

# **LIVING BEINGS IN THE COSMOS\***

**Konstantin Tsiolkovsky**

From a purely terrestrial standpoint the animal is composed of 29 elements known to us. Its chief component is water; it can stand temperatures not higher than 100°C and not lower than 100°-200°C (but then it does not live but is preserved alive in a state of anabiosis); most of the animals require a definite average temperature, approximately 20°C. The animal requires an atmosphere containing oxygen and water vapour. The source of the animal's activity, i.e., movements and thinking, comes from other organisms, or at least the Sun (zoophytes). The animal presumably cannot live without atmospheric pressure and gravity. The animal's body temperature must be above freezing point, but must not exceed 37°-40°C. The mature animal reaches a definite size.

Even the highest animal (man) is far from perfect; for instance, the life span is short, the brain is small and of poor structure, and so on.

All this is essentially a result of adaptation to the conditions of life prevailing on the Earth, chiefly to life on the equator, and a sign of incomplete phylogenetic development

(evolution). On other planets with different conditions of life the animal will be built on different lines. Our Earth, too, will produce more perfect forms in the course of time. Let us examine, in sequence, all the available information pertaining to terrestrial organisms.

Why are the animals made up of 29 elements and why do they not contain the remaining 61, for instance, gold, platinum and others (these are sometimes found in organisms but only by chance, in negligible quantities and playing no role at all)? (And of the 29 elements probably nine are unnecessary, too.)

The first reason is that the animal feeds on plants and plants contain just these elements. And why are plants made up of these substances? Plants are surrounded by the atmosphere, water and water vapour, while their roots are in the soil, so it is natural that they should contain these substances; hydrogen and oxygen come from the water while the soil, dissolved in the water, gives the plants chiefly calcium, phosphorus, chlorine, sulphur, sodium, potassium, fluorine, magnesium, iron, silicon, manganese, aluminium and other elements. The atmosphere provides oxygen, nitrogen and carbon. Soil and water in the soil contain other elements as well, but in infinitesimal doses, because these are either rare substances or heavy, and hidden deep down in the earth and not easily accessible to the plants. If other elements predominated in the composition of soil and atmosphere, the composition of plants and animals would be different.

The upper crust of planets lying closer to the suns contains more of the heavy elements, and organisms on these - planets should contain heavy elements. Organisms on planets that are far removed from the suns should, on the contrary, contain the lighter substances, because more of these occur there.

Man has extracted heavy metals from the bowels of the earth and made gold, for instance, part of his body (gold teeth, etc.); generally speaking, the composition of animals on Earth may yet undergo a change.

What inference can be drawn from the above? Given suitable conditions, all elements can be used to build up living organisms. So we may suppose that on every planet different substances predominate in the composition of living beings, depending on the elements in the planet's crust, its distance from the Sun, the latter's properties, the temperature on the planet, and other factors.

The animal consists of solids and liquids. And water is not the only liquid. But on the planets that are situated far from the Sun—and at low temperatures in general — water is a mineral while the prevailing liquid substances are of other composition, for instance, liquid carbon dioxide, various oils, alcohols, hydrocarbons, carbohydrates, liquid gases and so on. These would form the seas and living organisms. On the other hand, bodies that are solid on the Earth would be in a liquid state on planets nearer the Sun and might become parts of the composition of the animals.

Atmospheres of other planets, too, may have a different composition with hydrogen predominating on the cold planets, and, on planets nearer the Sun—water vapour or other liquids converted into gases because of the great heat.

The conclusion to be drawn is that on cold and hot planets there may be living beings composed of the seas, atmospheres and soils peculiar to each of the planets.

Is it true that for life to develop abundantly the environment must have a temperature of roughly 25°C? We have seen that neither a high nor a low temperature deprives planets of oceans and atmospheres, only their composition is different; so animal life should also be possible on the planets. The animals will be made up of the liquids and gases appropriate to the mean temperature of the given planet. Consequently, the greatest variety of temperature on the planets are no obstacle to the abundant development of life on them.

