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Human Consciousness, or Possibilities of Electronics. Part II.

Received on December 20, 2017
Accepted on January 17, 2018

The phenomenon of "human consciousness" is considered on the basis of the full electronic interpretation of brain functioning proposed earlier. In the second part of the work the following phenomena are considered on the basis of the developed theory of consciousness: creative thinking, self-healing, altered states of consciousness, free will, and also prospects of the supermind are analyzed.

According to the theory of human consciousness described in the first part of the work, it becomes clear what are a thought and other mental functions and their materiality is established. As a result, it is possible to understand a number of important phenomena: creative thinking, self-healing, altered states of consciousness, free will. Within the framework of the proposed full electronic interpretation of the brain functioning, it is made an estimation of the level of its integration as an object of electronics. The evaluation is carried out, as it is traditionally done in micro- and nanoelectronics, in accordance with the number of active elements. It turned out that it is about $10^{19}...10^{21}$ active elements for the brain. On this basis, and following from the most important advantages of the brain as an object of electronics determined in comparison with the integrated circuits of solid state electronics, it is possible to make a more realistic and "sobering" forecast of the supermind creation prospects. It is shown that the proposed hierarchical approach to brain research and the interpretation of its functioning represent a perspective not only for a more detailed study of the human brain, but also for creating a supermind.

Keywords: *human consciousness, brain, full electronic interpretation, nanoelectronics*

For citation:
Abramov I. I. Human Consciousness, or Possibilities of Electronics. Part II., *Nano- i Mikrosistemnaya Tekhnika*, 2018, vol. 20, no. 6, pp. 368—384.

DOI: 10.17587/nmst.20.368-384

Consequences of materiality of a thought and mental functions

From the previous consideration it is visible, that the author adheres to the classical materialistic point of view that "the matter is primary, and the consciousness is secondary". And this means, that consciousness is a function, first of all, of a highly organized matter of a live human brain, which, as a whole, has successfully passed the key stages of its formation and development. The most important factors are: 1) genetics; 2) environment. For the second factor it is necessary to underline especially the influence of the society and social environment.

The proposed theory singles out three types of the operation modes of a brain. The first type of functioning (under an external influence) is characterized by the fact that the signals, incoming from the outside, are converted into the electric ones, which result in a modification of the corresponding neural (electric) circuits. Exactly these modifications reflect the coded information concerning this or that event. Otherwise, memorizing would be impossible, and this is well-known in neurobiology [1, 2]. From the point of view of the described theory, the author does not see any basic difference in the case in point, how the electric signal is initiated from the outside (the first type of the modes) or from within (the second type of the modes). And this means, that in the internal modes of the brain work* (often, the cogitative activity and some other mental functions) a modification of the neural (electric) circuits should also occur. Therefore, a thought and the other mental functions, owing to their materiality, can and should render a reverse (probably not too strong) influence on the neural circuits of the brain, i.e. modify them, and consequently, change the brain itself. The latest data of the neurobiology prove that a thought can influence a human brain [6, 7]. However, there is no doubt that a live brain (neural circuits) is primary, while a thought is secondary.

Materiality of a thought and of the other mental functions has important consequences and can promote a deeper understanding of, at least, two sorts of activity: creative thinking and healing as a result of self-suggestion (self-healing).

Concerning the creative thinking. I have already pointed out [3—5] that, if we deny a possibility of modification of the neural circuits in the internal operation modes, then our thinking boils down only to "templates" or "stereotypes". Besides, big opportunities were noticed in operation of the nonlinear electric (neural) circuits without their modification, for example, during entry of various incoming signals, due to the flexibility of the bonds and enormous number of the circuits (let us call them "factors without modification"). Moreover, many brain researchers point out that people, especially, when approaching the advanced age, are inclined to think in "stereotypes" or "templates". All this is true.

And, nevertheless, even in the internal operation modes, in particular, in the course of the cogitative activity, when initiation occurs directly in the brain itself, during a passage of an electric signal (signals) via the corresponding set of the neural circuits the modifications occur owing to the materiality of a thought. Although the information stored in each person, first of all, is coded exactly in the topology (morphology) of the neural circuits [3—5], however, their individuality can be influenced by a big number of factors [3—5]. Here are only some of them: new bonds between the neurons; molecular variations of the synapses; synthesis of RNA and proteins leading to the structural changes in the synapses, spines, dendrites,

* I pointed out, that, strictly speaking, most of the operation modes of the brain have a mixed character (the third type of the modes) [3—5]. However, in the considered case the most difficult for understanding are the internal operation modes (the second type).

axons and changes in the cell nucleus, etc. This is connected with the fact that the neural circuits are constantly modified even during a simple decoding of the accumulated information, although the scale of this modification can vary in different people* and, basically, should be insignificant. Thus, in the course of a modification or reorganisation of the electric (neural) circuits the important factors are the changes in the bonds, geometry, conductivity, dielectric permeability, etc., of the corresponding sites of the circuits, which is reached by means of various biochemical processes initiated as a result of the passage of an electric signal (signals). Let us call them the modification factors.

