ONE

Time and Space

WHAT WE CALL CIVILISATION HAS EXISTED FOR SOMEthing like six thousand years. We are accustomed to thinking of this as an exceedingly long time. Some of us have a vague outline of it in our heads. In my part of the world this usually starts with the Old Testament of the Bible, followed or accompanied by the rise of Greek civilisation, which was followed by the Roman Empire—each of which lasted for hundreds of years. Then came the thousand years of the Middle Ages. This ended with the Renaissance, which was followed by the Reformation, followed by the Enlightenment, then by the Industrial Revolution

and the Romantic Era—and then on to the modern world and our own day. Across these same immensities of time other civilisations—unknown, or mostly unknown, to the people in my part of the world—rose and fell on other parts of the globe's surface: China, Japan, India, Central Asia, the Middle East, South America, Mexico. We think of these vast historical changes as happening in only-just-moving time—time moving in the sort of way a glacier moves.

But now consider the following. There are always some human beings who live to be a hundred. More do so today than ever before, but there have always been some. I have known three quite well, two of them public figures: the politician Emmanuel Shinwell and the musical philanthropist Robert Mayer. (Robert knew Brahms, who was a friend of his family and stayed with them in Mannheim.) When Robert was born there must have been individuals who were then a hundred years old, whom a person could have met and got to know in the same way as I got to know him (or as he got to know Brahms, who died when Robert was seventeen). When those others were born, there must have been yet other such individuals. And so on: one could go further and further back, putting the lives of nameable human beings together, end to end, without any gaps in between. It comes as a shock to realise that the whole of civilisation has occurred within the successive lifetimes of sixty people—which is the number of friends I squeeze into my living room when I have a drinks party. Twenty

people take us back to Jesus, twenty-one to Julius Caesar. Even a paltry ten take us back before 1066 and the Norman Conquest. As for the Renaissance, it is only half a dozen people away.

When one measures history by a single possible human lifetime one realises that the whole of it has been almost incredibly short. This means that historical change has been almost incredibly fast. Each of those great empires that so imposingly rose, flourished and fell did so during the overlapping lives of a handful of individuals, usually fewer than half a dozen. So we ourselves are still near the beginning of the entire story. Tomorrow will be followed by the next day, next year by the year after, next century by the century after, next millennium by the millennium after, and the year 20,000 will inevitably come, as will the year 200,000, and the year 2,000,000. It is unstoppable. In fact, as periods in the existence of our planet and other bodies in the universe go, these are short periods of time. From now on, as long as there are human beings on this or any other heavenly body, humans will have a continuous, ever-extending history that traces itself back unbrokenly to our day now and our planet here. What is going to happen to all those people—what will they do—in unending time? How in the far, far future will they think of us now, who are so near the beginning of it all, and whom they will know a lot about if they choose to? How shall we appear to them in the light of all that will have happened between us and them, in a period

many, many times as long as that between the dawn of civilisation and today?

I can imagine some of my readers throwing their hands up and protesting: "How can we even think about these things? What concepts do we have for getting hold of any of this? Surely it is self-evident that, a mere two or three thousand years ago, geniuses as great as any there have been, people like Socrates and Plato, could not have foreseen today's world, or almost any of the world's history between their time and ours? What imaginings can we hope to conjure up that are worth having about a period, all of it still in the future, so many times as long as that? It's a blank. We could make a few guesses about developments in the *near* future, perhaps, but history shows us that even those are more likely to be wrong than right. The truth is we don't know, we cannot know, we haven't the remotest idea. We have no choice but to go on with our lives in the present, pushing into that tiny little bit of the future that our "now" slides into, without thinking about any of the things you're saying—not because they aren't worth thinking about (it would be wonderful if we could) but because we have no way of thinking about them, nothing to think about them *with*."

