V. V. Shulikovskaya

THE PHANTOM OF CONSCIOUSNESS

Guide [1]

[1] Attention! This is not contents; this is a guide for those who are looking for information about a particular question. If you see the ciphers 1, 2, 3… after the title, it means that the question you are interested in is considered in several places.

THE PHANTOM OF CONSCIOUSNESS[2]

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I

Dear auditors![3]

We are gathered together at this seminar in order to discuss the properties of time. But each one of us has come to studying of time problems in his own specific way, and each one of us has particular understanding of the "time" phenomenon. Therefore, first of all it would be useful to specify the subject of my talk.

During my previous talk at Your Seminar, one of the members of the audience asked me to define the concept of time; and I refused to do that. I, actually, never liked to determine such abstract concepts. First, my education (which is mathematical, after all) tells me that if we want to formulate strict concepts we should primarily distinguish some initial indefinable notions in order to turn them into the constituents, the "building bricks", from which all the rest will arise. Otherwise, if we give a definition of time or of any other abstract entity we'll describe one word by using from ten to fifty other words, each one of which requires clarification. But as far as I know, there are no such initial indefinable notions in Natural Science in contrast to Geometry, for example. Second, our verbal way of communication is itself imperfect from the scientific point of view as long as the meaning of every word is very fuzzy and very individual. I think, every philologist will acknowledge that every single word in the consciousness of every human being is associated with a certain semantic field, with a set of its meanings. These semantic fields are different for different people, even for people of the same generation and speaking the same language, as long as there are no two different people with identical life experience. Furthermore, it is rarely possible to compare the borders of semantic fields of two different people — even if we talk about certain tangible and explicit things. For example, take such simple words as "table" or "chair". It should seem that their semantic fields are unequivocal. But it is possible to imagine a strange bit of furniture I would uncertainly describe: "It seems to be a table". And somebody would object: "No, I think it's a chair". So, for example, a computer program is unable to distinguish "A" and "B" letters when the writing is a scrawl. And what about such abstract things as "reality" or "time"? That is why I don't like to make definitions.

However, it is necessary to agree about the subject of our investigation. Therefore I, at least, will try to give a negative definition of time, i. e. I will try to explain what the time I am really curious about is not. I believe it is really worth doing because, as for me (I don't know about my listeners), I have been anxiously noticing during a long time how a lot of unclear and mysterious things are unthinkingly called "time", as if with the aim of explaining their mysteriousness by exploiting the mystique of time. That is to say, the word has become too multivalent, and its different meanings are not separated from each other and are mixed in complete disorder.

For example, in many modern esoteric teachings, time stands for a synonym of a mysterious supernatural power, which determines the order and the essence of the Universe. Followers of these teachings consider that to live in accordance with Galactic time is to completely extend their own abilities, to determine the occupation which is best suited for their own personality structure and to have spiritually familiar friends. It is clear that the word "time" is used here with some special meaning, which differs from the one of official science and from the one I need at the moment. I call this time *esoteric*.

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[2] Translated from Russian by V. A. Glushkov, V. V. Shulikovskaya; edited by I. Marshall.

[3] Presentation at the Russian interdisciplinary "Temporology Seminar", Moscow State University, November 8, 2011.

I will give another example. Physicists like to talk about the deceleration of time at speeds close to the speed of light, or under the influence of a very strong gravitational field; and common people who are far from science make a lot of amusing conclusions from this theory. Probably, when reasoning about time deceleration (regardless of whether it is real or apparent) we should better talk about deceleration of all processes that are possible in living and non-living Nature, including those in metering devices used to measure time intervals. I call the corresponding time *relativistic*; and it should not be used instead of other types of time. To clarify the difference, let's raise the following somewhat inappropriate question: what will happen to me if the speed of my motion becomes superluminal? In science fiction, in such cases they say that time will flow backwards for me. But what does it mean, backwards? Shall I get into the previous day? Or, may be, all the processes in my organism will go back and I will get one day younger but stay in today and tomorrow? I dare say, these are different things. Yes, today's physics supposes that superluminal velocities are impossible. However, it is sufficient to appeal to light speeds as well. It is usual to say that when a body moves with the speed of light its time stops; but it doesn't mean that this body will remain in today forever — it will keep moving both tomorrow and the day after tomorrow. All processes that would take place in this body actually stop, but they will resume as soon as the body's motion velocity reduces. This example demonstrates the confusion pertaining to the word "time".

By the way, to my mind, the problem of the determination of natural referents for time (the central problem at the present seminar) refers to the time of Relativity theory, i.e. with relativistic time. Maybe this applies to esoteric time as well, if time is the driver of the precise execution of natural laws. I suppose that the relativistic time group includes such types of time as biological, geological, chemical time etc.

Finally, dear listeners, I think you expect that when talking about the concept of time I cannot but touch upon the Theory of Nikolay Alexandrovich Kozyrev. Unfortunately, I'll not be able to do it because I didn't and don't have the chance to properly study this theory. The informal representation style available to me does not allow an adequate understanding of what rotation of the cause in relation to the consequence is, what the processes that take place with the emission of time look like, and why time is a creative element. All I have managed to understand is that when irreversible (necessarily irreversible) processes take place, i.e. when they cause an increase of entropy, space-time acquires auxiliary features for it has torsion (the second curvature) as well as usual curvature. Then the word "time" turns into a synonym either of this torsion, or properties related with this torsion, or of a kind of energy still unaccounted for. That is to say, the word obtains one more meaning, surely not identical to the previous ones. Again, if we imagine an ideal mechanism operating without the generation of entropy (a pendulum without friction, for instance), it does not remain in yesterday forever, does not escape from our hands, does not disappear staying in the past and breaking all possible conservation laws, but it comes with us into today and tomorrow. That is, time keeps flowing without generating entropy. Natural processes in this pendulum do not slow down and do not stop, therefore the relativistic time has nothing to do with it, either.

Apparently, the category which includes the Kozyrev's time should comprise the "time stream" related with irreversible processes and generation of entropy, like in Prigogine's theory, for instance. I call this time *entropic*; but it is not the subject of my present talk.

II

What I would like to talk about today can be simply expressed by the words "time flows" or with the question "does time flow?"

The notions that time flows and that the world changes are considered to be absolute truths. Such notions are so obvious that it's inconceivable to question them. From earliest childhood, everybody knows that time flows. And when you know something from your childhood, you cannot find the source of this knowledge and there is no logic to verify it.

In other words, besides the unconscious "moral law within us", which intrigued Kant so much, our consciousness comprises other models related to the operational principle of the World: models, which are either inherited and native or acquired by the child before it acquires independent thinking, along with the first words of its native language. Of course, such models are indispensable as long as it's impossible to invent everything from the very beginning and independently figure out explanations of everything happening around us during one single human life. The problem is that we even don't think to doubt these models, don't try to take a detached view of ourselves and our civilization. In the same manner, we don't try to hear our native language as the set of strange and irregular sounds a foreigner would hear.

But I belong to a category of people who always doubt even commonly accepted facts. Besides, my consciousness seems to have some congenital defect, which makes me consider the flowing of time not to be so beyond question. It may happen only rarely and spontaneously, but sometimes the past becomes very close, almost accessible for me[4]. And though my spiritual condition at such moments in no way encourages logical thinking, even these spontaneous short flashes of consciousness have been enough to change my comprehension of the world and to estimate natural laws and spiritual values independently and in my own way.

So, if we assume that everyone ought to do the things for which he has the most advanced faculties, then whether I like it or not, my destiny must be linked to the study of time — not relativistic, nor esoteric, nor entropic but just time.

Well, "time flows". But what do we objectively know?

First of all, our Universe exists and occupies a certain piece of space and a certain period of time. However, in order to avoid all singularities, we can choose to take into consideration only a part of the Universe, intentionally excluding "that kind of space where space already does not exist and that kind of time when time did not exist yet". Actually, this Universe can be trimmed and lopped all round thus leaving only the Solar System in space and the last couple of billion years in time. We are going to consider only them. So, there is a certain piece of space and a certain period of time; and, apparently, there is a fundamental difference between spatial and time coordinates. For example, in the formula which is used to calculate distances and which determines the squared line element, they present with different signs (fig. 1). Of course, it is our nature that we are unable to perceive several time moments at once, but some multidimensional observer who is external relative to our Universe could be quite able to look at our World entirely and in general, in all its spatial and time integrity: past, present, and future. The future is uncertain for us, but it doesn't mean that it is uncertain in general.

$$ds^2 = (c \cdot dt)^2 - \sum dx_i^2$$

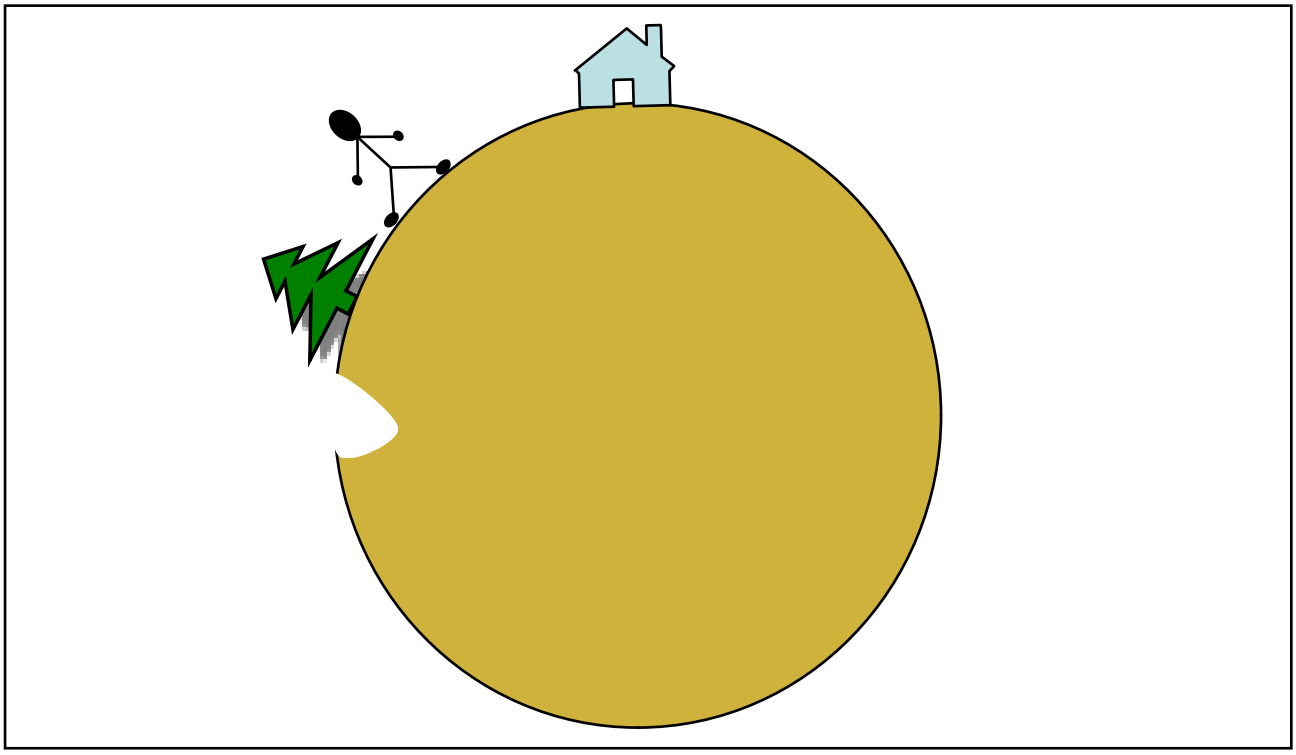
Fig.1

In order to better understand this observing stranger, imagine some not three- but two-dimensional planet (we'll restrict ourselves to one planet) with its own terrain and inhabited by living, moreover sentient, beings. If, from the point of view of these creatures, time flows in the same way as our time, then they are sure they live on a plain round planet, which gradually changes as they do (slide 1). However, an observer from outside, capable of perceiving three-dimensional objects, could see this world as a slightly irregular rough cylinder, the axis of which matches the "global line" of the planet's centre during all of its period of existence; the roughnesses are mountains, cavities, people, buildings erected by people, animals, vegetation (slide 2). In general words, we can say that these roughnesses are longitudinal bubbles and scratches, of irregular shapes but mainly orientated along the axis of the cylinder. In fact, mountains and trenches remain in existence during numerous millions of years (so, the longest bubbles and scratches cor-

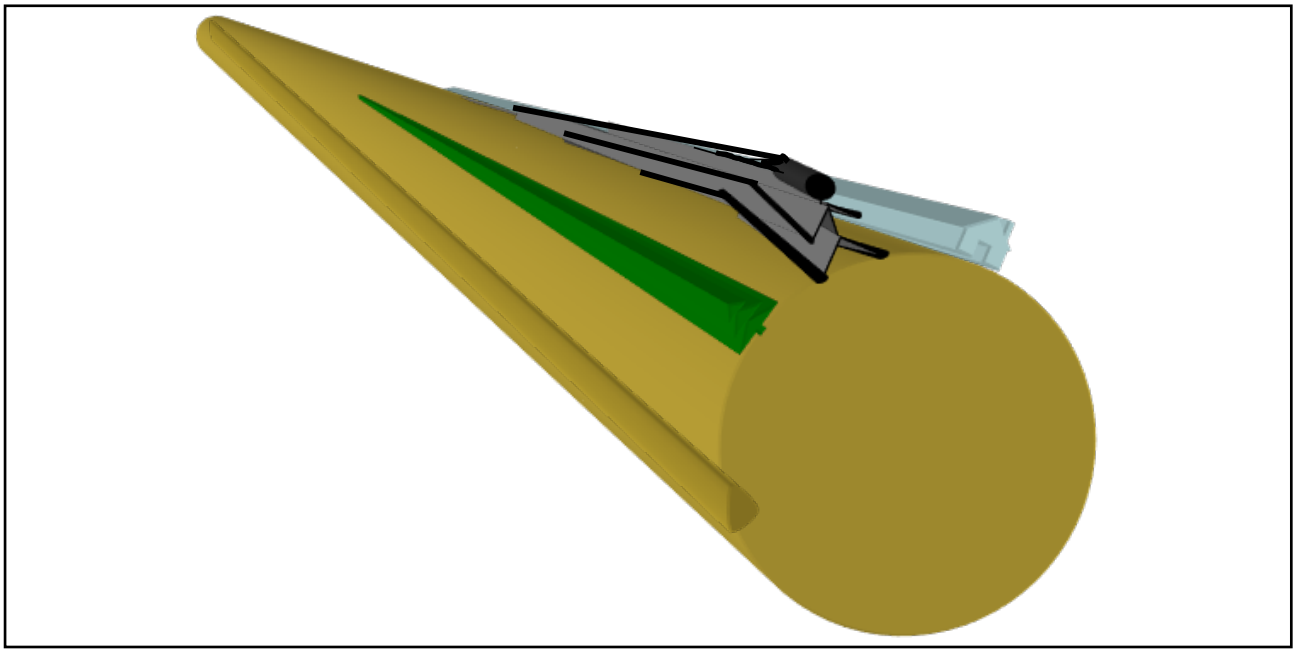
[4] Cf. Shulikovskaya V.V. *From Homo Sapiens Faber to Homo in Tempŏre.* (http://www.chronos.msu.ru/en/eelectropublications)

respond to these); trees and buildings, of course, also do not emerge in an instant and they continue to exist for a while after their appearance. From this point of view, people and animals are more restless as they leave a weird tracery on the surface of the cylinder; but these traces are at least continuous as long as no creature can suddenly disappear from one location and appear at another. The cylinder itself is possibly not an absolute cylinder: it is curved if consideration is taken of relativistic effects in determining the planet's motion. However, this imperfect cylinder exists after all. It exists entirely, in all its integrity. And there is no one to blame for the fact that its inhabitants are able to see their little world only in a perpendicular section; that is only in one moment of their time.

So it seems to us that the past has gone forever and the future has not yet happened. However, it does not really matter.



Slide 1 (to animate click the slide)



Slide 2

Of course, the subject we are talking about can obviously be connected with the notion of "space-time continuum". This notion seems to be common, but it has still not been comprehended completely. Nobody tried to make moral-ethic conclusions from its existence, and today there already emerge opinions that the space-time continuum does not exist at all.

However, even the authors of scientific works persistently mix their own common understanding of the *flowing* of time to the space-time continuum notion. Reasoning about the march of time in the world of particles and antiparticles, they in fact endow elementary particles with human properties. Talking about a picture that comprises the t-coordinate, they use such words as "before" and "later" as if this is not a picture but a movie frame, as if this picture is changing (fig. 2), apparently, in some auxiliary time t_1. In other words, even the intellectual understanding of the space-time continuum is far from being perfect. The status of its moral understanding is a little worse.

