5. TIME AS A DEFINABLE MEASURE OF CHOSEN KIND OF MOTION

5.1. Time cannot present a primary concept

Taking the Time being generally understood as a ***quantity*** for a primary concept ***excludes a possibility*** to ***define it***; as with space, in this case we obliged to define it concretely for any specific application area.

On the contrary, from both physical and esoterical points of view there exists ***neither an expediency, nor a possibility in a*** primary concept of time; indeed:

– ***physics*** shows that there are ***no grounds*** to consider ***Time*** as an ***absolute*** notion – as a single parameter which allows us to order the events of any nature, since the precedence and simultaneity of events are specified by the frame of reference, apart from other obstacles. For these reasons the time is defined in physics on the ground of operational definitions – in its own way for each concrete application;

– ***the Secret Doctrine*** goes further – it considers the events and processes in several planes that causes the concepts of past and future, as well as simultaneity, to lose their generality even if the events are considered at the same place and moment of physical time (when the past and future are physically definable). And although it also uses the term "time", this notion is used as an easily understood substitute reflecting the primary concept of duration inherent to any kind of motion that may proceed in several planes of existence (in physical space, as well as in the subtle planes), but at different rates.

For this reasons, making use of the same term "time" both in general understanding, and in operational definitions causes confusion and contradictions; the situation becomes especially tangled when the concept of physical time is used for studying the phenomena which are not described by physical models, although acknowledged as the facts.

Meanwhile, the esoteric understanding of time corresponds to an operational approach adopted in physics, since it also correlates time with motion, but in different planes of existence, not only in a physical plane. From this point of view ***there exist both an expediency and a possibility*** in a definable operational paradigm of time that reflects the property of duration for diverse classes of phenomena. However, even physics deals with a series of heterogeneous Time Count Systems (TCS): there exists no dominant time count system since each specific time reflects the properties of the base process and the way how this process is parameterized. This means that forming a general concept of time with the use of just physical models has proven to be insufficient.

Therefore, obtaining ***not a primary concept***, but a ***generalized definition of Time***, that would allow us to treat the phenomenon called "Time" from a common position, presents theoretical and practical importance. The goal of obtaining such definition consists not in supplementing the existing series of vague ones with a new uncertain version, but in developing a systematic methodology for uniform treating the phenomenon of time.

Solving this problem presumes that the time is to be operationally defined as a numerical quantity which reflects general understanding of duration and provide us with a possibility to reduce it uniformly to an operational definition, pertaining to the required sphere of physics, esotery, or other branch of knowledge by substituting the primary concepts with their analogs taken from the respective sphere. For this, it has to be expressed in terms of primary concepts which are equally applicable to any of these spheres.

So, we come to the following theses, the first two of which were grounded in the previous consideration.

T1. Time, as a quantity, does not present a primary (or universal) concept.

T2. Time, as a quantity defined by time count system, is not unique.

T3. Time is a quantity that could be given an operational definition with the use of primary concepts.

As to the third one, such a definition is proposed below which is based on the use of primary concepts, the applicability of which both to physics and to esotery, history and other branches of knowledge has been illustrated in the preceding parts of this work.

5.2. The primary concepts which are associated with time

5.2.1. Time as a measure

Time function as a measure. So long as we consider ***time*** as a ***numerical quantity*** (although it may equivalently be defined by a precedence relation, or in other way), it should present a kind of positively defined monotonic function – a measure – to be defined on the states of the base process making the basis of the ***Time count system*** (TCS). But ***the states***, in themselves, ***do not define a measure uniquely*** because for the given set of states a ***measure*** may be specified ***diversely***.

Thus, imply for simplicity that the states are described by a unit segment $J = [0, 1]$ where 0 corresponds to the start of motion, and 1 – to its termination. If this motion defines a unit of time, the ***time function*** $\tau = f(j)$ takes the values on a unit segment $T = [0, 1]$ as well. If this function is ***linear***, $f(j) = j$, the time is *numerically* defined by the states (viz. by values j). This is a typical approach that is used in TCSs and may give an impression that the time thus defined is "uniform". However, a ***nonlinear*** function, as it is shown in Sec. 1.4, may specify time even better if some external considerations are taken into account.