We know that even our own organisms adapt themselves to a low temperature. True, this applies to either the lowest of the animal kingdom or to rational man, capable of creating an artificial situation to protect himself from the cold, which costs him a tremendous effort. But the northern animals have migrated from warm climes, their place of origin was the equator and they were not adapted to the harsh climate at first. Hundreds of millennia had to pass before they grew accustomed to the cold, and then not all of them. That is why so far we have not observed any luxuriant blossoming of life in winter conditions and in the polar climate. Incidentally, the main reason for the scarcity of life in cold countries is the absence of the solar energy.

Why is the body temperature of the higher animals on Earth about 37°C? Life originated at the equator, in its seas and oceans. (Why? Because of the even

warmth and abundance of the solar energy.) The mean temperature of water there fluctuated around 25°C. That was the body temperature of the primordial animals, the height of whose existence coincided with just this temperature. The animals accepted the temperature of their environment, and although they could stand lower and higher temperatures they were at their best only in the mean temperature of the environment.

The body temperature of these first creatures was only Slightly higher than that of their environment, since they had little vital energy.

There then developed the warm-blooded animals with their tremendous vitality. As a result of this (the warmth, the burning up or chemical processes inside the animal) their body temperature became much higher than the average temperature of the surrounding medium. Thus, the body temperatures of animals are always a little higher than the mean temperature of the planet. But planets may have widely varying temperatures, and so, therefore, can animals. Some may be very hot, others ice-cold—from man's point of view. I leave out of the discussion cases where the temperature of the medium is a little higher than that of the animal; warm-blooded animals are then in danger of dying, because, if heated, the brain ceases to function. But actually when this happens the skin or the lungs give off water, the heat of the body is absorbed and the brain remains at its normal temperature. A certain constant temperature is another condition essential to life. Drastic fluctuations of temperature are fatal to any organism. But we know that on the few planets which have one side always turned to the Sun the temperature fluctuates between 250°C below zero and 150°C above.

How could there be life on such planets? The fact is that whatever difference there may be in the temperatures at the surface, this alone does not preclude life, because inside the planet the temperature remains constant. So animals can burrow down into the ground and hide in their holes from the excessive heat and cold. But the lowest animals would be quite helpless. The beginnings of life in such contrasting temperatures would be difficult. There are limits to everything, even to the endurance of living things; so perhaps rational beings having the highest development of knowledge and technology, might take possession of the places that are inconvenient for lower animal life.

Must there be a sun for animals to exist? The energy of solar radiation is widespread in the Universe: the Ethereal Island alone has over a million thousand millions of suns, young and old, constantly emitting their rays into space. It is clear, therefore, that most animals live by solar energy. Yet they may exist by force of some other energy. Some of the suns become extinguished and distant planets have almost no sun-rays at all, yet life does not immediately end on these planets. High temperatures and chemical energy are long preserved within the celestial bodies that have cooled on the outside. This makes it possible for different organisms to continue living for a long time. Only there is no particular need to utilise these meagre remnants of celestial energy, since there are vast numbers of flaming hot suns! Theoretically any form of energy can support life; for instance, the energy of planetary motion and revolution, gravity, heat, atomic energy, and other kinds. But we shall not discuss in what way.

A very important factor is the kind of brain an animal has. Can it grow larger with the animal's size remaining the same, and if so, to what extent? The important thing is the structure of the brain, but size is a good quality, because the larger the brain, the more capacious the memory and the mental powers in general. We can carry heavy loads, why then can we not have heavier heads? Mechanics shows that our brain can quite safely be twice or three times as large as it is. So far, however, there are obstacles to this. First, child-birth becomes more difficult and, secondly, development of the brain (at the initial stage) leads to circumscribed moral standards and man renounces personal happiness and leaves no offspring. At the second Stage this development leads to pessimism which destroys bright hopes, fills the mind with fears and is the cause of nervous disturbances and early death. Only at the third Stage, with the brain and mind reaching their highest development is a degree of equilibrium established between altruism and egoism and man realises that he has a duty both to himself and his offspring.

The first obstacle can be overcome by premature births and subsequent development of the foetus in a special artificial medium. Man will, as it were, have to return to the period of egg-laying (birds, reptiles and the like). The second and third obstacles can be removed by precautions undertaken during the first and second stages of development and the immediate development of the third, which gives rise to optimism, thanks to superior knowledge, penetration into the depths of nature and great wisdom.

