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On the philosophy of time

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The concept of time has always played a dominant role in philosophy and science. In modern physics, and also in philosophy of physics, it is the anisotropy of time that attracts particular attention. Taking up work by Grünbaum and others, the thermodynamic arrow of time is considered in detail, and this discussion is then extended to other time-asymmetric processes, whose relation to this arrow of time remains controversial. After that, some remarks are made about experienced time. It is the gestalt-like character of time that, in contrast to the arrow of time, reflects time in the everyday world.

Time is an unending theme of philosophical reflection. This is because time is ever present and, simultaneously, something puzzling; time in our experience is never constantly the same – sometimes it passes quickly, sometimes slowly, sometimes it passes by, sometimes it changes us – because time, especially in connection to space, leads us to the foundations of natural science and to its beginnings. Because time holds open the door between myth and reality, questions about beginnings in time easily become questions about the beginning of time. For Augustine, time was the unexplainable, for the Greeks it was a god. Time is the motion of the hands of a clock, the sunrise in the mountains, the reality of train schedules, of hope, of waiting and forgetting. Time is 'a tyrant that has his moods' (Goethe 1949, 89). It rules over becoming and passing away, it connects earth with the heavens, today with tomorrow and yesterday. Clocks are its representatives in nature and human life. They are derived from a gestalt notion of time – astronomical models of the cosmos are also clocks – and lead to a continuum notion or the time's arrow notion of time. In Plato's astronomy (see *Tim*. 37d–38e), for instance, the 'circle of the same' – the rotation of the heavens on its axis – represents pure periodicity (like the dial of an analogue clock), and the 'circle of the diverse' – the motion of the planets on the ecliptic – represents a celestial calendar that makes it possible to count the days.

Where time is ever present, it is subjected to analytic scrutiny in various ways. Different cognitive interests and different contexts determine different kinds of questions. Questions such as 'Does time exist?', 'Does time have properties such as a beginning and an end?' testify to an ontological interest and a metaphysical context. Questions such as 'How is time felt?', 'What role does time play for consciousness?' testify to a psychological interest and a context of theory of consciousness, of psychology or neurophysiology. Questions such as 'What role

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is played by time in cultural and social connections?', 'How are time and history related?' testify to the interest of social science or cultural studies and correspond to a social and cultural context. Questions such as 'What does (natural) science know about time?', 'How are the standards of time measurement formed?' testify to the interests of philosophy of science and to both an epistemological and a natural scientific context (see Janich 1996). No wonder that Augustine despaired at the question 'What is time?'.

In the following, I shall confine myself to pursuing a few natural scientific and anthropological pathways; my point of departure is an earlier, more detailed, analysis (Mittelstrass 1993). Philosophy has no exclusive access to the essence of time that could take the place of scientific or other approaches. However, in the form of epistemology and philosophy of science, it does possess critical instruments that may often still take hold where the scientific and the everyday understanding reach the limits set for them by theory and custom. Let me now turn to the physics of time – from a philosophical point of view.

Arrows of time

The natural sciences, it seems, are bound to assign a prominent role to time. After all, lots of things change in the world; and change needs time to unfold. The reverse also holds true; as the saying goes, 'the times they are a-changing.' Thus, there appears to be ample use for time. This apparent evidence of the senses notwithstanding, the view has gained acceptance in some quarters that in reality there is no change. The true world is timeless. Becoming and passing away are mere illusions of the deceived mind and have no foundation in nature.

In order to address this issue in somewhat more detail, let us consider the physical basis for the 'anisotropy' of time, one of time's most typical characteristics. This requires a careful investigation of the relevant theories of physics, a project prominently initiated by Reichenbach (1928) and Grünbaum (1973, 1976), and today advanced by Price (1996), Schulman (1997), Zeh (1999) and others, to mention only a few.