Space. Therefore, for the time to specify a quantity the ***states*** are to present the ***elements*** of ***some numerical space*** (or an abstract space that could be mapped in a numerical space); for example, the points on a ***coordinate space***, like the Cartesian coordinate system is used in Newtonian physics as a reference frame. But such space has no numerical properties (except of coordinates), until some ***metric*** is defined; this can be done in many ways, and each type of metric defines the respective ***metric space*** in mathematical sense (Euclidean, Minkowski, etc.) over the same coordinate space. Accordingly, in a physical theory that mathematical space is used which complies with its source hypotheses; thus, Newtonian mechanics and gravity are based on the properties of the Euclidean space, as the Special relativity – on Minkowski space, etc. In this sense a measure, as the a time function, may coincide with the metric, or be defined in a special way.

In an illustrative way we may say that the time function defines the "duration" of motion between the states, because the space of states, in itself, does not suffice for describing this motion. In this sense the duration, motion and space are mutually conditioned, or present different aspects of the same whole.

Reference time function and "uniformity" of time. Since for the same space the time function may be specified in a variety of ways, we may express time, specified by one TCS, through the time defined by the other TCS; this dependence is represented by the reference time function. The time specified by each of these TCSs is "uniform" in itself, but may be non-uniform if the reference function is nonlinear. Hence, it is not the metric or time function itself, which defines the adequacy of time (or rather – Time count system), but the properties of this time relative to some other Time count system (which we consider "exact" or "appropriate") that are specified by the reference function.

So, if a reference function is not linear, one of two compared TCSs is to be considered nonuniform, and although this is a typical situation, in some cases this nonuniformity may attain an extremal nature – when a reference function becomes instable (in this situation small variations in source data cause great variations in the result), thus engendering a point of bifurcation. This mathematical peculiarity denotes that the "physical" properties of time defined by the correlated TCSs differ incommensurably, thus defining some peculiarity in the considered process. That is why the measure of time must be chosen so that the adopted time function is tuned to that feature of the process(es) in following which we are interested, and if we are interested in several aspects of the process(es), we may consider several TCSs, as it takes place in physics (See Supplement 1), or if we consider a civil and evolutional time (See Part 3).

Discreteness and continuity of time. In a day-to-day practice we actually deal with time as with a discrete (or integer) quantity since we count it in seconds and greater units. Although in physics and technical applications time is usually modeled as a continuous value since it is defined on a continuous set of states of the base process, in reality they also deal just with discrete values since any measurement could be made but with a finite accuracy. As well, in many approximation models time is considered as a discrete value. Therefore, *in practice* it is not a principal question – whether the set of the base process states is continuous or discrete; it is crucial that the base process states must be defined and ordered; in this case they may be ordered on the numerical axis, and a time function mapping these points on the scale be defined.

Nonnumeric process. If we like to obtain a time that reflects the development of some nonnumeric process (historical, etc.) ***we must firstly digitize this process***. In other words, we have to compile a model of the process which presents its states in a numerical space; for instance, as that was done for evolutional time. After the states have been defined and ordered, the choice of measure becomes a problem of choosing a scale being appropriate for the application – like with physical TCSs. In this situation a ***process*** may also be considered as a ***sequence of events*** corresponding to a ***motion from a state to state***.

It may seem that this gives just a rare set of points. Even if so, that time would present simply a rough TCS, like a sundial. But the more states we take the greater the accuracy the TCS attains.

If the states cannot be properly allotted for a process, we are unable to define time by them; but in this case a question arises: what sense does it make to call something a process if we cannot distinguish between its states?

Resume. As far as time is defined with the use of some *model*, and the validity of any model is always *conditional*, there is always some randomness in any TCS; however, the latter could be used for TCS's good, since although we are required to define time as a measure of motion, in terms of the space and duration, we may choose the base process and tune its model (viz. space and time function) for better accordance of the resulting TCS with the goal of time count. This is apart from the esoteric paradigm which states that if a process develops in several planes of existence, the durations with which it develops in those planes may differ.

5.2.2. The primary concepts of Space, Motion and Duration and their manifestations in physics

Time, in general, is understood as ***duration*** (or its derivatives, such as "moment" of time, etc.). Meanwhile, a duration presumes changes, collectively – ***motion***, whereas the latter assumes the existence of environment where they take place, the ***matter*** and ***spatial properties*** of which are collectively called ***space***.

