9. Time

'There is not even a meaning to the word *experience* which would not presuppose the distinction between past and future.'

Carl von Weizsäcker

'But at my back I always hear
Time's wingèd chariot hurrying near'

Andrew Marvell

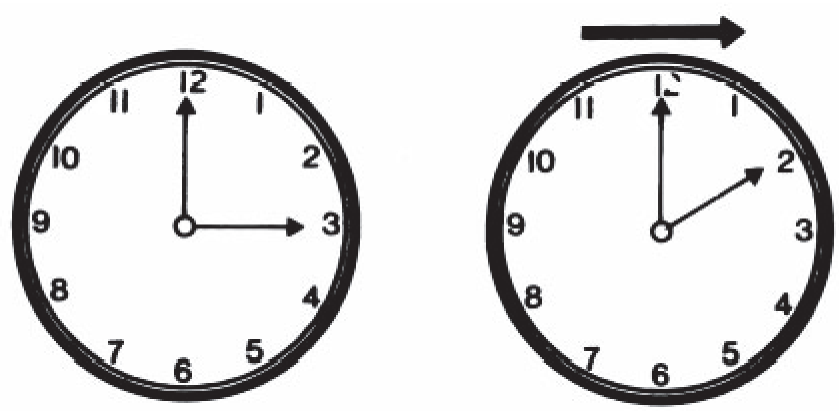
Two great revolutions gave birth to the new physics: the quantum theory and the theory of relativity. The latter, almost exclusively due to the work of Einstein, is a theory of space, time and motion. Its consequences are as equally baffling and profound as the quantum theory, and challenge many cherished notions about the nature of the universe. Never is this more so than in the theory's treatment of time — a subject of intense and longstanding concern in all the world's great religions.

Time is so fundamental to our experience of the world that any attempt to tinker with it meets with great scepticism and resistance. Every week I receive manuscipts by amateur scientists intent on finding fault with Einstein's work, attempting to restore the commonsense, traditional concept of time despite almost eighty years of success during which not a single experiment has marred the flawless predictions of the theory of relativity.

Our very notion of personal identity — the self, the soul — is closely bound up with memory and *enduring* experience. It is not sufficient to proclaim 'I exist', at this instant. To *be* an individual implies a continuity of experience together with some linking feature, such as memory. The strong emotional and religious overtones of the subject probably account both for the resistance to the claims of the new physics and for the deep fascination which scientists and laymen alike share for the mind-bending consequences of the theory of relativity.

The so-called special theory of relativity, published in 1905, arose from attempts to reconcile an apparent conflict between the motion of material bodies and the propagation of electromagnetic disturbances. In particular, the behaviour of light signals seem to be in flagrant violation of the long-standing principle that all uniform motion is purely relative. The technical details need not concern us here. The result was that Einstein restored the relativity principle, even for the case when light signals are involved, but at a price.

The first casualty of the special theory was the belief that time is absolute and universal. Einstein demonstrated that time is, in fact, elastic and can be stretched and shrunk by motion. Each observer carries around his own personal scale of time, and it does not generally agree with anybody else's. In our own frame, time never appears distorted, but relative to another observer who is moving differently, our time can be wrenched out of step with their time.



19 The time dilation effect, now a routine experience for physicists, can be demonstrated by using rapidly moving, sensitive atomic clocks, or subatomic particles with known decay rates. The moving clock runs slow relative to its neighbour. This leads to the famous 'twins effect' in which an astronaut returns from a high-speed voyage some years younger than his Earthbound twin.

This weird dislocation of time scales opens the way to a type of time travel. In a sense, we are all travellers in time, heading towards the future, but the elasticity of time enables some people to get there faster than others. Rapid motion enables you to put the brakes on your own time scale, and let the world rush by, as it were. By this strategy it is possible to reach a distant moment more quickly than by sitting still. In principle one could reach the year 2000 in a few hours. However, to achieve an appreciable timewarp speeds of many thousands of miles per second are necessary. At currently available rocket speeds only precision atomic clocks can reveal the minute dilations. The key to these effects is the speed of light. As it is approached, so the timewarp escalates. The theory forbids anyone to break the light barrier, which would have the effect of turning time inside out.