For example, what did the teaching of Copernicus do to the world view of the Renaissance people? Instead of a cosy little world safely surrounded by the seven celestial spheres, they suddenly found themselves on a rotating mass of rock, hurtling through empty space. All around is infinite. It is cold and scary, but it is impossible to get back. And this new unfamiliar and scary world picture, which is actually simple and comprehensible, was accepted by artists and philosophers, poets and politicians of that epoch; it gave an impulse to the origin of new ideas in various spheres of social life, just as well as scientific ones. The World view and cultural value of these ideas turned out to be so significant than no one rejected them when such opportunities appeared at the turn of the nineteenth century; by which I mean failed attempts at experimental determination of the Earth's absolute velocity. For some reason, no one wanted to consider the Earth as standing still; on the contrary, much more complicated hypotheses were proposed. As for the theory of Relativity, I think a good half of the community of physicists do nothing but wait for an opportunity to get rid of it and they will immediately do it if the opportunity arises. This vague rejection of Relativity theory is interesting enough in itself that it can be the subject of a proper and separate scientific investigation.

But let us go back to our observing stranger. Just like in the example with a 3D rough cylinder, different parts of the Universe possess some symmetry: the observer will find some interesting regularities. For example, taking the "world line" of some point in space, it will be possible to say what nearby "world lines" look like. In the same manner, sections considered at nearby time moments t and $t+\Delta t$ are related in a certain way; and this relation is of another kind than the previous one (fig.3). If we borrow the linguistic terminology, one can say that a picture made in synchrony (that is, at some fixed moment t) differs essentially from a picture made in diachrony.

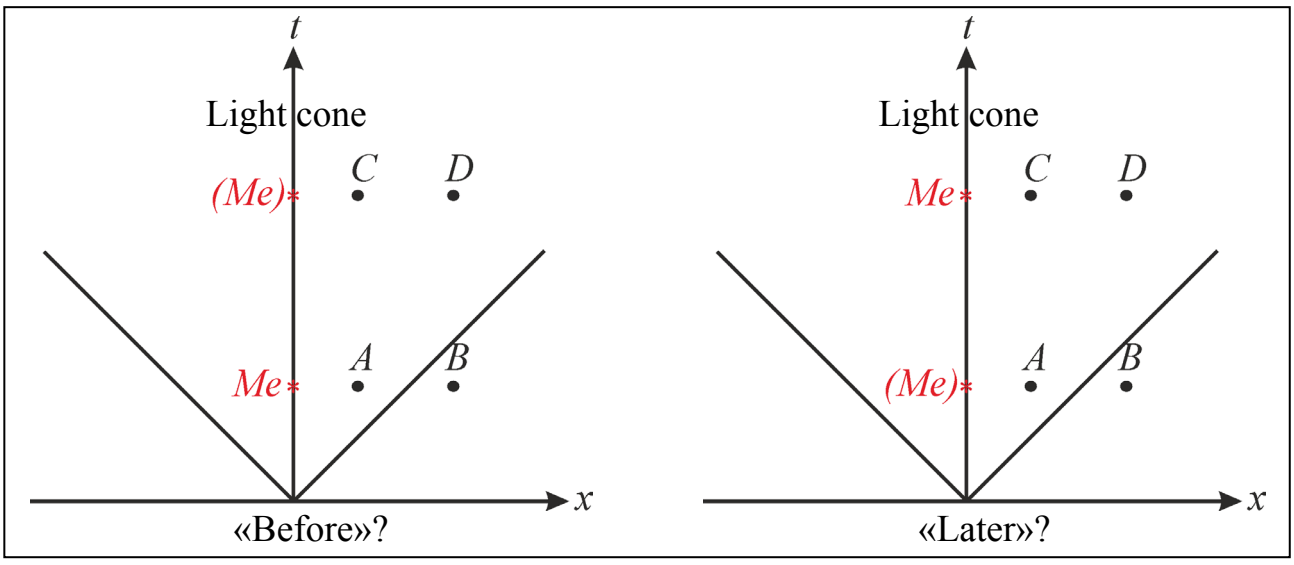


Fig. 2

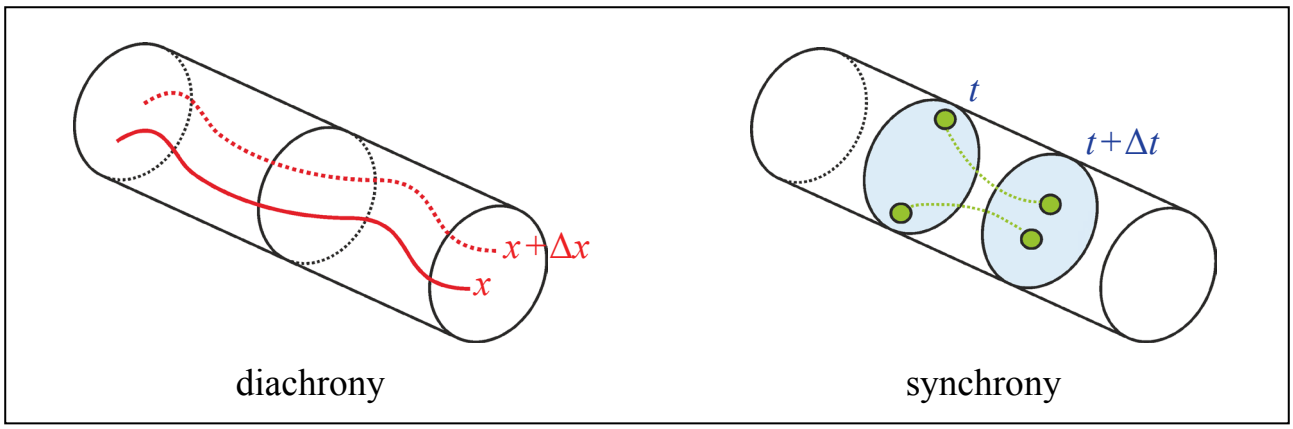


Fig. 3

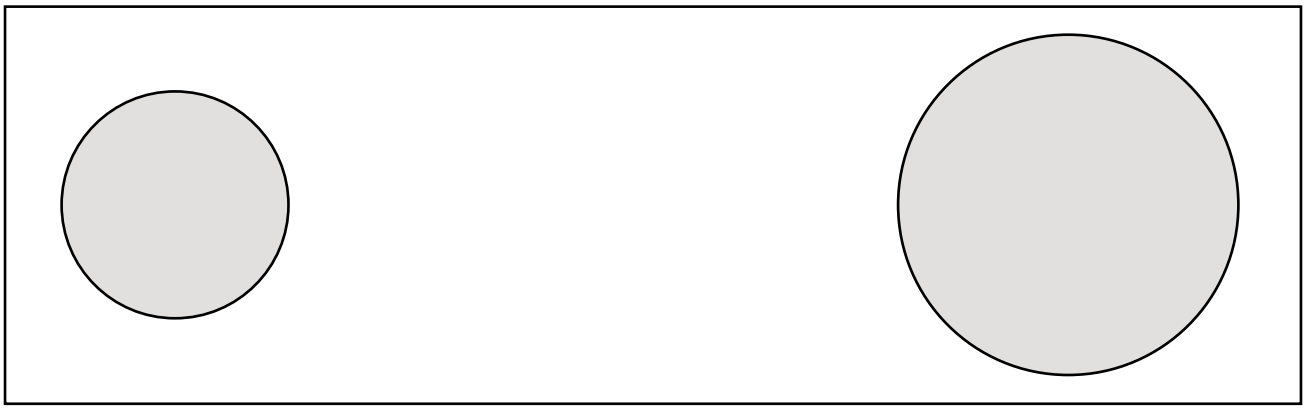
Humans have been trying, as long as they have existed, to understand similar odd and amusing pictures appearing before them; with the same curiosity they compared what is to the left with what is to the right, what is in front with what is behind, and what has already happened with what is going to happen. The process is called "Discovering the laws of Nature" or "Exploring the surrounding world".

Let us try to imagine our laws of Nature from the point of view of the observing stranger who does not fundamentally differentiate time and space in the way they are distinguished by an observer looking from inside. I'll give some examples based on a plane world with time as the third coordinate. First of all, we'll introduce an auxiliary concept of isochronous section, that is, of a section made in a certain fixed time moment t_0. Considering isolated shapes makes it possible to determine the mass of this isochronous section. By the way, this mass will be consistent with the law of mass conservation.

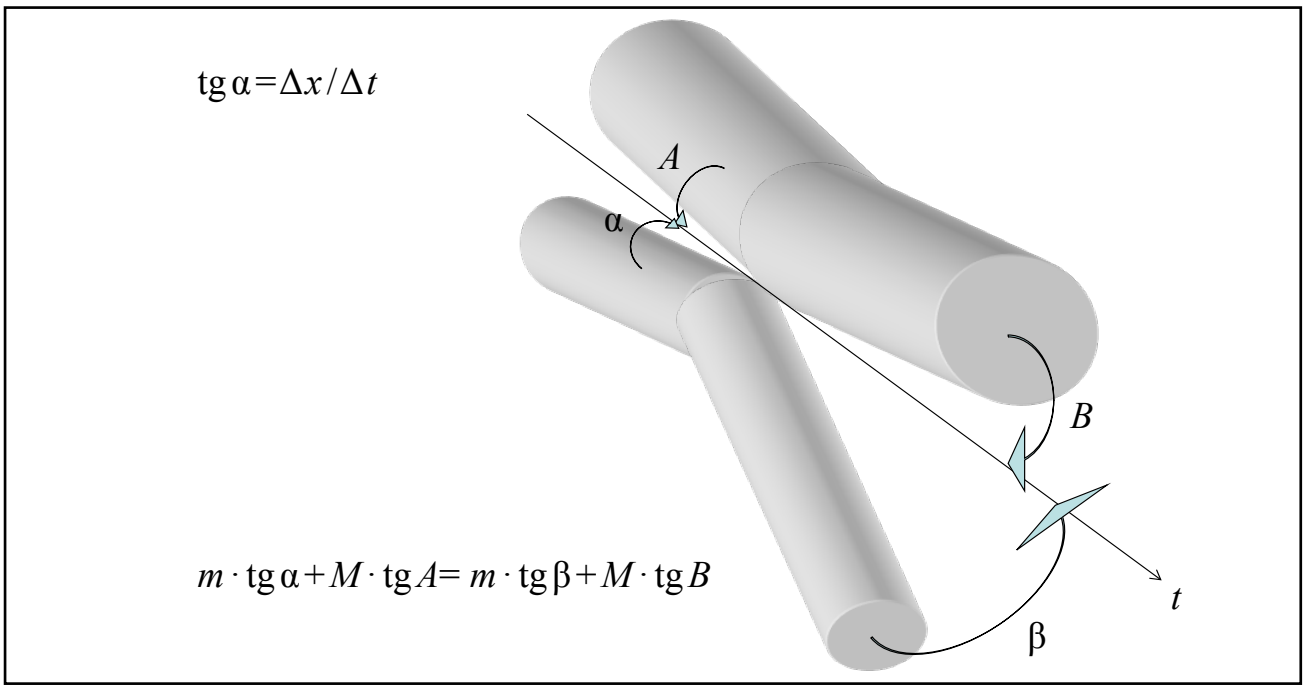
Imagine the process of colliding balls used to demonstrate the momentum conservation law to school students. From our point of view, this looks like the image in slide 3. The outside observer, will see certain cross-like figures on the surface of the 3D cylinder; the angles of intersection of their sides comply with certain regularities related to the mass of each isochronous section (slide 4).

Consider Kepler's law for two celestial bodies, i.e. a planet revolving around the Sun (slide 5). From the point of view of an outside observer, it means that 3D space-time is filled with figures of the following type (slide 6). The shape of the spiral, its curvature and torsion are closely related both to each other and to the masses of isochronous sections of the spiral itself and of the internal cylinder.

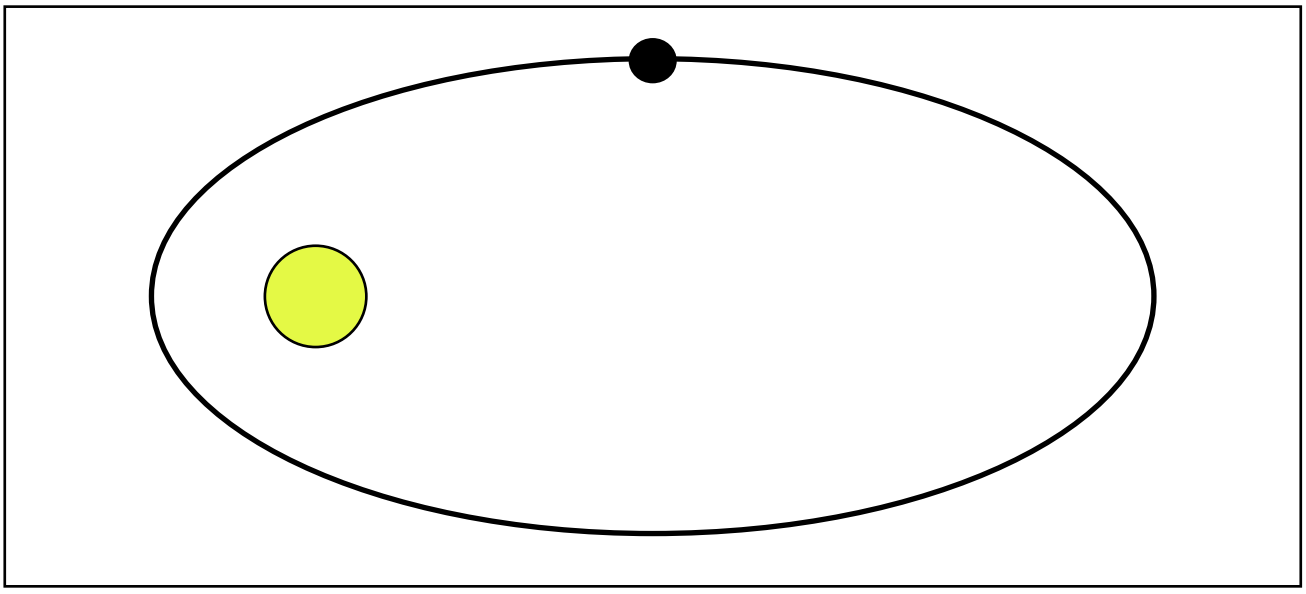
Existence of a maximum possible velocity, i.e. the speed of light, signifies that cones, like the ones in slide 7, can be distinguished at any part of time-space. The light ray, or, to be more exact, its 3D generalization, is always located at the surface of such a cone; and any other figure intersecting its vertex is sure to lie within the same cone.