My answer is: I have posited nothing outside the ordinary, everyday order of events—nothing religious, nothing supernatural, nothing transcendental. I have merely asked what will happen if circumstances continue exactly as they are today, and go on in this fa-

miliar way, as we expect them to do. For such a continuance *not* to occur might need the intervention of something supernatural, say, like time stopping. There is, it is true, a possibility that the earth will stop, because it could be smashed to pieces in a collision with a body from outer space, or frozen into lifelessness by the sun's cooling; but such possibilities lie either millions (at least) of years in the future or at the outer extremes of unlikelihood. Most are such that the human race will get warning of them before they occur, and may even be able to do something to prevent their happening. For instance, nuclear weapons may turn out to be the saving of the human race. If astronomers tell us that a huge asteroid is on a collision course with our earth, we may be able to knock it off course with nuclear missiles and save ourselves. The missiles would have to be far more powerful than any we have now, but that will happen in the normal course of events. On the other hand it is possible that the human race will destroy itself with those same weapons, thereby bringing its history to an end—but that is rendered unlikely by the fact that our every movement from present into future is dominated by our need to solve the problems of survival. The most obvious likelihood is that the human race will go on living through vast stretches of future time but not necessarily on planet earth: people may find somewhere better to live, or be forced into moving by the earth's becoming uninhabitable. In any case at every point in time they will have a past that

is continuous with our past, most of which they will know better than we know it ourselves, because information technology will have been developing during that time.

We are used to thinking of our knowledge of our own past as capacious. Through the last thousand years the nearer history approaches to our own day, the more detailed it becomes. Our knowledge of the twentieth century is unprecedentedly detailed. But we need to remind ourselves that the knowledge we have of the twentieth century was unknowable to anyone living only two hundred years ago. Their location in time sealed them off from it. To them, the twentieth century was as blank as future centuries are to us. Wherever in time human beings may be positioned they know their past but not their future. Yet the events themselves—past, present and future—are the same for everyone, and occur in the same order. It is emphatically not the case that, because we human beings can have little or no knowledge of future events, those events will be vague and indefinite. It is we who are vague and indefinite. It is our knowledge—or rather lack of it—that is the blank. The future is full. We just do not yet know what it is. The events that will fill it are as concrete, factual and specific as those that fill our past.

What we can know, and what we can understand, is so influenced by our location in time that it is impossible for us to disentangle that influence and get a clear look at it. It governs not only our knowledge of our present history and our present future but even

our present knowledge of our present society. We cannot see it in perspective. Wherever we are in time almost nothing about our society—from its social structure to its physical plant, from its arts and sciences to its cookery and clothing, from its economy to its religion, from its modes of warfare to its methods of transport, from its manners and mores to its uses of language—is the same as it had been a hundred years before, or as it will be a hundred years hence. For this reason most people are as provincial in time as they are in space: they huddle down into their time and regard it as their total environment. But the opposite would be nearer the truth. Their time is about to be swept away and become nothing but a memory—and not even that for very long, but rather an ever-receding sliver of an ever-expanding history. Little of it will survive in anyone's mind. Even less will be of lasting interest, except to historians.

Nevertheless, each one of us has no choice but to live the whole of his life in his own little bit of time. That is his ration, his all. In life as we know it, time is the cruellest, the most lethal of all the forms of our limitation. In the words of a well-known hymn:

> Time, like an ever-rolling stream,
> Bears all its sons away;
> They fly forgotten, as a dream
> Dies at the opening day.

There is no escaping this. Within the empirical world all time will be taken away from us, and with it everything we have and are in this world.

While we are enjoying our moment our spatial movements are confined to a small space, so our limitations in that dimension too are draconian. So narrowly programmed are we biologically for a life on the surface of this planet that if we attempt to depart far from the surface, either inward (under the earth or the sea) or outward (into space), we die unless we can find some artificial way of carrying our surface environment with us. Up to now we have not got far—neither deep nor high. The only object apart from earth that humans have set foot on is the moon, which is less than 240,000 miles away. Meanwhile the already-visible universe is 1,000,000,000,000,000,000,000,000 miles across. The Astronomer Royal tells us that we must expect the not-yet-visible universe to extend beyond that by distances which—measured not in miles but in light-years—would be written "not with ten zeros, not even with a hundred, but with millions." Our solar system is the merest speck in all this. Such is the relationship between a human lifetime and the astronomical distances involved that it is unlikely that humans will ever be able to penetrate even as far as the edge of their own solar system.

When I was a graduate student at Yale I was taught that the concept of time and the concept of space are logically interdependent. We find it impossible to define time-concepts without using space-concepts in the definition, and vice versa. Since Einstein, time and space have been understood by physicists to be "inextricably interconnected," as Stephen Hawking puts it.

The interconnections are many and profound and not always easy to understand. But let us consider the following.

