TIME AND ITS PHILOSOPHICAL IMPLICATIONS

STANISŁAW ZIEMIAŃSKI

Jesuit University of Philosophy and Education Ignatianum, Kraków

Abstract. The conception of time, presented by St. Augustine, unites within itself the physical-philosophical views of Aristotle, and its own psychological view concerning the lived experience of the flow of sensory impressions from the past towards the future. H. Majkrzak (1999) underlines, in Augustine, the existential moment of time. The time of a human life is limited: it is situated within borders stretching from the day of birth to the day of death. This faithful and precise representation of the Augustinian conception of time, nevertheless brings the reader up against a problem: What value does it have today?

I. Time as an Aspect of Energy

The parameter of time appears in a variety of physical equations. In the simplest form it appears in the equation for velocity: $v = s/t$. Velocity is the relation of distance traveled to time. But velocity alone is not yet a full reality. It in turn is an aspect of momentum. In the definition of momentum we take into account the mass of a body m; while mass associated with velocity is momentum: $p = m\ s/t$, or more succinctly: $p = mv$. This equation tells us that the magnitude of p is proportional to the mass of the body and the distance it travels, and inversely proportional to time. This means, that the greater the mass, or the greater the distance covered by a body within a defined unit of time, the greater the momentum. Momentum is a quantity, which we can discover by comparing it with another momentum, considered as a vector, whose sense is not identical with the sense of the given momentum, in other words, when the cos of the angle between them $\neq 1$. With regard to this it is not essential which momentum we recognize as the point of reference, because according to the theory of relativity every frame of reference is equally valid. However, the relation itself between momentums is important, and is not itself something arbitrary. The difference between momentums, or gradient, constitutes a certain tension, equal to energy. In the equation for energy: $E = mv^2/2$ or in the related equation for work: $L = F\, s \cos \alpha$, where $F = ma$, the parameter of time appears once again (in the velocity: v and in the acceleration: a). Thus, we can describe time as a partial measure of momentum or of kinetic energy.

Time was defined by Aristotle as the measure of motion in respect of the before and after, in other words according to the succession of phases approaching rest. However, Aristotle made this mistake, that in the case of movement in space (□□□□□□□), which today is interpreted as momentum, he absolutized place in such a way, as to suggest that being in a place constituted some kind of real property of being, belonging to the category of accident (□□□). Because of this he understood local movement as the exchange of one place which is lost for another which is gained. Such movement would be the realization of the potency for being in some specific place. This position lead him to insurmountable difficulties in the description of non-uniform movements, or movements of varying velocity. On the basis of the initial assumptions and the definition of movement in space it would be appropriate to treat the beginning and ending of movement as the change of change, which was for him an absurdity. Today we sometimes talk, in the case of accelerated motion, of overlapping movements, as if accelerated motion were the sum of infinitely many elementary uniform movements of ever greater velocity following one after the other. However, such a view seems artificial.

The resolution of the Aristotelian aporias concerning local movement is possible, if we state that movement in space is not a change at all, and if we treat the phenomenon of movement as the manifestation of a constant value, corresponding on the contemporary view to momentum, or a moment of rotation, and when they are correlated with momentum vector sense, or with a moment of a different sense rotation to the energy. This energy is subject to the play of different fields of force (presently four types of force, or static interactions, are known). In the case of a balance of forces acting on a given body, the body may not in a given system possess, in any last manner, a velocity, which does not exclude that it will have a velocity when measured in a different system. Accelerations are an expression of the gradient of these fields of force. Depending on the strength of a field of force the velocity of a moving body will increase or decrease proportionally. Its energy does not change, until the body encounters another body whose momentum differs from its momentum in velocity or its vector sense. The forces considered in themselves have a static character, they keep the system in a state of balance. An energy external to the given system is responsible for events, an energy which brings a «disturbance» to the current balance of forces.