As a matter of fact, the terms ***space***, ***motion, duration*** and ***time*** are widely used in bibliography as both the ***primary*** and ***definable*** concepts. However, in the below consideration the *former three* are considered as the primal, non-definable concepts (unless specified otherwise), whereas the *time* – as a definable one.

Thus, in the ***Secret Doctrine*** the Space, Motion and Duration are considered as those interrelated primary concepts that inhere in time, whereas the latter is used as an intuitively clear substitute for the primary idea of duration. The Doctrine affirms the absoluteness of Space and continuity of Motion, and thus – the continuity and absoluteness of Duration when they are considered as primary concepts, but it also considers their manifestations in various aspects (on a physical plane – in particular).

Physics does not deal with these concepts as with the primary ones, but by relying upon general understanding of these notions (while making no distinction between time and duration), it uses them as time – operationally; for this, any kind of a space or motion, as in mathematics, is defined by its elements and properties.

Therefore, any kind of physical space, motion, and duration may be considered in esotery as well, but still as a *reflection* of the respective primary concept.

Discussion

Although another notions could probably be used for expressing the concept of time, these are namely the Space, Motion and Duration which are used for this purpose as the keystone concepts, both in esotery and in physics. For this reason it makes no sense to introduce new concepts in this consideration if these suffice. But whether either of them is necessary? It depends on the way how the motion is defined.

Space model is required for obtaining a description of states of the matter in the considered plane of existence which specify a process, since if there are no events, as changes in states, it becomes senseless to discuss motion or duration of that what remains unchanging ("nothing happens"). As far as we are interested in defining time as a measure, the conventional and seemingly most convenient way to present a space is to define it as a ***phase space*** – by a set of n coordinates ($n \geq 1$); in this case any unique ***state*** of the ***base process*** is corresponded by the respective unique set of coordinates. In particular, they may present the conventional spatial coordinates, or does not contain them at all – as in case of non-physical process; in general, the coordinates may take logical or qualitative values.

In this approach the states reflect the actual situations that may take place in the Universe and may have any nature (physical, social, etc.). But once they are defined as the elements of a formally described phase space, we obtain a model of the space for the respective ***system*** (as a class of phenomena). Instead of states we may consider events, but this is just a way of formalization of the considered system, which presents a matter of convenience.

In physics, for a base process the physically observed phenomena are taken. In this case the space presents a description of physical matter. However, in esotery, like in psychology, history and other applications, a base process may present a phenomenon that develops not in a physical plane. In this sense the space may present a description of matter of subtle planes and, thus, be associated with the matter in a general sense.

Motion is generally understood in two main aspects. Firstly, as a variation of the states and, secondly, as a variation of the states as a function of time. It is clear that the use of the second alternative is unacceptable in an operational definition of time. And although we understand intuitively that the primary concepts of duration and motion are indivisible, for obtaining an operational definition we must accept the first alternative. In this case the motion (or rather ***phase motion***) is to be understood as a variation of phase space coordinates (excluding time parameter if it is present among them), viz. states of the process, for which the relation of precedence is defined.

Further on, we have two main variants. If all the phase coordinates are continual, the motion is described by a continuous curve in the phase space (this case complies with the esotery and non-quantum physics). If the coordinates are discrete (a discrete space being widely used in models), the motion is defined by the sequence of states; in this case a transfer from a state to a state may be interpreted as event. In both cases the points that constitute a curve or define a sequence of events could be parameterized so that some positive quantity $t = f(j)$ increases its value in the “direction” of the motion according to the relation of precedence; in this context the time may be called a ***phase time***.

The difference between the motion and parameterized motion may be illustrated by a contrail and trajectory: two jets leave the contrails of the same form, but one of them might have passed this distance twice faster.

Duration. In essence, this universally accepted approach to interpretation of time reflects a general assumption that there exists some objective property of motion, which we conventionally call time, that qualifies the “rate” with which the considered process changes its states; in esotery this property is called ***duration***, and in physics an operational definition of time simply quantifies this property.

Namely in this sense the ***concept of time***, as TCS, ***reflects*** the primary property of ***duration*** of motion since it uses an intentionally chosen time function (***as a measure*** for duration) defined on the set of the chosen sequence of states (modeling the considered motion) which describe the base process on the ground of the chosen model of space. It is obvious that in these circumstances we cannot expect an equivalence between the primary and definable concepts.