From the psychology it is known, that a creative process can be presented in the form of four stages [8]: 1) preparation; 2) incubation; 3) insight (enlightenment); 4) verification. Quite possible, that it is exactly in the period of incubation that a modification of the neural circuits (modification factors) and/or search for them (factors without modification**) occurs, although the latter, at least in a number of cases, is a faster process. All this can go on at a subconscious level, i.e. the work of only faster system 1 as a result of numerous passages of the signals, when the necessary set of the neural circuits, reflecting a solution to the studied problem, is formed, and the insight occurs as a result of a passage of an electric signal via it. At that, the participation of the neural circuits of the part of the brain responsible for awareness is of priciple importance. Otherwise, a solution can be lost, at least, for a certain period of time. Thus, the *process of creative thinking can be influenced by numerous factors, both with modification, and without appreciable modification of the neural circuits, which complicates considerably an analysis of this sort of human activity and makes it very diverse, with a huge number of versions and one of the most complicated ones. The process of creative thinking itself, although it is based on the internal perception by a person of the information coded in the human brain, this information, however, can vary owing to the modification of the neural circuits.*

Concerning self-healing. Unfortunately, the widespread view of self-healing boils down to the following [9]: "... Whenever we talking about health, the traditional science and medicine are inclined to ignore or underestimate the influence of the consciousness on a body... The thought that... an emotional state can prevent illness, while the consciousness possesses "a salutary force ", is considered extremely doubtful". Nevertheless, as is known, the brain is the main control system of the whole body, and consequently, of all human organs. Therefore, for the author it is not surprising that by means of the brain and mental functions, in particular, a modification of the control is possible by this or that sick organ and eventually even its healing. In literature such a recovery is called "recovery as a result of self-suggestion" [9], and the corresponding cases are considered and studied in the behavioural medicine or the psychology of health [7]. From the point of view of the author, at the heart of the psychological methods of healing, first of all, lays materiality of a thought and other mental functions, and also plasticity of the brain, and modification of the neural circuits, in particular. To make it short, it is possible to present the healing scheme in the following way: mental functions (thinking, emotions, etc.) $\rightarrow$ electric processes $\rightarrow$ biochemical processes $\rightarrow$ healing.

What kinds of processes can be stimulated owing to the materiality of a thought and of the other mental functions? They can be quite numerous, therefore, I will enumerate only some of them: 1) modification of the work of the control circuits by this or that organ; 2) modifications of the bonds of the control neural circuits; 3) stimulation of the immune system for increasing the influence on this or that organ or its area (this could be most important in case of the oncological diseases); 4) stimulation of the gene modifications; 5) normalisation and additional generation of the neurochemical substances; 6) stimulation of generation of the substances, which have curing effects; 7) balancing adjustment of the work of the organs (including restoration of the homeostasis) including also the subsystems of the brain itself, etc. Modern data of the neurosciences confirm such possibilities. I will note only certain serious scientific research in the neurobiology concerning this topic and described in the works [6, 7, 9, 10].

Actually, the question is even more complicated. Thus, strengthening of the self-correction is also possible (strictly speaking, it occurs constantly and automatically), when an organ signals to the brain about more serious disorders and deviations in its work from the norms as a result of a feedback and the brain tries independently (subconsciously) to cope with the arisen disorders (the first tool). When the brain cannot cope with a correction in an automatic mode, the additional measures may be required. And in this case the auto-suggestion (the second tool) may not be superfluous, i.e., simply speaking, it can intensify the brain's work in the direction of healing. Most likely, in case of a self-healing we witness a combination of actions of both tools, which are really available to the human brain.

Up till now a number of the research works concerning the self-healing have been done. Of special interest is the widely investigated "placebo effect" (see, for example, [9]). "The phenomenon of recovery after an imaginary treatment is well-known in medicine and is called the placebo effect" [9]. From the point of view of the author of the work [9], "the placebo effect" is an example of "probably, the purest influence of consciousness on an organism".

Today it is possible to consider it proved that certain medicines are not more efficient than the placebo effect. Moreover, it is a kind of tradition to do a preliminary research on the groups of patients, during which in one group the patients get placebo (tablets imitating medicine, etc.), and in another group — a newly proposed medicine. If the efficiency of the latter is not higher than that of placebo, and such cases are quite frequent, the new "medicine" is usually not recommended for manufacture. I should point out, that a number of rather well-known and widespread medicines have not passed successfully such "more scrupulous tests", independent, as a rule, of a manufacturer. The readers can find many examples of "the placebo effect" in history of the B. C. period and nowadays (see, for example, also [9, 11]).

As a result of the undertaken research works concerning "the placebo effect" it was established, that it could have a positive impact on most varied diseases, namely [9]: Parkinson's disease, irritable bowel syndrome, depression, anxiety disorders, addiction, migraines and headaches; it could have an anaesthetising influence, etc. And, nevertheless, "the placebo effect", as it seems to me, is defined not only by the consciousness, but it also depends on various mental functions, including at the subconscious level.

Not less impressive results were obtained due to the use of the eastern meditation practices (see, for example, recent research [6, 7]) of the other empirical practices (methods of E. Kue, J. Silva, J. Kehoe and others [12]) of the modern psychotherapeutical methods (see, for example, [13, 14]) for healing of most varied diseases, including cancer. In general, these successful examples can also be explained by a set of the above-mentioned processes and tools, available for the human brain, sometimes, by their more intensive and addressed action.

However, it is necessary to mention certain possible negative features of the self-healing attempts. Firstly, not every illness of a concrete person can be cured by the given method. And the explanation is trivial enough: there are simply not enough resources, which the brain (organism) of a person has for this purpose, because all of them are limited, while the illness itself may probably be an advanced case. Secondly, the brain is a supercomplex system and it is not so simple to direct signals for modification of the work of the necessary neural circuits. The problem is aggravated by the fact that a patient often does not know the essence of his (hers) illness, and sometimes simply does not even suspect or understand, that he (she) is sick. As a result, the method can have a slow or little effect, which

* This explains well the phenomenon known in psychology as "the false memories".