Slide 3 (to animate click the slide)



Slide 4



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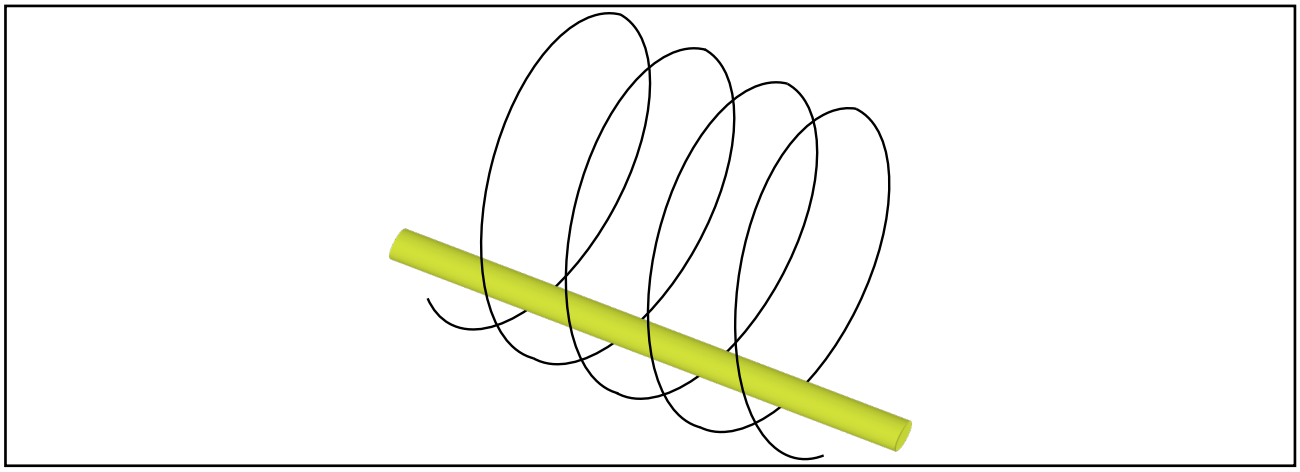
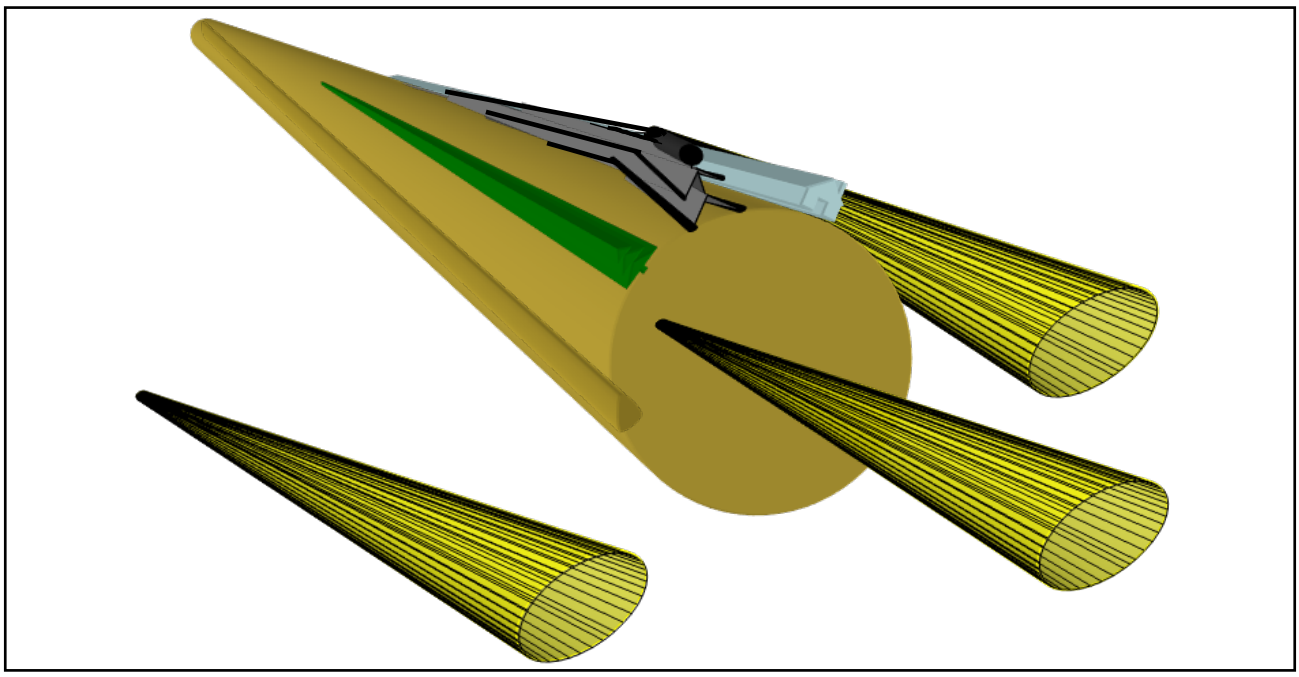


Slide 6



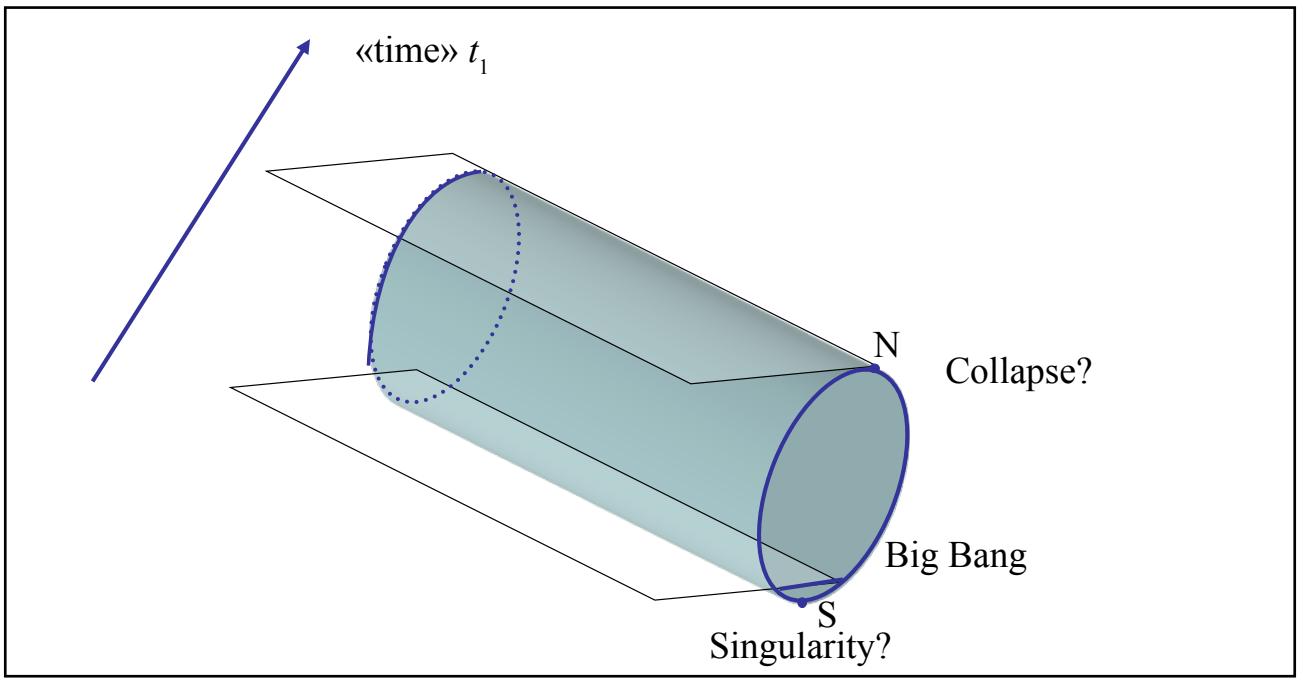
Slide 7

Of course, it would be useful to give an example of 3D space-time being curved in the way that Relativity refers to; but in this case we would need the fourth dimension and the resulting picture will become complicated. On the other hand, it is not interesting to consider a reduced world that has only one space dimension. But if we return to the laws of classical physics, which work perfectly well both for the plane and for space, it will be obvious that, if desired, we could continue our examples, finding more and more complex regularities and reformulating them in a "stationary" variant. It's a matter of custom and of the experiences of previous generations, which makes us consider variations of isochronous sections rather than the entire picture.

It should be noted that in contrast to the inhabitants of the 2D planet, the outside observer perceives the cylinder as something that has been made once and for all. Even noting regularities of the cylinder's layout, the observer will not use such words as "earlier", "later" or "because" to describe them. For example, not making any difference between time and space, he could consider the planet's sections perpendicular to one of its diameters, from what we may call the South Pole to the opposite North Pole, as in slide 8. But he would never think to recognize the world line of the South Pole — that is, the "moment" when the section for the first time includes terra firma in addition to the atmosphere — as the initial singularity; further increasing the solid matter portion as a Big Bang, and the line of the North Pole as the ultimate collapse of this hypothetical world. He would not try to explain these mysteries because he would see no mysteries at all and the shape of the universe would be just a fact to be accepted and to be reconciled to. Though, if he has some external time of his own, he could explain the round shape of the cylinder by the influence of some specific reasons that are external with respect to the world inhabitants.

III

Reasoning about the flow of time, we probably cannot fail to bear in mind the so-called "arrow of time" as well as the famous saying: "The Future is uncertain". One might have concluded that I am trying to contradict this saying, but such a conclusion would be wrong. In reality, all the works devoted to the time arrow (as a rule, to the entropic one) do not ascertain the existence of time flow but correlate the processes that are irreversible in time and cause entropy increase with the reversible laws of classical physics,



Slide 8

then try to integrate them and to show how one is derived from the other. There is a hope that this process can uncover fundamental natural laws that could imply both reversibility in time and its absence — depending on the idealization level when building the model.

To my mind, the phrase "time arrow" means only the fact that our world is not time-isotropic; but nobody objects to this fact. When the outside observer considers isochronous sections at different time moments, he will easily see that certain unidirectional changes are accumulated in them and form a system (fig. 3). And he will not have to appeal to non-decreasing entropy or to expansion of the Universe — it will be sufficient to take the standard gravitation law in the form written by Newton. If we consider two isolated mass points and leave them free, then increasing of time will cause the certain decrease of their mutual distance and decreasing of time will increase this distance. The masses are attracted to each other, but we do not try to give logical explanations of this fact, and we accept it as it is without trying to reduce it to some more elementary laws, nor to make far-reaching philosophical conclusions from it. We live in a world which is familiar to us, and permanently see that bodies fall to the ground. If we lived in the time-inversed world, we would permanently see bodies suddenly taking off the ground when slightly disturbed; and this usual fact would hardly excite us.

Hence, our world is really time-anisotropic, at least locally, within the region that is available for our investigation; at least in a greater degree than with respect to other directions, which are called spatial. However, there is probably something we just do not know. Imagine that light emitted by the stars could not reach the Earth because of a space dust cloud surrounding the Solar System. In this case we would discover that all celestial bodies known to us, i.e. large planets, comets and asteroids, are located almost in one plane. Then we would probably conclude that the 3D space is anisotropic, but this is in fact wrong. The people observing *only one* Galaxy would come to the same false conclusion.

As for the phrase "the future is uncertain", I believe that it means only one thing: even possessing complete information about the world before some time moment t and possessing infinite intellectual capabilities we will not be able to precisely predict the condition of our world at the time moment $t+\Delta t$, for an arbitrarily small positive increment Δt even within a small piece of space (fig. 4). However, it does not mean that our world *does not exist yet* at the time moment $t+\Delta t$.

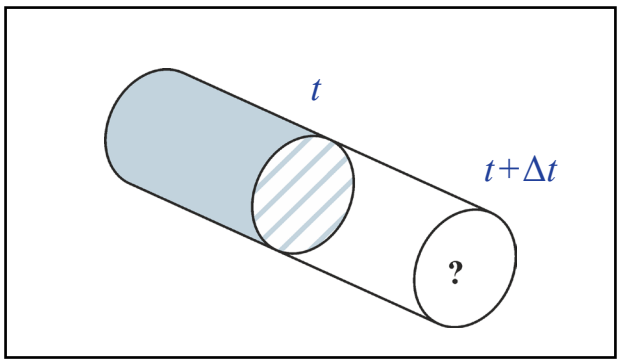


Fig. 4

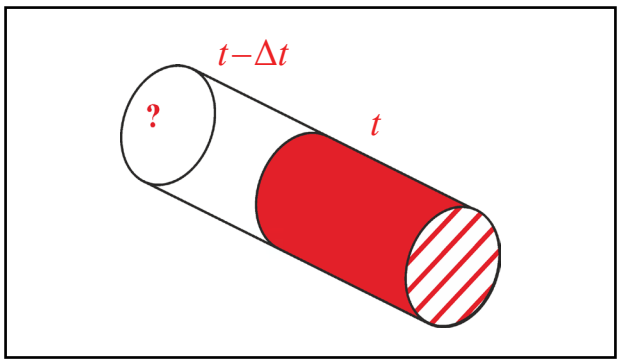
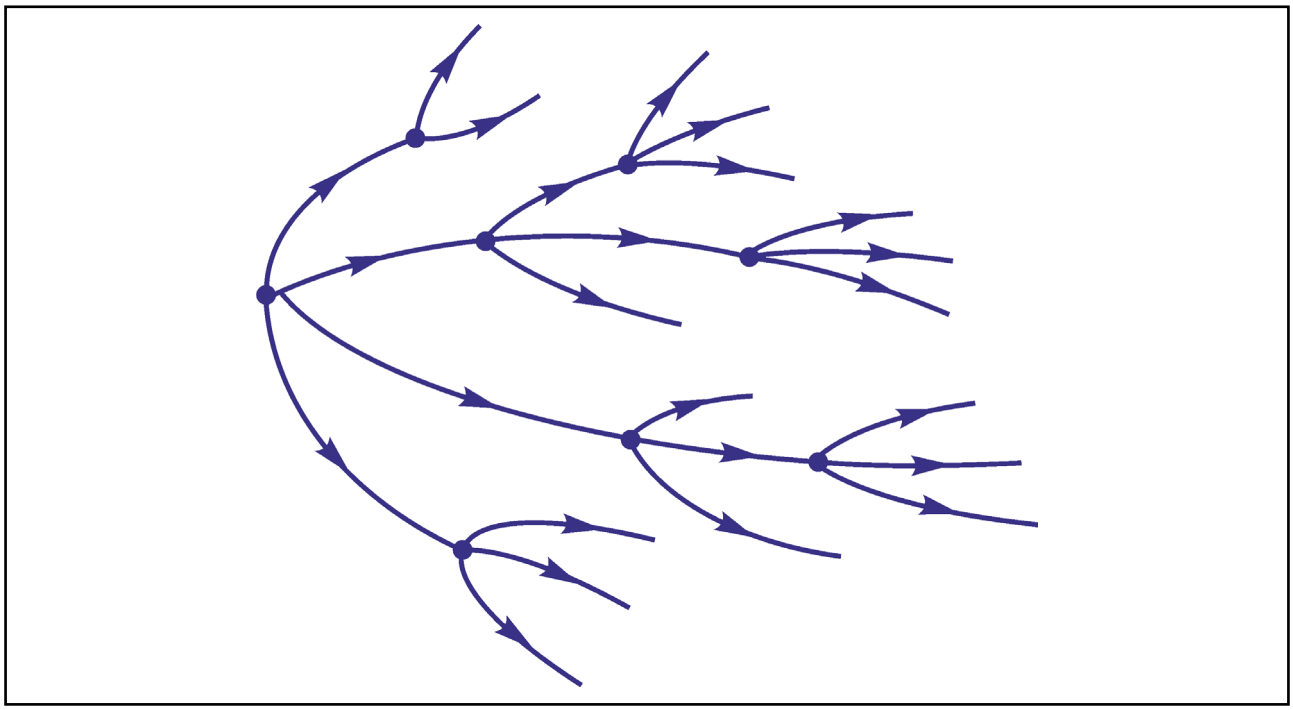


Fig. 5

By the way, when talking about the uncertain character of the future, we should ask if the past is certain as well. Indeed, the features of our unidirectional memory alone determine the fact that the future prediction problem has always been preferred. As for the past, there is no need to reconstruct it — it can be simply remembered. Restoration of the past is the occupation of historians and, sometimes, of criminologists. Though even they do it in a substantially limited way. The essence of indeterminism is the assumption that each cause may have a variety of consequences. We cannot *a priori* choose just one of them; at the best case, we can estimate their probabilities. But one consequence can be conditioned by different causes as well; and only our memory tells us which one of these causes takes place in a certain situation. And certainly, even possessing complete information about the world at a moment t and for all times later and even possessing infinite intellectual capabilities, *without memory* we will not be able to completely reconstruct our world at an earlier time moment $t-\Delta t$, even for an arbitrarily small positive Δt (fig. 5). However, it does not mean that the world did not exist at the time moment $t-\Delta t$.

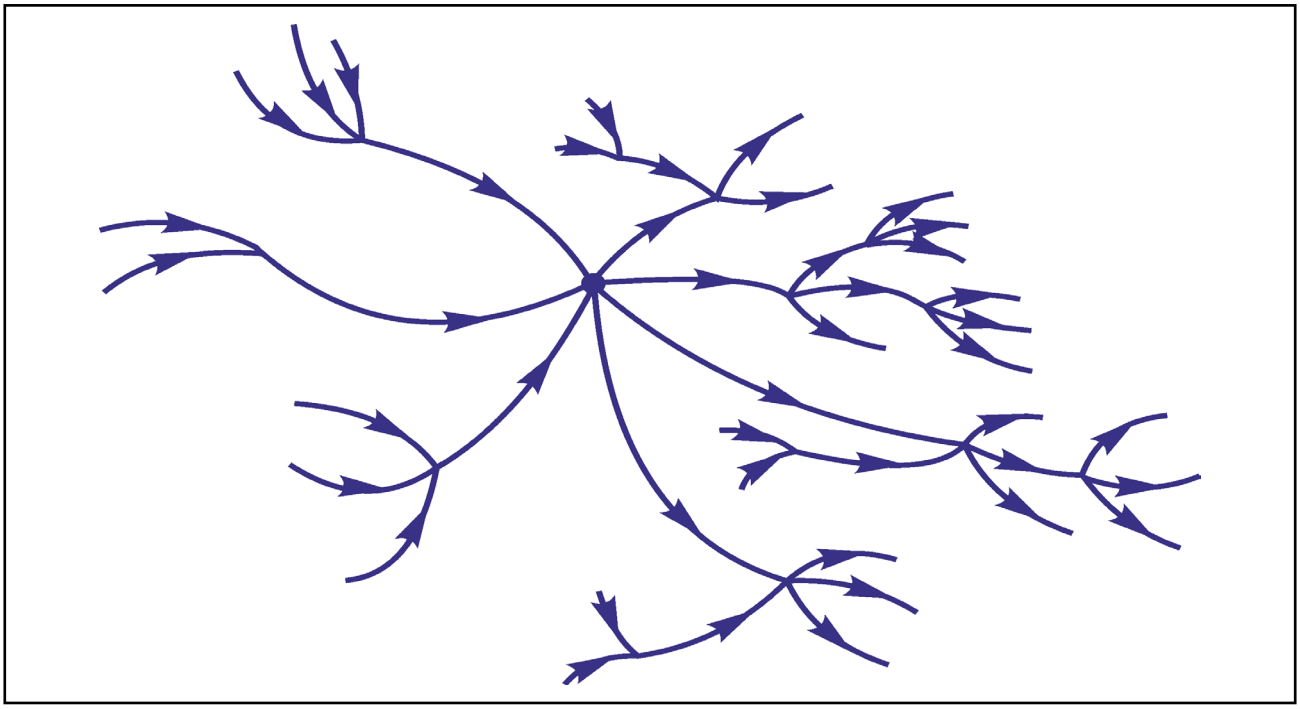
In other words, the well-known picture of the branching world (slide 9) should be added with branching that takes place in the past (slide 10) though only one probability from the infinite amount of them becomes true in reality both in the past and in the future.