As we recalled at the beginning, time is an essential element of kinetic energy. No distance can be covered instantly. In truth we can accumulate energy, produce fields of force and direct them onto a given body, so that it gains an every greater velocity, nevertheless there exists a boundary to this acceleration, namely, the speed of light in a vacuum, approximately 300 thousand km/second. Because of this limitation, every process occurring in the world is temporally extended. We use uniform movements as standards of this temporal extension, namely movements occurring in an environment of balanced fields of force. We can also use periodically recurring cycles, in which energy moves from a phase of high velocity to a phase of minimal velocity, and returns, an unlimited number of times.

Clocks are often built according to this principle. In wall clocks with a pendulum we make use of the oscillation of the pendulum within the gravitational field. A weight, or spring, thanks to the mechanism of the so called escapement, with every sway transmits a minimal portion of energy to the pendulum, compensating for the loss of energy suffered by it because of friction. The pendulum describes a small arc, a fragment of a circle whose diameter is equal to the length of the rod on the end of which hangs a part, usually in the form of a small round disk. The inertia of the movement of a pendulum causes its end to raise itself in the gravitational field till it achieves a momentary balance, when the velocity of the pendulum is zero, while the potential energy is at a maximal value. Without stopping the pendulum falls within the gravitational field regaining maximal velocity, to lose it again on the opposite side, when it reaches its highest point, at which point the potential energy is once again at a maximal value. With every cycle the pendulum makes possible the movement of the gear wheel most closely connected with it, and consequently, through a series of other wheels which reduce the velocity of the movement, causes the stepwise movement of the clock hands. Thus, on the appropriate place on the clock face one can determine what distance the clock hands have covered. The cycles of the movement of a pendulum are so regular, that the clock hands move almost uniformly, moving over the markings on the clock face with the same fixed velocity (the abrupt movements and moments of rest between them are to the naked eye almost imperceptible).

The solar system is also a kind of clock. The earth, within the gravitational field of the sun, moves with a uniform motion thanks to it possessing an energy with a vector sense perpendicular to the radius of its orbit around the sun. The period of time needed for the earth to make one orbit around the sun we call a year. We call a month the period of time needed for the moon to make an orbit of the earth, while the time needed for the earth to make one revolution on its own axis is called a day. Problems arise concerning the mutual relations of these periods of time, because they are not simply multiples of each other. This requires that the appropriate correctives be applied in the construction of calendars, depending among other things, on the addition of the so called leap days every four years (with the exception of years ending in hundreds, and not divisible without remainder by 400, e.g. 1900). In order to be able to measure the time of various processes, it was necessary to establish a unit of time. The second was accepted as the basic unit. Up until 1956 it was defined as 1/86 400 of the mean solar day, from 1956 to 1967 as 1/31556925,9747 of tropical year. Presently, the second is defined as the duration of 9 192 631 770 periods of the radiation of the caesium 133 atom.

However, because it turned out that the astronomical «clock» allows us to orient ourselves in time only with a certain approximation, while wall clocks, which utilize the earth's gravity are difficult to carry around, wrist watches were introduced, in which the role of the oscillator is played by a special wheel called a balance wheel, while the exchange of kinetic energy into potential energy and back happens thanks to a special delicate spring, called a hairspring. The moment of rotation of the balance wheel isn't restricted to the sectors of the circle as in the case of the pendulum in a wall clock, rather it constitutes multiple of the whole angle (360^0). The length of the radius of the balance wheel is chosen so that the periods of its revolution in both directions correspond to the periods of the revolution of the clock hands across the clock face, as required by the standards. Since, as we mentioned at the beginning, as long as the movement maintains the same duration and velocity the segments traveled will also be same, and vice versa, the time of the swings and revolutions will depend on the length of the distance covered, we regulate the speed of the swings in a wall clock by sliding the disk at the end of the pendulum along the rod, while the speed of the revolutions of the balance wheel is regulated by shortening or lengthening the hairspring.

Electronic clocks: tune-fork, quartz, and atomic are almost perfect. The function of a regulator is here played by a generator of electrical vibrations.

