

## CHAPTER 2

# Change

Stand still, you ever-moving spheres of heaven.  
That time may cease, and midnight never come

Christopher Marlowe, *Doctor Faustus*

### Time as Change

'Stop all the clocks,' writes W. H. Auden, in a poem lamenting the death of a (real? imaginary?) friend. Grief brings time to a standstill, or rather brings with it a desire to stop time taking us further and further away from the person we loved. A different kind of grief, and one that blights her embittered existence, is suffered by Miss Havisham, the elderly lady whom Pip visits in Dickens's *Great Expectations*. Abandoned by the groom on the day they were to be married, she sits, a grotesque figure in her wedding-dress, in a darkened room, with the clocks stopped forever at twenty minutes to nine. At first, Pip feels only horror, until he begins to take in the significance of his surroundings:

It was then I began to understand that everything in the room had stopped, like the watch and the clock, exactly, a long time ago. I noticed that Miss

Havisham put down the jewel exactly on the spot from which she had taken it up. As Estella dealt the cards, I glanced at the dressing-table again, and saw that the shoe upon it, once white, now yellow, had never been worn. I glanced down at the foot from which the shoe was absent, and saw that the silk stocking on it, once white, now yellow, had been trodden ragged. Without this arrest of everything, this standing still of all the pale decayed objects, not even the withered bridal dress on the collapsed form could have looked so like grave-clothes, or the long veil so like a shroud.

As all this decay shows, attempts to stop time are futile, for we cannot stop change. But what if all change *were* to stop? Would that be the end of time too?

The question is raised in Aristotle's *Physics*, which contains one of the earliest and fullest attempts to provide a philosophical account of time. Aristotle (384–322 BC) is a towering figure in the history both of philosophy and science. His writings cover an extraordinary range of subjects, from biology to the nature of tragedy. But we should not be misled by the title of the *Physics* into thinking that Aristotle is engaged in the kind of study that we would recognize as physics in the modern sense. He is not, for example, concerned to formulate laws governing physical phenomena. Rather, he is interested in the most general categories into which physical items, properties, and phenomena fit—change, objects undergoing change, places, time, quantities—and attempts to give an account of what these are, and how they are related to each other. The kind of inquiry to be found in the *Physics*, then, is a highly abstract one, but one that Aristotle thinks necessarily precedes any more specific investigation into the detailed workings of physical phenomena.

Aristotle's discussion of time begins with a catalogue of paradoxes that seem to point to the conclusion that there is in reality no such thing as time. It is remarkable how many of Aristotle's successors embraced that extraordinary conclusion. Aristotle himself, however, is not willing to deny the reality of time, and hopes later on to resolve the paradoxes (and we shall encounter some of them ourselves later in this book). Having alerted us to the dangers of the

territory through which we are now journeying, Aristotle presents the dominant view of his predecessors, which was that time and change are one and the same. The most famous exponent of this view was Aristotle's one-time teacher Plato (c. 429–347 BC, who presents us, in the *Timaeus* (which takes the form of a dialogue between Socrates and three friends), with an account of the 'birth of time', this being the first motion of the heavenly bodies. But, as with many of his predecessors' opinions, Aristotle finds fault with this identification of time and change. Time could not be the same thing as change, he says, for first change can go at different rates, speed up or slow down, but not so time, and secondly change is confined to a part of space whereas time is universal.

What are we to make of these objections? Surely time *does* speed up or slow down, or at least it appears to do so. For people in love, a few hours spent together will pass all too swiftly, whereas time will hang heavily during a labour of unremitting tedium. But such phenomena are easily dismissed as illusory. We can be deceived about spatial matters, such as the shape or size of an object, or its distance from us, so why not also about temporal matters? To see whether it makes sense to suppose that *time itself* could pass at different rates, consider how we measure the rate of other kinds of change: the speed of a passing bus, for example. We measure the distance the bus covers against time. Or consider a kettle on a stove. Its rate of heating is given by measuring the rise in temperature against time. So rate of change is variation in some dimension in so many units of *time*. How, then, would we measure the rate of passage of time? Why, against time, presumably. But this leads to the conclusion that the rate of the passage of time must never vary. For how long could five minutes take if not five minutes? But Aristotle's objection perhaps misses the point. It is true that time could not be identified with *particular* changes, such as the crumbling of a sand castle. But to identify time with change is surely to identify time with change *in general*. Now it is not at all clear that change in general—that is, the sum of all changes in the universe—could intelligibly be regarded as