Of course, nobody can guarantee that reality is in fact a solitary one. The structure of our world can turn out to be much more complicated, it may be really branching at every point of

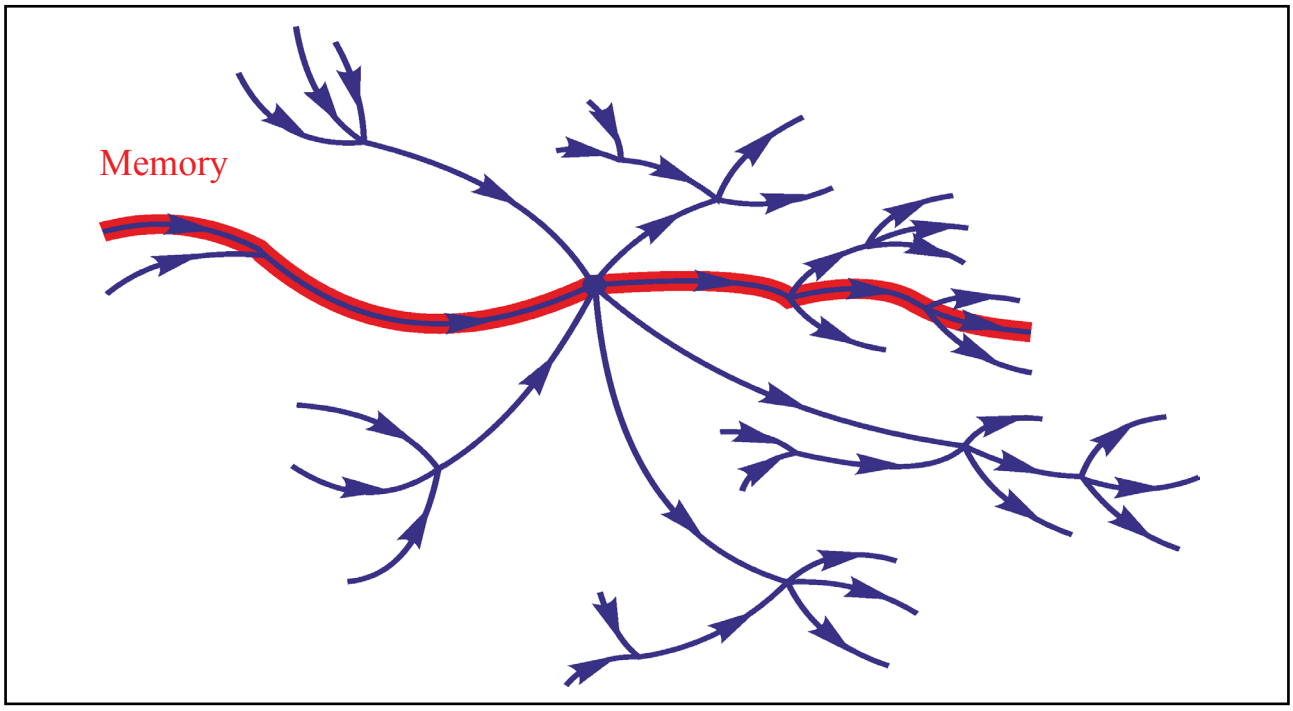


Slide 9

space and at every time moment, so that various points differ only by their branching order. Then every time moment should be represented as the result of a fusion of infinitely many past parallel worlds and, at the same time, as a source of infinitely many future parallel worlds. In particular, our consciousness is a result of fusion of the senses from several of our copies that lived in past parallel worlds and, at the same time, the source of various implementations of our personality that will live in future worlds. But again, our much-mentioned memory works in such a way that we remember only one past from the infinite number of possibilities. Furthermore, this "general line of history" is absolutely identical for different people, excepting insufficient discrepancies occurring, as a rule, due to psychological traits of memory (slide 11).



Slide 10



Slide 11

That is why the real existence of parallel universes or the so-called many-worlds interpretation in quantum mechanics remains no more than a hypothesis as yet, to my mind.

Finally, there is the problem of free will, which today is usually solved based on the uncertainty of the future. In this interpretation, the inner psychological life of every human being is also the source of fluctuations that ultimately determine the choice of one of many possible ways. However, all this occurs at the level of the subconscious or the unconscious, so that we shouldn't talk about will and responsibility. By the way, I have never considered this lack of free will to be a tragedy. Remember that any kind of faith in God implies rejection of free will, but it does not deny responsibility for our deeds. Two and a half millennia have gone, during which philosophers and theologians have been trying to find a compromise between the omnipotent divinity (or the tyranny of Natural laws) and the human right to choose. Additional predeterminancy (i.e. the fact that the future already exists) can hardly introduce something new into these arguments. But in any case, the general motto says that even if the future already exists, we should behave as if it has not existed yet. Besides, freedom of our will can turn out to manifest itself in such unexpected and unusual ways that we have never had the chance to understand it as yet.

However, before talking about the human consciousness problems we should consider living beings in general.

IV

While talking about inorganic nature, one person will reject world time-symmetry, whereas another defends it. In spite of this, time flow seems undeniable for all living creatures. Any life begins with birth, then it matures, decays and dies with no exceptions, at least if we speak about one individual life.

However, we shouldn't forget that this picture of continuously changing life is ours, it's generated by our consciousness while it moves from the past to the future, from one time moment to another. That is why, when reasoning about life on the Earth (as long as nothing is known yet about life elsewhere), one should ask oneself the following questions.

The first question: Is the ability to be aware of oneself at one and only one time moment — and successively to transfer from one moment to another — a typically human trait? Or is it inherent to any living creature? What if, when watching animals' behaviour, we unwillingly attribute to them *our own* feelings and understandings?

The second question: Is this trait a necessary property of any living matter or a local abnormality arising only on our planet? Remember, for instance, that we have not succeeded in finding traces of life on other celestial bodies. What if our failure is due to some specific reason: to the fact that our understanding of life and our way of looking for it are both wrong?

The third question: Is it possible to determine any features of living matter that cause the self-awareness property? Is there a mystery hidden in the structure of our bodies? For example, is it possible to find material carriers of the non-symmetry which have caused our memory to be more developed in comparison to our foreknowledge?

The fourth question: How can we imagine life without motion in time? Is it possible to determine life "from the point of view of a multidimensional observing stranger", i.e. without making reference to such concepts as birth, death and reproduction? I mean that all these concepts implicitly refer to the flow of time.

My biological education is limited to the secondary school level, and I will not dare to propose my answers to the first three questions, though they seem very important to me — from the point of view of morality as well as from the point of view of science. In the course of trying to understand what life is and comparing the model of life on the Earth with other possible models (even those not manifest) we realize more and more the importance of our life and of its unique character.

As for the fourth question i.e. determination of life "from the point of view of an observing stranger", I will try to partially answer it. I hope that biologists will forgive me.

As far as I know, there exists no accepted rigorous definition of what life is. We have just a number of characteristics, that is, of properties which are inherent to all living organisms, with no exceptions, and only to them. If we omit for a while everything related with evolutionary biology, then to my mind the following five properties can be distinguished as those most often mentioned in definitions of life given by different scientists. First is homeostasis, which means that living matter tends to maintain stable and relatively constant internal conditions. Second is the ability of self-reproduction. Third is irritability, which is the ability to respond to actions of the environment. Fourth, I would distinguish memory, as it is a very important property for the subject we discuss, though it may not be inherent to all living creatures. Finally, there is a thing usually called ageing, though the lower organisms possibly do not have this property. I would reformulate the last property in the following way: characteristics of a living organism both at the beginning and at the end of its existence differ to some extent from what we see in the middle of its existence. In other words, I would keep in mind the helplessness of childhood as well as the decrepitude of age.

Three of these properties, namely, homeostasis, irritability and some difference between the two ends of life and its middle, can be considered as reversible in time. Indeed, when formulating these properties we did not mention any definite direction of time flow. Furthermore, there is no necessity to mention time flow at all. What is homeostasis? If some living organism has a certain chemical content, then metabolic processes in this organism operate in such a way that the chemical content does not change significantly with respect to time. If the external environment acts in some way on the organism at time moment t, then conditions of the organism before and after this action, that is at time moments $t+\Delta t$ and $t-\Delta t$, will differ from one another. If we know what the action looks like, we'll be able to give an approximate description of this difference. This property is called irritability. Finally, childhood and old-age, the beginning and the end of existence, are in many respects helpless in the same way; the difference is that a child has everything in the future, therefore, features of its organism are perceived positively. As for age, it signifies approaching death that's why age manifestations frighten us and we try to fight them. However, this is a feature of our consciousness, not of living organisms. The only objection which comes to my mind now is that childhood always exists, childhood is universal, while age isn't, because a sudden death may be caused by an accident or a serious illness. Though, after all, these cases are abnormal.

The other two characteristics, the abilities to reproduce and to exercise memory, seem to be irreversible in time. However, the existence of memory irreversible in time might be inherent not to all life forms but just to the higher ones. Hence, we should find out if it is possible to preserve the first three features of life while modifying the other two.

Now, let's proceed to theories of evolution. First of all I propose to neglect the period during which life began and that during which it will disappear — assuming that it will disappear someday. In other words, let us agree for a while to consider the processes that accompanied abiogenesis (the origins of life) to be so singular that they are inaccessible to our modern level of understanding — just like the processes that accompanied the origins of the Universe. We will study the limited period of natural history which is more or less knowable to us.

One of the numerous definitions of life says that the basic function of living matter is the informational and energetic supply of anti-entropic processes in the Nature. In other words, life, considered at the level not of a single organism or biological species but of the entire biosphere, represents growth of complexity and progressive diversification; motion from the more possible to the less possible. There were proposed a great variety of mechanisms of this motion — from entelechy and the vital principle to the modern theory of evolution based on the triad "heredity, variability and natural selection".

On the other hand, primitive organisms are usually more biologically successful than more developed ones. Natural selection is not a striving towards a transcendental objective; it's more likely an adaptation to certain environment con-

ditions. Is it correct to say that living organisms have become *better* during the last 10 million years? Or maybe they have just changed because of the changing environment? They appear from non-organic matter and finally become this matter again… Though, the mass of the whole biosphere is gradually increasing…

The situation with the theory of evolution looks somewhat like that of the kinetic theory of gases. There are no time-irreversible processes associated with accumulation of hereditary information due to mutations at the level of one particular organism. Similarly there are no irreversible thermodynamic processes at the level of one particular molecule. For any particular organism, obtaining new hereditary information is accompanied with forgetting of the previous one: forgetting, in that the "memory" about the previous gene disappears forever at the moment of mutation. Indeed, every living organism (excepting viruses) has neither three nor ten but only two genes responsible for any biological trait. We do not accumulate different versions of hereditary information for all of life's emergencies — it happens only at the level of a population, and even then not in all cases. However, might it be that increasing the complexity and the diversification of living organisms is a kind of living matter response to the same non-decreasing of entropy — so to say, a higher order irritability? By the way, a complete description of the diversity of genes would demand ever-increasing amounts of information. Once again we see that our world is time-anisotropic. This is just the way the things are.

V

Finally, after living organisms in general, let us talk about human beings.

As has already been mentioned, our consciousness works so that we are able to be aware of ourselves only once at each time moment, living through these moments sequentially, one after another. I would call this property of our consciousness a basic one. It's firm and resistant to any kind of fluctuations, though this is really hard to believe in the context of today's scientific understanding of the world. In fact, elementary particles appear from the boiling vacuum and re-disappear into it; and we aren't able in principle to precisely define either the velocity or the location of any of these particles. The world in general is full of instable and random things. But nevertheless, with a frightening unavoidability I shall live my eighth year only after the seventh, April — after March, Wednesday — after Tuesday. And nobody has heard anything about exceptions from this rule. What is the reason for it: the way our bodies are designed, the structure of our brains, or something else? To my mind, the greatest mystery of Nature is hidden here, though we obviously got used to it. And we even cannot suppose that our one-moment and consequent existence in time is not absolute, not eternal and not infinite, that it may change one day — at least, after death.

Besides, we are asymmetric. I mean that it is much easier for us to remember past events than to foresee future ones. The result was that prehistoric man could return to the unchanged places of space (unchanged at the level available to his perception), but he was unable to re-experience some time periods again though he remembered them. That is why when mastering the surrounding world, creating the human society and generating spiritual veracities, people involuntarily started from the one-moment and irreversible character of time. And the longer people were observing the surrounding world, the more they were getting confirmations of the fact that time flows as long as the world around them was gradually changing. In addition to this, people invented the means to communicate by sequentially emitting different sounds; and the process of our thinking is mostly just the reproduction of the same sounds in our minds. All this only aggravates the situation. So, the sense of irreversibility of time, and of time flow, has become the base of our general understanding of the world — of everything the modern children learn almost unconsciously, before they really learn to speak and before they become able to doubt the learnt veracities. And if we consider spiritual values such as morality, faith, love, desire to create and to cognize the world, which are so common in human society, to be conditional and illusive to some extent, then time flow is the

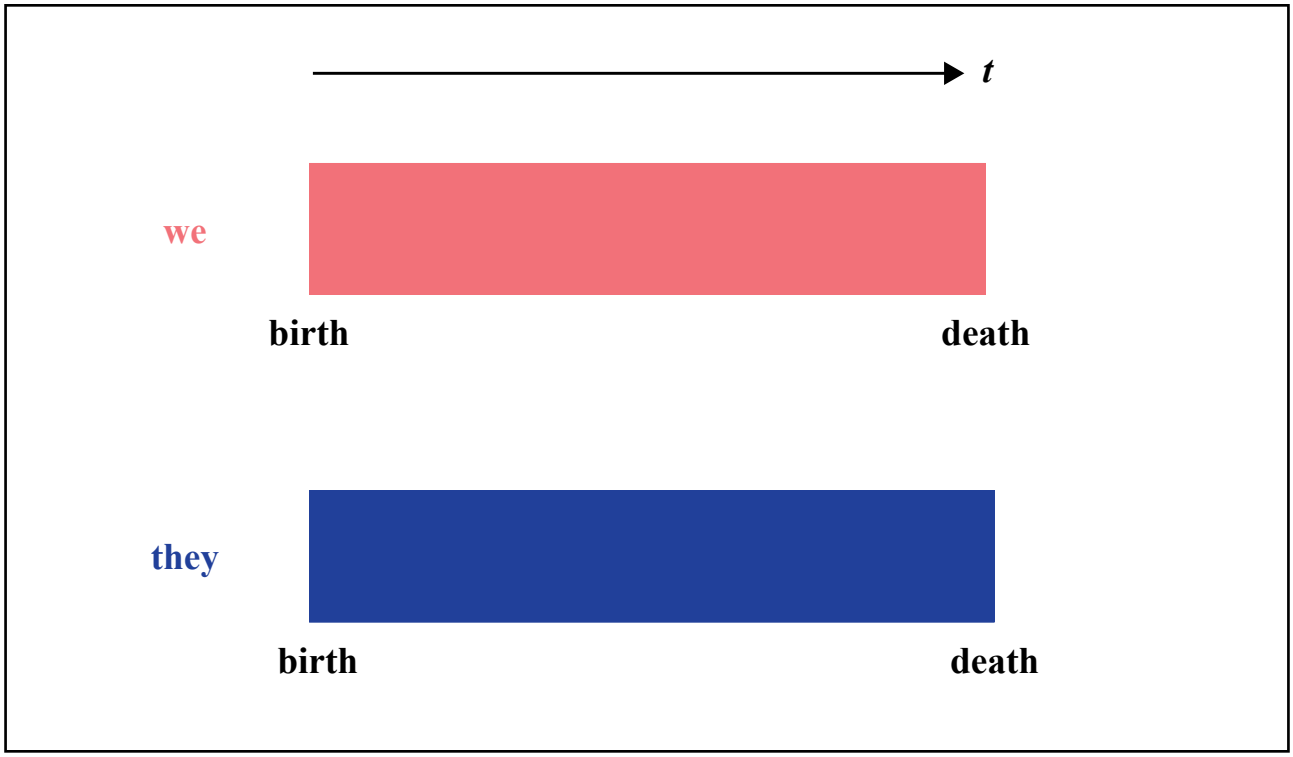
main, fundamental illusion, the phantom that all other constructions of the mind are based upon.