Clearly, the basis of physical time is to be sought in physical processes (as Aristotle already knew). The processes in question are *irreversible* in kind. Irreversible processes are temporally directed in that they go only one way; their temporal inverse does not occur. That is, no counter-processes exist that would be suited to restoring the original type of state. In addition, we should distinguish between two kinds of irreversible processes. Processes are *nomologically* irreversible if the realization of the temporal inverse is excluded by a law of nature. They are *de facto* irreversible if their temporal inversion requires that particular initial or boundary conditions be realized which, as a matter of fact, do not occur (see Grünbaum 1973, 209–210; Grünbaum 1976, 474).

Grünbaum argues that the occurrence of *de facto* irreversible processes is sufficient to establish the anisotropy of physical time. *Anisotropy* means that there is a structural distinction between the two opposite time directions. If some states always follow one another in a fixed sequence, we are in a position to distinguish earlier and later states. Irreversible processes thus provide a basis for a physical implementation of the temporal relations 'earlier than' or 'later than,' and this is precisely what the anisotropy of time comes down to. An isotropic time would require that no such physical implementation exists, which would in turn demand that all processes can actually be inverted. For this reason, the mere existence of irreversible processes,

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of whatever origin, confers anisotropy to time. And this is why the occurrence of *de facto* irreversibility is sufficient for anisotropy to emerge (see Grünbaum 1973, 211–212; Grünbaum 1976, 475).

What are the irreversible processes that might be suited to confer anisotropy to time? Consider processes such as the development of apparently homogeneous mixtures out of heterogeneous components, or the equalization of temperature differences. If cream is poured into a cup of coffee, both liquids mix as time passes; the reverse process – that is, the spontaneous separation of cream and coffee – has never been observed. Analogously, the differently heated ends of a metal rod will acquire the same temperature in the course of time; nobody has come across the spontaneous generation of a temperature gradient. Irreversible processes of this kind are described by the so-called *second law of thermodynamics*. According to that law, a quantity called *entropy* exists which, in every closed system, either increases in time or, in the case of equilibrium systems, remains unaltered. The second law thus appears to express the existence of irreversible processes and to afford, consequently, the physical basis for the anisotropy of time. For every closed non-equilibrium system, higher entropy states are *later* than lower ones. In what follows, I focus on this thermodynamic basis of the anisotropy of time.

The seemingly smooth solution just outlined is, in fact, afflicted with a serious difficulty. Namely, the entropic behaviour of macroscopic thermodynamic systems should evidently be rooted in the behaviour of their microscopic constituents. It should be derivable from the motions of atoms or molecules. Boltzmann attempted such a derivation and came up with his famous H-theorem. He applied the laws of mechanics to colliding gas molecules and assumed that the molecular motions proceed in a random fashion; that is, he supposed that on the mechanical level there are no preferred states of motion. On that basis, he arrived at a microscopically definable quantity that could be related to the macroscopic entropy, and which, correspondingly, exhibited the same temporally asymmetric behaviour. Since the randomness premise entering this deduction is, however, of an essentially statistical nature, the resulting version of the second law is likewise statistical in character. In contrast to its thermodynamic model, the mechanically derived second law does not rigorously preclude decreasing entropy values; it merely says that such cases are less probable and occur less frequently than the contrary cases of increasing entropy. Moreover, on the statistical variant, the entropy does not remain constant in equilibrium states but fluctuates irregularly around a fixed value. This implies that, in these states, the entropy drops and rises with equal frequency.

Grünbaum has shown, elaborating and substantially improving an earlier conception of Reichenbach's, how we can take advantage of this attenuated version of the second law so as to specify a physical basis for temporal asymmetry. It follows from the above considerations that we must resort to non-equilibrium systems for that purpose. Suitable systems of that kind are *branch systems*. Such systems branch off from their environment in a state of comparatively low entropy, remain closed for some time and finally merge again with the surrounding wider system. The low entropy state realized in branch systems is not the result of a statistical entropy fluctuation; rather, it is the product of an interaction with some outside agency of natural or human origin. Take an iced drink as an example. By immersing an ice cube into a lukewarm liquid we create such a low-entropy system. Subsequently, as the ice cube melts, the whole drink assumes a uniform temperature that finally agrees with the temperature of the

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environment. This process of continual equalization of temperature represents an increase in entropy with the result that the branch subsystem is eventually reintegrated into the larger system from which it was initially detached by the intervention. The temporal evolution of the entropy in branch systems is thus markedly asymmetric.