** Strictly speaking, the influence of the modifications is insignificant.

depends on many internal and external circumstances for the given person. In this connection I should underline in the given method a special importance of belief, persistence and concentration*, which can be ensured by the above-mentioned practices and methods. In this case a positive influence can also be rendered by religion, which is well-known by numerous cases of healing from history. I do not think, that all of them were flights of fancy. Thirdly, in the considered case an extremely negative influence is rendered by the negative stress or distress — "harmful or unpleasant stress" [15]. Modern scientific research works demonstrate, that many human diseases are explained by the influence of the distress [16]. It can render especially bad influence on the brain; up to destruction of the neural circuits. There is also a special term of "nocebo effect" [9], when instead of the organism improvement, the consciousness causes pathological symptoms and changes. The sad examples of that are the deaths of even quite healthy people as a result of the woodoo damnations [9]; after the ship-wrecks in the sea with available quite sufficient means for the rescue (lifeboats, foodstuff, water) [17]; panic, for example, after an earthquake [9]. In these cases a person dies of fear. It is possible to say, that in such situations the brain starts the "self-destruction" mechanism (instead of self-preservation), caused by a strong distress.

Is it possible to intensify the effect of healing by the other artificial methods, except the traditional ones in medicine? I think, yes. Here, again, in connection with the proposed full electronic interpretation of the brain functioning, I see as very promising the use of the possibilities of the electronics and nano-sciences [18]. I in this connection I have already mentioned various methods of electric stimulation of a brain (ESB), namely: electric irritation of a brain; deep stimulation of a brain. However, it is necessary to single out the methods of medical electric stimulation (MES) of the brain and the spinal cord, and also human peripheral nerves with application of "the sparing methods of stimulation", developed under the guidance of Academician N. P. Bekhtereva, by means of which an important success was reached in healing of most varied diseases [19]. A special value of ESB methods consists in the fact that they can stimulate not only creation and modification of the neural circuits of the brain, but they can also destroy the superfluous, pathological circuits. Among the recent works I should note the research works of Doctor K. Tracy in healing of the inflammatory processes by means of electrostimulation of a vagus nerve [9]. Notwithstanding the good prospects of these works, a lot is still should be done for their development (especially the accuracy of stimulation, levels of the excitation signals, etc. [3, 18]) and for their wide introduction in practice.

So, *the use of force of consciousness, the materiality of a thought and other mental functions can be an important addition to the traditional methods of the medical treatment.* Hence, it would be expedient to realize a complex treatment combining these two approaches, although it is not excluded, that they may not only help, but also "hinder" each other. In particular, it is known, that a number of medicines have a negative influence on the human brain (see, for example, [20]). But, nevertheless, at least, a belief in recovery is desirable!

Altered states of consciousness

The things, which occur in a human brain in the consciousness as a whole are well described in the book [21]: "The flow of our subjective experience flows continuously, following its course; feelings, images, emotions and thoughts merge with each other, gradually overflowing from one into another in changeable patterns and designs". And sometimes the flow can be special. "Unusual sets of the subjective experiences are called "altered states of consciousness"" [21]. Hereinafter — ASC. Now, a wide spectrum of phenomena are referred to ASC, and the most important and interesting among them are the following [21]: states in a dream; hypnotic states; narcotic intoxication; meditative states; "flow" states; out-of-body experiences; near-death experiences; mystical experiences. Certain PSI phenomena can be regarded as close to the ASC states, namely: clairvoyance, telepathy, etc. Various mental diseases can be basically referred to the pathological (sometimes irreversible) ASC (this question was considered in the work [18]).

So, what are the factors which define all these phenomena? What is common for all of them? Firstly, exactly the individuality of the neural circuits of each concrete person is the predetermining material basis of the subjectivity [18]. Secondly, ASC, including also the mental diseases [18], can be connected to a deviation of the functioning of the neural (electric) circuits from the normal operation modes. I should point out, that the definition of the notion of "normal" in psychology is no less complex, than the definition of the notions of "consciousness" and "ASC", which again is connected with the multifarious character of the corresponding phenomena. However, in psychology this is a question of principle. I should say, that in neuropsychology the notion of "a normal mental function" was introduced long time ago [22]. In general, without this notion it is actually impossible to consider either various mental diseases, or ASC proper. So, *in accordance with the full electronic interpretation I will single out two key factors decisive for ASC, namely: individuality of the neural (electric) circuits of the brain and deviations in their functioning from the normal operation modes.*

Individuality of the neural circuits depends on a great number of factors considered in detail in the works [3—5, 18] and more briefly — above. In the considered case one of the basic ones is the topology of the neural circuits formed for realisation of this or that function. Data of the neurosciences, visualisation, in particular, testify that even the ensembles of the neurons in a concrete person are varied during realisation of one and the same function, and quite often essentially, which underlines the importance of the flexibility of the bonds. In terminology of Academician N. P. Bekhtereva [23] support for the functions is carried out by both rigid and flexible bonds of the neurons.