These vibrations are transmitted to a frequency distributor, while the current obtained from the distributor is used to power the synchronous motor which moves the clock hands by means of a toothed gear transmission, or causes numbers to be displayed.

In mechanical clocks, whether wall clocks, or wrist watches, we use generally circular movement, a fragment of the circumference of a circle in the first instance, and in the second its multiple. In watches with a balance wheel a fairly long path is contained in a small space, as if wound around the same point, thanks to this we can carry this kind of watch around with us. One can imagine a clock, in which the path would be linear, although such chronometers would in practice be very uncomfortable. A clock like this would have no face, but rather a line with a scale depicting the segments of time. Some kind of body would move along this line with a uniform motion. A clock like this would involve a certain discomfort, namely that in order to read its indications one would need to travel at the same time along the scale. This problem could of course be prevented by constructing a clock in which the scale would move with a uniform motion relative to a point taken as constant. On this principle, the inhabitants of a town, through which trains pass frequently and at definite times in accordance with a timetable, can orient themselves in time. The series of trains passing through this town at regular intervals of time corresponds here to the moving scale, while the town itself constitutes the point of reference.

II. Ahistorical Time

Elementary motion, or momentum, which, having being correlated with another momentum, is a portion of energy, has no history.[1] In this way also none of the motions of the hands of a clock stands out, and similarly none of the movements of the pendulum. For the observer, who watches a clock for 12 or 24 hours, its face looks the same as it did 12 or 24 hours ago. Without other information he would not be able to tell that in between these indications a fairly long interval of time had passed.[2] If he fell asleep

[1] Bartlett (1975, p. 17) writes in his book: «We conclude that microscopic phenomena have no *intrinsic* time-direction, at least if this can only be defined in relation to internal entropy increase.»

[2] H. Reichenbach makes use of the notion of the flow of time in the book: (Reichenbach 1958, p. 114) P.C.W. Davies, does not agree with his conception, and he writes: «A closer inspection reveals that it is more appropriate to regard the asymmetry as a collective property

and then later woke up, he would not be able to tell how long his sleep had lasted simply from the position of the clock hands, because 12 o'clock on a clock looks the same as 12', 12," or for that matter 24 or 24'. The identification of individual revolutions would require their continual observation. Similarly with uniform motion along a straight line, no moment or interval of time is in any way privileged. They are all equivalent. So, in case of linear motion also there is no history, and any singling out or favoring of moments is arbitrary. If we have become accustomed to treating time as a *continuum fluens* – a continuous flowing quantity, this is only because we project the properties of macroscopic time, or historical time, onto elementary phenomena whose time is ahistorical. Let us add that progressive motion along a straight line is a special or extreme instance of progressive motion along a curved line, among other things a circle; the straightness of a line is in any case a relative matter which depends on the real geometry of space. More complicated are the instances where energy changes its form, for example from mechanical to electrical or the other way around, or from potential to kinetic and or vice versa. Potential energy, whether in the form of differences (gradient) in height within the gravitational field, or in the form of gradients within the sphere of electromagnetic (chemical) effects, is not directly as real an existent as kinetic energy. It is only the potency for the expression of kinetic energy. The calculation of its value, and even naming it energy, is done in relation with kinetic energy, from which it comes and into which it often passes. Kinetic energy can therefore be called the main analogue of energy. Likewise the time of duration of potential energy is measured not according to itself, but in relation to some kinetic energy, whose time is the parameter. Thus, strictly speaking there is no time in potential energy, it is atemporal.

The sequence of transformations of energy can form a circle. So, for example, atomic energy can, under appropriate circumstances, pass into electrical energy, which in turn can pass into kinetic energy, and this into electrical and eventually once again into atomic. This doesn't mean that a given form of energy returns to itself taken individually, it suffices that we accept that it returns to the same type of energy. The equivalence of individual forms of energy shows that none of the forms of energy, of which time is an aspect, have a history. Ahistorical time is akin to a line, which has neither ends, nor senses.