However, we have not yet taken into account the statistical nature of the second law. After all, due to that statistical nature it cannot be ruled out that some (untypical) branch system actually undergoes a decrease in entropy. This problem can be overcome by resorting to a large number of like branch systems. We employ a class of such systems characterized by the same initial macroscopic entropy states, and we *demand* that the microscopic realizations of these initial states be distributed at random. As a consequence of the second law, a typical representative of such a class will display a temporal increase in entropy. This feature constitutes the physical basis for the anisotropy of time (see Grünbaum 1973, 254–260, for more detail).

The next question to be addressed is: why exactly does this temporally asymmetric behaviour of branch systems arise? The relevant point is the peculiar status of the irreversibility as expressed by the statistical variant of the second law. As already indicated, this law does not follow from the laws of mechanics alone. After all, the latter are perfectly reversible and do not exclude the time reversal of any process. This reversibility of the mechanical laws is reflected in the temporally symmetric entropic behaviour of equilibrium systems. What we need in addition, in order to arrive at irreversible processes, is reference to the prevailing *initial or boundary conditions*. The derivation of the statistical version of the second law requires premises that are not law-like in character but rather refer to actual circumstances as they *happen to occur*. Accordingly, the second law is not a fundamental law of nature; it arises from more basic, time-symmetric laws only by having recourse to particular states of affairs. This peculiarity is reflected in the branch-systems approach, for this method likewise relies essentially on the realization of particular non-equilibrium states that are supposed to exhibit microscopic randomness. Consequently, the anisotropy arising from this kind of irreversible processes is not nomological but merely *de facto*.

The conclusions drawn in philosophy of science often depend crucially on the particulars of the pertinent scientific theories. One exciting development in recent physics *might* induce a significant alteration as regards the philosophical interpretation of the directedness of time, which is the rise of irreversible thermodynamics. The relevant point here is the *status of the second law*. Underlying the more traditional picture outlined so far is the view that the laws of mechanics are more fundamental than the principles of thermodynamics. This is certainly not an implausible premise, since the thermal properties are supposed to arise from the statistical behaviour of microparticles whose motions are, in turn, governed by mechanical laws. It is precisely by way of this premise that the limited derivability of the second law from the laws of mechanics leads to the interpretation that the second law, along with the temporal anisotropy based on it, cannot be ascribed a fundamental status.

Since the development of the laser and the subsequent initiation of scientific research programmes such as synergetics, chaos theory, and irreversible thermodynamics, phenomena that occur far away from equilibrium have been of central interest. It turned out that order is often created far away from equilibrium. If we want to understand order, classical (equilibrium) thermodynamics is of not much help. This order consists of the fact that in appropriate systems,

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under conditions far from equilibrium, branchings of the system state – so-called bifurcations – occur. This means: if the relevant system parameters attain certain critical values, the system so to speak has the choice between two or more states; and under such circumstances it is minor fluctuations of the state of the system that determine the further development. Contrary to classical thermodynamics, minor fluctuations do not compensate for one another, rather they become macroscopically meaningful. This occurs by quasi-evolutionary mechanisms through which certain fluctuations are reinforced at the cost of others and thus determine macroscopic behaviour. The ordered structures that arise in this manner are based on small fluctuations; they are not determined by the initial conditions of the system. In this sense, *novel* structures arise in such processes. It seems that non-equilibrium thermodynamics allows 'becoming' to enter nature. 'The concept of order by fluctuations discards the static universe of dynamics for an open world, in which the new can arise through activity, in which development means innovation, creation and destruction, birth and death' (Prigogine and Stengers 1981, 204). Becoming and passing away would now seem to acquire a central place in nature – within physical theory formation as well.