proceeding at varying rates. Try to imagine every change in the world suddenly doubling in speed. Does that idea make sense? Aristotle would not have thought so. For one thing, we could not possibly *notice* such a change in rate, for we only notice the change in the rate of some change when comparing it with other changes. We notice the shortening of days with the onset of winter by measuring the time between sunrise and sunset against conventional timepieces or our own biological clocks.

The idea that time is to be identified, not with particular changes, but with change in general seems also to avoid Aristotle's second objection, that change is confined to parts of space, whereas time is universal. Only individual changes are spatially confined, but the totality of change covers the whole of space.

This may have removed one ambiguity in the notion of change, but there remains another. What kind of change do we suppose time to be? Do we think that time is the same as the sum of all the ordinary changes of which we can directly be aware, such as the changing colour of a leaf, and also those which underlie perceivable changes, though not themselves perceivable, such as the motion of molecules? Or are we instead thinking of the passage of time itself, the inexorable movement of things once present into the ever-distant past? Of course, a philosopher who said that time was to be defined as the passage of time would not get much of a following, since such a definition defines time in terms of itself. We need to have some way of defining the passage of time. This is most naturally described (though some philosophers would object to this way of describing it) as the change in events as they cease to be future, become present, and then increasingly past.

One way of capturing the distinction above is in terms of first- and second-order change. *First-order change* is change in the properties of things in the world, where 'things' are conceived of as items that persist through time, such as trees, atoms, and persons. First-order changes, then, are what we would ordinarily describe as events. Can events themselves change? *Second-order change* is, or would be, the



change that events suffer ('second-order' because it is a change in first-order changes) as they cease to be present and slip into the ever more distant past. Second-order change, then, is nothing other than the passage of time itself. So when we say time is change, is this first-, or second-order change? Or both? It is certainly a plausible suggestion that time is at least partly constituted by second-order change, for how could time exist unless it also passed? The passage of time is surely its most striking characteristic. Nevertheless, in a later chapter we shall consider reasons to favour the strange hypothesis that, although time is real, it does not pass but exists, as it were, in a 'frozen' state.

In the remainder of this chapter, however, we shall concern ourselves with the suggestion that time is *first-order* change. Now, it might seem to us that we could imagine every process in the universe coming to a stop—perhaps after the so-called 'heat-death' of the universe, where all energy is perfectly evenly dispersed—and yet time continuing to pass. Endless aeons of time might pass in a completely dead, motionless universe. So maybe time can exist in the absence of first-order change. But is this a real possibility?

### **Time without Change?**

Aristotle did not think time without (first-order) change was a real possibility, and many later writers agreed. We shall now look at three arguments against the possibility of what we might call a 'temporal vacuum', that is a period of time in which absolutely nothing happens. Aristotle's is the simplest: were all change to cease, we would cease to notice the passage of time. This statement is, of course, irrefutable. To notice anything is to undergo a change in mental state. The cessation of all change is also the cessation of any experience, so it is impossible to experience a temporal vacuum (in the sense of experiencing anything *as* a temporal vacuum). But for this irrefutable proposition to imply that it is impossible for time to

continue in the absence of change, some connection must be made between the reality of something and the possibility of experiencing it—or at least having evidence that reality contains the feature in question. The missing link is provided by the stronger verificationist principle introduced in the previous chapter: if there is, even in principle, no possible means of establishing whether a statement is true, or at least likely to be true, then that statement has no meaning. The resulting argument we may call ‘the experience argument’. In full, it goes as follows:

*The experience argument*

1. During a period of time without change, there would be no experience at all—since experience itself is a form of change—and so no experience of the period of time without change.
2. A period of time by itself changes nothing, and so makes no difference to what we could experience after that period.
3. We can establish that some contingently true statement is true only if its being true could make some difference to what we experience, either now or at some later stage.