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of physical systems in (space-)time. In this sense, time as such does not possess any intrinsic orientation, asymmetry, movement, direction or arrow. (Davies 1974, p.)

III. Historical Time

In order to pass from ahistorical to historical time, it is necessary to take into account not elementary motions on any given level activity, but rather the motion of groups of particles. As long as the particles in a given group move in a manner organized in such a way that all the senses of their momentums or moments of rotation are, when measured within some given frame of reference, in conformity with each other, we have to do with ahistorical time. When, however, as a result of the mutual influence between one group of particles moving in a given direction and another group of particles moving in a different direction, or even in the opposite direction, the layout of the directions of movement changes or the layout of the velocities of individual particles changes, there comes about a process known as relaxation or in other words, chaotization. In such instances there remains for us to study the result of the chaotic motions. The energy of the system arising from the combination of these two groups of particles is measured indirectly on the basis of the Boyle-Marriot law (or the Gay-Lussac law), for example by observing in a thermometer the increase in the volume of the mercury with the increase in temperature. As long as, in a given system, there is no loss of heat to the environment, the temperature maintains itself at the same level and in consequence we still have no reason to determine the direction of the flow of time; the time of this system is ahistorical. However, when a system is not isolated, in other words, when it is connected to another system with a higher or lower temperature, a new process of relaxation occurs and lasts for a definite interval of time. The state of a system before and after relaxation can be described mathematically in terms of the theory of probability. A basic term in this description is entropy. Entropy is defined as the logarithm of the number constituting the numerator of the fraction which expresses the probability of the state of the system of a given number of particles. An ordered state is expressed by saying that entropy equals 0, because the numerator of the relevant fraction is the number 1. The more homogenized is the system of particles, the greater the numerator of the relevant fraction, sometimes reaching astronomical values. In this case, the logarithm of this numerator, the entropy, is also proportionally large. An increase in entropy is a sign of the progressive chaotization of the system. Because the state of chaos, being more probable, is therefore more natural than the state of order, the processes within a given system which are connected with an increase in entropy, are, without interference from outside, on a macroscopic level practically irreversible. Thus we establish one direction: from the less probable state (ordered) to the more probable state (disordered). In the same way we can differentiate the past of a system from its future. Individual particles within the system still move ahistorically, but the global system begins to have a history. The increase in entropy is responsible for the historicity of time. By measuring the degree of chaotization of a given system it is possible to describe whether a given stage in the development of the system is earlier or later than another. This historical time is not in conflict with ahistorical time, because each has to do with something different. Ahistorical time is the time of the movement of particles taken individually, whereas historical time is the time of the states of a system, connected to the sequence of phases of chaotization. Historical time is therefore connected to global changes, affecting whole webs of relations among particles. The energy of an ordered system is, in terms of its quantity, equal to that of a chaotic system. Nevertheless its quality is different. In an ordered system it is united, easily lending itself to being utilized; in a chaotic system it is dispersed in portions having differing directions of movement, and because of this reason it has less potential for practical utilization, or none at all.

To measure the history of the macroscopic world, normal clocks which show time without direction do not suffice. A different type of clock is needed, which we call a calendar. We distinguish between the following calendars: thermodynamic, cosmological and electromagnetic. The thermodynamic clock-calendar has as its scale the relevant degree of entropy, which we spoke of above, that is, a numerical quantity, interpreted as the so called «reduced heat» □ Q/T or as k. log W, where W indicates the probability of the state of some system. Greater entropy indicates that a given system has moved in the direction of the future, whereas a smaller amount of entropy indicates what its state was like in the past.