But the brain may grow in size in proportion to the growth of the entire animal. Growth is hampered on the Earth by gravity. Mechanics definitely

proves that the mass of the brain of animals similar in shape is proportional to the cube of the decrease of gravity to which the animals are subjected. Thus on Mars and Mercury where gravity is half what it is on the Earth the volume of the brain could be eight times larger than that of the terrestrial animals provided, naturally, for an animal with a similar external appearance. The creatures would be twice as large as on the Earth. On the Moon they would be 16 times as large and the mass of the brain 216 times greater.

This conclusion of mechanics does not apply to aquatic creatures, for their weight is counteracted by water. Animals with large brains could originate in water. But no industry is possible in a water medium (no fire can burn there), there is insufficient oxygen and solar energy (light), so life could not and did not develop there to any extent.

When man has settled down in the ether, in artificial dwellings, i.e., when he has overcome the Earth's gravitational pull and escaped from it, he will not, in interplanetary space, encounter any obstacle to the growth of his brain if we ignore the complexity of a large brain and the organs that supply it with nutriment which, of course, are bound to put a limit on the development of the mass of the brain.

But while man is on the Earth (and part of mankind will certainly remain on the Earth) his brain can increase only two or three times. It will not be beautiful, but one can get accustomed to anything. Beauty is a conventional, subjective thing.



The lungs of mammals are very imperfectly constructed. This organ ought to be transformed. Take the example of the alimentary canal. In lower forms it has an entrance for food but no special exit. What is left after food has been digested goes out the way the food came in. Locusts, for instance, excrete through the mouth. This slows down the digestive process. That is why higher animals have acquired an anus. They have an advantage over animals without it. Primitive blood circulation, again, was in waves (to and fro). It is only the higher forms that have a decent pump (the heart) and regular blood circulation.

It is the same with the lungs of the majority of mammals who inhale air, extract oxygen from it and exhale the products of respiration through one and the same orifice. Because of this the blood is oxidised slowly, the organ of respiration has a big volume yet gives little oxygen to the animal. Like the alimentary canal, the respiratory chamber should have a separate exit; the air should enter uninterruptedly through one opening and go out through another. That this is possible can be seen from the structure of insects and birds which willy-nilly release enormous energy during flight. Insects, for instance, have respiratory tubules (tracheae) through which the air flows. All they lack is a pneumatic pump, and we can be sure that at least some insects possess one. In birds the thoracic muscles are pierced with similar tubules, although we know little of the mechanism of how the air passes through them: whether the streams of air flow in one direction or whether they fluctuate backwards and forwards as in the lungs. One thing is clear—the air current through these tubules is brought about by the contraction of the

thoracic muscles during flight (just when great amounts of energy are needed).

There is no doubt that the evolution of animals even on the Earth might have taken a different course and produced animals with “through” respiratory organs. And it is quite possible that such creatures do exist on the many millions of other planets. They may originate on the Earth as well, either naturally or artificially, when man begins to model his body. Physiologists are well aware of the numerous defects in the structure of the bodies of even the highest animals. All these defects should be eliminated by means of exercise, selection, crossing, operations and so on. We have mentioned a few of the shortcomings by way of illustration. There is not a single-organ in man that does not require to be improved. We might mention in passing that in many aquatic creatures oxygen, dissolved in water, moves along with it in the same direction. In fish it travels from the mouth to the gills. Perhaps that is why fish can live on the small amount of oxygen available in water.

Is gravity, and particularly the gravity of the Earth, essential to man? In similar organisms (or ones that have an external likeness but are of different sizes) the greater the gravity the more it hampers growth. Consequently, it makes for a smaller brain and weaker mental powers. So it appears that gravity is harmful.