However, here too there is room for doubt. In spite of all the important and impressive theoretical and experimental progress of non-equilibrium thermodynamics during the past two decades, this field has changed nothing in the philosophical interpretation of time. On the contrary, even in the synergetic age the situation is precisely the same as, for instance, in Reichenbach's analysis of classical thermodynamics. In both, the analysis is based on irreversible processes under conditions of non-equilibrium. In addition, for the philosophical interpretation of irreversibility, it is inconsequential whether these processes take place far from equilibrium (as in synergetics) or near to equilibrium (as in classical thermodynamics). The decisive point is that even in non-equilibrium thermodynamics, the anisotropy of time and the asymmetry of past and future are not anchored in the laws of nature, but are based on particular boundary conditions, on actually realized circumstances.

It turns out that the thermodynamic arrow of time is not time's only arrow. There are at least five other time-asymmetric processes, whose nomological relation to the thermodynamic arrow of time is still controversial (Penrose 1979).

(1) Radiation emitted by a source always expands in the future time direction. This is a well-known wave-phenomenon. Consider a stone that has been dropped in a lake; after a while one observes concentrically diverging waves on the surface of the lake. We never observe, however, waves that converge on a single point. From a theoretical point of view this is quite curious, since the basic equations of Maxwell's theory permit such 'advanced' solutions as well as the usual 'retarded' solutions. Because of the lack of nomological constraints, one would expect, as in our discussion of the thermodynamic arrow of time, that the initial or boundary conditions of the universe are responsible for the radiating arrow of time.

(2) According to our best cosmological models, based on Einstein's general theory of relativity, our universe is expanding. It expands in time, which in turn defines the cosmological arrow of time. Interesting questions occur when one tries to

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relate this arrow of time with the thermodynamic arrow of time. Gold (1962) raised the question of whether the entropy rises or drops when the universe eventually re-collapses in a 'big crunch' as some models suggest. Given the second law, the entropy should of course increase, even if the universe returns to its initial state in the end. This initial state was, however, supposedly a state of very low entropy and can therefore only be reached again if the entropy decreases after a certain turning point. In order to resolve this riddle, ingenious arguments have been put forward, although a conclusive resolution has still not been reached (see Kiefer 1990; Price 1996; Zeh 1999).

(3) The general theory of relativity predicts that the gravitational collapse of a sufficiently massive star results in a *black hole*. After the collapse 'the hole settles down and remains unchanging until the end of time' (Penrose 1979, 600f.). The time-reverse of this process, which is permitted, in principle, by the equations of the general theory of relativity, would be a singularity, known as a *white hole*, that sits for some indeterminate amount of time from the beginning of the universe and then erupts in a shower of ordinary matter. Given that we are now quite sure that black holes exist (presumably even at the centre of our own galaxy, the Milky Way), without having any evidence whatsoever for white holes, there seems to be evidence for a *de facto* gravitational arrow of time which might, in turn, be connected with the cosmological arrow of time.

(4) Microphysics also seems to have its arrow of time. In a quantum mechanical measurement process, a given state, expanded in a basis formed by eigenstates of the operator corresponding to the measured quantity, instantaneously collapses in one of these eigenstates with a certain probability, which can be calculated following the rules of quantum mechanics. This, at least, is the story told by the Copenhagen interpretation. Obviously, the measurement process is irreversible, because all the information about the other contributions to the state of the system prior to the measurement have been deleted. This information is lost – forever. That conclusion depends, however, on the interpretation of the quantum mechanical formalism one chooses. Take, for example, Bohm's variant of quantum mechanics, which turns out to be empirically indistinguishable from the standard formulation *à la* Bohr and Heisenberg. Given the close relation of Bohm's interpretation to classical statistical mechanics, it is clear that there is hope of eventually reducing the quantum mechanical arrow of time to the thermodynamical arrow – provided that the problem of the reduction of thermodynamics to statistical mechanics is solved.