The thermodynamic clock-calendar is, however, not completely independent. Changes in entropy depend on changes in the gravitational field, in this sense, that in order to calculate the quantity of entropy one must assume closed systems, namely those in which the sum of kinetic energy is constant. However, it seems that in a world which is expanding or contracting there is no guarantee of such constancy. In the case of the expanding of the Universe there also come into play the distances between individual heavenly bodies, which determine the density of the matter making up the universe, as also the velocity of their escape, and thus also the energy of these bodies. Were the density of matter less than the critical density, which amounts to 5.10^{-30}g/cm^3, the Universe might stop expanding and begin to shrink. Then the potential energy gained during the phase of expansion could change into kinetic energy. An energy like this, not being degraded, would have a small entropy. In essence, then, the amount of entropy in the universe would momentarily decrease. Although not for long. The falling of bodies onto each other and their collision would be accompanied by the dispersal of their kinetic energy, and this would mean an even more intensive increase in entropy. We should not forget here that irrespective of possible oscillation, namely the increase or decrease in the radius of the Universe, the processes leading to an increase in entropy would continue as a result of the transformations occurring in the interior of individual stars. In the opinion of Paul C.W. Davies, according to the oscillation model, the time of possible periods of expansion and contraction of the Universe does not coincide with the time of the relaxation of energy emitted by stars (Davies 1974, p. 96). This time, amounts to approximately 10^{23} years, in other words much more than the time of the phases of expansion and contraction, which is estimated at approximately 10^{10} years. From this comes the conclusion that although the entropological clock-calendar has a partial relation to the cosmological clock-calendar, nevertheless this relation is not absolute, in such a way that ultimately the first one predominates.

The cosmological clock/calendar allows us to distinguish past and future thanks to the rate of the density of matter in the universe. The greater the density of matter, which means its relation to space, the earlier the state of the Universe, and vice versa. This is how it happens in the phase of expansion. In the phase of contraction, it would be the opposite.

The electromagnetic clock/calendar is based on the theory of the propagation of light. Normally, light upon emerging from a source propagates through space. And yet the equations describing the propagation of light waves allow of two kinds of solution: delayed and accelerated. This means that a possible return of light to its source is not ruled out. However, in practice electromagnetic radiation which has been emitted predominates over returning radiation. The clarification of this predominance lies once again in the theory of probability: since it is easier to achieve chaos in the form of the dispersion of rays in space, than order in the case of the return of light to its source. This is therefore another example of the use of the law of increasing entropy. In this case the electromagnetic clock/calendar would eventually be reduced to an entropological clock.

The electromagnetic clock/calendar also has a relation to the cosmological clock/calendar. In an expanding universe electromagnetic radiation, generally speaking, moves from sources of light out into space, because as a result of expansion capacity of space to receive radiation increases. In other words, as a result of the Doppler effect the energy of the radiation emitted by stars which are moving away from each other is reduced, which means that the frequency of the light waves decreases, while wavelength increases, as can be noticed by observing the shift of their spectra towards red. This reduction in radiation allows for the further radiation of these stars. If the Universe started shrinking the opposite would occur. The sky at night would not be black, but filled with a white heat. In this way, namely through the expansion of the universe, we can clarify Olbers' famous paradox, and get an answer to the question, why does the sky not shine?

We can also ask, is our psychological feeling of the flow of time inborn and independent of other mechanisms which explain the «arrow of time»? Let us recall that this flow caused Augustine some difficulties in interpretation. It seems that our psychological time is also based on the same mechanisms described above. Beginning from our earliest years we become accustomed to phenomena which involve increasing entropy, in other words, which are practically irreversible. And because these phenomena are the most probable, we regard them as normal. Even a decrease in entropy within some region does not determine the reversibility of phenomena. A local decrease in entropy in one space is connected to an even more intensive increase of entropy in another. On account of this irreversibility in our experience of time we locate all phenomena, even those possessing no history, along the axis of time, on which the present is point 0, while the past is in the direction of minus, and the future of plus. The past is connected with the traces recorded in memory, the present with attention on what is happening, while the future is connected with expectation and planning (*Confessiones*, XI 20, 26).

