeed. Now, thanks to Darwin, it is merely very odd. Darwin seized the window of the burka and wrenched it open, letting in a flood of understanding whose dazzling novelty, and power to uplift the human spirit, perhaps had no precedent - unless it was the Copernican realization that the Earth was not the centre of the universe.

'Tell me,' the great twentieth-century philosopher Ludwig Wittgenstein once asked a friend, 'why do people always say it was natural for man to assume that the sun went round the Earth rather than that the Earth was rotating?' His friend replied, 'Well, obviously because it just *looks* as though the Sun is going round the Earth.' Wittgenstein responded, 'Well, what would it have looked like if it had looked as though the Earth was rotating?' I sometimes quote this remark of Wittgenstein in lectures, expecting the audience to laugh. Instead, they seem stunned into silence.

In the limited world in which our brains evolved, small objects are more likely to move than large ones, which are seen as the background to movement. As the world rotates, objects that seem large because they are near - mountains, trees and buildings, the ground itself - all move in exact synchrony with each other and with the observer, relative to heavenly bodies such as the sun and stars. Our evolved brains project an illusion of movement onto them rather than the mountains and trees in the foreground.

I now want to pursue the point mentioned above, that the way we see the world, and the reason why we find some things intuitively easy to grasp and others hard, is that *our brains are themselves evolved organs*: on-board computers, evolved to help us survive in a world - I shall use the name Middle World - where the objects that mattered to our survival were neither very large nor very small; a world where things either stood still or moved slowly compared with the speed of light; and where the very improbable

could safely be treated as impossible. Our mental burka window is narrow because it didn't *need* to be any wider in order to assist our ancestors to survive.

Science has taught us, against all evolved intuition, that apparently solid things like crystals and rocks are really composed almost entirely of empty space. The familiar illustration represents the nucleus of an atom as a fly in the middle of a sports stadium. The next atom is right outside the stadium. The hardest, solidest, densest rock, then, is 'really' almost entirely empty space, broken only by tiny particles so far apart that they shouldn't count. So why do rocks look and feel solid and hard and impenetrable?

I won't try to imagine how Wittgenstein might have answered that question. But, as an evolutionary biologist, I would answer it like this. Our brains have evolved to help our bodies find their way around the world on the scale at which those bodies operate. We never evolved to navigate the world of atoms. If we had, our brains probably *would* perceive rocks as full of empty space. Rocks feel hard and impenetrable to our hands because our hands can't penetrate them. The reason they can't penetrate them is unconnected with the sizes and separations of the particles that constitute matter. Instead, it has to do with the force fields that are associated with those widely spaced particles in 'solid' matter. It is useful for our brains to *construct* notions like solidity and impenetrability, because such notions help us to navigate our bodies through a world in which objects - which we call solid - cannot occupy the same space as each other.

A little comic relief at this point - from *The Men who Stare at Goats* by Jon Ronson:

This is a true story. It is the summer of 1983. Major General Albert Stubblebine III is sitting behind his desk in Arlington, Virginia, and he is staring at his wall, upon which hang his numerous military awards. They detail a long and distinguished career. He is the United States Army's chief of intelligence, with sixteen thousand soldiers under his command . . . He looks past his awards to the wall itself. There is something he feels he must do even though the thought of it frightens him. He thinks about

the choice he has to make. He can stay in his office or he can go into the next office. That is his choice. And he has made it. He is going into the next office . . . He stands up, moves out from behind his desk, and begins to walk. I mean, he thinks, what is the atom mostly made up of anyway? Space! He quickens his pace. What am I mostly made of? He thinks. Atoms! He is almost at a jog now. What is the wall mostly made up of? He thinks. Atoms! All I have to do is merge the spaces. . . . Then General Stubblebine bangs his nose hard on the wall of his office. Damn, he thinks. General Stubblebine is confounded by his continual failure to walk through his wall.

General Stubblebine is appropriately described as an 'out of the box thinker' on the website of the organization which, in retirement, he now runs with his wife. It is called HealthFreedomUSA, and it is dedicated to 'supplements (vitamins, minerals, amino acids, etc.), herbs, homeopathic remedies, nutritional medicine and clean food (untainted by pesticides, herbicides, antibiotics), without corporations (through the use of government coercion) dictating to you what dosages and treatments you are allowed to use'. There is no mention of precious bodily fluids.*

Having evolved in Middle World, we find it intuitively easy to grasp ideas like: 'When a major general moves, at the sort of medium velocity at which major generals and other Middle World objects do move, and hits another solid Middle World object like a wall, his progress is painfully arrested.' Our brains are not equipped to imagine what it would be like to be a neutrino passing through a wall, in the vast interstices of which that wall 'really' consists. Nor can our understanding cope with what happens when things move at close to the speed of light.