It is possible to telescope time dramatically using high-speed subatomic particles. Whirled about in a giant accelerator very close to the speed of light, particles called muons have been 'kept alive' for dozens of times longer than would be expected if they were at rest (when they decay in about a microsecond).

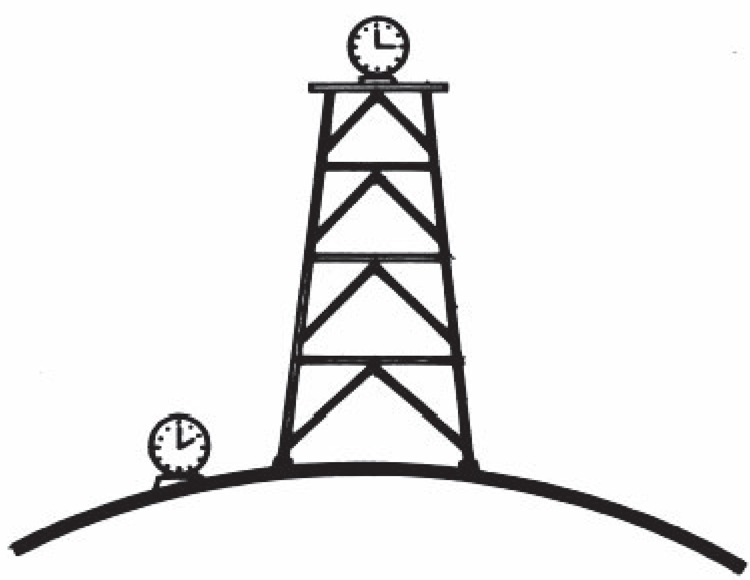
Equally extraordinary effects afflict space, which is also elastic. When time is stretched, space is shrunk. Rushing on a train through a railway station, the station clock runs slightly slower as viewed from your-frame of reference, relative to that of a porter on the platform. In compensation, the platform appears to you to be somewhat shorter. Of course we never notice such effects because they are too small at ordinary speeds, but they are easily measured on sensitive instruments. The mutual distortions of space and time can be regarded as a conversion of space (which shrinks) into time (which stretches). A second of time, however, is worth an awful lot of space — about

186,000 miles to be precise.

Time distortions of this sort are a favourite sci-fi gimmick, but there is nothing fictional about them. They really do occur. One bizarre phenomenon is the so-called twins effect. An itinerant twin blasts off to a nearby star, nudging the light barrier. The stay-at-home twin waits for him to return ten years later. When the rocket gets back, the Earth-bound twin finds his brother has aged only one year to his ten. High speed has enabled him to experience only one year of time, during which ten years have elapsed on Earth.

Einstein went on to generalize his theory to include the effects of gravity. The resulting general theory of relativity incorporates gravity, not as a force, but a distortion of spacetime geometry. In this theory, spacetime is not ‘flat’, obeying the usual rules of school geometry, but curved or warped, giving rise to both spacewarps and timewarps.

As discussed in Chapter 2, modern instruments are so sensitive that even the Earth's gravitational timewarp can be detected by clocks in rockets. Time really does run faster in space, where the Earth's gravity is weaker.



20 Gravity slows time, as may be demonstrated experimentally even on Earth. The clock at the top of the tower gains relative to that at the base.

The stronger the gravity, the more pronounced is the timewarp. Some stars are known where the grip of gravity is so ferocious that time there is slowed by several per cent relative to us. In fact, these stars are on the brink of the threshold at which runaway timewarps set in. If the gravity of such a star were a few times greater, the timewarp would escalate until, at a critical value of the gravity, time would grind to a halt altogether. Viewed from Earth, the surface of the star would be frozen into immobility. We could not, however, see this extraordinary temporal suspension because the light by which we would view it is also seized by the same torpidity, and its frequency depressed beyond the visible region of the spectrum. The star would appear black.