This assessment is, however, something learned, and not inborn. As the researches of Piaget have shown, a child at first does not have a feeling of the flow of time, and cannot coordinate activities moving at different speeds. Imagine, for example, that we ran an experiment with a tube in the shape of a reversed Y, whose diameter was everywhere the same and into which water was poured, in order to flow into certain vessels. A child would measure the speed with which the water was being poured, on the basis of the size of the vessel, the speed with which the water level rose, or simply the water level itself, although it is obvious that exactly the same amount of water is being poured into the vessels from each of the openings of the tube.

Because of the fact that we have within ourselves an inner assessment, gained through experience, of time as flowing, i.e. a certain *a priori* condition, the form of time as it were, we project onto static (or ahistorical) time our own conceptions of time passing. Thus we classify as past, present or future, not only those processes which deserve this, namely global processes of macroscopic transformation, but also processes in relation to which, talk of the past, present and future has no sense, either because the level of entropy in them remains stable, or because it has no application with respect to them. Furthermore, in the opinion of Paul W.C. Davies, „contrary to widespread belief, time asymmetry is only *a type of description* relevant to the macroscopic world-view of the physicist, rather than an extra *physical* ingredient to be added to the laws of mechanics (Davies 1974, p. 4).

VI. Philosophical Implications

Since ancient times two philosophical conceptions have been in conflict: the staticalism of Parmenides and the variabilism of Heraclitus. The static view, particularly in the atomist versions of Democritus and Leucippus, did not recognize either real changes or causality, whereas Heraclitus did not recognize stable and invariable values. Aristotle reconciled both these tendencies in his theory of act and potency. Potency is something which is not yet realized, but which is somehow determined by means of the properties of the factors acting on it, and which are both active and passive. Aristotle accepts some kind of coming into being, in other words change, though not as radically as Heraclitus. Independent parts enter into a new whole, thereby losing their individuality. There remains however a certain stable aspect, because these parts do not completely melt into the whole, but are present in it virtually, which means that they can be brought back into individual existence. Nevertheless, changes do not depend only on the shuffling of elements unchanging in themselves, as the atomists assumed. Moving this discussion onto the terrain of contemporary science, we can say that we have to do with the conflict between two main theories concerning the laws of nature: theory T-invariable represented mostly by Mehlberg, and another theory which accepts the existence of history in the world (Grünbaum, Prigogine, Eddington, Denbigh, Penrose, Popper and many others).

How to reconcile these two theories? Theory T-invariable corresponds to ancient staticalism. It recognizes the principle of the preservation of mass and energy and also the impossibility of determining the direction of time. On this theory causality involves only the mutual exchange of mass and energy. J. Imbach calls this „closed causality." The other competing theory accepts that there is history and assumes that there is one direction in the development of the universe, it also accepts the existence of unrepeatable values, as well as the fact of real causality, even if this were to occur only once. It seems that these two theories can be reconciled. Namely by seeing that although the laws of nature are really T-invariable, at the same time the boundary conditions do not allow for the reversal of history. One of the most important boundary conditions is the state of the universe at the moment of the «Big Bang». Historicity concerns global phenomena, whereas individual particles have no history. Were there no important unique events, such as the birth of Christ in Christian culture, it would be impossible to introduce the calculation of time, it would be impossible to count how many years have already elapsed. Unique events allow us to assume a zero point on the time scale. The cycles of the moon, or of the earth around its own axis or around the sun, do not suffice for the creation of a calendar.