(5) Another arrow of time is quite curious. It only shows up once in a while in high-energy particle reactions that can be artificially created in the lab and which, perhaps, also showed up in the very early universe. Neutral K-mesons decay by violating parity and charge invariance. Due to the famous CPT theorem, decays of this kind therefore also violate time invariance. Unlike the other arrows of time presented so far, here we encounter, for the first time, a truly nomologically irreversible process. Unfortunately, this fundamental arrow of time resists any connection with, for example, the thermodynamic arrow of time.

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Given this list of arrows of time, interesting foundational questions can be addressed. The most urgent one is perhaps how all these different arrows of time hang together. Is there a 'master arrow' to which all other arrows of time reduce in some sense? Or do we have to accept a plurality of fundamental and irreducible arrows of time in nature? A lot of work has been done on this issue by physicists and philosophers of science, and it is fair to say that so far no definite conclusions have been reached. There are several ingenious proposals to relate, say, all other arrows of time (with the possible exception of that involved in the decay of neutral K-mesons) to the cosmological arrow of time, but all have serious flaws, as for example Price (1996) and others have shown in detail. We are therefore faced with a plurality of arrows of time in physics. Current physics does not provide us with a 'master arrow', and it therefore also does not explain the direction of time.

Maybe, however, this comes as no surprise since physics still lacks a final theory, which covers quantum mechanics (including quantum field theory) and general relativity. There are several proposals for such a theory of everything (such as supersymmetry), but due to the severe conceptual problems that these approaches face, a thoroughgoing discussion of the problem of the direction of time is quite difficult at the moment.[1] It turns out that the relevant fundamental equation, the so-called Wheeler–de Witt equation, does not exhibit a time variable at all. This suggests that we do indeed live in a kind of a Parmenidean block-universe, in which time is (at worst) an illusion of the human mind and (at best) an emergent phenomenon.[2] The hypothesis that time is not fundamental, but only shows up at a higher level of organization of the universe to order events, is currently favoured by most of the scientists working in this field. Many problems, however, remain. It has, for example, to be shown how this idea can be made more precise mathematically and conceptually. After all, time cannot emerge in time. So how and why does it emerge?

These are some of the problems discussed by physicists and philosophers of physics today. However, the concept of time also has facets that we experience in our everyday life and which I shall address now.

Time in the lifeworld

What is not in nature is *in us*.

This is the philosophical alternative to a physical concept of time. Alongside physical time there enters, in the form of a 'stream of consciousness,' *experienced* time. This is the object not only of a theoretical interest, which also applies to the time concept of natural science, but also of an anthropological interest. The physics of time and the anthropology of time seem to be philosophical worlds apart. But this could be mistaken. If, physics too, as I have indicated, possesses no conclusive theory of time, then there might well not be so much distance between a natural scientific and an *anthropological* concept of time.

Augustine is taken to be the founder of the anthropological concept of time. For him, time was not a property of the world but a property of the soul. Time, understood as *lasting presence*, is not 'measured' by motions in the world or in nature, but is 'measured' by the *soul* (Augustinus, 1955, 632ff.). Here a 'cosmological' paradigm of time, such as Plato and Aristotle propounded, is replaced by a 'psychological' or 'mental' paradigm that is independent of clocks and replaces the concept of physical time by the concept of experienced time. No longer

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does the world, nature (in the form, say, of periodic planetary motions) 'have' time; only the soul 'has' time. Thus, the soul is also the measure of time. That means that time has a *subjective* structure, and not just some time or other (i.e. the (physical) world has its time and man has his time or the soul has its time) but *the one and only time*. For Augustine, the memories of humans, their acts of bringing to mind (*memoria*, *contuitus*, *expectatio*), constitute time itself (Augustinus 1955, 640ff.).