That the total removal of gravity in no way precludes life is seen from the fact that aquatic creatures, with gravity (or weight) counteracted by the counter-pressure of the liquid, come to no harm. On the contrary, nowhere does the

size of organisms reach such dimensions as in the ocean. Quite helpless on land, the whale in water frisks like a kitten. An animal upside down does not die or suffer, although gravity operates in the reverse direction. Even less does it suffer when lying down, when the pressure of the blood column is several times less than usual. In this same position a man can swallow, digest his food and perform other actions. Apart from their therapeutic influence, baths often ease the condition of sick people by abolishing their weight. Decreased gravity should diminish the mass of the organs of locomotion (legs, feet, wings, etc.) if it does not increase the size of the organism. This is what can be expected to happen on planets with little gravity:

1. The less the radius of gravity of the planet, the larger the organism on it.
2. If this is not the case, the organs of locomotion (legs and so on) become very weak or thin.
3. If this is not the case, the animals move in longer leaps or at greater speed.
4. The three cases may be combined, that is, a moderate increase in size, moderately weakened leg or thorax muscles, moderately increased leaps and other movements. The three extreme cases may be found in the most varied combinations.

The opposite is observed on big planets with a strong gravitation pull.

But it may be objected: How can gravity be dispensed with—the oceans will evaporate, the atmosphere will disperse and without them life is impossible.

Let us sort it all out in its proper order. Can water and air be dispensed with, and to what extent are they necessary? Man easily adapts himself to heights, where there is half as much air and oxygen as elsewhere. There are mountain villages at such heights and the children born there thrive on the shortage of oxygen while mountaineers feel the lack of it. Healthy people can, for a time, tolerate only a quarter of the usual amount of oxygen. If there are ever such things as “through” lungs people will be satisfied with still less of this vitalising gas. Fish can be said to breathe not air but water saturated with it. The water streams in one direction (from the mouth to the gill slits), just like the blood and food of the higher animals. Water contains 60 times less oxygen than the atmosphere but this does not prevent the fish from keeping alive. What is more, aquatic creatures can exist perfectly well when there is far less oxygen. It will be said: “That’s just what a fish’s life is like!” But pure oxygen (without water and atmospheric nitrogen), if there were such things as “through” lungs, would rapidly dissolve in the blood and give it no less than our land animals get.

But how can atmospheric pressure be dispensed with? Where there is ‘no pressure from the air or some other medium, the result is bleeding from the nose, throat and other organs. This is understandable, for the strength of the blood vessels is partly supported by the external pressure of the atmosphere. Once there is no pressure or only a little, the weaker vessels in the, nose and throat are burst by the blood. Man and the higher animals are not adapted to weak pressure from the environment. If, indeed, in such an environment people are born and survive, it is because, in consequence of the ability of

organisms (as Lamarck observed) to adapt themselves to new conditions, their blood vessels become stronger and they come to no harm in a rarefied environment.

Organs of locomotion are also articulated by atmospheric pressure. Without air this bond is disrupted. But the bones will not fall apart even without pressure from the air because they are also connected by cartilages and the constant tension of the surrounding muscles. That this is so is evident from the experience of gymnastic exercises: an athlete can hang by the arms or legs, subjected to a force of gravity many times exceeding the atmospheric pressure on the inconsiderable areas of his connecting joints. In spite of this weight the joints do not come apart. From this it is evident that muscular tension alone is enough to keep the bones articulated.

In a rarefied medium perspiration from the lungs and sweat glands should be intensified. But there are some animals (the dog) which have no sweat glands in their skin. So there can be organisms which do not lose water through perspiration. There are also some plants that do not transpire water (some cacti). What is the conclusion? That there can be creatures which would in no way suffer from the loss of external pressure. True, with lungs incapable of evaporating water the animals would be unable to regulate their body temperature and would perish. But if the temperature remains constant this danger will not be present.

There are many other indications of the influence of the pressure of the environment. For instance, the lungs of mammals expand exclusively owing

to atmospheric pressure. We are nevertheless hoping that lungs will also be able to adapt themselves to the absence of gravity. And indeed, if lungs are of the “through” type, with air flowing right through them in an uninterrupted stream, they may lose their elasticity which will become unnecessary, or they may become attached to the thoracic cavity. We cannot go into all that here.

So we see that animals can dispense with gravity and exist with a small amount of gases exerting little pressure.

Another question arises: is gaseous oxygen or any other gas-like nutrition necessary at all? No, it is not. Animals can take oxygen in, like food, in the form of its unstable compounds in solid or liquid form. Chemistry knows of numerous compounds of this kind and the chemistry of the future will discover many more. Perhaps a new organ —a kind of stomach—will be necessary, from which oxygen will gradually pass into the blood. An organism will have two stomachs and no lungs. It does not lose water and will in no way suffer without an atmosphere. Organisms of this kind are possible on the Moon and other planets where there is no atmosphere or where the atmospheres are highly rarefied.