A question arises: how it is possible to carry out interaction of such grandiose number of the essentially nonlinear active elements, i.e. noted NEMS, electric (neural) circuits, which, apparently (see the last section) make an insignificant part of their total number, for support of a function? At that, they do not hinder each other in supporting the numerous functions which go on in parallel. The author sees only *the possibility resulting from the locally-distributed character of the brain as a system, namely: synchronisation of the dynamic interactions of the electric (neural) circuits in various areas of the brain. At that, considering the nonlinearity of the electric circuits, not only the phase, but also the frequency and amplitude characteristics of the electric signals should be important. I should point out, that exactly the amplitude of a signal basically determines the power consumption.*

Many experts in the area of the neurosciences underline the importance of the neural synchronisation. Traditionally, in neurobiology they single out the local synchronisation and the phase synchronisation. So, in supporting of the conscious activity a special role is given to the gamma waves (phase synchronisation) (see conversation with Professor V. Singer in [24], [7]).

It is also necessary to pay attention to the facts presented below.

1. The levels of the activity of separate areas of the brains of different people can differ considerably in case of the same actions and reach the level of "three thousand percent" [7].

2. Even serious mental diseases can be caused by the insignificant, as it would seem at the first sight, deviations, in particular, "the people with depression lackeed not in stimulation, but support for the activity of the renumeration system in the prefrontal cortex" [7].

3. Important data are received by means of MES, namely: "Repeated stimulations of one and the same zone (structure) of the brain with the identical parametres depending on its initial state can cause

* These factors, apparently, promote numerous passages of an electric signal via the corresponding neural circuits (NCC, NCMF, see Part I), and, hence, and, probably, to their more radical change in the necessary direction.

reactions, not only differing by the intensity and signs, but also qualitatively new" [19].

The above enumerated data are quite enough to understand, that the question concerning the deviation of the work of the neural (electric) circuits from the normal modes is not less complicated, and depends on a concrete person, and, moreover, on the time moment. This underlines the dynamic character of the brain both in its work and in its development. Thus, even normal mental functions can be supported in each person by a different set of the neural circuits, and vary from case to case, and for various people the activation level can differ considerably. In this connection it seems to be promising to establish a databank with "a set of portraits of the basic psicological functions" of a healthy young person, for example, by means of visualisation, and in future with advancing of the age to be guided by this "normal set", and here also an individual approach is preferable.

And, nevertheless, the recent data of the neurobiology testify that the brain reconstructs the reality (see, for example, [24—26]). The author shares completely this point of view [3, 4] and consequently considers, that *all ASC are connected with various sorts of changes, distortions and disorders in this reconstruction in the human brain, as a rule, characterised by essential displays.*

According to the given point of view, it is possible to single out the dominating, characteristic reasons and properties of those or other ASC. We will discuss briefly some of the above ASC, because this question deserves a separate paper.

As an analysis of the available data shows, we can connect meditative and "flow" states, first of all, with an intensification of the synchronization. In particular, the research of the brains of the meditating Tibetan Buddhist monks by means of visualisation tools allowed to receive a number of important results [7]. The most interesting of them are the following [7]: 1) intensification of the activity of the gamma waves, at that, the process increased gradually, which testified to the necessity of time for the synchronisation; 2) "the monks with the greatest experience of meditation demonstrated the greatest gamma synchronism (both in the initial state and during the meditation)"; 3) in the areas of attention "the activity grew and increased with the augmenting quantity of the hours, which the meditating monk devoted to the practice, but then fell, when the quantity of the hours started to exceed twenty five thousand or about that". The latter means, that the activity of certain areas of the brain may not only increase, but also fall, which testifies to the more economic operation modes of the brain of the more experienced meditating monks. Certainly, a lot depends also on a concrete form and the meditation practice [7, 21]. Apparently, such phenomena occur in the states of "the flow" of the creatively thinking people [27].

Among the known reasons for a dream the author singled out the following [3—5]: 1) physiological ones; an organism, including its brain, requires rest, restoration of the necessary substances, etc.; 2) possibility of processing and systematization of the newly coming and the already stored information including its fixing (consolidation), simply speaking, an additional modification of the neural circuits occurs. The means of visualisation allow us to obtain important information. "A functional tomography of a brain shows, that during the dreams, in the cortex, the visual (occipitotemporal), emotional (tonsil) and motor areas (frontal cortex) are active, while the areas connected with the critical thinking and self-consciousness (in the prefrontal cortex) are deactivated" [21]. On one side, this testifies to a transition of the brain during a dream to a more economic operation mode of system 1 (the lucid dreams, perhaps, are exception), and on the other hand, actually shows how system 1, i.e. subconsciousness, works. However, we should have in mind, that thus the limbic system responsible mainly for emotions is most active [28]. As a result, apparently, system 1 is characterised by more "chaotic passage of an electric signal via the neural circuits of the brain" [3—5]. Therefore a conclusion was made that "dreams are a chaotic mode of the brain work", although it was noticed, that "some cogitative acts can have a close "pseudo-chaotic" character" [3—5]. In this connection, no wonder, that the practice of the attentive awareness [6], characteristic for meditation, systematises the work of thinking and makes it more directed, which often takes place also for "the flow" states.

Although, in general, the author shares the critical point of view on PSI phenomena (see, for example, [11, 29]), however, I do not adhere to the extremely negative view on this problem, up to a full negation of the phenomena. I think, that many PSI phenomena, the clairvoyance and telepathy in particular, can often be explained by those or other features of the modes of functioning of a human brain, i.e. their correct interpretation is important.

First of all, the main problem with explanation of such phenomena is the fact that the lion's share of the work of the brain in these cases proceeds at the subconscious level. This explains their mysteriousness.