The dilemma seems perfect: on the one hand, *physical* time, which as far as the essence of the laws of nature is concerned does not actually exist for modern physics or exists only in the boundary conditions of nature; on the other hand, *mental* time, which even the modern disciples of Augustine claim to be the only time. Between these two notions of time, epistemologically speaking: between a philosophical physicalism and a philosophical psychologism – time itself seems to lose its own proper reality. Where we expect time to be, somewhere between the time in nature and the time in us, there it is not, we are told by physics and philosophy.

To solve this dilemma, I would like to propose the thesis that temporal structures are taken from *action structures*. Neither nature nor the ego (the 'soul') holds the key to time, but rather the way humans orient themselves in, and through, their actions. Actions occur not so much *in* time – this aspect is external to actions, for example, when we consider them relative to a time measured by a clock – rather they have their *own* time. That is, they have their own *duration* and their own *order*. Let us take chess as an example. Here a context of action has its duration and its order (in this case determined by rules). That the game of chess, as with other games, can also be played against the clock is rather an external arbitrary element. Games have their own time. Wherever they are adapted to the clock's time they lose a part of their essence.

Action contexts, such as chess, can be expressed in (measured) time. However, this only grasps a part of the action that is *transferable*, and thus is not a constitutive element of the action itself. In other words, every action – that is, every context of action – has so to speak two times, its *own* time and an *alien* time. Its own time is primary, the alien time secondary. If actions did not have their own times, we would not understand what time means. The 'universal' or the *public*, i.e. social or cultural time has a derivative mode. It derives from the need – itself related to action – to compare and co-ordinate actions *and their times* (for instance, in the form of train schedules or appointment calendars).

Nature too, that is, that which we perceive as 'natural' time – for instance day and night, summer and winter – appears in this context primarily as the nature-like side of actions. Actions themselves do not distinguish between what in them is action and what in them is nature. However, actions can 'in retrospect' be analysed conceptually, for example, into a time of action and a time of nature, without identifying the former with the time of the 'soul' and the latter with the time of physics. What is decisive is rather that we are dealing with a concept of time that does not suffer the previously mentioned dilemma between physicalism and psychologism and itself has a (temporarily) clock-free gestalt character.[3] Such gestalt-like forms of time are the time to go home, the time to say goodbye, the time of love, and also the monsoon season, the age of Aquarius, and the strawberry season.

What I have tried to clarify about the concept of action can also be explained by the concept of *life*. Human time is reflected in the temporal gestalts of life. These are the 'fateful forms'

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of life, because – like youth, maturity and old age – 'they are essential to the process of development (…) being submits to them and endures them' (Plessner 1981, 211–212). Youth and age, but also farewell and happiness, are not properties of (individual) life but rather *forms*, *gestalts*, *times* that life submits to. In the 'nature' of life lie the determinants of the time of life; life is not a temporal process. Or in another formulation, *the time of life is its times*.

Once again, what I have just said has nothing to do with a physics of time that has lost sight of time, nor with an internalization of time that declares the soul to be the custodian of time. It is closer to Kant's notion that time is a (pure) form or shape that underlies all our intuitions, experiences and actions.[4] We find time, which is our time, human time, neither in a four-dimensional manifold nor in the soul. This is how the Greeks saw it.