Organisms that have lungs can exist in atmospheres of widely differing composition. Energy does not come from oxygen alone: sodium burns in carbon dioxide and chlorine. Chemistry offers many examples of the kind. And then even on the Earth there are creatures living in a carbon-dioxide medium and needing no oxygen (anaerobia). The millions of thousands of millions of planets of our Ethereal Island alone offer such an immense variety, such

unforeseeable possibilities that it is unlikely that the human mind today, no matter how brilliant, can encompass them.

Is even food necessary after all? Perhaps there can be creatures who take no food, that consume no gases, water, plants, meat and salts! We know that plants can subsist on mineral substances alone, but still this is food of a kind. And the atmosphere, too, contributes to their nutrition by supplying carbon dioxide, sometimes oxygen, sometimes nitrogen (mostly through bacteria).

There are animals that are like plants, capable of subsisting on inorganic substances; there are the plant-animals (zoophytes). Their bodies contain tiny grains (chlorophyll) through whose agency (together with sunlight) they decompose the carbon dioxide of the air into carbon and oxygen. The oxygen is released into the air while the carbon combines with other inorganic substances to form Sugar, starch, cellulose (carbohydrates), nitrogenous and other organic tissues that go to make up the body of the organism.

All we see from this is that plants and animals can subsist with the help of inorganic food alone in the presence of sunlight. But all the same atmosphere, water and soil also play a part here. Is life possible without the constant participation of these elements of the Earth, i.e., without the participation of the environment?

Let us imagine a perfectly isolated individual animal. Suppose that no gases, liquids or other substances find their way into its organism, and no substances can be removed from it. The animal is permeated with light rays alone. When

the light rays encounter in its body the chlorophyll, the carbon dioxide and other products of the decomposition of animal tissues dissolved in the blood, they decompose them and combine with them, producing oxygen, starch, sugar and various nitrogenous and other nutritive substances.

In this way our animal gets all that is necessary for its existence. The food (what is formed in the body by the action of sunlight) and oxygen build the animal's tissues. The latter are again decomposed into carbon dioxide and other products of decomposition (urea, ammonia and others). These need not be excreted but can return to the blood and remain in the organism. The Sun's rays again act on them as they do on gaseous and liquid fertiliser in plants, i.e., transform them into oxygen and nutritive substances that compensate the loss from the constantly working parts of the body, such as the brain, muscles, and so on. This cycle goes on eternally until the animal itself is destroyed.

That such a creature is possible is evident from the following. Imagine a transparent sphere of quartz or glass, pierced by the rays of the Sun. It contains a little soil, water, some gases, plants and animals. In a word, this tiny sphere is like our enormous Earth and, like every other planet, it contains a certain amount of isolated matter and one and the same cycle of matter takes place in the Earth and in the tiny sphere. One glass sphere is just like a hypothetical being which manages on an unchanging amount of matter, and which lives for ever. If some animals within the sphere happen to die, new ones are born to take their place (the animals feed on plants). The sphere can be said to be immortal, just like the Earth.



One may ask, “How can there appear an animal whose mass remains constant?” An animal living, thinking, moving and, let us assume, not even dying. But how is it born and how does it give birth to new animals? It is conceivable that at the initial stage of its existence it develops like terrestrial animals from an ovule developing in a suitable nutritive medium (perhaps with the participation of solar energy), growing, breathing, reaching its maximum size, fertilising or producing ova, then undergoing transformations (like the caterpillar in chrysalis and the butterfly), losing sweat glands, lungs, digestive organs, becoming covered with an impenetrable skin, in a word, becoming isolated from the surrounding medium and developing into the extraordinary being we have already described. It subsists on sunlight alone, its mass remains constant, it continues to think and live like a mortal or an immortal being.

The cradle of such beings, of course, is a planet like the Earth, i.e., having an atmosphere and oceans consisting of some kind of gases or liquids. But a mature being of this kind can live in a void, in the ether, even without gravity, so long as there is solar energy. Fortunately there is no dearth of it as millions upon millions of suns, young and old, with and without families of planets, have been tirelessly emitting this energy for many trillions of years. When some of the suns become feeble or extinguished, new ones take their place. Beings similar to those we have described cannot fail to make use of this abundant radiating energy. They surround all the suns, even those that have no planets, and utilise their energy to live and think. There must be a purpose for the stars’ energy!