Theory suggests that a star in this condition could not remain inert, but would succumb to its own intense gravity and implode in a microsecond to a spacetime singularity, leaving behind a hole in space — a black hole. The timewarp of the erstwhile star remains imprinted in the empty space.

A black hole, therefore, represents a rapid route to eternity. In this extreme case, not only would a rocket-bound twin reach the future quicker, he could reach the *end of time* in the twinkling of an eye! At the instant he enters the hole, all of eternity will have passed outside according to his relative determination of ‘now’. Once inside the hole, therefore, he will be imprisoned in a timewarp, unable to return to the outside universe again, because the outside universe will have happened. He will be, literally, beyond the end of time as far as the rest of the universe is concerned. To emerge from the hole, he would have to come out before he went in. This is absurd and shows there is no escape. The inexorable grip of the hole's gravity drags the hapless astronaut towards the singularity where, a microsecond later, he reaches the edge of time, and obliteration; the singularity marks the end of a one-way journey to ‘nowhere’ and ‘nowhen’. It is a nonplace where the physical universe ceases.

The revolution in our conception of time which has accompanied the theory of relativity is best summarized by saying that, previously, time was regarded as absolute, fixed, and universal — independent of material bodies or observers. Today time is seen to be *dynamical*. It can stretch and shrink, warp and even stop altogether at a singularity. Clock rates are not absolute, but relative to the state of motion or gravitational situation of the observer.

Liberating time from the strait-jacket of universality, and allowing each observer's time to roll forward freely and independently, forces us to abandon some long-standing assumptions. For example, there can be no unanimous agreement about the choice of ‘now’. In the twins experiment, the rocket twin, during his outward trip, might wonder: ‘What is my twin on Earth doing *now?*’ But the dislocation of their relative time scales means that ‘now' in the frame of the rocket is quite a different moment from ‘now' as judged on Earth. There is no universal ‘present moment’. If two events, A and B, occurring at separated places, are regarded as simultaneous by one observer, another observer will see A occur before B, while yet another may regard B as occurring first.

The idea that the time order of two events might appear different to different observers seems paradoxical. Can the target shatter before the gun fires? Fortunately for causality, this does not happen. For events A and B to have an uncertain sequence, they must occur within a short enough duration that it would be impossible for light to travel from place A to place B in that interval. In the theory of relativity, light signals make all the rules, and in particular they forbid any influence or signal to travel faster than they do. If light isn't fast enough to connect A and B, nothing is, so A and B cannot influence one another in any way. There is no causal connection between them; reversing the time order of A and B does not amount to reversing cause and effect.

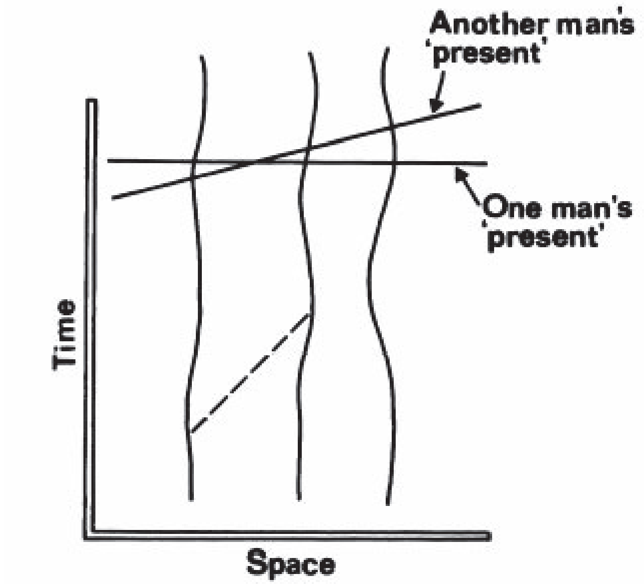
One inevitable victim of the fact that there is no universal present moment is the tidy division of time into past, present and future. These terms may have meaning in one's immediate locality, but they can't apply everywhere. Questions such as ‘What is happening *now* on Mars?’ are intended to refer to a particular instant on that planet.