In the light of the above arguments we can assess the polemic which developed between Albert the Great and Thomas Aquinas concerning the beginning of the world in time. Albert, referring to an earlier tradition, for example that of St. Bonaventure, struggled to prove philosophically that the world was created in time, meaning that were we to go back from the present towards the past we should reach a moment, prior to which there would no longer be any moment. Because were there no such moment, the past would include an infinitely long time, and an infinity cannot be traversed. In such a case we would not have reached the present day. And yet we clearly have a present day. From this comes the conclusion that the number of days since the creation of the world is limited (see *STh* I, qu. 46, a. 2, 6 and *SCG* II, 38). Thomas assessed these arguments negatively: «The third argument is not convincing. Because the infinite, if it is not actually simultaneous, can arrive successively, because viewed in this way anything infinite is limited. Thus every rotation among the preceding could have been traversed, since it was limited. Whereas in the case that all of them arrived simultaneously, and the world had existed forever, we could not accept the first rotation, and consequently also transition, which always demands two extremes. The fourth argument is likewise flawed. Because nothing stands in the way, of it being possible to add to the infinite something from the side of end. From the assumption that time is eternal, it follows that it is infinite in the direction of what came before, whereas finite in the direction of what comes after, because the present is the conclusion of the past.» (*SCG* II, 38) To the sixth difficulty from the *Summa Theologica* he replies: «Traversal, as everybody knows, is achieved by going from one end to the other. Were we to designate any day in the past, the number of days from that day to the present would be limited, and could be traversed. The charge thus comes from the assumption that between two ends there should exist infinitely many intermediate elements (*STh* I, 46, a. 2).

Thomas ends this discussion with the following conclusion: «That the world has not always existed, we recognize on the basis of faith, it is not possible to discover this by means of argumentation.» (*Ibidem*) And even had the world existed from time immemorial, namely always, it would not be equal to God, as writes Boëthius at the end of the *De consolatione philosophiae* [Consolation through Philosophy], because the being of God is whole simultaneously, without succession, whereas the world is different. (*Ibidem*) We can agree with this last conclusion. The world, as a collection of contingent beings, would be dependent on the creative activity of God, even if it existed for an infinitely long time.

And yet, the whole discussion quoted above is based on an unfounded assumption that the time flows, and furthermore, that the days determined by the revolutions of the sun (according to the Ptolemaic cosmology) constitute separate temporal units. Meanwhile, in accordance with what we have explained in this article, time, in the fundamental sense, is ahistorical and therefore doesn't flow, but rather is a constant duration, a constant now. Irreversible events occur against the background of this duration because of the chaotization of energy. The discussion of Thomas with his predecessors had to do however, not with events like this but rather with uniform revolutions, which constitute a certain form of energy, classified, ontologically, as a state. The treating of individual revolutions as separate units is an arbitrary division of something continuous, and a creation of the imagination, because, after all, the sun does not physically inscribe the line of its path on the firmament. If we wanted to argue today in favor of the finite duration of the universe, we could reach for the phenomena of the increase of entropy and ask, why, if the world has existed forever, has entropy not yet reached its maximum, which would be equivalent to complete chaotization, or so called heat death? The answer which proposes itself is that apparently the universe, as we see it in its current state, has not existed forever.

Summing up our considerations, we have to admit, that the riddle of time is difficult. Time is tied to kinetic energy as one of its aspects. On this point, Aristotle's intuition that time is the measure of movement was correct. We need only to interpret movement as the energetic state of some substance, in other words a quality, and not place it under the category of change. The phenomena of oscillation, as for example the movement of a certain body towards or away from some point, the reversible transformation of kinetic into potential energy, and the vibration of crystals, allow us to order our chronometers, in other words tools for the measuring of the flow of time. This flow of time is however only apparent. In reality time is the duration of elementary processes, onto which are superimposed the macroscopic structures of the world, and it is these latter that change. Thanks to this we can distinguish ahistorical and historical time. Historical processes are measured by means of clock-calendars, which function on the principle of the increase of entropy in the Universe or the decrease of its density in proportion to its spatial dimensions.

This conception of time allows us to explain certain controversial problems, for example, the problem of the existence of past and future, and the legitimacy of the static and dynamic views of the world. It allows us to throw a certain light on the mediaeval conflict concerning whether the world was created in time or existed eternally. However, a problem remains to be resolved, namely, whether the division of time into historical and ahistorical is accurate, and whether so called historical time is perhaps not only the projection of our own psychological habits.

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