We have mentioned beings like terrestrial plants and animals. We are not going outside the limits of science, but our imagination has all the same produced that which does not exist on the Earth but which is possible from the viewpoint of our narrow (so-called scientific) understanding of matter.

By this we mean 80-90 elements, their transformation, protons, electrons and other working hypotheses. We have reached several conclusions that living organisms could adapt themselves to the many conditions of life to be found on millions and millions of planets and beyond them; the forms and functions of these beings are naturally much more varied than is the case with terrestrial plants and animals; the same applies to their degree of perfection, but this, in general, is far higher than the highest found on the Earth; in comparison human genius is nothing. All this is the result of a great variety of conditions and aeons of time, of which there could be no shortage whatsoever.

In the course of time unity is achieved on every planet, all imperfections are eliminated, it attains a perfect social order and the greatest power; its supreme council elects one who administers the whole planet. This one is the most perfect being on it. His qualities gradually spread to all the inhabitants but still they cannot all become quite alike.

But the planet's population multiplies and the surplus can only find room in the space around their sun. This population is many million times more numerous than that left on the planet. It, too, is administered by an elected

body and its president. The latter is still more perfect than the president of the council on an individual planet.

Then neighbouring groups of suns, galaxies, ethereal islands, and: so on also unite. The representatives of these social units ascend higher and higher in the scale of perfection. Thus, besides the rank-and-file population of the Universe, which is at a fairly high level of perfection, we find representatives of planets, solar systems, constellations, galaxies, ethereal islands, and so on. It is difficult to imagine the degree of perfection they have attained. They may be likened to deities of different ranks.

One would think that perhaps there is no purpose in the solar system or in several systems being united. Let each solar system, for example, live as best it can. What does it care about some other solar system? But each sun with its planets will not exist for ever. All of them, in any case, finally explode, become extinguished or suffer various catastrophes. Before disasters happen some suitable place to live, that is not occupied, has to be found for the population. We must know all there is to know about other solar systems. The president of each group will consider what is in the common interest, he will give the necessary information and direct the movement of the societies and give them every assistance in settling in the new place.

Can communication be established between neighbouring suns? Since we can obtain some knowledge of them even now you can imagine what will happen later on, when man has begun to live in the ether where there is no atmosphere to hamper the almost unlimited increase in the power of

telescopes, when we become free from the devastating force of gravity, and so on.

For interstellar distances light does not travel fast enough, it needs years and years to cover them. But perhaps a new medium will be discovered in the ether, one lighter and more elastic than the ether (just as ether is still found in the atmosphere). Perhaps its invisible vacillations will reach neighbouring suns in a matter not of years but days or even hours. Then it will be easier to discuss this problem than it is now.

\* \* \*

All this is terrestrial, within the comprehension of the simple scientific human mind. But perhaps there is a higher point of view, less comprehensible to us. That this may be so is proved not merely by inspired reasoning but by the facts. But for this we must rise above commonplace working hypotheses—all these electrons, protons, hydrogen and the like.

Indeed, what course has the trend of scientific development, i.e., the development of knowledge, taken? At first man discovered a countless host of bodies with varied properties and took them to be an infinite number of fundamentally different substances. Later, all this variety was reduced to 90 elements. Finally the conclusion was arrived at that these 90 simple substances were made up of electrons and protons; the idea of the ether was discarded completely. But the majority of physicists still use the ether as a working hypothesis; they think of it as an extremely rarefied and elastic

substance, the particles of which are many thousand million times smaller than protons and millions of times smaller than electrons.\*\* But what tremendous leaps are those between the masses of the particles! If the mass of a proton is taken as unity, the mass of an electron will be expressed by the ratio 1:2,000 and that of ether 1:( $16 \times 10^{12}$ ).

This muddle can be cleared up if we discard the narrow standpoint of modern working hypotheses.