Let us try to consider this phantom from the point of view of an observing stranger. To do this, imagine a civilization which possesses memory and a perception of time that somehow differ from ours. We don't care if such a civilization really exists and believe that unrealizable models are sometimes useful as well.

VI

I propose to consider an example — a civilization which differs from ours only by the fact that its people live in reverse time and perceive the moments of their life like us — successively but contrariwise — not from birth to death but from death to birth. Suppose as well that they accumulate memories reversely, i.e. they remember everything they have already lived through in their life (slide 12). Such an assumption is of course highly arbitrary and not quite correct. But as far as it seems that no material memory carriers that would make it possible to obviously link the growth of memories with the ageing of organisms have been found, our assumptions do not look too exotic. For the sake of convenience, I will call such folk *mirror people* with respect to us. And no hidden meanings or implications of different physical theories should be looked for in this definition.

So, let us take a closer look at this amazing and incredible civilization. Imagine, how the shapes of bones white under the influence of time gradually show through from the dust of the ground, here and there. At first, they are separate, but after a while they form a kind of a skeleton. Bones gradually acquire flesh and people who live in this world sometimes come and see how the human body appears slowly and imperceptibly, year by year. Finally, judging by some indicators, which are known to any inhabitant of this world, they understand that this immovable body will soon be endowed with life. People gather together and wait for the first breath, the first acquaintance with a new human being. It should be noted that, unlike us, they are able to say pretty soon how long this new human being will live. Substantial body height and weight, weak muscles and grey hair, a face deeply lined with wrinkles and many other things we consider as indicators of ugly age — all of them make the mirror people happy as long as all this means the forthcoming longevity. With absolutely different eyes they look at small toothless bodies of those who are destined to leave very soon.



Slide 12 (to animate click the slide)

It's necessary to say that each new inhabitant of the mirror world has some physical affliction or, from our point of view, there was some illness which killed that organism. These disadvantages gradually go away, possibly with help of local medical doctors who know not so much how to provide healing as just how to accelerate it. For us, it would mean to strive for the lethal disease to arise as late as possible and to last for a short time. Here comes the period of prime and full conscious life of a sentient being. But once upon a day unavoidable things come. At first, changes are slightly visible: cartilaginous tissue emerge to replace some bones, then the third molars retreat. Gradually, some sexual characteristics disappear, height decreases, the thymus gland begins to operate actively, all the teeth change. The head becomes disproportionally large with respect to a small body. This human being loses movements coordination and becomes absolutely helpless, it becomes unable to walk or to eat food properly. And all these changes are frighteningly inevitable, though mirror people will possibly try to slow them down. We also could artificially continue our childhood, which is likely to be possible in principle, though none of us have ever thought to do it. However, when the first fatal changes appear, there arise some people with whom our mirror man establishes a particular tender emotional connection. More often but not necessarily, they are the people he saw showing through the dust of the ground. Little by little, they start taking care of him, so helpless is he; and one of them, always a woman, soon notes certain changes in her body and realizes that it is her who is meant to have a specific relationship with this disappearing one. Finally, when his body becomes too small, there happens a thing, which would seem disgusting to us and would seem absolutely common and obvious for the mirror world inhabitants. This man disappears into the womb of this woman and dissolves there. Probably, this process is full of mystic sense for the mirror people. As a result of the civilization development, they possibly will be able to understand that a little part of the disappeared human being will once get into the organism of another human being — a Man.

Now it doesn't matter for me whether this world is really possible. I am concerned rather about the probable spiritual characteristics of this civilization as long as such comparisons allow us better to understand our own spiritual characteristics. I think that the mirror world inhabitants would view their life with a greater degree of fatalism. This is due to the fact that life duration is already preliminarily known at their arising from the dust of the ground, and dissolution in the woman's womb is unavoidable. It cannot happen suddenly unlike in our world where some accidents and unexpected illnesses exist. Though, it's unlikely that something really sudden exists in the mirror peoples' life as long as they perceive all natural phenomena in the opposite order (I'll talk about this a bit later). The fact that the mirror people cannot unexpectedly disappear because of any fatal concatenation of circumstances makes them much more courageous than us. They never ask the Hamlet question "to be or not to be?" as they do not have a fear of undue death. But it does not mean that they will be more active than us.

It is easy to guess that the basic life collisions, the centre of emotional life, the main object of art of the mirror people are not gender relations, not the search for a matrimonial partner like in our life but obtaining parents. A mirror human cannot know beforehand who of these people around him will care about him in his helpless infancy when it comes. But he surely knows that such people will certainly appear, sometimes — in the very nick of time. It is like in our life — sometimes women die soon after the birth of a child. And there are mirror women which already feel fatal changes in their bodies and these changes tell such a woman that she is to be a mother soon. This woman does not see an infant around who is to vanish inside her organism. But finally she finds it in the very nick of time. (From our point of view, it corresponds to the death of the newborn.) What great freedom for the emotions! What pathos! What touching scenes!

While every human being from our civilization has a sketchy understanding of the necessity to reproduce, an unshaped integral striving to continue the existence of mankind in order to

spread our numerous descendants not only all over the Earth but also all over the Galaxy and beyond, the mirror people would certainly have the same unshaped belief that one day people will fuse into something unified and they will understand their history as motion towards this exact goal. And maybe they would be much happier in their motion than we are. Disappearance of people in each other would cause different beliefs in obtaining of others' memory, others' life experience, a belief in the fusion of consciousnesses. And somebody from the new generation would search inside of himself for the memories of the disappeared people; it would be done as diligently as our spiritualists try to communicate with souls of the dead…

It should be noted that only as far back as one hundred years ago both sequences of pictures — from birth to death and from death to birth — could have been considered as equal. This is due to the fact that people at that time had no idea about such carriers of hereditary material as genes and DNA. Today we can say that after a complete genetic analysis of all the people around him, a mirror man could exactly determine his own parents and all his emotional problems would be happily solved. However, along with carriers of heredity traits, there can be material carriers of other information which determines that a certain couple consisting of a man and a woman is to have a common child. On the one hand, we have not found such carriers yet. On the other hand, we never looked for them.

The mirror people perceive the phenomena of Nature in a different way than we do. They more often have to see how small, almost imperceptible, causes result in a sudden and significant consequence; and they deal with consequences of their *own actions* much more rarely. The surrounding world teaches them fatalism in much greater degree than it does us. To illustrate the idea, let us consider manifestations of the law of gravitation from our and from their points of view.

Imagine a falling meteorite. We consider it as a stone which falls onto the Earth from somewhere above. If it is large enough, the falling process is accompanied with a gradually abating roar and clouds of dust settling slowly. And whereas the original reason for the appearance of the stone is unclear for an ignorant observer, the roar and the dust are obvious consequences of its falling onto the Earth, i.e. this is a known and common thing. A mirror observer begins from hearing the roar and seeing dust clouds. At first, they are tiny, but then they gradually increase and intensify. And finally, all of a sudden, the stone blasts off the ground and disappears into the sky. Perhaps, our observer will first of all try to explain for himself the origin of the stone, to understand where it came from, whereas the mirror observer will most likely set himself the following task: to learn these low-observable increasing indicators in order to determine the blast off moment.

Another example. Imagine a rockfall in the mountains. This case is much more symmetric as long as insignificant reasons cause sufficient consequences both in the direct and in the reverse time. The difference is in the fact that the hardly perceptible but gradually increasing instability, which suddenly causes the rockfall, is an extraordinary and rare event for us. We will try to change it in the way we need, i.e. to use our conscious actions and cause a rockfall at a comfortable time, not waiting for it to occur naturally. As for mirror man, to his mind, nothing unusual happens. The difference with the meteorite fall is only in the fact that stones do not disappear in the sky but lay down on a higher piece of the mountain. Perhaps, he will try to predict where exactly.

A third example: a man picks up a little stone and throws it. For us, the path of the stone is a predicted consequence of our conscious action. As for a mirror man, the situation is that the stone somehow finds itself in his hand, as if in some mysterious way, though he could have intuited its arrival from the brief tiredness of hand and arm muscles occurring shortly before the appearance of the stone in his grasp.

Finally, a fourth example: a man falls from a tree. For us, this emergency will be the sequence of our conscious behaviour: the man wanted to climb the tree, made a false step and could not keep himself from falling. Then there will be pain, bruises, or worse, broken bones.

The mirror man will first feel a pain, gradually increasing pain; and his experience will tell him: this pain signifies that he is to blast off the ground soon, and the pain will immediately go.

Even these elementary examples allow us to understand that our efforts to master the surrounding world and, ultimately, our science will be related with attempts to cause changes in our environment by using our conscious actions, i. e. with attempts to consciously manage the world. For the mirror people, the main point is the ability to predict significant consequences of insufficient reasons; the developing civilization will learn to do it more and more precisely.

In other words, we can ask the following question: to what extent is our modern science based on the fact that our consciousness is oriented in time in the direction of non-decreasing entropy? And will the mirror civilization representatives preserve our illusion of free will?

When talking about this mirror civilization we assumed that their memory was mirror-like as well. It means that they know about everything they came across and do not know what they are about to encounter. Now it is interesting to ask one more question, which is, however, absolutely theoretical, about the speed of the awakening of human personality. As is known, intelligence gradually awakens at the beginning of our life: at first, a little child isn't aware of itself at all; then it remembers some distinct episodes; and only after several years these episodes become one continuous picture. Probably, that is the way the brain learns to process information coming from sense organs. On the contrary, consciousness rapidly fades at the end of life. What would happen in the case of time-reversed life?

By the way, I note that we have given the simplest example of a civilization with another perception of time. It is the simplest because it is the most like us and therefore it is the most available for understanding. Of course, there can be more complicated cases. As a home task for the auditors I propose to imagine people who live *days* of their lives (periods of their wakefulness) in arbitrary order. Every evening these people go to sleep and do not know at which period of their life they will wake up, though they have sketchy memory, a misty (like in a dream) general understanding of the whole of their life; and it helps them to orientate themselves within each single day. Unlike us, they even do not know whether their existence is finite. How can we imagine the psychical life of these people? What are their dreams, hopes and fears? Are we able to establish some kind of communication with this civilization while living our days continuously, remembering the past, and having no idea about the future?

VII

To summarize my presentation I will briefly refresh the questions I have been considering. I don't think we'll be able to answer them in the near future, but at least they should be set down clearly.

1. How can the notion of time be clarified and how can the variety of different formulations fused into one this word be distinguished one from another? I remind that it was proposed to distinguish relativistic time, entropic time, esoteric time from everyday time, which does not fall in any of those other three categories. Perhaps, there exist some other types of time which should be distinguished as well.

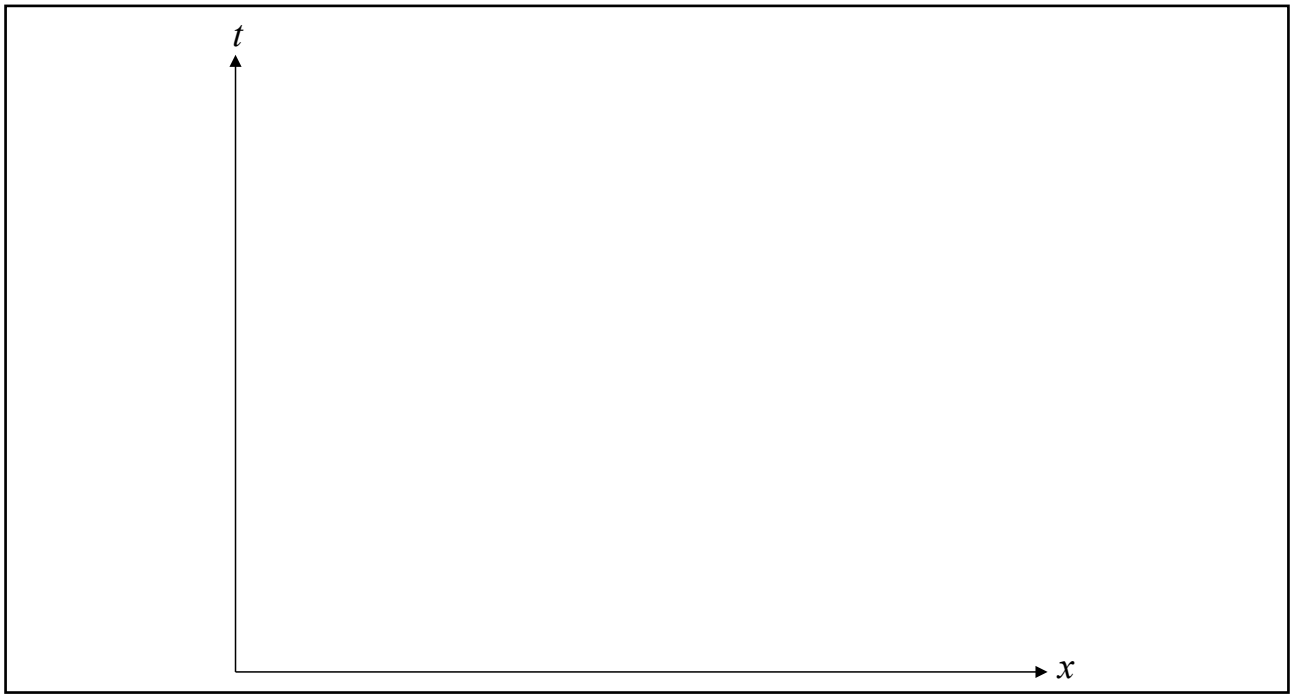
2. Is "time flow" an objective property of our world or just a feature of our consciousness? And if the second variant is true, then shouldn't we try to get over this feature? For example, shouldn't we try to re-formulate laws of Nature "in the stationary variant" using the analogy with the three-dimensional world (two spatial dimensions and one — temporal) for the sake of simplicity?

To what extent is our perception of time related to our use of verbal communication and verbal thinking extended in time? Is language a consequence of the progression of our consciousness in time or is it one of its causes? A child who cannot speak, how does it perceive time?

It should be emphasized that I doubt not the fact of the *existence* of time but of its *flow*. Space-time can be continuous (slide 13) or discontinuous (slide 14). Maybe it is curved and comprised of heterogeneous and different-sized

quanta (slide 15). *But it does exist*. As for our consciousness — it *moves along* our world line. There is one more significant feature, which should be considered as well. If we compare the world line of some electron with the world line of human "ego" in a discontinuous space-time, then it should not disturb us to see several *different* electrons, each one of them occupying its own cell of the space-time though they are neighbours to each other (slide 16). As for flashes of the human "ego" in different cells of space-time — we integrate them into a unified "Me". In the same way, we consider that there is only one and the same electron existing and moving from past to future side by side with us. But can we truly justify this analogy?