If I look through a telescope at a star whose light takes nearly a hundred years to reach the earth, I see that star as it was nearly a hundred years ago. For all I know it may not be in that position now: it may have exploded at some time during the last century, or it may now be in a different part of the sky. In any event what impinges on my retina is the light that left that star all those years ago. But this is no different from what happens when I look at anything else. If I look at a person in the same room as myself I see him not as he is "now" but as he was at some point in the past—namely the length of time ago that it has taken light to travel from him to me. In our ordinary lives the distances involved, and therefore the time-intervals, are so minuscule that we ignore them—in fact we are unaware of their existence. But they do exist. And this has the following consequence.

If, on the star I was talking of, there is a sentient being looking at our earth through a telescope, he sees our earth as it was nearly a hundred years ago (in our time). If his telescope is a super-powerful one which enables him to observe human movements, he could be sitting there in my "now" watching World War I being fought. He is watching not a record of the events, or some sort of re-run of them, as in a film, or anything of that sort: he is watching *them*. He is looking at the events themselves, and seeing the

same things as an officer standing on the battlefield with a pair of field-glasses. Both of them are receiving the same light waves travelling towards them at the same speed, and impinging in the same way on the lenses through which they are looking. The sentient being with the telescope is as direct an observer of events as the officer on the battlefield.

If, at the same time by our time, on a different star almost two thousand light-years away, another observer is observing our earth with an even more powerful telescope, he could be watching the crucifixion of Jesus. From a star much nearer, someone could be directly observing the Battle of Hastings. And from a star nearer still, someone could be watching the first Queen Elizabeth processing through the crowded streets of sixteenth-century London. Events not only in human history but throughout the whole history of the earth could be directly observed simultaneously by watchers from stars at different distances. And there would be nothing supernatural about any of it. We are familiar with the idea of God as a being who sees the whole of history simultaneously, but a group of human beings could do it if they were able to set up appropriate observation equipment in the right places. There would be no time-travel involved in any of it, and no magic or miracles. They would merely be connecting themselves up to something that is going on all the time.

Einstein believed, on purely scientific grounds, that there is no objective "now" as far as physics is con-

cerned, and that what counts as "now" depends on the position of the observer relative to what is observed. But if only relative to an observer can there be "now," then only relative to an observer can there be past and future. Einstein was explicit about this: he thought that the idea of pastness and futureness as existing objectively was an illusion, albeit a persistent one that has almost a stranglehold on the human mind. We can better understand the meaning of this if we reflect that every moment in the history we know was "present" for the people living in it, "future" for those who lived before it, and "past" for those who came after, yet the events and their sequence were exactly the same for everybody. This is true, says Einstein, of everything in time. Events have an order in time, so there is temporal order—it is important to understand that he is not disputing that—but in this temporal order there is no privileged moment which is "now." To put it another way, time *sequence* is objective, but the *flow of time* is not. The flow of time is a characteristic of experience. So many physicists since Einstein have followed him in this that it cannot be said to be a mystical view: it is a scientific one. Actually the philosophers got there first, with Kant; but it makes a world of difference when a philosophical conjecture acquires a scientific foundation.

So deeply mysterious is the nature of time that important aspects of it continue to be matters in live dispute among physicists. I would be foolish, not being a physicist, to attempt to argue in scientific terms for

one view as against another. But the very existence of the controversy among scientists demonstrates, as I have said, that these problems exist independently of philosophy or religion; and they certainly do not have solutions in terms of common sense, or even solutions that are easily intelligible to common sense. Quite the contrary. They baffle common sense.

In some fundamental way, time and space are structural to matter, which could not exist without them. All physical objects, to exist at all, must have a location in space, and also a location in time. What is more, all material objects are ephemeral: they come into existence, are perpetually changing throughout their existence, and—whether suddenly or slowly—go out of existence. To this our bodies are no exception. As Galileo said, if we were immortal we could not be in this world. The time-span of a human body's existence sets limits to the distances through which it can move, so at any given time we may be able to make a partially informed guess as to what these may be. For instance, if it were the case that nothing could move faster than the speed of light, and no person could live longer than 200 years, then no one would be able to get more than 200 light-years away from his starting point—though of course that would not necessarily have to be the earth. Even if the speed of light is not a limiting velocity, it may well be that successive journeys in successive lifetimes will still have the effect of keeping human beings confined to a corner of their universe for aeons of time.