Unaided human intuition, evolved and schooled in Middle World, even finds it hard to believe Galileo when he tells us that a cannon ball and a feather, given no air friction, would hit the ground at the same instant when dropped from a leaning tower. That is because, in Middle World, air friction is always there. If we had evolved in a vacuum, we would *expect* a feather and a cannonball to hit the ground simultaneously. We are evolved denizens of Middle World,

* www.healthfreedomusa.org/aboutus/president.shtml. For what looks like a very characterful portrait of General Stubblebine, see www.mindcontrolforums.com/images/Mind94.jpg.

and that limits what we are capable of imagining. The narrow window of our burka permits us, unless we are especially gifted or peculiarly well educated, to see only Middle World.

There is a sense in which we animals have to survive not just in Middle World but in the micro-world of atoms and electrons too. The very nerve impulses with which we do our thinking and our imagining depend upon activities in Micro World. But no action that our wild ancestors ever had to perform, no decision that they ever had to take, would have been assisted by an understanding of Micro World. If we were bacteria, constantly buffeted by thermal movements of molecules, it would be different. But we Middle Worlders are too clumsily massive to notice Brownian motion. Similarly, our lives are dominated by gravity but are almost oblivious to the delicate force of surface tension. A small insect would reverse that priority and would find surface tension anything but delicate.

Steve Grand, in *Creation: Life and How to Make It*, is almost scathing about our preoccupation with matter itself. We have this tendency to think that only solid, material 'things' are 'really' things at all. 'Waves' of electromagnetic fluctuation in a vacuum seem 'unreal'. Victorians thought that waves had to be waves 'in' some material medium. No such medium was known, so they invented one and named it the luminiferous ether. But we find 'real' matter comfortable to our understanding only because our ancestors evolved to survive in Middle World, where matter is a useful construct.

On the other hand, even we Middle Worlders can see that a whirlpool is a 'thing' with something like the reality of a rock, even though the matter in the whirlpool is constantly changing. In a desert plain in Tanzania, in the shadow of Ol Donyo Lengai, sacred volcano of the Masai, there is a large dune made of ash from an eruption in 1969. It is carved into shape by the wind. But the beautiful thing is that it *moves* bodily. It is what is technically known as a barchan (pronounced bahkahn). The entire dune walks across the desert in a westerly direction at a speed of about 17 metres per year. It retains its crescent shape and creeps along in the direction of the horns. The wind blows sand up the shallower slope. Then, as each sand grain hits the top of the ridge, it cascades down the steeper slope on the inside of the crescent.

Actually, even a barchan is more of a 'thing' than a wave. A wave *seems* to move horizontally across the open sea, but the molecules of water move vertically. Similarly, sound waves may travel from speaker to listener, but molecules of air don't: that would be a wind, not a sound. Steve Grand points out that you and I are more like waves than permanent 'things'. He invites his reader to think ...

... of an experience from your childhood. Something you remember clearly, something you can see, feel, maybe even smell, as if you were really there. After all, you really were there at the time, weren't you? How else would you remember it? But here is the bombshell: you *weren't* there. Not a single atom that is in your body today was there when that event took place . . . Matter flows from place to place and momentarily comes together to be you. Whatever you are, therefore, you are not the stuff of which you are made. If that doesn't make the hair stand up on the back of your neck, read it again until it does, because it is important.

'Really' isn't a word we should use with simple confidence. If a neutrino had a brain which had evolved in neutrino-sized ancestors, it would say that rocks 'really' do consist mostly of empty space. We have brains that evolved in medium-sized ancestors, who couldn't walk through rocks, so our 'really' is a 'really' in which rocks are solid. 'Really', for an animal, is whatever its brain needs it to be, in order to assist its survival. And because different species live in such different worlds, there will be a troubling variety of 'reallys'.

What we see of the real world is not the unvarnished real world but a *model* of the real world, regulated and adjusted by sense data - a model that is constructed so that it is useful for dealing with the real world. The nature of that model depends on the kind of animal we are. A flying animal needs a different kind of world model from a walking, a climbing or a swimming animal. Predators need a different kind of model from prey, even though their worlds necessarily overlap. A monkey's brain must have software capable

of simulating a three-dimensional maze of branches and trunks. A water boatman's brain doesn't need 3D software, since it lives on the surface of the pond in an Edwin Abbott Flatland. A mole's software for constructing models of the world will be customized for underground use. A naked mole rat probably has world-representing software similar to a mole's. But a squirrel, although it is a rodent like the mole rat, probably has world-rendering software much more like a monkey's.