But as we have seen, a space traveller sweeping past Earth in a rocket who asked the same question at the same instant would be referring to a different moment on Mars. In fact, the range of possible ‘nows' on Mars available to an observer near Earth (depending on his motion) actually spans several minutes. When the distance to the subject is greater, so is this range of ‘nows’. For a distant quasar ‘now’ could refer to any interval over billions of years. Even the effect of strolling around on foot alters the ‘present moment’ on a quasar by thousands of years!

The abandonment of a distinct past, present and future is a profound step, for the temptation to assume that only the present ‘really exists’ is great. It is usually presumed, without thinking, that the future is as yet unformed and perhaps undetermined; the past has gone, remembered but relinquished. Past and future, one wishes to believe, do not exist. Only one instant of reality seems to occur ‘at a time’. The theory of relativity makes nonsense of such notions. Past, present and future must be equally real, for one person's past is another's present and another's future.

The physicist's attitude to time is strongly conditioned by his experiences with the effects of relativity and can appear quite alien to the layman, although the physicist himself rarely thinks twice about it. He does not regard time as a sequence of events which *happen*. Instead, all of past and future are simply *there*, and time extends in either direction from any given moment in much the same way as space stretches away from any particular place. In fact, the comparison is more than an analogy, for space and time become inextricably interwoven in the theory of relativity, united into what physicists call *spacetime*.

Our psychological perception of time differs so radically from the physicist's model that even many physicists have come to doubt whether some vital ingredient has been omitted. Eddington once remarked that there is a sort of ‘back door’ into our minds through which time enters in addition to its usual route through our laboratory instruments and senses. Our sensation of time is somehow more elementary than our sensation of say, spatial orientation or matter. It is an internal, rather than a bodily experience. Specifically, we feel the *passage* of time — a sensation which is so pronounced that it constitutes the most elementary aspect of our experience. It is a kinetic backdrop against which all our thoughts and activity are perceived.



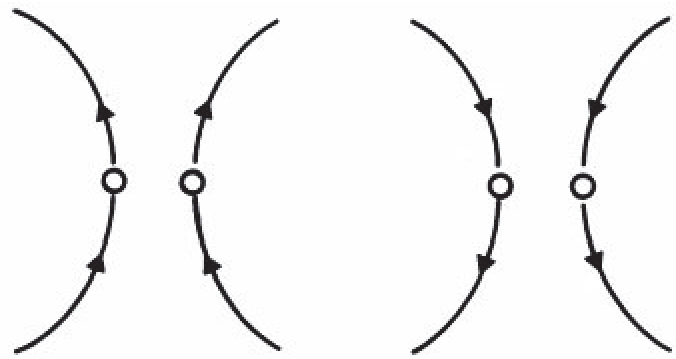
21 Physicists do not regard time as passing but laid out as part of 'space-time', a four-dimensional structure depicted here as a two-dimensional sheet by suppressing two space dimensions. A point on the sheet is an 'event'. The wiggly lines are the paths of bodies that move about; the broken line is the path of a light signal sent between two bodies. The horizontal line through the figure represents a slice through all of space at one instant from the point of view of one observer. Another observer, moving differently, would require the oblique slice. Thus, there must be a temporal (vertical) extension to make sense of the world. There is no universal 'slice' representing a single, common, 'present'. For that reason, division into a universal past, present and future is impossible.

In their search for this mysterious time-flux many scientists have become deeply confused. All physicists recognize that there is a past-future asymmetry in the universe, produced by the operation of the second law of thermodynamics. But when the basis of that law is carefully examined, the asymmetry seems to evaporate.