3. Is the ability to be aware of oneself at one and only one time moment and successively transfer from one moment to another a typical human trait? Or is it innate in any living crea-



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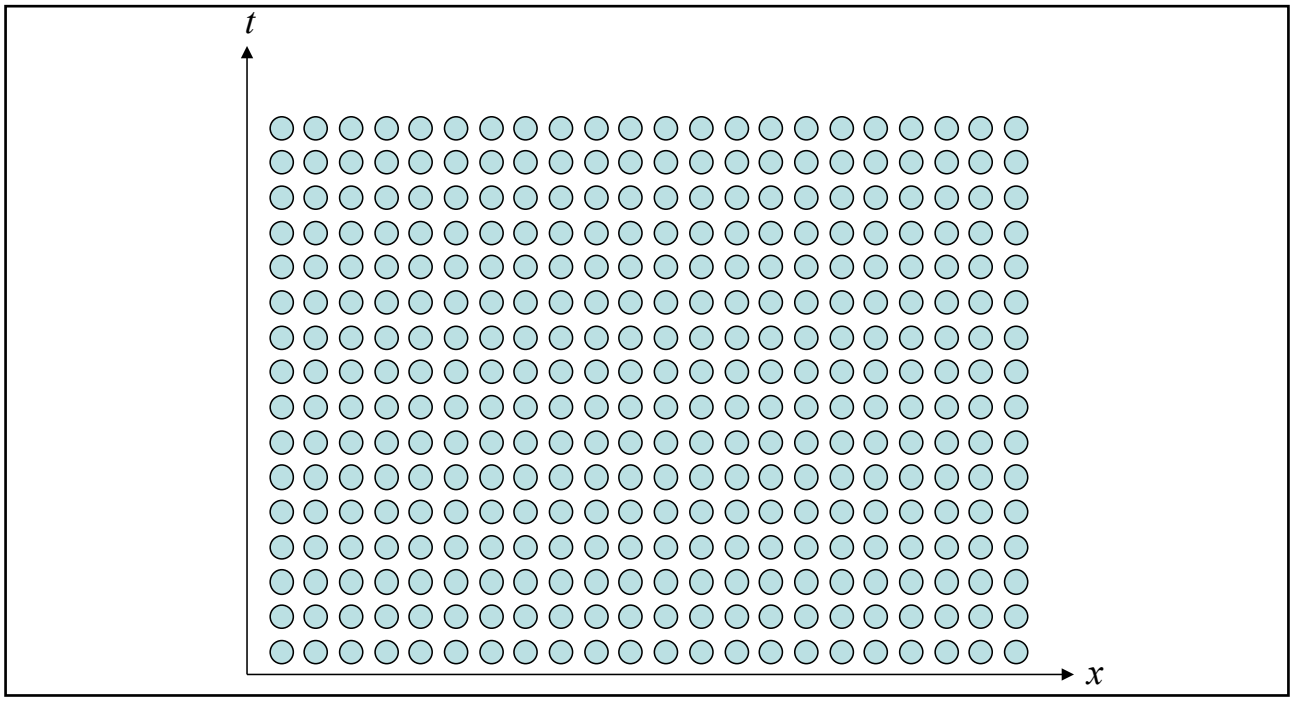

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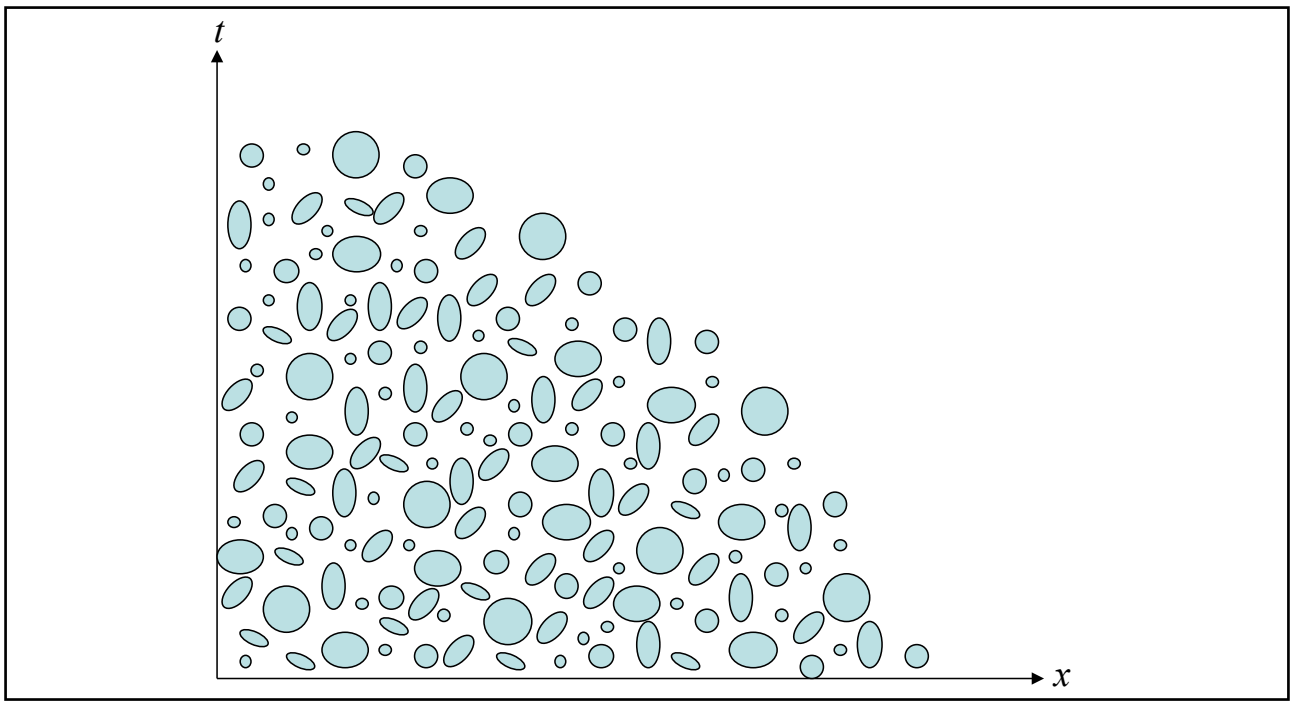

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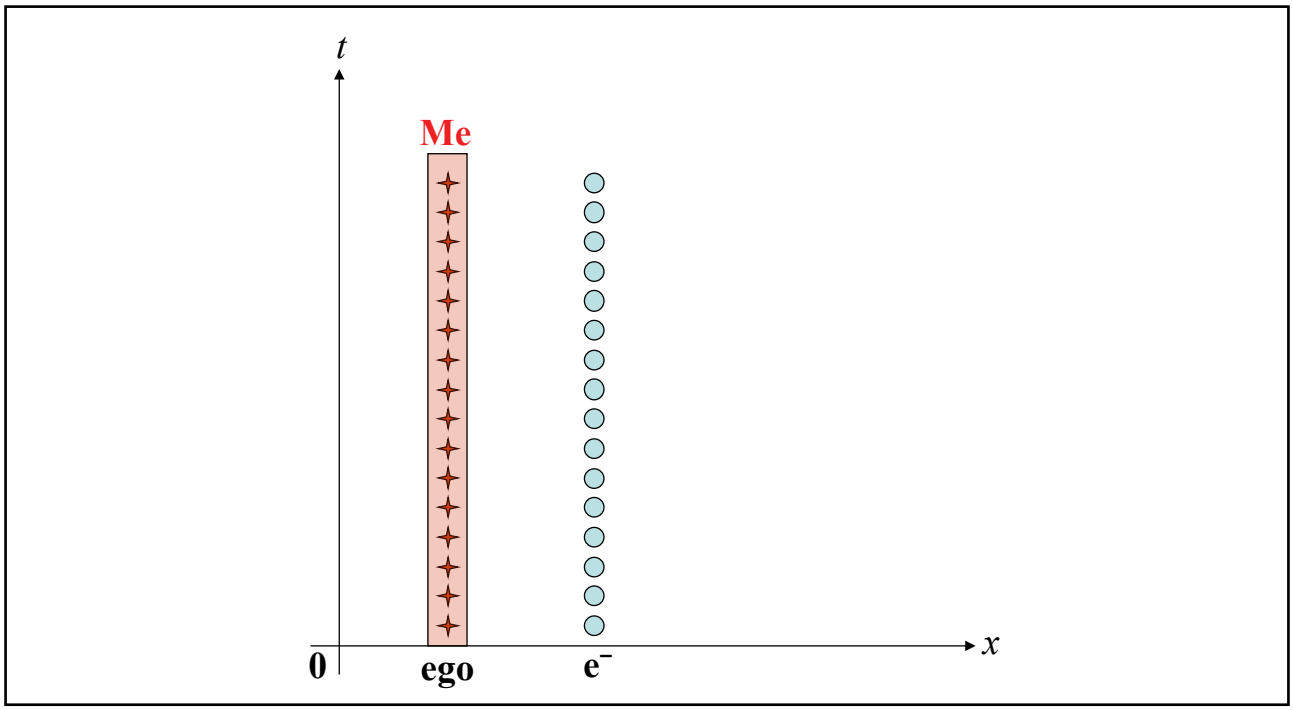


Slide 16

ture? Is it a necessary property of living matter everywhere in the universe, or a local abnormality appeared only on our planet? Is it possible to distinguish any features of living matter that engender this property? For example, to find material carriers of the asymmetry which has caused our memory to be more developed in comparison to our foreknowledge? Is it possible to determine life "from the multidimensional point of view of an observing stranger", i.e. without reference to such concepts as those of birth, death and reproduction?

4. If human civilizations are unique exactly because of our perception of time, then what are their moral, spiritual and scientific values in comparison to other possible civilizations? What role do we play in the Universe? Maybe the point is that we created specific notions of

good and evil, of faith and belief? One more question especially for those who believe that we, our current perception of time, and the whole world have an author: when creating man, why did God gift him with precisely this perception of time? And how does He perceive time Himself? We should understand how unusual our perception of time is — by its zero-dimension, by inexorable motion, by absolute lack of randomness. How it is odd and strange. We should be surprised, at least.

5. Should we try to travel in time, i.e. somehow to manage the flow of time? As an exception, here I'm giving my answer to this question: yes, we should. But the reason is likely that I just do not see another variant. Otherwise — the linear history of mankind will become a bad dream, a haunting nightmare.

Should we try to overcome that trait of our consciousness which makes us live time moments point by point, separately? As for me, I can never reconcile myself to the fact that we should tear our souls into pieces, that we have to use only one little immediate piece of soul at each time moment. My soul should be mine, entirely mine. And if these attempts are to any extent successful, what might they lead to? The answer to this last question is actually the axis of my works of fiction, which I presented here one and a half years ago.

AFTERWORD [5]

The hypothesis that our perception of time is not a necessary consequence of the other laws of Nature cannot be verified; neither logic nor experiment can help us to do it. However, all of the humanitarian culture of mankind is based on unverifiable hypotheses, such as the existence of God or the afterlife. In any case, one thing seems to me to be beyond doubt: sooner or later, people will have to think about mastering time. I don't know when this epoch will come: in one hundred years, in one thousand years or in ten thousand years — but it will definitely come. I think, today we know too little about the properties of time and the world in general. What we can do already today is to study ourselves more thoroughly. I only propose to change the point of view and to see everything that was always considered obvious and firm as just a concantenation of circumstances, as an inheritable deformity, as a temporary abnormality; to understand the advantages and disadvantages of our existence; to see ourselves from outside. It is not as easy to do as it might seem, but it is possible. Even if we have nothing but this view from outside, it alone will be sufficient to change a lot, at least in our minds. Who can predict, however, whether this change will be to the good or to evil?

[5] Concluding words following the discussion at the end of the seminar.

DISCUSSION

This section contains my answers to questions that were posed by auditors and readers both at the seminar and after it. As some questions were repeated and some others copied each other, I decided to group them in accordance to their subjects and make some kind of generalized answers.

1. General notions

About the non-scientific character and fogeyism of my views.

First of all I'd like to answer remarks (which are quite fair) concerning the non-scientific character of my talk and to explain why my views may seem so obsolete as if I've stopped at the stage of the first half of the twentieth century. Of course I've acquired a higher education, which was in fact not the best one, but it was mathematical, after all. Besides, I have translated into Russian a lot of modern and not so modern scientific works from different European languages. Some of these works were dedicated to theoretical physics. So, I am surely able to write the quadratic form of Schwarzschield, or de Sitter, or somebody else's, to apply the Einstein equations, theory of tensors, the Christoffel coefficients; also I am able to say that any problem concerning motion can be reduced to the determination of a geodesic in a special hyper-space. When, instead of this, I prefer to draw some childish pictures, it means that I do it with certain intention, that I want to say some certain thing by doing so. It does not signify just a lack of education and professional skill. It brings additional information to think about — the information, which should be searched for not only in words but also in every simple fact and action. For example, it can signify that I do not trust mathematical models much, at least, due to the fact that in spite of myths about their rigour, they are based on set theory, which is full of paradoxes and hypotheses that cannot be either proved or disproved, and on mathematical logic, also not so firm as it could seem. It can also mean that when the whole of science is mathematized (sometimes out of proportion) somebody must object it inasmuch as every trend, every principle has both advantages and disadvantages. When everybody says "Yes", it's necessary to have somebody who would say "No". The tendency to create mathematical models of different complexity for every application is not an exception. There are quite enough people without me who are able to practice mathematics and are fond of it. So, isn't it better for me to try something different?

Also it was said that I ignore the language of modern physics and do not use up-to-date information, referring to old-fashioned and outdated definitions. These remarks can be considered both as a compliment and quite the opposite. Now I want to ask the following question: does anybody still believe in progress, for instance, in the claim that every new theory is certainly better than the previous one? I may remind the reader that the age of an overall European belief in progress (in the modern sense of this word) is still less than three hundred years. On the contrary, previously, mankind was considered to be steadily degrading. For example, as early as the seventeenth century, when the French Academy of Science was founded, one of its announced tasks was to create a complete vocabulary of the French language *with the aim to preserve the language from the forthcoming corruption*. In other words, it was considered in the seventeenth century that the language was gradually deteriorating. Consequently, if it is impossible to get back to the ideal language — Classical Latin, then it is necessary to save what remains of it. And if we measure on a historical scale it was really quite recently when the most rigorous proof in any scientific dispute was held to be a quotation of some ancient philosopher (the more ancient, the better). I perceive history "from the point of view of an outside observer", and, for me, there is no principal difference between a motion from the past to the future and a motion from North to South or from West to East. Of course, in the course of travelling from the North Pole to the South Pole we will visit a lot of different countries; and each of these

countries will be unique. But whether it would be correct to say that each new southern country is better than its northern neighbours? Of course, each epoch has its own distinctive features and its own dramas, but I do not see motion from worse to better or contrariwise. Finally, since we do not know the ultimate objective of mankind, we cannot say whether we approach it or move away from it. It's even more pointless to speak about progress when there is no objective.

Finally, every scientific paradigm (a meta-paradigm, more precisely) has its own life time, This includes the paradigm of modern European science, which originated during the Renaissance, and which, to some extent grew out of works of the philosophers of antiquity; it is based on experiments and mathematical modelling. Being "inside the picture", we cannot say with certainty if the acme of its development has been passed. If it is passed, then new models will be poorer and poorer, more and more boring, full of insufficient details. These models will be hard to perceive and in many aspects they will be worse than the old ones, which are more clear and universal. Should we then be so proud of knowing them?

Terminology.

The second range of general questions is related to terminology, or rather to uncertain use of the word "time". Properly speaking, it was the main point of the first part of my talk. Recall that I consider the verbal mode of communication to be rather imperfect, as well as the mathematical language. However, common words have certain advantages: everybody knows about their imperfection whereas a mathematical model is often considered to be a spotless Sun. Of course, in scientific language the fuzzy semantic fields of separate word-terms are greatly shrunken. But it does not mean that they become pinpoint and completely loose their subjectivity, even within the framework of any one separate science.

Investigating the notion of time I had no better thing than to propose a quite simple test, which allows us to understand what we mean by the word "time": descriptions of interpretations of phrases such as "time slowed down", "time stopped", and "time started flowing backwards" should be given in each specific case. Even this simple test will be useful to help us to understand whether or not different speakers mean the same subject.

When we say that "time pierces everything", I understand it as a statement that our (four-dimensional) world is organized in a certain manner and its separate parts are similar to each other with respect to the equivalence of natural laws within them. Each part has certain extension in time. In other words, we can consider two arbitrary regions in the Universe; and there will be a similarity between them. If these regions are chosen not in an arbitrary manner, this similarity can be increased. To my mind, in this case, the word "time" is used in the so-called "esoteric" way (I do not insist on using this notion as it is probably not very correct).

When they say that "each entity — a man, a living or non-living system — has its own time", I conclude that there are certain individual changes in every system — both in time and in space. For some reason, changes in time are commonly considered in a special way. They are considered to happen with a certain "velocity", which may vary in correspondence with external or internal circumstances. In my talk I determined relativistic time as one related with properties of constant-time sections, with interdependence of these sections. As a matter of fact, time isn't the only coordinate to be used.

For example, fix our planet at some time moment and start moving from its centre towards the exosphere. We can formulate some rules that would make it possible preliminarily to predict what will happen at the next kilometre (metre, centimetre) — based on particularities of the chemical content, the temperature and other parameters of every region. These rules will be more or less equivalent, they don't depend on the radius along which we move. If noticeable differences appear, they will appear at the end — close to the surface. In this case, why not talk about variation of the Earth crust, mantle and core parameters with some "velocity" (the "velocity" of temperature, for instance, can be represented as variation of the temperature depending on the distance from the Earth centre)? Why not introduce the concept of "entropy" (in

the sense that small portions of the earth *surface* differ from each other much more than small regions of the Earth's mantle or core that are at the same distance from the centre)? By the way, in the course of this motion radial directions will be qualitatively different from other ones. We can define a network of trajectories that connect the Earth's centre with its surface and introduce the concept of "network time".

For me, the term "cyclic time" means that one of these fine days the history of the Universe will start developing again from the very beginning according to the very same scenario. The history of the Solar system, of mankind and of every human being will repeat precisely. As far as I know, nothing like this has ever happened. However, both individual and collective memory should be reset at the beginning of each cycle. In practice, when cyclic time is mentioned, something different is actually meant: cyclic processes in the Nature. But these concepts are not equal! There are no strictly periodic functions in Nature.