The clairvoyance and telepathy, apparently, are connected with strengthening of the prognostic possibilities of a human brain. This can be caused by the following circumstances: 1) increase of the sensitivity of the sensor systems; 2) sharpening of the sensitivity of the neural circuits to the external and/or internal signals; 3) flexibility of the bonds during the associative processing of information in the neural circuits available in the brain. The first and the second points mean that the neural circuits become susceptible even to the subthreshold signals, i.e. not susceptible for most people or in many situations for a concrete person. So, whan can cause such a sharpening?

The author sees the following numerous possibilities contributing to this: rituals, meditation, mystical states and other ASC, states of strong stress (and not only distress), etc. Interesting to note that the biographies of the outstanding telepathist and clairvoyant of the recent time — W. Messing and Vanga — testify that their extrasensory abilities appeared after their great distresses on the verge of death [30, 31]. The people, who survived the state of the clinical death, sometimes acquire similar abilities (or they are sharpened) [32—34]. These sharpenings of the sensitivity of the neural circuits, apparently, are caused mainly by a variation of the biochemical processes proceeding in them, or, probably by their morphological changes. Their organisms somehow try to adapt to the qualitatively new states caused by great distresses.

At last, there can simply be outstanding predictors possessing such abilities from their births, i.e. genetically predisposed to this sort of activity. After all, if there are outstanding scientists, politicians, sportsmen, etc., then why not outstanding predictors? The history knows numerous facts of ingenious guesses, forecasts, etc. The epigraph to this work says quite enough already. The more so, it is well-known that the brain of each person is constantly engaged in forecasts, i.e. it practices them regularly. Actually, forecasting is one of the basic functions of the brain (see above). I do not see any serious obstacles to development of such abilities (see, for example, [34, 35]).

At the same time, a telepathist makes a forecast using the information available about another person or/and coming from him (her). And here, apparently, the known various physical fields can be important. In literature they are often called "biofield". Thus, Academician Yu. V. Gulyaev noticed, that "a complex picture of the physical fields appears around any biological object in the course of its vital activity. Their distribution in space and change in time bear important biological information, which can be used "[36]. Apparently, exactly this information is, at least partially, used by a telepathist for his (hers) forecasts, i.e. for "reading of the thoughts". Besides, the specific features of his (hers) associative processing of the information can also be important.

Unfortunately, these phenomena are frequently unreliable, casual and, as a rule, have an approximate character, which usually demands their additional decoding. The latter is done especially well, when the "predicted", "forecasted" event has already occurred, i.e. post factum. Simple coincidences, swindles, etc. are also not so rare. Usually, this is also marked in serious works on the topic of the PSI phenomena (including others). The verge between the serious research works, experiments and charlatanism is often very thin. After

all, these phenomena are very "slippery" (unreliable), which is a common thing and no wonder for the forecasts, even the collective ones.

In any case the episodes of "clairvoyance" and "telepathy", as well as of many other PSI phenomena, are the products of the brain activity of concrete persons in concrete situations, and not of any other wordly forces, mythical fields. In this connection it is possible to consider the outstanding clairvoyants and telepathists as "the geniuses of the sharpened intuition".

The most difficult for explaning seemed to be the following ASC: out-of-body experiences (OBE) and near-death experiences (NDE). Five basic elements are characteristic for NDE [21] (more than fifteen characteristic elements [32, 33]), one of which is OBE. OBE means experiences of a person which have a very strong impression first of all upon him (her) and are often used as the obvious proof of immateriality of the consciousness, which in these cases ostensibly separates from a physical body. The author does not share this point of view.

OBE and NDE are ASC in which there are obvious disorders of reconstruction of the reality in the human brain in the corresponding situations and characterised by hallucinogenic experiences. So, what causes OBE and NDE?

Apparently, in case of OBE and NDE there are rigorous disorders of the biochemical processes in a human brain, which lead to serious deviations in the work of the neural circuits, so, the causes are the physiological changes in an organism.

In recent time these phenomena attract more and more attention. I will present the most important and at the present moment established authentic scientific facts, namely:

1. In neurology and psychiatry the experiences similar to OBE, have been known for a long time and are called autoscopy (see, for example, [21, 24]).

2. OBE can appear under various life circumstances: excessive physical and intellectual loads, dangerous situations (not necessarily NDE) [21].

3. In case of OBE often there are deviations (and also as a result of damages) in the work of the parietotemporal cerebral cortex, etc. [21, 24].

4. It was demonstrated, that OBE can be caused artificially "by the convulsive activity, stimulation of the brain and certain psychotropic substances" [37].

5. Virtual OBE, caused by unusual and inconsistent information concerning the position of a human body participating in the experiment, are also possible [24].

The important research works concerning NDE described in the work [21] confirm the connection with the damages in certain areas of the brain, at that, it is pointed out, that "all these structures are often appear damaged in the patients, who survived a cardiac arrest, but restored completely" [21]. Such hallucinations, similar to NDE, appear during the centrifuge tests, when blood flows back from the brain [11].

And at last, another very important factor noted by Doctor R. Moudi, one of the pioneers of the research of NDE, [32], is the following: "Notwithstanding a big variety of the circumstances connected with the approach of death, and also types of people, experiencing it, the stories about the events occurring during this moment have an amazing similarity. It is so great, that it is possible to single out about fifteen elements, which again and again are encounted in a large number of stories". This similarity, which is common for absolutely different people, as it seems to me, confirms once again that both in case of OBE and of NDE there are characteristic sequences of the physiological changes in the brain (there are common regularities), fortunately, in the considered cases they are reversible in many respects. Exactly these physiological changes lead to the approximately identical specific operation modes of the neural circuits caused by the corresponding biochemical changes in the human brain. However, it is necessary to point out the qualitative changes in the lives of the people after NDE, noted in many researches (see, for example, [32—34]), i.e. these changes are not traceless.