This paradox can easily be illustrated. Suppose, in a sealed room, the top is removed from a bottle of scent. After a while the scent will have evaporated and dispersed throughout the room, its perfume apparent to anyone. The transition from liquid scent to perfumy air — from order to disorder — is irreversible. We should not expect, however long we wait, for the disseminated scent molecules to find their way back spontaneously into the scent bottle and there to reconstitute the liquid. The evaporation and diffusion of the scent provides a classic example of asymmetry between past and future. If we witnessed a film showing the scent returning to the bottle we should spot immediately that the film was being run backwards in the projector. It is not reversible.

Yet there is a paradox here. The scent evaporates and disperses under the impact of billions of molecular bombardments. The molecules of air in their ceaseless thermal agitation serve to knock the scent molecules about at random, shuffling and reshuffling, until the scent is inextricably mixed with the air. However, any given individual molecular collision is perfectly reversible. Two molecules approach, bounce and retreat. Nothing time asymmetric in that. The reverse process would also be approach, bounce and retreat.

The mystery of time's arrow — how can a past-future asymmetry come from symmetrically colliding molecules — has exercised the



22 The origin of time asymmetry in the world is a mystery when we examine matter at the atomic level. The collision between any two molecules is completely reversible, and displays no preferred past-future orientation.

imaginations of many eminent physicists. The problem was first stated clearly by Ludwig Boltzmann in the late nineteenth century, but the controversy continues today. Some scientists have asserted that there exists a peculiar non-material quality, a time-flux, that is responsible for the arrow of time. They assert that ordinary molecular motions are incapable of imprinting a past-future asymmetry on time, so that this extra ingredient, the time-flux, is essential. Efforts have even been made to trace the origin of the flux to quantum processes or the expansion of the universe. In many ways the belief in a time-flux is closely analogous to — and equally as dubious as — the belief in a life-force.

The mistake is to overlook the fact that time asymmetry, like life, is a holistic concept, and cannot be reduced to the properties of individual molecules. There is no inconsistency between symmetry at the molecular level, and asymmetry on a macroscopic scale. They are simply two different levels of description. One suspects then, that time doesn't really 'flow' at all; it's all in the mind.

When we try to pin down the origin of the time-flux in our perceptions we encounter the same tangle of paradox and confusion that greets attempts to understand the self, and it is hard to resist the impression that the two problems are really closely related. It is only in the flowing river of time that we can perceive ourselves. Hofstadter has written of the 'whirling vortex of self-reference' that produces what we call consciousness and self-awareness, and I strongly believe that it is this very vortex that drives the psychological time-flux. It is for this reason I maintain that the secret of mind will only be solved when we understand the secret of time.

Naïve images of time are to be found everywhere in art and literature: time's arrow, the river of time, time's chariot, time marching on. It is often said that the 'now' or present moment of our consciousness is steadily moving forward through time from past to future, so that, eventually, the year 2000 will become 'now' and by the same token the instant in which you read this will by now have been passed over and consigned to history. Sometimes the now is considered anchored, and time itself is thought to flow, as a river flows past a bankside observer. These images are inseparable from our feelings of free will. The future seems not yet formed, and thus capable of being shaped by our actions before it arrives. Yet surely all this is rubbish?

Problems instantly crop up when one tries to defend the above imagery. A conversation in 1983 between a physicist and a sceptic might go something like this:

Sceptic:	I just came across this quote from Einstein: 'You have to accept the idea that subjective time with its emphasis on the now has no objective meaning… the distinction between past, present and future is only an illusion, however persistent.' Surely Einstein must have been off his rocker?
Physicist:	Not at all. In the external world there is no past, present and future. How could the present ever be determined with instruments? It's a purely psychological concept.
Sceptic:	Oh come now, you can't be serious. Everybody knows the future hasn't happened yet, whereas the past is gone – we remember it happening. How can you confuse yesterday with tomorrow, or today for that matter?
Physicist:	Of course you must make a distinction between various days in sequence, but it's the labels you use that I object to. Even you would agree that tomorrow never comes.
Sceptic:	That's just a play on words. Tomorrow does come, only when it does we call it today.
Physicist:	Precisely. Every day is called today on that day. Every moment is called 'now' when it is experienced. Division into *the* past and *the* future is the result of a linguistic muddle. Let me help you sort it out. Each instant of time can be ascribed a definite date. For example, 2 p.m. on 3 October 1997. The dating system is arbitrary, but once we have decided on a convention the date of any particular event or moment is fixed once and for all. By giving date labels to all events, we can describe everything in the world without recourse to dubious constructions like past, present and future.
Sceptic:	But 1997 *is* in the future. It hasn't happened yet. Your date system ignores a crucial aspect of time: namely its flow.
Physicist:	What do you mean '1997 *is* in the future'? It is in the past of 1998.
Sceptic:	But it's not 1998 *now*.
Physicist:	Now?

Sceptic: Yes, *now*.

Physicist: When is now? Every moment is 'now' when we experience it.

Sceptic: *This* now. I mean *this* now.

Physicist: You mean the 1983 now?

Sceptic: If you like.

Physicist: Not the 1998 now?

Sceptic: No.

Physicist: Then all you are saying is that 1997 is in the future of 1983, but in the past of 1998. I don't deny that. It is precisely what my dating system describes. Nothing more. So you see, your talk of the past and future is unnecessary, after all.

Sceptic: But that's absurd! 1997 hasn't happened yet. That is a fact you will surely agree with?

Physicist: Naturally. All you are saying is that our conversation occurs before 1997. Let me repeat. I don't deny there is an ordered sequence of events, with a definite before–after or past–future relation between them. I am simply denying the existence of *the* past, *the* present and *the* future. There clearly is not *a* present, for you and I have both experienced many 'presents' in our life. Some events lie in the past or future of other events, but the events themselves are simply *there*, they don't *happen* one by one.

Sceptic: Is that what some physicists mean when they say that past and future events exist alongside the present — that they are somehow *there*, but we only come across these events one after the other?

Physicist: We don't really 'come across' them at all. Every event of which we are conscious, we experience. They don't lie in wait for us to creep up on them, temporally speaking. There are simply events, and mental states associated with them. You talk as though today's mind is somehow transported forward in time to stumble on tomorrow's events. Your mind is extended in time. Tomorrow's mental states reflect tomorrow's events, today's reflect today's.

Sceptic: Surely my consciousness moves forward from today to tomorrow?

Physicist: No! Your mind is conscious both today and tomorrow. Nothing *moves* forward, backward or sideways.

Sceptic: But I *feel* time passing.

Physicist: Hold on a minute, if you will forgive the expression. First you say your mind is moving forward in time, then you say that time itself is moving forward. Which is it to be?

Sceptic: I see time as like a flowing river, bringing future events towards me. Either I can see my consciousness as fixed, and time flowing through it, from future to past, or time is fixed and my consciousness moves from past towards the future. I think the two descriptions are equivalent. The motion is relative.

Physicist: The motion is illusory! How can time move? If it moves it must have a speed. What speed? One day per day? It's nonsense. A day is a day is a day.

Sceptic: But if time doesn't pass, how do things change?

Physicist: Change occurs because objects move about through space *in time*. Time doesn't move. When I was a child I used to wonder 'Why is it *now*, rather than some other time?' When I grew up I learned that the question was meaningless. It can be asked at every moment of time.

Sceptic: I think it's a perfectly legitimate question. After all, why is it 1983?

Physicist: Why is *what* 1983?

Sceptic: Well, why is it 1983 now?