*Therefore:*

4. We cannot possibly establish that a period of time without change has occurred.
5. If it is impossible to establish whether or not some statement is true (or likely to be true), then that statement has no meaning.

*Therefore:*

6. Any statement to the effect that a period of time without change has occurred would have no meaning.

A ‘contingently true statement’, mentioned in premiss 3, is one that concerns a state of affairs that might not have obtained, such as ‘I like asparagus.’ It is to be contrasted with a necessarily true statement such as ‘If I like asparagus then I like asparagus’, which could hardly have failed to be true.

Once the argument is stated as explicitly as this, it begins to seem less compelling (although it should be said that this is not the only

way of enlarging upon Aristotle's own rather brief rejection of the temporal vacuum). For one thing, the conclusion just seems far too strong. Can it really be *meaningless*—as opposed to just wrong—to say that a temporal vacuum lasting five minutes has just occurred? We certainly seem to know what it means, namely that for five minutes absolutely nothing happened in the entire cosmos. And if the statement really is meaningless, despite appearances to the contrary, then it is hard to see how we are supposed to understand premiss 1 of the argument, which tells us how things would be *if* there were a temporal vacuum. How can it be both meaningful and true to say that there would be no experience in and of a temporal vacuum if all talk of a temporal vacuum is meaningless? The conclusion of the argument, then, appears to undermine its first premiss. That can hardly be a mark of a good argument.

A point in favour of the meaningfulness of temporal vacuum talk is that, although we cannot tell whether the statement 'There was a temporal vacuum going on' is true or false, we can recognize that the statement 'There is a temporal vacuum going on' is *false*. Could we do that if the statement had no meaning? Surely genuinely meaningless statements are neither true nor false, since they fail to say anything intelligible about the world.

The suspicion, then, is that the principle of meaningfulness articulated in premiss 5 is far too strong. There are, however, occasions when it delivers the right result. Suppose I say to you 'There is a moncupator in my fridge', and when you ask, reasonably enough, what a moncupator is, I confess that I can offer very little in the way of characterization. For moncupators are invisible, do not prevent other objects from occupying the same region of space, and in general are completely undetectable. There is, in other words, no possible means of establishing whether or not there is a moncupator in my fridge. At this point, you would be justified in declaring the word 'moncupator' to have no meaning, for there is no way in which we can learn to use it correctly. We cannot, for example, teach a child the meaning of the word by pointing and saying 'Look, a moncupator!'



In consequence, my statement about the contents of my fridge is similarly devoid of meaning. But we are not in anything like the same sorry state when it comes to the word 'time'. *This* word is one that we successfully learn to use appropriately (although it is no simple task to explain in detail *how* we come to use it appropriately). So perhaps it does not matter if we cannot establish whether the statement 'There was a period of time in which nothing happened a while ago' is true or false: it is meaningful because the component parts are meaningful. But this is too generous a criterion of meaningfulness. Consider 'Happy the is a whereas pink'. The individual words have a meaning, but the whole does not. We could insist that the statement be grammatically well-formed, but this is still not enough. Consider the grammatically well-behaved but ultimately unintelligible 'No probable tree vetoes a pungent absence.' What is wrong with this? Well, it is pretty clear that we have no idea of how to go about establishing whether it is true or false, but if this is to be our criterion then we are back with what we suggested a moment ago was an implausibly strict condition of meaningfulness.

Perhaps a more promising approach is this. When we learn a word, we learn the contexts in which it may appropriately be applied. We do not, for example, think it appropriate to apply colours to numbers ('Three is a red number'). So one condition of the meaningfulness of a sentence is that it does not use terms in inappropriate contexts. Here is an interesting and relevant example from the Austrian philosopher Ludwig Wittgenstein (1889–1951), who spent most of his professional life in Cambridge: 'It is 5 o'clock on the sun.' Now is the sun a place where it would be appropriate to talk of its being 5 o'clock? Arguably not, for what time it is depends upon one's time zone, which in turn is defined by one's longitude—a position which is well-defined for the surface of the Earth but not elsewhere. However one could turn 'It is 5 o'clock on the sun' into a meaningful statement by means of further explanation, for example that sun time is defined as Greenwich Mean Time. The point is that 'It is 5 o'clock on the sun' only means something when it is clear



how the sun can be included among the legitimate contexts in which dates and times are applicable.