Concerning a free will

The author pointed out: "Exactly the huge volumes of the incoming information are a kind of locomotive (initiator) of the evolution" [3]. The natural selection of the Darwinian theory can be considered the basic method for its practical realisation. At the same time the information imprint of the evolution of the live organisms is "the DNA annals" of the molecules [38], which actually code the program for creation of the corresponding organism. And the human consciousness is connected with the information, and in effect the consciousness appeared and was intended for its better processing, but, unfortunately, this is not always achieved in practice.

Let us consider in detail another complicated question, one of the basic ones connected with the consciousness, namely: "a free will".

The question of "a free will" is directly connected with the specificity of the work of system 2 considered earlier. In particular, the version presented in fig. 2, *a* of Part I, in effect, also caused an acute discussion in the neurobiology (experiments of B. Libet, J.-D. Haynes, etc.), i.e. action is first, and then comes awareness. Surprisingly, these experiments led many specialists, including the well-known neuroscientists, to the conclusion that "a free will" did not exist. This is not an idle question, because behind this negation there is a possibility of justification of and impunity for the crimes, including serious ones (see, for example, [39]).

The main error in such reasonings is that another version of the cogitative activity presented in fig. 2, *b* of Part I is not taken into account, i.e. first we simply think, prepare for action, and also that the process of thinking can be presented as an event "going via a spiral", because usually it is not limited to one "turn", one cycle. The freedom of choice or "free will" consists exactly in the fact that, in principle, we can turn on the awareness and its action at any moment of "the spiral" of the cogitative activity in a normal awake state. And this is the most important thing! After all, without an awareness there can be no intelligent actions, it will be a simple reflexion. In other words, we should not limit the possibilities of the human cogitative activity.

I think, that the described organisation of the conscious activity is the most rational one. If the consciousness could control all the human actions, it would hardly be better, because a delay in them would be quite often essential, and sometimes even dangerous. Introduction of automatism in some actions, their transfer to the subconscious level (system 1 works) is, indeed, a big invention of Nature!

Prospects of the supermind

Let us define the notion of "the supermind". "This is any intellect considerably surpassing the cognitive possibilities of a person actually in any area" [40]. At the same time the artificial intellect (AI) of the human level (AIHL) is defined as "the ability to master most trades, at least, those, which are accessible to an average person" [40].

The work [40] presents analysis of various ways to the supermind and shows, that two of them have special prospects, namely: digital intelligence and computer modelling of the brain. We will not consider here a way for improvement of functioning of the biological brain, although, undoubtedly, it has good prospects. The author calls such an approach "from available" [3, 41].

First, let us consider the digital intelligence. In estimation of the advantages of its hardware in comparison with a human brain in the work [40], a reference point was given, as usual, as the number of the neurons. Such estimation underestimates greatly the brain possibilities. We will show that. So, as it was mentioned earlier, the level of integration of the human brain as an object of electronics would be more correct to estimate by the number of the channels, and it is the range of $10^{19}...10^{21}$, i.e. by 8—10 orders more than that of the neurons. Let us present a comparison. It is expected, that in near future the level of integration of IC of the solid state nanoelectronics will be about $5 \cdot 10^9$ of the active elements [42]. So, in order to reach approximately the level of integration of a human brain in IC we will need not less time than all the development of the solid state micro- and nanoelectronics, if it goes according to Moore's law (which is

doubtful), i.e. about 60 years. I should say, that this approximately corresponds to the average estimation (with probability of 90 %) done by the specialists of certain AI advisory councils of the time demanded for development of AIHL [40]. Certainly, we can take more than just one IC, i.e. "the computer hardware can be scaled up to huge physical sizes" [40]. This is quite so, but after all, can we take 10^{10} of IC?!

Unfortunately, the situation is even more complex. The author compared a brain as object of electronics and IC of the solid-state electronics, and underlined very essential distinctions [3—5]. Besides the integration level, at least the following properties are of great importance for a human brain: 1) hybridization (the main role is played by at least two types of the processes: electric and chemical ones); 2) a flexible system of organisation (architecture); 3) individuality of the neural circuits; 4) plasticity, constant modification of the neural circuits; 5) a big variety of the elements of the electric (neural) circuits, including the active elements. All this characterises a human brain as an extremely flexible and powerful information system. Anyway, in the solid state electronics almost all the above mentioned properties are unattainable so far. In this connection in the work [18] it is noted, that indeed on the example of the brain the Nature shows also the main direction for development of the artificial electronics after the Moore's law. Therefore, the advantages of the digital intelligence [40] are rather doubtful, i.e. the human brain as a whole was essentially underestimated. Indirectly this is proved by the real achievements in the computer technologies, AI, which are much more modest, than they were expected.

Let us consider the second way — computer modelling (simulation) of the brain. Notwithstanding the good prospects of the given approach, underlined by many authors (see, for example, [3, 18, 40, 43]), the achieved success is not impressive. In particular, in the work [40], in view of absence of a full computer model of a brain now, a deplorable conclusion is made that such a model "will hardly be implemented in near future". Here the problem is aggravated by the fact that, unfortunately, there are no convincing theories and even there are no more or less detailed models of functioning of the human brain. In connection with the proposed theory and the complex hierarchical approach to the research of the brain, based on a multilevel modelling in a combination with the experimental methods, described in detail in the works [3, 4, 18], the author, nevertheless, sees "light at the end of the tunnel".