Physicist: Your question is a bit like asking 'Why am I *me* and not somebody else?' I am myself by definition — whichever person asks the question. Obviously in 1983 we regard 1983 as 'now'. The same would apply for any year. A legitimate question could be 'Why am I living in 1983 and not, say, 5,000 B.C.?' or 'Why are we having this conversation in 1983 and not 1998?' but there is no need to appeal to notions of past, present and future at all in such discussions.

I'm still not convinced. Almost all our daily thoughts and activities, the tense structure of our language, our hopes, fears and beliefs, are rooted in the fundamental distinction of past, present and future. I am afraid of death, Sceptic: because I have yet to face it, and I am uncertain what lies beyond. But I am not afraid because I don't know of my existence before birth. We can't be afraid of the past. Again, the past is unalterable. We know what happened because of our memories. But we don't know the future, and we believe that it is undetermined, that our actions can change it. As for the present, well, that is our instant of contact with the external world, when our minds can order our bodies to act. Byron wrote ‘Act, act in the living present’. That sums it up admirably for me.

Physicist: Most of what you say is true, but still does not require a moving present. Of course there is an asymmetry between past and future, not just in our experiences such as memory, but in the external world. The second law of thermodynamics, for example, ensures that systems tend to become more and more disordered. Other systems possess accumulating records and ‘memory’. Think of the craters on the moon: that is a record of past, not future events. All you are saying is that later brain states have more stored information than earlier brain states. We then make the mistake of translating that simple fact into the muddled and ambiguous words ‘We remember the past, not the future' in spite of the fact that *the* past is a meaningless phrase. Indeed, in 1998 we shall remember 1997, which *is* in the future of 1983. Stick to dates and you don't need tenses, or the flow of time, or the now.

Sceptic: But you just said ‘shall remember’ yourself.

Physicist: I could have said: ‘My brain state in 1998 records information about events in 1997. But 1997 is in the future of 1983, so is not recorded in my brain states of 1983’. See, no need for past and future after all.

Sceptic: What about the fear of the future, freewill and unpredictability? If the future already exists that must mean complete determinism. Nothing can be changed. Freewill is a sham.

Physicist: The future doesn't ‘already’ exist. That statement is a contradiction in terms, for it says ‘events exist simultaneously with events prior to them’ which is obviously nonsense by definition of the word ‘prior’ As for unpredictability, that is a practical limitation. It's true we can only predict certain simple events, such as an eclipse of the sun, because of the world's complexity. But predictability is not the same as determinism. You are mixing your epistemology with your metaphysics. Future states of the world could all be determined by prior events, but still be unpredictable in practical terms.

Sceptic: But is the future determined? Sorry. Are all events completely determined by prior events?

Physicist: Actually no. For example, the quantum theory reveals that, at the atomic level, events occur spontaneously, without complete prior causation.

Sceptic: So the future doesn't exist! We *can* change it!

Physicist: The future will be what it will be, whether our actions beforehand are involved or not. The physicist views spacetime as laid out like a map, with time extending along one side. Events are marked as points on the map — some events are linked by causal relations to prior events, others, like the decay of a radioactive nucleus, are labelled 'spontaneous'. It's all *there*, whether the causal links are incorporated or not. So my contention that there is no past, present and future says nothing about freewill or determinism at all. That's quite a separate subject — and a minefield of confusions.

Sceptic: You still haven't explained to me why I *feel* the flow of time.

Physicist: I'm not a neurologist. It has probably got something to do with short-term memory processes.

Sceptic: You're claiming it's all in the mind — an illusion?

Physicist: You would be unwise to appeal to your feelings to attribute physical qualities to the external world. Haven't you ever felt dizzy?

Sceptic: Of course.

Physicist: But you do not attempt to attribute your dizziness to a rotation of the universe, in spite of the fact that you feel the world spinning round?

Sceptic: No. It's clearly an illusion.

Physicist: So, I maintain that the whirling of time is like the whirling of space — a sort of temporal dizziness — which is given a false impression of reality by our confused language, with its tense structure and meaningless phrases about the past, present and future.

Sceptic: Tell me more.