The way we apprehend all material objects other than ourselves is affected by their size relative to us. They range from stars millions of times the size of our earth to the constituents of sub-atomic particles. Our perspective on them differs from that of other sentient creatures, even though those creatures may have a lot in common with us, and by the measures of the universe may be similar in size to us. For instance, to us a lawn looks and feels like a carpet underfoot, but to an ant living in its grass it must seem in almost every way different. Yet the differences are of proportion, position and perspective only. Physically, all of us—not only sentient creatures but physical objects of every kind—are made of the same stuff. When any of us dies, or any physical body is destroyed, the atoms that constituted it disperse, but they do not cease to exist. Having, before our existence, been part of other solids, liquids and gases—and having then come together temporarily to constitute you and me—they will disperse again to constitute other things. All the material objects thus formed are ephemeral, are temporary arrangements. Only the atoms, or rather their constituents, are indestructible.

It is an astonishing fact, but it is a fact, that the same matter constitutes everything, like a gigantic pack of cards that are never-endingly reshuffled and redealt. As Heisenberg, who introduced the uncertainty principle into quantum mechanics, put it: "Now we know that it is always the same matter, the same

various chemical compounds that may belong to any object, to minerals as well as animals or plants; also the forces that act between the different parts of matter are ultimately the same in every kind of object. . . . We have here actually the final proof for the unity of matter. All the elementary particles are made of the same substance, which we may call energy or universal matter; they are just different forms in which matter can appear." The number of years for which each particle has existed is so great that each has been part of countless billions of other objects, no doubt some of them organisms, before it was part of us. And of such an order is the number of particles needed to make up a human being—such, also, the biochemistry of human reproduction—that huge numbers of the particles that constitute each one of us have almost certainly belonged to other people. In that sense, each of us is a reincarnation. And, as I have said, each of us is only a temporary arrangement.

Hundreds of years before science had explained these things to us in terms of particles and atoms, Shakespeare seems to have grasped the essential point. (One sometimes feels he understood everything.) At one moment in *Hamlet* the Prince says (or sings) the lines

> Imperious Caesar, dead and turn'd to clay,
> Might stop a hole, to keep the wind away.
> O, that that earth, which kept the world in awe,
> Should patch a wall to expel the winter's flaw!

Earlier in the play Hamlet says to King Claudius: "A man may fish with the worm that hath eat of a king, and eat of the fish that hath fed of that worm." The King, aware that he is being needled, says: "What dost thou mean by this?" and Hamlet answers: "Nothing, but to show you how a king may go a progress through the guts of a beggar."

Every one of these perspectives needs to be absorbed into an adequate view of ourselves. And the list is nowhere near complete. How can we, buried almost invisibly as we are in the ongoing processes of the universe—each of us here for only the flicker of an eyelid—hope to know even so much as *what* there is to be understood, let alone understand it? The idea that everything is in principle comprehensible to humans—and therefore that nothing can exist that is not comprehensible to humans—is unworthy of head-space. The pioneering scientist J. S. Haldane (father of the better-known J.B.S.) was always, I believe, a materialist, and once said: "The universe is not only queerer than we suppose; it is queerer than we *can* suppose." Even the most rational of persons needs to grasp that.

When all these factors have been taken into account, it is surely clear that reality will never be intellectually mastered by humans. New discoveries are being made all the time, nonstop, and some of them require us to change our existing ideas. And there is always indefinitely more to discover. The sciences are racing ahead even during the time I am writing this

book. Hardly does an enquirer get a grasp of the latest developments before the significance of them is altered by new advances. Any individual who looks at the world around him and tries to master it with his understanding is all the time having the rug pulled out from under his feet. He has scarcely finished struggling to liberate himself from the inadequacies of an earlier way of looking at things before he finds the inadequacies of the new way being exposed. There is no end to this process.

Another factor that makes it impossible to achieve intellectual mastery of the world is that nothing can be fully understood only from inside: everything needs always to be seen from outside as well. This is true of people, objects, countries, societies, institutions, belief-systems, ideas—everything. This being so, those of us engaged in this kind of pursuit already have one foot in a trap. In our attempts to understand the universe we cannot get outside the universe. In our attempts to understand the empirical world we cannot get outside the empirical world. In our attempts to understand ourselves as human beings we cannot get outside ourselves as human beings. This is not, and I hope obviously not, to say that we cannot understand anything. But it is certainly to say that we cannot understand everything.