It would be expedient to begin with modelling of separate subsystems of the brain (see above), the mental functions, stereotypes, templates, etc. We will estimate the complexity of the neural (electric) circuit demanded for realisation, for example, of the cogitative activity. Estimations by the number of the neurons participating in it are known [3, 44]. We will take the bottom limit — 10^5 of the neurons [44]. So, we are talking about a nanoelectronic circuit with the level of integration not less than 10^{13}. This, of course, is very much. Nevertheless, we are talking about an electronic device (equivalent) containing 10^4 of IC with the level of integration of 10^9 of each one, i.e. a device, which is modelled by means of the multilevel approaches.

An important advantage of the proposed complex hierarchical approach for research of the brain, as it was pointed out in [18], is its property of openness, possibility of combination with the other approaches, in particular with the connectomics, a relatively fast realisation in the first approximation. A combination of the approaches, especially at the initial stages, apparently, is most promising for development of the supermind. At the same time, during construction of the systems of the multilevel modelling of a human brain, it can be useful to employ the principles noted in the work, and some of its positions in addition to the ones considered in the works [3, 4].

Conclusion

A precise description of the human consciousness is impossible, and only an approximated one is admissible. Within the framework of the proposed full electronic interpretation of the brain functioning it is possible to construct a monistic materialistic theory of the human consciousness of the emergent type. In the given theory it becomes clear, what a thought is and what the other mental functions are, and their materiality is established. As a result, it is also possible to explain as a whole a number of important phenomena: creative thinking, self-healing, altered states of consciousness, free will. Using the undertaken estimation of the level of integration of the brain as an object of electronics, and also of its most essential advantages in comparison with IC, it is possible to undertake a more realistic and "sobering" estimation of the prospects for creation of the supermind. In connection with this it is possible to draw a conclusion that the area of the artificial intelligence, metaphorically saying, will probably have to expect more than one "winter" (the "winter" metaphor is used in the work [40]), despite the indisputable importance of continuation of the works in this area. At the same time, the proposed complex hierarchical approach to the research of the human brain, based on a multilevel modelling in combination with the experimental methods, presents good prospects not only for its more detailed studying (including specification of the developed theory), but also for development of the supermind.

Finally, the huge volumes of the incoming information also resulted in creation of the information system of a fantastic complexity in the form of the human brain. By creating the brain, the Nature has solved a supercomplicated optimisation complex problem: 1) interaction of various signals (mechanical, optical, thermal, chemical, electric, etc.); 2) flexibility of the bonds; 3) minimisation of the power consumption; 4) small dimensions, etc. Unfortunately, in the solid state electronics similar problems are still very far from their really optimal solutions, even in the complex of the questions touched upon in the work.

For the sake of justice we should recollect, that Nature has spent billions of years for creation of the human brain, and maybe even more, who knows? Anyway, the author does not share the theory of the Big Bang, which gave birth to the Universe, considering, that the matter, space and time as the substances of its existence, have always existed. A possibility of the catastrophic changes like the Big Bang in separate areas of the Infinite World is another question.

And, at last, proceeding from his more profound understanding of the functioning of the human brain and his greater admiration of its work and the beauty of its organisation, the author is inclined to think, that, probably, Nature has found one of the few ways (if not the only one) and this way is the organic hybrid nanoelectronics or "live electronics", to be more exact!

The author is pleased to express his sincere gratitude to his disciples N. Kolomeitseva, I. Romanova and I. Shcherbakova for the preparation of the manuscript of his work for publishing.

References

1. **Shepherd G. M.** *Neurobiology*, New York, Oxford University Press Inc., 1983.

2. **Nicholls J. G., Martin A. R., Wallace B. G., Fuchs P. A.** *From neuron to brain*, 4-th ed. Sunderland, Massachusetts, Sinauer Associates, Inc. Publishers, 2001.

3. **Abramov I. I.** *Mozg kak obekt jelektroniki.* Saarbrücken, LAP LAMBERT Academic Publishing, 2012. 80 p. (in Russian).

4. **Abramov I. I.** *Brain as an object of electronics.* Saarbrücken, LAP LAMBERT Academic Publishing, 2013. 76 p.

5. **Abramov I. I.** Mozg — obekt organicheskoj gibridnoj nanojelektroniki, ili vzgljad so storony. Chast' II, *Nano- i Mikrosistemnaya Tekhnika*, 2013, no. 3, pp. 45—53 (in Russian).

6. **Siegel D. J.** *The mindful brain. Reflection and attunement in the cultivation of well-being*, New York, London, W. W. Norton & Company, 2007.

7. **Davidson R. J., Begley S.** *The emotional life of your brain*, New York, Penguin, 2012.

8. **Solso R. L.** *Cognitive psychology.* 6-th ed. Boston, Allyn & Bacon, 2001.

9. **Marchant J.** Cure: *A journey into the science of mind over body*, New York, Crown Publishers, 2016.

10. **Amen D. G.** *Healing the hardware of the soul*, New York, London, Free Press, 2002.

11. **Smith J. C.** *Pseudoscience and extraordinary claims of the paranormal. A critical thinker's toolkit*, Wiley—Blackwell, 2010.

12. ***Psihologicheskie*** *metody obretenija zdorov'ja:* Hrestomatija, Sost. K. V. Sel'chenok. Minsk, Moscow, Harvest, AST, 2001, 720 p. (in Russian).