Now, when we learn the concept of time, we necessarily do so in a context of change. We learn, for example, that it is appropriate to say that time has passed when we have witnessed some change. The different times of day are often introduced by association with different activities (1 o'clock: lunch; 6 o'clock: bath-time, etc.), and the different months with appropriate seasonal weather. Further, when we think, not of a repeatable time like 6 o'clock, or autumn, but a particular, unique and unrepeatable moment, we inevitably think of it in terms of what was happening at that moment. And, as we noted in the previous chapter, time is measured in terms of periodic changes. So when we contemplate the phrase 'period of time in which no change occurs', we find a term (time) which is being used in an unfamiliar context. We might go further, and say that the term is actually inapplicable in such a context: where there is no change, we cannot talk of time passing. Talk of a period of time in which no change occurs therefore makes as little sense, so the argument goes, as talk of a number changing colour or of its being 5 o'clock on the sun.

This is a rather more subtle argument than the one that goes, in effect, 'we could never notice time passing if there were no change, so time does not pass in the absence of change'. That way of putting it makes the argument from experience look rather obviously fallacious. However, even the more subtle argument can be resisted. It is clearly true that we acquire temporal concepts in a context of change. Indeed, this is true of any concept, since we are constantly surrounded by change. What is not at all obvious is that temporal concepts are therefore inextricably linked with the idea of change. We can, after all, abstract the idea of a time from the particular events that occurred at that time. I may, for example, be contemplating a particularly poignant moment in the past when I was saying goodbye for the last time to a friend at a railway station. I recall to mind lowering the window of the carriage, seeing the station clock indicate the time of departure, hearing the stationmaster

slamming the train doors, catching the acrid whiff of smoke from the engine (the memory is evidently a rather old one), and whispering 'Try to forget me'. As I remember the scene, I think 'If only I had at that moment leapt off the train, flung myself on the platform and cried "Marry me!"' Had I done such a thing, that moment, indeed perhaps all of life thereafter, would have been different. So, if I can imagine a time without being obliged to think of it as being filled by the very events that did happen then, why can I not think of it as filled by *no events at all*? Why can I not say 'If only the entire cosmos had come to a standstill for five minutes at that moment'? The experience argument, then, whether in its original or more subtle form, rests on questionable assumptions.

Let us now turn to a second argument against temporal vacua, one put forward by the German philosopher, G. W. Leibniz (1646–1716). In the *New Essays on Human Understanding*, which is written in the form of dialogues, Leibniz has one of his characters, Theophilus, say the following:

[I]f there were a vacuum in time, i.e. a duration without change, it would be impossible to establish its length. . . . we could not refute anyone who said that two successive worlds are contiguous in time so that one necessarily begins as soon as the other ceases, with no possible interval between them. We could not refute him, I say, because the interval is indeterminate. (Remnant and Bennett 1981, 155)

This passage suggests an argument against the temporal vacuum, although the conclusion is not actually made explicit. The interpretation is a plausible one, as we know from things he says elsewhere that Leibniz did indeed reject temporal vacua. Laying bare the tacit assumptions, then, we have the following:

*The measure argument*

1. Periods of time are measured by changes.

Therefore:

2. Since, by definition, nothing happens in a temporal vacuum, there is no possible means of determining its length.

3. If there is no means of determining the length of a temporal interval, it has no specific length.
  4. Every interval of time has a specific length.
- Therefore:*
5. There cannot be a temporal vacuum.

Premises 1 and 2 look safe enough, but 3 seems to contain a hidden fallacy. As with Aristotle's argument, a connection needs to be made between our inability to discover a certain kind of fact and the proposition that there are no facts of that kind to discover. In this, as in the earlier case the connection must be some theory of meaning. The principle that meaningfulness depends on verifiability would provide the desired result, but as we noted above, the principle seems implausibly strong. As before, however, we can appeal to more subtle considerations: given judgements concerning the length of intervals are made in the context of regular changes, we cannot legitimately extend the notion of duration to the context of no change. If this is the right way to defend the measure argument, then it is clearly not really distinct from the experience argument, but is just a slightly more specific version of it. It therefore does not seem to merit a separate response. There is, however, one point which applies specifically to the measure argument, and which is sufficient to defeat it.