When philosophy invented time as a philosophical problem, it was dealing with cosmological questions. Time, according to Plato, has a cosmic nature. It arose with the cosmos, whereby Plato distinguishes between the time forms of an ideal cosmos, called the 'eternal animal' (*–ζῷου –ἀίδιον*, *Tim*. 37d), a created cosmos, which also has an incorruptible structure, and the 'moved' or measured time, which is the reflection of the astronomical nature of the cosmos, and like this has a periodic structure (see *Tim*. 37d–38a; on the 'astronomy' of time see *Tim*. 35a–36d). According to this notion, the cosmos is the totality of different forms of time, among them the forms of natural time, action time and life time. This is also clear in Aristotle: '[The cosmos] continues through its entire aeon unalterable and unmodified, living the best and most self-sufficient of lives. (…) for the fulfillment (*τέλοζ*) which includes the *time of life* of any creature outside of which no natural development can fall has been called its aeon' (*de cael*. A9.279a20–25). That means, not only does the cosmos has its time, its aeon, but so does every living creature. But this can be understood along the lines of the assertion that time does not create life but life has its time (Aristotle: its aeon; see Böhme 1974, 80–81). This time is, at the same time, a cosmological 'natural' time. Nature and time are still interwoven.

In Plato's conception, this is expressed by saying that it is the 'parts' of the moved time that 'imitate' the structure of the whole of cosmic aeon. As the 'time of the cosmos' has days and nights, months and years, so too human time has, for example, the periods of childhood, youth, adulthood, and old age. The life as well as the time of humans consists of structured wholes, that is, (temporal) gestalts. It has no temporal structure in the sense of dissolution in a temporal continuum or an arrow of time on which we are supposedly riding; it has purely temporal gestalts. Therefore, life consists not of time but of *times*, and these in turn 'imitate' the temporal structure of the cosmos. Human time and human life represent cosmic time and cosmic life. It is senseless to mark boundaries for the temporal gestalts of life; the invention of the clock only leads us astray in this regard. An alternative would be a continuum model of time or the picture of time's arrow, but both of these belong to the world of physics. It is not *time* that flows but *things* that flow and change, albeit gestalt-like in time. Even Aristotle's theory of time does not allow such notions as are expressed in the phrase 'time flies'. For Aristotle, time is a form of motion (*Phys*. *Δ*11.219b23). However, in motion, time does not move; only *duration* grows analogously to the space traversed in a motion (see Janich 1980, 255).

Thus, the Platonic and the Aristotelian constructions of time correspond to the lived, and in mythical and everyday form represented the time of their time. What might seem archaic

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here is rather the expression of lifeworld experience in dealing with human time, which has not yet made its way either into an abstract physical theory or into the soul. In other words, physics and anthropology have much to say to one another. That we seem today to have other experiences and that we look at things differently, lies in the need to co-ordinate concrete times. Modern constructions of time are doubtless theoretically superior to the notions of classical antiquity; but in lifeworld terms, from the point of view of human time, they are, in spite of their practical character, perhaps inferior. In this regard we are only misled by the fact that analogue watches that simulate the motion of the sun have become old-fashioned, and digital watches, which represent nothing but only 'count', are on the march. At the same time, the insight of the Greeks, that life is not time, processual time, but rather has times, gestalt-like times, is fading. The difficulties that we today have with physical theories of time and with philosophical, psychological and social-scientific notions of the essence of time may lie in the fact that firstly (in a theoretical context), there is, obviously, more than one arrow of time, and that secondly (in a practical context), we no longer live the gestalt-like character of time and no longer comprehend it.

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Notes

1. See Butterfield and Isham (1999) for some recent work on time in the canonical approach to quantum gravity; see also Kiefer (1990).
2. A moderate block universe view is defended by many contemporary philosophers of time, such as Smart (1966, 131–148) and Price (1996). According to this position, time is not something external to the world, but in it. 3. I use the term *gestalt* for the shape things take. In doing so, I do not intend any of the holistic connotations often associated with the term in psychology.
4. In Kant's terminology (*Critique of Pure Reason* B 47) time is not a discursive concept but rather a 'pure form of sensible intuition' (Kant 1956–1964, vol. 2, 79). That is, time is not an element of the physical world like heaven and earth; rather it has to do with our ways of experiencing and representing. Empirical time, that is, that which is the element of our experience, is formed in time which is not a part, an essential part, but the form of this experience. Heidegger (1977, 323ff., 355ff.) later formulated this using the concept of the temporality of existence.

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