Physicist: Not now. I've run out of time…

What can one conclude from this sort of exchange? There is no doubt that in organizing our daily affairs we depend heavily upon the concepts of past, present and future, and never question that time really does pass. Even physicists soon lapse back to that way of talking and thinking (as we saw above) once their analytical faculties have been withdrawn. Yet it must be conceded that the closer we scrutinize these concepts the more slippery and ambiguous they seem to become, and all our statements end up as either tautologous or meaningless. The physicist has no need of the flow of time or the now in the world of physics. Indeed, the theory of relativity rules out a universal present for all observers. If there is any meaning at all to these concepts (and many philosophers, such as McTaggart, deny that there is[1]) then it would seem they belong to psychology rather than physics.

This raises an intriguing theological question. Does God experience the passage of time?

Christians believe that God is eternal. The word 'eternal' has, however, been used to mean two rather different things. In the simpler version, eternal means everlasting, or existing without beginning or end for an infinite duration. There are grave objections to such an idea of God, however. A God who is in time is subject to change. But what causes that change? If God is the cause of all existing things (as the cosmological argument of Chapter 3 suggests), then does it make sense to talk about that ultimate cause itself changing?

In the earlier chapters we have seen how time is not simply there, but is itself part of the physical universe. It is 'elastic' and can stretch or shrink according to well-defined mathematical laws which depend on the behaviour of matter. Also, time is closely linked to space, and space and time together express the operation of the gravitational field. In short, time is involved in all the grubby details of physical processes just as much as matter. Time is not a divine quality, but can be altered, physically, even by human manipulation. A God who is in time is, therefore, in some sense caught up in the operation of the physical universe. Indeed, it is quite likely that time will cease to exist at some stage in the future (as we shall see in Chapter 15). In that case God's own position is obviously insecure. Clearly, God cannot be omnipotent if he is subject to the physics of time, nor can he be considered the creator of the universe if he did not create time. In fact, because time and space are inseparable, a God who did not create time, created space neither. But as we have seen, once spacetime existed, the appearance of matter and order in the universe could have occurred automatically as the result of perfectly natural activity. Thus, many would argue that God is not really needed as a creator at all *except* to create time (strictly, spacetime).

So we are led to the other meaning of the word eternal — 'timeless'. The concept of a

God beyond time dates at least from Augustine who (as we saw in Chapter 3) suggested that God created time. It has received support from many of the Christian theologians. St. Anselm expresses the idea as follows: ‘You [God] exist neither yesterday, today, nor tomorrow, but you exist directly right outside time.’ [2]

A timeless God is free of the problems mentioned above, but suffers from the shortcomings already discussed on page 38. He cannot be a personal God who thinks, converses, feels, plans, and so on for these are all temporal activities. It is hard to see how a timeless God can act at all in time (although it has been claimed that this is not impossible). We have also seen how the sense of the existence of the self is intimately associated with the experience of a time-flow. A timeless God could not be considered a ‘person’ or individual in any sense that we know. Misgivings of this score have led a number of modern theologians to reject this view of an eternal God. Paul Tillich writes: ‘If we call God a living God, we affirm that he includes temporality and with this a relation to the modes of time.’ [3] The same sentiment is echoed by Karl Barth: ‘Without God's complete temporality the content of the Christian message has no shape.’ [4]

The physics of time also has interesting implications for the belief that God is omniscient. If God is timeless, he cannot be said to think, for thinking is a temporal activity. But can a timeless being have knowledge? Acquiring knowledge clearly involves time, but knowing as such does not — provided that what is known does not itself change with time. If God knows, for example, the position of every atom today, then that knowledge will change by tomorrow. To know timelessly must therefore involve his knowing all events throughout time.

There is thus a grave and fundamental difficulty in reconciling all the traditional attributes of God. Modern physics, with its discovery of the mutability of time, drives a wedge between God's omnipotence and the existence of his personality. It is difficult to argue that God can have both these qualities.