The problem concerns the tension between premisses 3 and 4. Our view of these will depend on whether we adopt the conventionalist or objectivist view of temporal metric, the debate between which was described in the previous chapter. Take a look first at premiss 3: 'If there is no means of determining the length of a temporal interval, it has no specific length.' This is strongly suggestive of conventionalism, which states, we recall, that whether or not two successive intervals are the same or not depends on one's chosen means of measuring them. In the absence of any possible means of measurement, there will simply be no fact of the matter as to whether the two intervals are the same or not, and so no fact of the matter as to

how long each is. The conventionalist, then, will happily accept premiss 3. The objectivist, however, who holds that the length of an interval is an objective matter, and not dependent on the availability of any means of measurement, will certainly reject it. Now consider premiss 4: 'Every interval has a specific length.' The objectivist will have no difficulty with this—indeed, it might be taken as a statement of objectivism in a nutshell. For this reason, however, the conventionalist will reject it. For conventionalism allows for the possibility of intervals which do *not* have specific lengths, precisely in those cases where there is no possible means of measuring them. So, in sum, whether we are conventionalists or objectivists over temporal metric (or still sitting on the fence) we have good reason not to accept *both* premiss 3 and premiss 4, although we might accept either one.

And so we may take our leave of the measure argument.

There is something, as we might put it, rather egocentric about the two arguments we have just considered: both are concerned with what we can experience or be affected by. Let us now remove ourselves from the picture, and ask what effects temporal vacua could have on the world at large.

### Everything Has a Reason

This takes us to our third argument, which is suggested by a characteristically terse and enigmatic remark from the Ancient Greek philosopher Parmenides:

And what need would have aroused it later or sooner, starting from nothing to come into being? (Barnes 1982, 178)

The 'it' here is the cosmos, or entire universe. It cannot have simply come into being at a particular moment in time, suggests Parmenides, for not only would there would have been nothing to make it come into being, we would have no explanation of why it



came into being at precisely that moment and not at an earlier or later time. The principle on which this line of reasoning rests is rather more visible in the following passage from Leibniz's reply to a letter written by the Revd Samuel Clarke:

For since God does nothing without reason, and no reason can be given why he did not create the world sooner; it will follow, either that he has created nothing at all, or that he created the world before any assignable time, that is, that the world is eternal. But when once it has been shown, that the beginning, whenever it was, is always the same thing; the question, why it was not otherwise ordered, becomes needless and insignificant. (Alexander 1956, 38–9)

Here Leibniz is attacking those who take time to be independent of the existence of the various changes that constitute the history of the cosmos. For suppose that time were so independent, and that the universe had a beginning in time. Then there would have been aeons of empty time prior to creation, and no answer to the question: 'Why did God create the universe at precisely that moment and no other?' for one moment of empty time is much like any other. However, once we recognize that the beginning of the universe and the beginning of time are one and the same, God is no longer faced with such a choice. The universe could not have begun any earlier or later than it did, since there was no time before the universe existed. The principle appealed to, and which here is stated in theological terms, is called the Principle of Sufficient Reason. It has an appeal even for those who do not believe in a deity, but who do believe that everything has a cause. So putting the principle in more neutral terms, terms which are consistent with, but which do not imply, the existence of God, we have something like the following: for everything that occurs at a given moment, there is always an explanation of why it occurred at precisely *that* moment and not at some other moment. This not only makes difficulties for the idea of empty time before the existence of the universe; it also makes difficulties for the idea of limited periods of empty time during the history of the universe. For suppose that, exactly one hour ago, there was a complete

temporal vacuum in which everything stopped for ten minutes. What made everything start up again? Since things remained exactly the same during that ten-minute period, there is no explanation of why things started up after ten minutes rather than, say, five, or fifteen.