This means that in particular cases time may be considered as the measure of motion (e.g. when a motion is described by a one-parametric curve as in Sec. 1.4), but in general case time should be considered as a measure of duration of motion. For example, for the expanding Universe the scale factor may be considered as the measure of motion; in this case the comoving time presents the duration of expansion, but with respect to the adopted cosmological model.

So, a continuous parameterization of motion $J=\{j\}$ eventually provides us with the “milestones” for an operational definition of time: either this parameterization itself may be taken for the time function, $t = j$, or its transformation $t = f(j)$, but there is no process that could in any sense be considered as “primal”, since none of such parameterizations is unique in its essence. Considering a discrete model of space, with which we always deal in practice, does not change this approach essentially, just – in formal aspects of the model.

5.2.3. The primary concepts of Space, Motion and Duration in the Secret Doctrine

The Secret Doctrine affirms the relativistic idea of unity of space and time:

> "Space and Time are one. Space and Time are ***nameless***, for they ***are*** the incognizable THAT, which can be sensed only through its seven rays – which are the Seven Creations, the Seven Worlds, the Seven Laws," etc., etc., etc… [SD2 -612]

Meanwhile, as it was shown above, it also states explicitly that any definable notion of ***time*** *is not equivalent* to the primary concept of Duration, but is used as a ***substitute*** for it. Moreover, alongside with the Duration, the Secret Doctrine considers the Space and Motion as the primary concepts:

> The appearance and disappearance of the Universe are pictured as an outbreathing and inbreathing of "the Great Breath," which is eternal, and which, being Motion, ***is one of the three aspects of the*** **ABSOLUTE** – Abstract Space and Duration ***being the other two***. [SD1-43]

The resembling comments are given in [7]:

> What is the one eternal thing in the universe independent of every other thing?
> Space.
> ***What*** things are ***co-existent with space***?
> (i) Duration.
> (ii) Matter {See a comment above – SS}
> (iii) Motion, for this is the imperishable life (conscious or unconscious as the case may be) of matter, ***even during the pralaya***, or night of mind. …
> … Cosmic matter, space, duration, motion – all one.
> ***In short,*** motion, cosmic matter, duration, space, ***are everywhere …***

Therefore, the duration presents an inalienable property of motion and space, but is not reduced to neither; and by embodying a primary concept it cannot be defined, but could be *reflected* in a definable concept which associates all these aspects of duration with the general concept of measure that is required for defining time as a numerical quantity. As far as it characterizes any type of motion – both on physical and in subtle planes, such a definable concept which we call time possesses equal rights to be associated with any kind of motion, not only with the physical processes. So, by giving a (*numerical1) measure* of duration, an operational time presents a "legal" feature of that kind of motion the base process of which it reflects.

5.3. Time as a measure of duration of motion

So, if there is a motion, there is a time, but just as an estimate of its duration, since any attempt to define an "absolute" time would be inconsistent: time may be defined operationally for any kind of motion the flow of which we can digitize, but its meaning does not go beyond the sphere that is described by the chosen model. In this sense as the physical time may be not quite appropriate for revealing the peculiarities of an evolutionary process, so the evolutional time may be inappropriate for modeling the physical processes. In other words, the Time, as a numerical measure of duration of motion, reflects the internal rate of development of the considered kind of motion in the light of the chosen process model and time function.

Nevertheless, if a generalized operational definition of time is based on the primary concepts we obtain a possibility to transform it to a specific form reflecting the properties of these primary concepts in terms of the notions pertaining to the chosen model of the considered phenomenon. If, in addition, such a definition is unambiguous and constructive, it would allow us to treat time uniformly for diverse applications.

By allowing for the definitions of time for various kinds of motion and their properties that were considered or obtained in the previous parts, as well as the esoterical properties of the respective primary concepts, in the upshot we come to the following general operational definition of time:

TIME IS A MEASURE OF DURATION OF MOTION

This definition is not new in wording – it could be found among a series of other ones – but it provides us with a new and uniform insight into the phenomenon of time due to the use of the primary terms in their esoterical meaning. This makes it applicable not only to physical processes, but equally to those ones that develop in other planes of existence. Besides, it gives a clue to understanding of the mysteries of time that are associated with the past and future.

From this point of view this definition determines time as a general concept, although not as a primary one.