By the way, even if time in the Universe is cyclic (in the sense I understand this word), then it does not differ from the common linear time at the small range available to us. As for proofs of the fact that the history of the mankind (and of the Universe) is really closed-loop in time — they seem not to exist yet.

To my mind, the statement "time can be designed and is generated by the natural processes, while they are going on" reflects a typical (and incorrect) opinion that there is no future yet and the Universe is in the process of creation. As is clear from my talk, I suppose that the future already exists, no matter in how many variants: only this fact is not appreciated by us**.**

2. Theoretical physics

The Relativity.

When preparing my talk I, of course, tried to presuppose probable questions. And first of all I expected that somebody would certainly accuse me that I have a preconceived prejudice against Relativity. As a rule, scepticism about this theory and fuzzy hopes it will finally turn out to be false are explained by its complexity. Well, when an army retreats, it's rather simple to say that all the soldiers are cowards and all the officers are fools. It's much harder to find true, intrinsic reasons of failure though they surely exist. Quantum mechanics is hardly more simple than Relativity. Perhaps it is even more complex, from a purely mathematical point of view,but it does not cause such rejection. I believe it unlikely that the differential geometry of multi-dimensional spaces and tensor calculus can be considered to be too complex branches of mathematics. It's another matter that when a mathematical model is compared with the real world, especially in the case of Relativity, one feels as if one were looking at Nature through a dirty lens. It always seems that just one more small attempt is required to make the picture clear; but we do not know yet how to make this small attempt.

Time and space, relativity of simultaneity. How the world outlook depends on the observer.

From the point of view of modern physics, the phrase "time and space are fundamentally different" is certainly not absolutely precise; at least, it requires commenting on. Of course, we can imagine an outside observer, as mentioned above, holding a snarl of multicoloured threads, examining it and scratching his head over the question: "And which one is the time here?" As for our case, I don't think it's so hopeless. If we are far from a black hole (remember that we have agreed to consider the Solar system during the last couple of billion years), then the squared line-element in the Universe is associated with a quadratic form, which is almost Galilean (pseudo-Euclidean), i.e. almost matches the form written on the blackboard (fig. 1). This allows us to distinguish time from other coordinates. The outside observer sees a picture which contains visible light cones, world lines — all of which together help him to orientate himself.

Imagine a slab of plasticine, a simple slab with stripes, which we take out from the box. Then we tear away one piece from the left end and one piece from the right end; the result will be a conditional, simplified model of our world. Distinct horizontal lines ("world lines")

are visible in the middle; and the block itself has a regular shape. These lines are crumpled and intertwisted at the ends of the block, the world lines are mixed together and become indistinguishable: singularities appear, and there is no fundamental difference between time and space.

Perhaps, it also makes sense to discuss the remark that I shouldn't introduce the notion of an isochronous section, it wasn't well defined as long as simultaneity of events, like many other things, depends on the observer.

First, it would be useful to bear in mind that this outside observer is as virtual as, for example, the imaginary unit. Then, we may suppose that, in reality, every outside observer is associated with a consistent system of internal observers (frames of reference) taken at each point of space and each time moment. So, the world outlook from outside will depend on this system of internal observers; isochronous sections will change along with them.

Second, though simultaneous events can be chosen in different ways, it does not change the fundamental laws of Nature. In my talk I mentioned isochronous sections only in order not to rack my brains over the question how to replace the term "mass". If we just change the angle of isochronous section, then each mass, in fact, is multiplied by a constant. Obviously, it doesn't affect the form of natural laws.

In the general case, when choosing isochronous sections, we really induce a fibration of the four-dimensional time-space into three-dimensional fibers. Then the question should be posed, not about which one of these fibrations is the "correct" one, but rather about something else: for example, how a fibration might be chosen that will provide the minimum quantity of information for the formulation of all natural laws; or which fibration would provide the clearest difference between time and space.

By the way, I was sure that nobody would ask me the question: "How can we determine which space point to consider to be the same as another one when building a world line?" in addition to the question: "How do we pick simultaneous events?" But, after all, the first question is of no less importance!

Multi-dimensional character of time.

There was a remark concerning the fact that time isn't one-dimensional but has the form of a three-dimensional sphere in the four-dimensional space. However, in reality, this three-dimensional sphere is comprised of all directions of time that are *possible* in all different frames of reference. As soon as we choose one frame of reference and fix the observer, the dimension of time is equal to one.

In the same way, for instance, when looking at a light ray we can change our position and see this ray at the level of our eyes as if it's oriented horizontally, vertically (relatively to our body) or at some other angle. But it does not mean that it really resides in all these positions simultaneously. If three objects do not lie on the same straight line, an observer will be able to change his position so as to see any of these things appearing to be located between the two others; but it does not imply that their positions were really changed.

Therefore, the world lines of "all participants of the show", though distorted and intertwined in all imaginable ways, are not "smeared out", but they remain one-dimensional: they continue to be lines, they do not turn into rectangles. Of course, it is only on condition that the world isn't branching and we don't speak about the microworld with its uncertainty principle. (To be honest, I don't know how modern physics handles rotational motion, the angular velocity of which is sufficiently great to cause relativistic phenomena, while linear velocities of different parts of the body are different.)

By the way, it is also appropriate to consider one more question: my attitude to the hypothesis about the two-dimensional character of time in the world of elementary particles. Though the second time dimension is a deficient one, it describes the uncertainty of the particle position and momentum. First, it's important to understand the criteria by which the authors of this hypothesis distinguish spatial dimensions from time dimensions. In the same way, the additional dimension introduced by them can be considered as spatial. Second, if one rejects the mathematical model and considers the pure Nature, then what does this two-dimensional character

of time mean? Third, how can the wave function collapse be explained upon the condition that mathematical simulation is again *not used*? I have not heard answers to these questions yet though the hypothesis itself is quite acceptable.

March of time in the world of particles and antiparticles.

Apparently, my phrase about the march of time in the world of particles and antiparticles when, as I've said, physicists endow elementary particles with human properties, requires additional clarification. I meant the commonly known model given in fig. 6 where an electron-positron couple arises at zero time moment, and then, at some later moment, this positron is annihilated together with some another electron. (For example, this model is used to explain electron-positron scattering.)

In this figure we can see three different particles, which "live" in direct time. But there exists another interpretation which says that we have one and the same particle here, which "lives" in direct time first, then in reverse time, and then again in direct time. In other words, an electron "lives" in direct time whereas a positron "lives" in reverse time.

However, as far as I know, elementary particles have no soul and they aren't aware of themselves in time, moment by moment. Therefore, in the same way, we can suppose the opposite — that an electron lives in reverse time whereas a positron lives in direct time as long as we have no obvious indicators of an elementary particle's "age" that would show these particles "ageing" in some specific direction. And even if there are some observable differences between numerical characteristics of one and the same particle in different time moments, we will hardly be able to exactly say if these changes signify "ageing" or "anti-ageing".

Finally, nothing prevents me from saying that eighteenth different particles are seen in my picture given for discrete time-space. Each of these particles moves neither in time nor in space. For some reason, the laws of Nature are arranged so that the particles will surely be organized to form such an interesting scheme. This is what I meant when talking about the integrity analogy at the end of my talk (slide 16).

By the way, about the discrete space-time... One more remark concerning my talk was related to the fact that there is no such particle in Nature as the "electron". I think, this remark reflects only an excessive pedantry on the part of its author. For the sake of simplicity, in many branches of physics the electron is still represented as a particle as long as it is convenient for certain models, and every model is always imperfect and is much more simple than reality. As a character in a story by G.K. Chesterton has it, "to have a perfect system is impossible, to have a system is indispensable". However, in slide 16, the electron can be replaced with any other elementary (or not absolutely elementary) particle, the existence of which might seem more real. The same thing may be said about the discrete and continuous character of space-time. To illustrate some ideas, it is more convenient to apply continuous models. In other cases it is more convenient to use discrete models. However, both variants fail to provide a complete

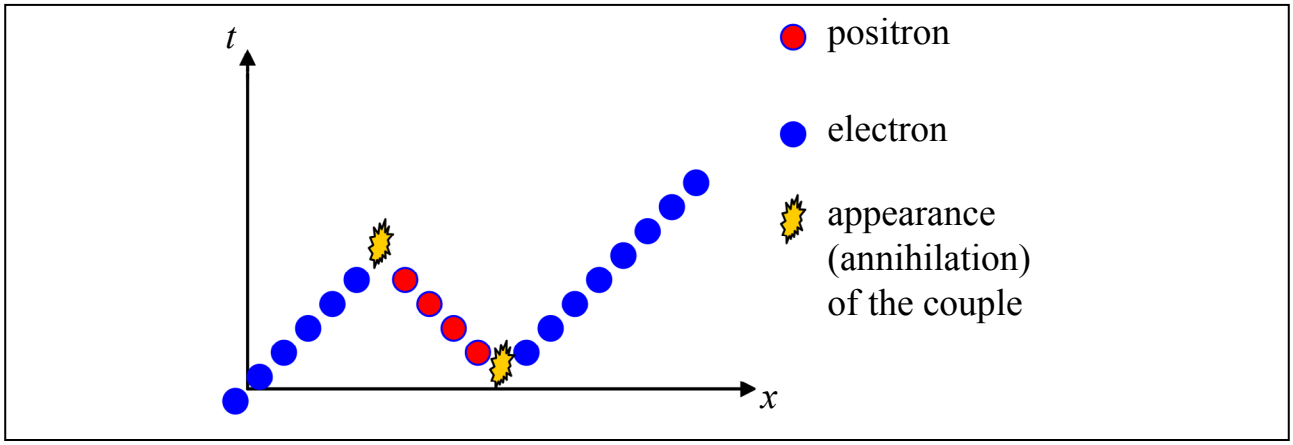
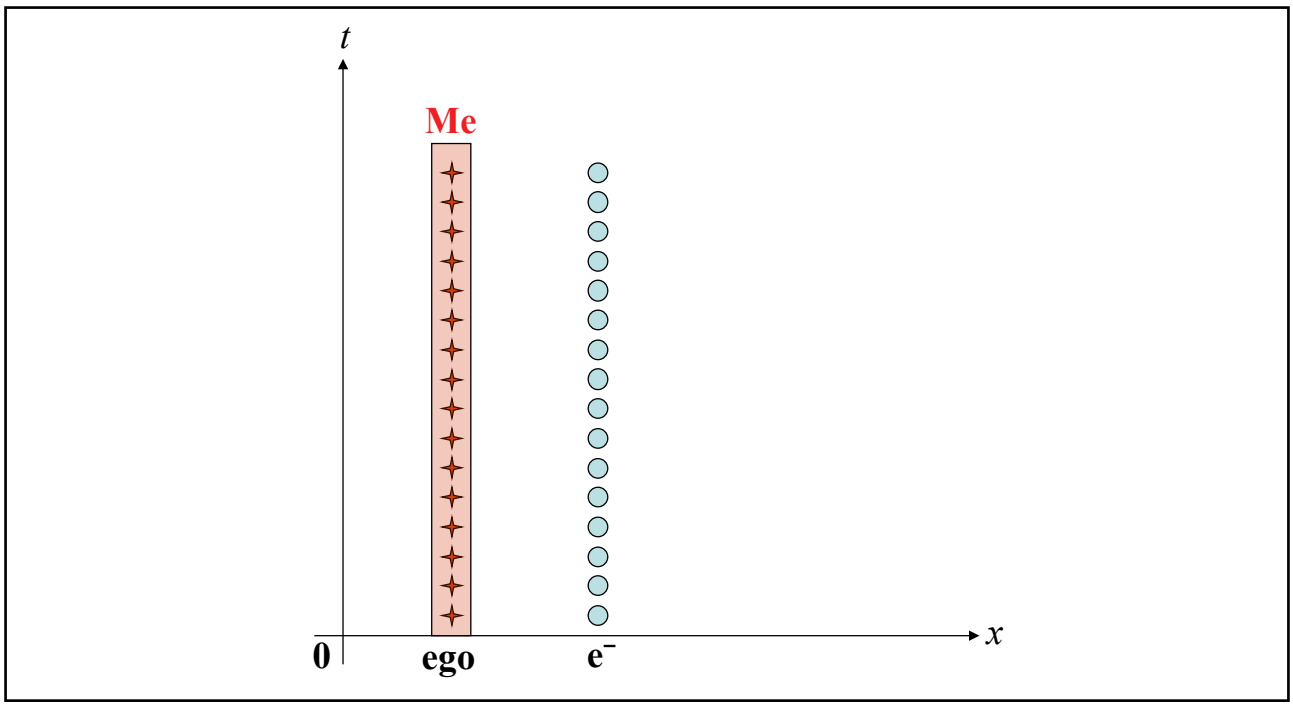


Fig. 6



Slide 16

correspondence to the real world. That is why I considered myself to be right, talking about "one-moment and consequent perception of time" though this approach is no more than an idealisation to some extent as long as our consciousness is unable to distinguish one moment from another.

3. Philosophy of Nature

Laws of Nature.

Figuratively speaking, laws of Nature for me are no more than a picture printed on the wallpaper hanging on the walls of my prison. Examining this wallpaper we can find different regularities, seeing, for example, that three little red points will certainly be followed by a blue one, and three green stripes by two yellow ones. If the picture is sufficiently complicated, then after an unlimited amount of time it will be possible to find a lot of different rules of such character. I call the wallpaper regular and symmetric exactly in this sense. But we need to get out of the prison if we want to find the origin of this picture, of this wallpaper.

Yes, there are many and various laws and regularities in the world; but the point is not to describe natural laws. It is more important to understand why there exist some laws in Nature at all, and where they have come from. In fact, when studying time, we look for answers to two absolutely different questions: "why is our world so symmetric and regular?" and "why is our consciousness arranged so strangely?". Probably, the answers are interrelated, but they are hardly equal.

Possibility of the existence of a Universe with reverse time.

Based on the "stationary" perception of the world, I will answer the question about the possibility of the existence of a Universe with reverse march of time. Judging by the fact that our Universe is expanding with constantly increasing velocity, we will be able to fix one spatial coordinate and represent the three-dimensional section of the Universe in the following form (fig. 7).

Hence, there exists some strange "squiggle" in the four-dimensional space-time with complex multilayered structure; and various kinds of filigree-like tracery, with certain symmetry liable to a lot of rules, can be distinguished at any of its sections.

I see nothing strange about the possibility that there could be another "squiggle" nearby

with the same complex structure, to some extent symmetric with respect to the first structure; that is I don't insist that the different kinds of tracery are to be identically equal in all cases, but they resemble each other in many details (fig. 8).

Is it possible to distinguish in the second "squiggle" figures that correspond to living beings? Will some of these living beings be sentient and will they understand each of their time sections successively from the right to the left but not contrariwise like we do? All this is a separate specific question.

Time anisotropy.

The next comment was about time anisotropy. I remind that I've considered an example of a planetary system which is similar to ours, but the inhabitants of which do not see any stars. The majority of matter appears to them to lie within the ecliptic plane, and consequently they conclude that not only their time, but also their space is anisotropic. Of course, as one of the auditors quite reasonably pointed out, even in this case, our planet's inhabitants would easily discover by experience that the space is isotropic *when dealing with volumes comparable with those of their own bodies*. However, even our modern levels of technology make it possible to transfer from these volumes to the global scale only in a discontinuous way. We do not conduct experiments that involve a part of our planet, for example, an entire continent, or even several planets along with their satellites. It is natural to suppose that inhabitants of the hypothetical planet would see an abyss between the common macro-level and the global, planetary scale: an abyss, which is akin to the hiatus between our micro-world and our macro-world. We can wrack our brains over the question of why the macro-world has no uncertainty of states immanent to the micro-world; we can build models that describe this qualitative jump. As for a planet from which stars are not visible, its inhabitants would solve one more problem: how to explain the fact that three-dimensional space ceases to be anisotropic on the scale of small bodies.

As for time anisotropy, it may be the case that it does not exist on scales either so very large or so very small that we have never tried to model them as yet.

Parallel worlds.