Laying, once again, all assumptions bare, the third argument can be presented thus:

*The sufficient reason argument*

1. If there have been temporal vacua in the past, then there have been times when change has resumed after a period of no change.
2. For every change that occurs at a given moment, there is always an explanation, in terms of an immediately preceding change, of why it occurred at precisely that moment and not at some other moment.

*Therefore:*

3. There is no explanation of why a change occurring immediately after a temporal vacuum occurred when it did (since no change immediately preceded it).

*Therefore:*

4. There have been no temporal vacua in the past.

We may note at once that the argument does not rule out a temporal vacuum in the *future*, though it would have to be one that had no end: an eternity of darkness and silence after the death of the cosmos. Not, it has to be confessed, a cheering thought. This is a serious limitation of the sufficient reason argument, though we could supplement it with the following considerations: just as everything has a cause, everything has an effect. Change thus begets change, so once started on its changing course the universe could never cease changing. This further line of reasoning, however, is not hard to resist. Even if everything has an effect, why should the effect take the form of change, rather than the cessation of change? Could some changes not cancel each other out? Now, if a temporal vacuum—the absence of change—can be an effect, why can it not be a cause? We cannot say

that it is cause of *change*, for otherwise we run up against the sufficient reason argument. But we could say that the absence of any change whatsoever in the cosmos is the cause of the *continued* absence of change. This suggests a compromise in the debate over vacua. Before revealing that compromise, however, let us sum up the situation so far, and introduce some useful terminology.

We began this chapter considering the suggestion that time and change are one and the same. This is one form of what is referred to as *relationism about time*. This brand of relationism asserts that time is just an ordered series of events, each individual moment identified with a collection of simultaneous events. Opposed to relationism is *absolutism about time*, which regards time itself as existing quite independently of what is happening *in* time. The absolutist will affirm the possibility of temporal vacua, for if time is independent of change it can exist where there is no change at all. The relationist, typically, will deny the existence of temporal vacua. Now, one way of supporting relationism is by means of arguments designed to establish the impossibility of temporal vacua, and we have considered three such arguments. Two of them, unfortunately, rest on dubious premisses, or at least on dubious combinations of premisses. The third, although perhaps more persuasive, was rather more restricted in the scope of its conclusion. But perhaps we can develop it a little further.

One way of expressing the sufficient reason argument is to say that temporal vacua do not explain anything. They make no difference. And it is a powerful argument for something's non-existence that it would make absolutely no difference, as the example of the moncupator shows. It is a problem for the absolutist to explain what difference time makes *over and above* the effects of what happens in time. The egg is ready to be consumed five minutes after I started to boil it, not simply because five minutes have passed, but because of the changes going on inside the egg throughout that time. Again, it is not time that heals all wounds, but rather the (psychological, physical, political) changes that go on in time that do so. On the other

hand, if we allow the absence of change to be a cause, then it is not true to say that temporal vacua could never make a difference. The fact that nothing whatsoever was happening at one time would explain why nothing whatsoever was happening at a later time. This is not, admittedly, the most exciting of explanations, but it does appear to satisfy the demand for sufficient reason.

The absence of anything happening is not the same as there being nothing at all: the absence of change is a state of affairs, and states of affairs, like events, occupy times. In fact, if one is going to be precise about this, one could insist that, fundamentally, all that exists at individual times are states of affairs, and what we call events are just series of different states of affairs (a view of change we shall consider critically in a later chapter). For example, the event that consists of a commuter travelling to work is just a series of states in which the commuter occupies a number of positions vis-à-vis other objects. So a temporal vacuum is a series of states of affairs, distinguishable only in that some states of affairs occur later than others. And this is what provides us with a face-saving manoeuvre for both relationist and absolutist, allowing them to retire from the field of combat with equal honour. The relationist can continue to maintain that time does not exist independently of its contents, but make the important concession that these contents do not have to be viewed as events only: they might be unchanging states of affairs. This then allows what the absolutist has insisted on all along, namely the possibility of time without change.



### Questions

Why does it not make sense to think of *time* speeding up or slowing down?

Does it make sense to imagine every process in the universe suddenly doubling in speed?

Can you imagine any circumstances in which it would be possible to measure the length of a temporal vacuum?