I've speculated, in *The Blind Watchmaker* and elsewhere, that bats may 'see' colour with their ears. The world-model that a bat needs, in order to navigate through three dimensions catching insects, must surely be similar to the model that a swallow needs in order to perform much the same task. The fact that the bat uses echoes to update the variables in its model, while the swallow uses light, is incidental. Bats, I suggest, use perceived hues such as 'red' and 'blue' as internal labels for some useful aspect of echoes, perhaps the acoustic texture of surfaces; just as swallows use the same perceived hues to label long and short wavelengths of light. The point is that the nature of the model is governed by how it is to be *used* rather than by the sensory modality involved. The lesson of the bats is this. The general form of the mind model - as opposed to the variables that are constantly being inputted by sensory nerves - is an adaptation to the animal's way of life, no less than its wings, legs and tail are.

J. B. S. Haldane, in the article on 'possible worlds' that I quoted above, had something relevant to say about animals whose world is dominated by smell. He noted that dogs can distinguish two very similar volatile fatty acids - caprylic acid and caproic acid - each diluted to one part in a million. The only difference is that caprylic acid's main molecular chain is two carbon atoms longer than the main chain of caproic acid. A dog, Haldane guesses, would probably be able to place the acids 'in the order of their molecular weights by their smells, just as a man could place a number of piano wires in the order of their lengths by means of their notes'.

There is another fatty acid, capric acid, which is just like the other two except that it has yet two more carbon atoms in its main chain. A dog that had never met capric acid would perhaps have no more trouble imagining its smell than we would have trouble

imagining a trumpet playing one note higher than we have heard a trumpet play before. It seems to me entirely reasonable to guess that a dog, or a rhinoceros, might treat mixtures of smells as harmonious chords. Perhaps there are discords. Probably not melodies, for melodies are built up of notes that start or stop abruptly with accurate timing, unlike smells. Or perhaps dogs and rhinos smell in colour. The argument would be the same as for the bats.

Once again, the perceptions that we call colours are tools used by our brains to label important distinctions in the outside world. Perceived hues - what philosophers call *qualia* - have no intrinsic connection with lights of particular wavelengths. They are internal labels that are *available* to the brain, when it constructs its model of external reality, to make distinctions that are especially salient to the animal concerned. In our case, or that of a bird, that means light of different wavelengths. In a bat's case, I have speculated, it might be surfaces of different echoic properties or textures, perhaps red for shiny, blue for velvety, green for abrasive. And in a dog's or a rhino's case, why should it not be smells? The power to imagine the alien world of a bat or a rhino, a pond skater or a mole, a bacterium or a bark beetle, is one of the privileges science grants us when it tugs at the black cloth of our burka and shows us the wider range of what is out there for our delight.

The metaphor of Middle World - of the intermediate range of phenomena that the narrow slit in our burka permits us to see - applies to yet other scales or 'spectrums'. We can construct a scale of improbabilities, with a similarly narrow window through which our intuition and imagination are capable of going. At one extreme of the spectrum of improbabilities are those would-be events that we call impossible. Miracles are events that are extremely improbable. A statue of a madonna could wave its hand at us. The atoms that make up its crystalline structure are all vibrating back and forth. Because there are so many of them, and because there is no agreed preference in their direction of motion, the hand, as we see it in Middle World, stays rock steady. But the jiggling atoms in the hand *could* all just *happen* to move in the same direction at the same time. And again. And again ... In this case the hand would move, and we'd see it waving at us. It could happen, but the odds

against are so great that, if you had set out writing the number at the origin of the universe, you still would not have written enough zeroes to this day. The power to calculate such odds - the power to quantify the near-impossible rather than just throw up our hands in despair - is another example of the liberating benefactions of science to the human spirit.

Evolution in Middle World has ill equipped us to handle very improbable events. But in the vastness of astronomical space, or geological time, events that seem impossible in Middle World turn out to be inevitable. Science flings open the narrow window through which we are accustomed to viewing the spectrum of possibilities. We are liberated by calculation and reason to visit regions of possibility that had once seemed out of bounds or inhabited by dragons. We have already made use of this widening of the window in Chapter 4, where we considered the improbability of the origin of life and how even a near-impossible chemical event must come to pass given enough planet years to play with; and where we considered the spectrum of possible universes, each with its own set of laws and constants, and the anthropic necessity of finding ourselves in one of the minority of friendly places.

How should we interpret Haldane's 'queerer than we can suppose'? Queerer than can, *in principle*, be supposed? Or just queerer than we can suppose, given the limitation of our brains' evolutionary apprenticeship in Middle World? Could we, by training and practice, emancipate ourselves from Middle World, tear off our black burka, and achieve some sort of intuitive - as well as just mathematical - understanding of the very small, the very large, and the very fast? I genuinely don't know the answer, but I am thrilled to be alive at a time when humanity is pushing against the limits of understanding. Even better, we may eventually discover that there are no limits.