I think I should give more information concerning my attitude to the hypothesis of the existence of parallel worlds. First of all, I must note that I belong to the generation of people who naturally acknowledge the possible existence of parallel worlds and who do not intuitively reject this hypothesis. However, there are a lot of things in theories known today that I don't like and consider doubtful. First of all, the initial point of the many-worlds hypothesis is an attempt to justify the wave function collapse according to different principles than the Copenhagen ones; but there exist alternatives to both models. Secondly, the source of the branching of worlds is either uncertainty at the micro-level or someone's volition, which is also initially undetermined due to presence of free will: it is not clear to me why precisely these two reasons are at play, nor how they are interrelated. I think, the possible sources of branching should be described more completely and in a more detailed manner. Thirdly, in currently existing theories parallel worlds either have no influence on one another or they merge together. (I like "merge" more than "glueing", as "glueing" suggests the conscious interference of some outside agent). I think, there should be intermediate states as well as mutual influences of

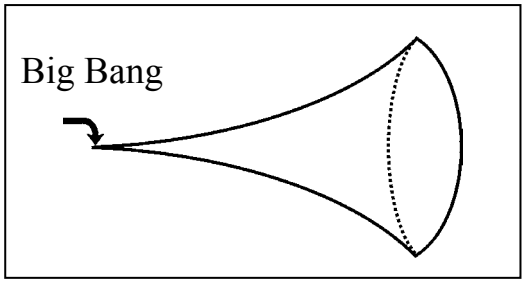


Fig. 7

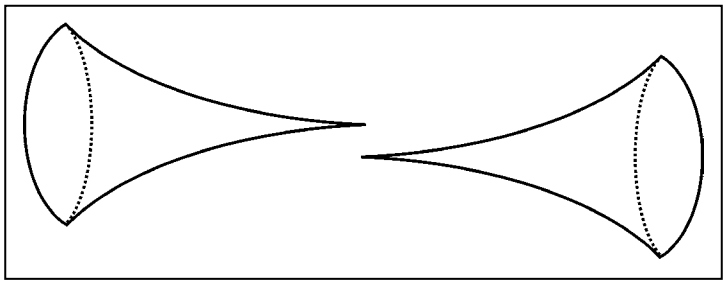


Fig. 8

varying degrees. Besides, merging of the worlds has too strong a relation with loss of information. It looks as if we could consciously destroy a part of the information with intention to cause a premeditated gluing of the worlds. Finally, there exists the problem of memory and the "general line of history", which I spoke about in my talk. Isn't it necessary to make a comprehensive explanation of how the integral and relatively non-controversial memory of each individual is formed? Memories from the parallel worlds possibly take part in some weighted fashion in the formation of an overall picture, so that a weighted mean appears: how and why then are these weights defined?

Free will. Correction of the past.

Many of the questions and remarks, in their essence, were about difference between "the stationary" and "the dynamical in time" worldviews. Moreover, it's clear that the problem of free will happened to be especially connected with this central topic: does the world together with its past and future already exist or is it in the process of continuous formation (or creation)? Is it a motion picture film of a-priori known length, which we watch sequentially, frame by frame, or is it a film whose duration increases as it is being watched?

To my mind, the first variant is fair. Perhaps, in order to describe the relation between the film frames, sometimes it is necessary to use not only natural laws, which are always and everywhere the same, but also the unique volition of some third person. It changes nothing. Even if the parallel worlds hypothesis is true, and if selection of one of the possible worlds is due to this unique volition of one person, the whole of the Multiverse already exists. However, our custom makes it more convenient for us to see the world in the process of formation, despite the fact that this actually does not agree with modern physics.

As I've said in my talk, most of the discoveries of twentieth century physics are still not assimilated. They remain sophisticated, pure mathematical constructions, strange even for the academic community of experts in science, to say nothing about those from philosophy or religion. To clarify this idea, I'd like to quote one famous philosopher.

"Perché lui, più studioso de la matematica che de la natura, non ha possuto profondar e penetrar sin tanto che potesse a fatto toglier via le radici de inconvenienti e vani principii… Perché quella [la dottrina], benché sii comoda alle supputazioni, tutta volta non è sicura ed ispedita quanto alle raggioni naturali, le quali son le principali…[Perché] altro è giocare con la geometria, altro è verificare con la natura… Chi dunque sarà sì villano e discortese verso il studio di quest'uomo, che, avendo posto in oblìo quel tanto che ha fatto, con esser ordinato dagli dèi come una aurora, che dovea precedere l'uscita di questo sole de l'antiqua vera filosofia."

"Being more intent on the study of mathematics than of nature, he was not able to go deep enough and penetrate beyond the point of removing from the way the stumps of inconvenient and vain principles… Because this doctrine, though convenient for computations, nevertheless is not safe and expeditious in regard to the natural [physical] reasons, which are the principal ones… For it is one thing to play with geometry and another thing to verify with nature… Who will, therefore, be so nasty and discourteous toward the work of that man as to forget both what he has done and his very being, destined by the gods to be that dawn which was to precede the rising of the sun of the ancient and true philosophy"[6].

The author of these words is Giordano Bruno; and here, of course, he was talking about the Copernicus theory. It may be a surprising thing, but his words could be addressed to many of the modern theories, especially in physics. Especially as "verification with nature" has lately become a long-lasting and expensive procedure, so that "playing games with geometry" is preferred more and more often.

One strange discrepancy puzzles my mind. On the one hand, we can freely handle the geometry of multi-dimensional manifolds: we mix all of the four coordinates and create models where time and space are equal. On the other hand, we

[6] Giordano Bruno, *La Cena de le Ceneri* (*The Ash Wednesday Supper*, transl. Stanley L. Jaki).

like not to see elementary, evident and natural conclusions that result from these models. For example, we choose not to see Reality from the point of view of ancient philosophers — an integral, eternal, stationary and permanent four-dimensional *ontos*, where neither past nor future can be changed. And if we want the integral spatial-temporal picture to change like multi-dimensional frames in a multi-dimensional cinema, one more full-featured, valid dimension is required. But it does not exist! I still cannot understand, it's beyond my comprehension that this simple conclusion has not become commonly accepted during the last hundred years.

The only possibility to change the past or the future — already existing but unknown for us — is the existence of parallel worlds. Then when changing history we actually get to another branch of reality; but it does not mean that the other branches cease to exist. We will make this world neither worse nor better; we just will choose the variant which is the most appropriate for ourselves. As for motion of our consciousness relatively to the parallel worlds or, what is the same thing, motion of the parallel worlds relatively to our consciousness — it occurs not in time but in some other coordinate. You may call this coordinate somehow or other, using any combination of sounds, but it is certainly not time.

Every time, hearing about prospects for modification of the past, or for modification of both the past and the future together, I always try to imagine how all of it could be presented in a picture similar to the three-dimensional cylinder I've depicted in my slides (slides 2, 7, 8). Even if not all natural laws may be reformulated for a two-dimensional space, it is always possible to consider that we study sections of a four-dimensional object for which the value of one spatial coordinate is fixed. But, for some reason, I cannot imagine a picture that would explain changing the past "from the point of view of an outside observer".

One of the reasons why it is actually more convenient for us to believe in free will and continuous formation of the world is that in addition to logic and experiment we unconsciously apply yet another criterion for the validation of scientific knowledge — a moral criterion. We are always trying to decide if our current world view satisfies the moral law inside us. This is one of the reasons for an aversion to Relativity or to Darwin's theory of natural selection. In particular, each of us decides for himself what is more precious — the capability to go back to the (unchangeable) past or the presence of free will. Lack of free will does not satisfy many people because it offends our human dignity. On the other hand, somebody may be ready to sacrifice his free will for the sake of understanding that the past does not disappear forever, but remains existing even being unavailable.

4. Biology

It's a pity, but I was not asked many questions concerning biology. As it is more convenient to discuss the contradiction between biological and moral characteristics of human kind in the subsequent section, I will make only two brief remarks.

First, the basic question I wanted to answer in the fourth section of my talk can be expressed as follows: why does the green bubble in slide 2 signify a living object (a spruce) whereas the blue one — a non-living object (a house)? How should an outside observer identify which of the objects is alive?

Second, I think it makes sense to give examples explaining how the irritability mentioned in my talk as one of characteristics of living matter, is displayed in a stationary and, for simplicity, discrete interpretation (fig. 9). The image on the left shows the temporary "burning-out" of a retina under the influence of a bright light: the eye is depicted as moving closer and closer to a fixed light source, i.e. time is vertical and space is horizontal. The image on the right depicts how characteristics of the digestive system change at the approach of food (salivation, gastric juice production etc.).

5. Human psyche. Religion. Morality

God and spirituality. Contradiction between biological and moral principles.

To my strongest surprise, the audience has shown a vivid interest in the question of whether

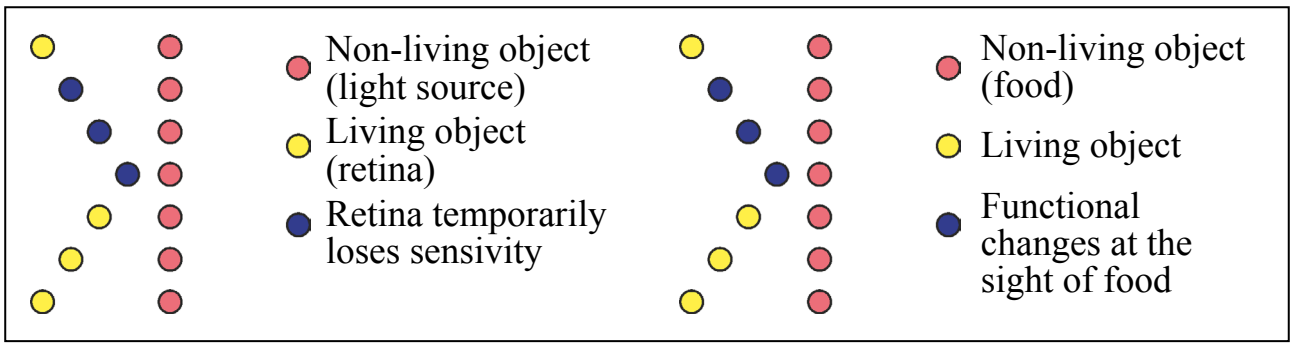


Fig. 9

or not I believe in God. That is why I will first of all specify that I've given a sufficiently explicit and, I hope, clear explanation of my understanding of God in part 5 of my poem "A Brief Course on General Physics", which was included in my collected papers "The Real Time Travellers"[7]. I will briefly recall that I absolutely admit that our world might have been created by some sentient creature of a superior degree. But I never can believe that such a creature is infinitely wise and infinitely moral and that there is no other god who created him and has dominion over him. If we estimate The Creator by the results of His activity, I at least cannot accept the principles according to which living matter exists: they are immoral.

Indeed, extremum principles that manage living nature (the principle of maximum adaptability, maximum expansion, maximization of the biomass or maximization of diversity) are in contradiction with our own understanding of morality *in our direction of time*, and this makes the problem of co-existence of biological and moral origins rather interesting.

I've devoted so much time to the so-called mirror civilization for a reason. I fancy, so to speak, "a dim light of the mirror-world" in the rules of morality (at least, in the rules that are common for the better part of mankind). In this mirror-world, let us imagine how small brave cholera germs penetrate the intestinal tract of a sick man in order to absorb deadly poison and then leave the organism via the upper digestive tract to save someone else. Imagine how insects, that in our world are called bloodsuckers, in the mirror-world produce blood within their organisms, then find a haematothermal creature this blood matches best and inject it under its skin, removing pruritus and irritation. Or, as another example, imagine how a koala-bear sucks in some suspicious earth-balls and then climbs the eucalyptus to adjust green leaves taken from its mouth to the tree. Doesn't it seem to the auditors and the readers that the described pictures better correspond to the Christian view of universal love and mercy? Where has this view come from? How could morality have appeared in human society? I want to accentuate that I hint nothing, but this inconformity seems to me very strange and worthy of special attention.

One more reason for the coolness of my attitude to religion is the fact that faith in God will not solve my internal problems. As far as I understand, none of the contemporary religions promises people an ultimate happiness of such a kind that would satisfy me. Eternal felicity in the afterworld with preservation of memory and personality or without them, sequence of reincarnations causing nirvana — all this still implies the one-moment and temporally-consequent self-awareness. I am looking for the answer to the following question: "How should this world be arranged so that I would want to live in it? How should time flow in this world?" I don't think that any religion is able to help me to find answers.

Besides, I'd like to recall that rejection of God absolutely does not mean rejection of spiritual origins. Finally, like many of my contemporaries, I make ample use of religious terminology when discussing spiritual problems at least due to lack of any other terminology. Further-

[7] Edited in Russian (www.chronos.msu.ru/RREPORTS/shulikovskaya_timetraveller.pdf)

more, I respect very much the founders of the world religions, no matter who they are — gods who became people, people themselves or, so to say, a team of authors.

Spiritual health.

One more question asked during the discussion of my talk was about spiritual health, about the fact that any deviant perception of time is actually an altered state of consciousness indicating a mental illness. I can state that I fully understand what psychiatric illness is, how it is painful and terrible. At the same time, I have written a lot of poems clearly presenting the following idea: it is better to become insane than to stay a philistine all one's life. Ultimately, a human being is no more than a monkey gone mad, and any genius, hero or saint is crazy for people in the street. Besides, in a certain period of my life I had an interest in so-called "dignified" types of mental illnesses where "labour of a philosopher combines with properties that are interesting to a psychiatrist" ("Directions to a Stage Director" as an afterword to "Jesus, known as Messiah", a play from the collected papers "The Real Time Travellers"). In spite of a horror of madness, perhaps it is essential to mankind for some reason that a certain number of people in any society will go mad. The failure of experiments conducted by the Nazis, to try to kill off all mentally ill people in Germany with the aim of improving nation health give weight to this proposition.

Probably, the question about my own mental health should be left open. Probably, much of my worldviews have been formed under the influence of some distinctive features of my psyche, as an attempt to get rid of a psychic pain. In the same manner a mutilated person intuitively develops his own way of walking, which looks strange from the point of view of the others, but which is maximally painless for him. Well, ultimately, that is my affair and I don't call anyone to follow me.

Memory.

During discussions of my talk, it was proposed that the direction of our memory in time could be explained by an increase of entropy, by an increase in the number of micro-states, which "can't be placed" in memory corresponding to earlier time moments. But in this case at least some of those micro-states should have "reached their destination", i.e. we would have had an image of the future, even if a "fuzzy" one. Meanwhile, in reality this image does not exist at all. So, we should look for another explanation. And before thinking about why our memory is so unidirectional we should answer the question of what the nature and the mechanisms of memory are in general. However, the ultimate answer to this question will be given only when we are able to artificially reproduce mechanisms of memorizing, which is as yet impossible even as a very distant prospect.

At last, I would propose to begin studying the mechanisms of memorizing and foreknowing not from people but from elementary organisms, bacteria and viruses. It is possible that equilibrium between their past and future is emphasized more strongly; and only an increase in the complexity of the structure of living beings causes a "deviation" towards one side — towards the past.

Mirror people.

Concerning my story about the mirror civilization, first of all I want to re-emphasize that it is no more than a theoretical example, the purpose of which is first of all to develop our imagination. For instance, supposing the mirror people had their own Shakespeare, what could his plays be about? I in no way think that every one of us lives in two directions: from birth to death, then from death to birth and so on — eternally. The first obvious reason is that we bury our dead whereas in my example I describe how bodies gradually appear "from the dust of the ground". The version when gravestones with dates appear "from the dust of the ground" is too fantastic even for me.

By the way, my example has a lot of small drawbacks. I will draw attention to only one of them: it turns out that some images will arise in the brain of the mirror people, and only after that do sense organs get the corresponding information. (Is it, however, possible to assert with certainty what arises earlier and what arises

later for the ordinary human being? The process of formation of the image is accompanied with so-called circular reactions when the brain exchanges with receptors and motor centres such amount of signals, which might cause us but not them to be the mirror beings.) As for oddities appearing from "playing the film backwards", for example, a cigar, which grows in the mouth or an unexplainable desire to raise the hand to receive a stone in it — all of them are only matters of habit. When a child is born, it encounters various facts it has to accept as they are, in the best case having satisfactory explanations from grown-ups. I am sure that we can find a lot of oddities in our "common" life if it be considered independently. But the fact is that we have got used to them!

As for the "illusion of free will", in most cases, our supposedly conscious actions and even thoughts, when examined more closely, are certainly and unequivocally determined by genes, education, the surrounding environment and the whole of our past life. Actually, the problem of free will in its classical representation goes as follows: does there exist anything which truly depends on human choices? And the answer pretty often is negative. In this sense, it is most likely that there is no substantial difference between direct and reverse time. The mirror human being will decide that it was only up to him where to put the stone which has appeared in his hand. He will see an indication of *his* free will here.

Human in "time stream".

The last objection I'd like to answer is the fact that every newborn human being, for some reason, subconsciously starts perceiving time from the past to the future — just like all other people. However, the child does not live in a vacuum. Even the so-called "Mowglies" spent their prenatal period within their mother's organism under her probable mental influence. In the same way I can say that one and the same experiment has been repeating itself many millions of times during the last hundred years: a newborn child was put into the Russian-speaking environment. He almost always started to speak Russian by the third year of his life; the exceptions were the deaf and the mentally deficient ones. From this I might conclude that the Russian language is the only one possible; one hundred million experiments more than sufficiently prove this.