Matter as it is at present is the result of the evolution of a simpler matter whose elements we do not know. What I mean is that at some period of time matter used to be lighter and more elastic, because it consisted of smaller particles than electrons. Perhaps those were particles of ether.

When was this? Well, time is as infinite as space and matter. There is any amount of it. No number can express it. All known and imaginary times are zero compared with time. So take enough time and we shall come to simpler matter.

This “simple” matter is the result of still “simpler” matter. At some date the latter predominated in the Universe. We can go on and on without an end in this way, and come to the conclusion that matter can be divided infinitely owing to the infiniteness of past time.

Say what you will, but to consider proton or hydrogen to be the basis of the Universe, the true element, the indivisible, is as absurd as to consider a sun or a planet to be that element.

It may be that someone, some giant for whom the whole sky is only a small particle of matter, and for whom individual suns are as invisible as atoms are for us, on examining the “sky” through his “microscope”, will notice the suns and will joyfully exclaim: ‘At last I have discovered the particles of which ‘matter’ consists!’ But we know that he would be grossly mistaken in taking the suns for indivisible atoms.

We make the mistake taking an electron, a proton or even a particle of ether for an indivisible element. Our reason and the history of the sciences tell us that our atom is as complex as a planet or a sun.

What is the use of saying all this? What practical conclusion is to be drawn from it? I want to make it clear that the infiniteness of past time opens up before us a succession of worlds made up of substances more and more rarefied, more and more elastic. (It has been observed that with the decrease of the mass of particles their translational velocity increases as does their elasticity. Hence, in more complex matter elasticity decreases, in less complex matter it increases.) I want to make it clear that our matter, too, will continue to evolve. Some time in the future worlds will arise consisting of more and more complex and massive particles. To the future generations of conscious beings, these, too, will seem at first to be atoms. But in this they will be as mistaken as we are.

“Well, what of it, what follows?” the reader may ask. And we shall answer: The epochs that have become lost in the infinity of time produced beings that achieved perfection just as beings made up of “our” matter are achieving it. Each of the rarefied worlds had its own solid, liquid and gaseous substances which served too for the formation of thinking beings (consisting of very “subtle” matter). There has been an infinite number of such epochs before us and there will be an infinite number in the future. Our epoch, with conscious beings like those on the Earth, is one of this endless chain of epochs.

Our imagination presents to us an infinite number of epochs in the past and in the future, each with its living beings. What are these beings like, is there any connection between them, how do they manifest themselves, can they manifest themselves, do they disappear with the arrival of a new epoch?

We shall give an example. Plants and animals on Earth have undergone an evolution. They sprang from a single source—very simple protoplasm. One could even say that they sprang from inorganic matter which gave rise to protoplasm, from which developed a number of very different beings. Some of them became extinct, but in general the development of higher animals did not prevent the lower, more ancient, primitive forms from continuing to exist without much progress. At the feast of life on Earth we see existing simultaneously bacteria, infusoria, worms, insects, fish, amphibia, reptiles, birds, mammals and man. True, the power of man threatens to destroy beings that are inimical to him. Others, on the other hand, are necessary for his well-

being (bacteria and plants) and still others have some kind of intelligence and are useful to him, so there is no point in destroying them.

Similarly the epochs, parts of immense and infinite time, preserved not only the denser beings of our epoch but also the lightest ones belonging to past epochs. Many of them could have become extinct, but not all of them: those more perfect and useful could have remained as beings that are useful to man.

Formerly we advocated the repetition of phenomena, or the periodic nature of the worlds, that the worlds were time and again destroyed and time and again arose. Periodicity there is, but the periods are not all alike, they seem to descend for they yield ever more complex matter. It can be compared to an undulating road: we first ascend then descend as we go along, never noticing that the road slopes downwards all the time and that at the end of each period we are on a lower level than before. There is no end, of course, to periods (waves), to the descent (the increasing complexity and density of matter).

*\* The article offers a broad view of the universal occurrence and variety of forms of life in the cosmos. It deals with worlds within worlds, the periodicity and complexity of matter and phenomena, which have no end; it speaks of infinitely remote epochs where there were "ethereal" animals unlike any found on Earth, and difficult to imagine, but in their way perfect and almost humanly conscious. -Ed.*

*\*\* See my Kinetic Theory of Light.*

Translated by X.Danko