13. **Kondrashenko V. T., Donskoy D. I., Igumnov S. A.** *Obshhaja psihoterapija*, Minsk, Vyshjejshaja shkola, 2003, 464 p. (in Russian).

14. **The mind.** *A user's guide*, Consultant ed. R. Persaud, Royal College of Psychiatrists, 2007.

15. **Selye H.** *Stress without distress*, New York, Penguin, 1975.

16. **Sapolsky R. M.** *Why zebras don't get ulcers*, New York, Henry Holt and Company, 2004.

17. **Bombard A.** *The voyage of the Heretique*, New York, Simon and Schuster, 1953.

18. **Abramov I. I.** Prospects of nanoelectronics, nanomaterials and nanotechnologies in research and medicine of the human brain, *Nano- i mikrosistemnaya tekhnika*, 2016, vol. 18, no. 1, pp. 49—64.

19. ***Lechebnaja*** *jelektricheskaja stimuljacija mozga i nervov cheloveka*, Ed. N. P. Bekhtereva. Moscow, AST; Saint-Petersburg: Sova; Vladimir: VTK, 2008. 464 p. (in Russian).

20. **Perlmutter D., Colman C.** *The better brain book*, New York, Penguin, 2005.

21. **Revonsuo A.** *Consciousness. The science of subjectivity*, Hove and New York, Psychology Press, Taylor & Francis Group, 2010, 324 p.

22. **Homskaya E. D.** *Nejropsihologija*, Moscow, Izd-vo Mosk. universiteta, 1987, 288 p. (in Russian).

23. **Bekhtereva N. P.** *Magija mozga i labirinty zhizni*, Moscow, AST; Saint-Petersburg, Sova, 2007, 383 p. (in Russian).

24. **Metzinger T.** *The ego tunnel: The science of the mind and the myth of the self*, New York, Basic Books, 2009.

25. **Eagleman D.** *The brain. The story of you*, New York, Pantheon Books, 2015.

26. **Humphrey N.** *Soul dust. The magic of consciousness*, Princeton University Press, 2011.

27. **Csikszentmihalyi M.** *Creativity. Flow and the psychology of discovery and invention*, New York, Harper Perenniel, 1997.

28. **How** the brain works, ed. by P. Abrahams, Bright Star Publishing Co., 2015.

29. **Sagan C.** *The demon-haunted world. Science as candle in the dark*, New York, Ballantine Books, 1996.

30. **Messing V.** *O samom sebe, Fenomen "D" i drugie*, Moscow, Politizdat, 1991, pp. 11—106. (in Russian).

31. **Stoyanova K.** *Vanga, ili Otkrovenie jasnovidjashhej*, Moscow, Molodaja gvardija, 1990, 157 p. (in Russian).

32. **Moody R. A.** *Life after life*, New York, MBB, Inc., 1975.

33. **Moody R. A.** *Reflections on life after life*, New York, Bantam Books, 1977.

34. **Rubel V. A., Savin A. Yu., Ratnikov B. K.** *Psi-vojny: Zapad i Vostok. Istorija v svidetel'stvah ochevidcev*, Moscow, POSTUM, 2016. 530 p. (in Russian).

35. **Silva J., Miele P.** *The Silva mind control method*, New York, Simon and Schuster, 1977.

36. **Fizicheskie** polja biologicheskih obektov. Interv'ju s Ju. V. Guljaevym i Je. Je. Godikom. Vestnik AN SSSR. 1983, no. 8, pp. 118—125 (in Russian).

37. **Burton R. A.** *A skeptic's guide to the mind: What neuroscience can and cannot tell us about ourselves*, New York, St. Martin's Griffin, 2013.

38. **Carroll S. B.** *The making of the fittest. DNA and the ultimate forensic record of evolution*, New York, London, W. Norton & Company, 2006.

39. **Satel S., Lilienfeld S. O.** *Brainwashed: The seductive appeal of mindless neuroscience*, New York, Basic Books, 2013.

40. **Bostrom N.** *Superintelligence. Path, dangers, strategies*, New York, Oxford University Press, 2014.

41. **Abramov I. I.** Problemy i principy fiziki i modelirovanija pribornyh struktur mikro- i nanojelektroniki. IV. Kvantovomehanicheskie formalizmy, *Nano- and microsystemnaya tekhnika*, 2007, no. 2, pp. 24—32 (in Russian).

42. **International** technology roadmap for semiconductors 2.0: 2015. Edition. Executive report.

43. **Kaku M.** *The future of the mind: The scientific quest to understand, enhance, and empower the mind*, New York, Doubleday Publishers, 2014. 400 p.

44. **Ivanov-Muromsky K. A.** *Nejrojelektronika, mozg, organizm*, Kiev, Naukova Dumka, 1983. 175 p. (in Russian).

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Журнал зарегистрирован в Федеральной службе по надзору за соблюдением законодательства в сфере массовых коммуникаций и охране культурного наследия. Свидетельство о регистрации ПИ № 77-18289 от 06.09.04.

Технический редактор *Т. А. Шацкая*. Корректор *Е. В. Комиссарова*.

Сдано в набор 21.04.2018. Подписано в печать 23.05.2018. Формат 60×88 1/8. Заказ МС0618. Цена договорная
Оригинал-макет ООО «Адвансед солюшнз». Отпечатано в ООО «Адвансед солюшнз». 119071, г. Москва, Ленинский пр-т, д. 19, стр. 1. Сайт: **www.aov.ru**