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MYTH OF THE SOUL; PRESENT DAY SCIENCE CONCERNING
THE PSYCHIC ACTIVITIES OF MAN

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/A Translation/

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**MYTH OF THE SOUL; PRESENT DAY SCIENCE CONCERNING
THE PSYCHIC ACTIVITIES OF MAN**

/A Translation/

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For many years religion and common sense have been implacable enemies.

Where religion spoke of the intervention of the divine forces, common sense pointed to the dependence of observed phenomena on the forces of nature and on the natural course of events in the outside world.

Where religion threatened with punishment in the other world, common sense spoke of the impossibility of the existence of such a world and of the continuous process of birth and death on earth.

This is why even in ancient times, parallel with religious fanaticism and the perilous influence of religious prejudices, scepticism and an atheistic attitude to various religious teachings grew and acquired strength.

Where, then, did this unbelief originate and what did it feed on? The answer lies in the very essence of human nature and in the forms of cognition of the surrounding world by man.

Even as far back as during the epoch of the primary manifestations of life on the terrestrial globe, organisms were able to survive only on condition that they "reflected" in some way in their still primitively constructed protoplasm, the continuous effect of the external, inorganic forces. With the passage of time, the entire development of life on earth was subordinated to the universal law of dependence on the external environment. In their structure and functions the organisms had to reflect accurately the requirements of the inorganic world. Even

the first sparks of psychic activity in primitive man had to be inevitably subordinated to this law of dependence of the organism and its nervous activity on external conditions, and to adjust themselves to the surrounding world. This is precisely the reason why the human brain and the forms of its relationship with the surrounding world had to follow the natural causative associations which existed also in the external world.

The inorganic nature constantly influenced and is continuing to influence the organism: light, sound, heat and cold, mechanical action, chemical reaction, pulverization of substances in the atmosphere, etc. contributed to the evolution of the organisms which, in their persistent struggle for existence, developed within themselves and perfected the ability to capture these external energies and to adjust themselves to them accordingly in their daily behavior.

Thus, in the span of millions of years, eyes, ears, gustatory organs and olfactory apparatus in most diverse variations were created.

The question arises, can a highly developed organism, at the present stage, avoid "reflecting" the actual material world and the causative associations of events which are taking place in it? No, it can not. It must follow these causative associations. Thus, already in primitive man this "common sense" appeared which represented the reflection of the laws of the external material world in the mental processes. The appearance of unbelief and atheism at all stages of human civilization is due in fact to common sense.

Thought, which has developed in man on the basis of causative associations existing in the material world, always had a tendency to deny anything which lies outside these causative associations.

I. P. Pavlov said: "A true active mind, in its strict natural and scientific conception of life in its complete entity without the minutest remainder, sees in it only the acknowledgement of the effect of the basic condition of everything in existence -- the law of causation."

All above mentioned must lead us to the conclusion that the integral property of the human mind is its reflection of the causative associations of the entire material world. The human mind, originated and developed only thanks to this ability to reflect in itself these causative associations.

A natural question arises: How did the human society acquire all these religious prejudices and religious psychoses which prompted

nations to engage in mutual wars, divided kindfolk by mortal hatred, and created the black darkness of the inquisition which oppressed every live thought, every manifestation of normal "common sense".

The Marxist-Leninist theory offers a clear and precise answer to this seemingly paradoxical question.

The natural fear of primitive man of the mighty forces of nature, his propensity to a naive and fantastic explanation of the natural phenomena surrounding him -- all this was employed as a means of subordination and enslavement of man during the period of the development of human society, when the domination of priests, and the wealthy class first began to take place.

From then on, religion never ceased to serve as a powerful means of spiritual subjugation of the masses of people, an influence so powerful that even the "common sense" of an educated person at times was paralyzed.

Thus, during the period of thousands of years, two philosophic movements came to exist in irreconcilable mutual hatred -- idealism and materialism. While the first was the stronghold of the ruling classes and directed our thought toward "non-material", "other-world" forces which were not subjected to the laws of nature known to us; materialism, on the contrary, indicated the path to the natural and scientific interpretation of the world, to the development of a world outlook in which all phenomena are bound by material causative associations. Thus, idealism and religion became the enemies of the scientific conception of the world and inhibited the progress of human civilization.

One must not imagine that religious prejudices, enforced through millennia, and religion which had developed a technique of rituals, and rites, can be eliminated, or will simply disappear of their own accord with the development of science and education and with the growth of the science of nature. One must not forget that religion has very shrewdly utilized (it has had enough time for it) human weaknesses which, in certain moments of life are very substantial. Religion got hold of the primitive man's conception of the "soul" and indicated to him the path of its migration to an "other world" independently of the body. Religion shows much attention to human misfortunes when man is in a grave condition, loses all points of support and is ready to lean upon any help, even a doubtful one. Religion here again appeals to the soul of man, points the way to its salvation which consists of passive subordination to the injustices of the social structure.

In our epoch, the religious teaching of a non-material "soul" which exists independently of the body and which reproduces the intermediate bridge connecting man and God, represents the main stronghold of religion and the basis of all religious prejudices.

Can science "coexist" with these prejudices? No, it can not. Science is strong precisely through its "common sense". Its very development is taking place because of man's urge to learn the causative bonds within the world phenomena of which we spoke above.

Briefly, the atheistic propaganda must advance a convincing scientific explanation of everything known to us, and equally convincingly explain why we still don't know certain things, and that we shall certainly learn them in due time.

This is precisely the most effective approach in unmasking the most inveterate and dangerous prejudice of a non-material soul and of its transformation and migration to another world.

This book which is offered to the reader is written by the corresponding Member of the Academy of Medical Sciences, Prof. D. A. Biryukov who develops step by step the entire panorama of modern achievements in the field of study of human mentality, as the highest manifestation of the material processes of the brain.

Only fifty years ago this problem represented an example of complete domination of idealistic conceptions and of passive side-tracking by scientists of this "non-cognizable" world, as suggested by religion.

The teaching of I. P. Pavlov's conditioned reflexes produced a breach in this centuries old wall which had separated man from the true scientific knowledge of the "soul". D. A. Biryukov tells us of all the stages of the development of this grandiose achievement of our science, of which we are justly proud, and not only we, compatriots and students of I. P. Pavlov, but the entire progressive humanity.

The realm of psychic phenomena contains much that is mysterious and is as fascinating to the large masses of people as it is incomprehensible. Hypnosis, suggestion, sleep, dreams, sleep-walking, lethargic sleep, and many other phenomena since time immemorial, have served the people as sources of phantasies, superstitions and religious codes. Religion used man from this arsenal of "mysterious" phenomena; it is precisely the activity of the nervous system which is usually advanced as the proof of the need of religious beliefs. That is why the physiological analysis

of these phenomena, the convincing demonstration of the true causes of psychic activity, and the interpretation of the cerebral laws which create all above mentioned conditions, must become the basis for scientific atheistic propaganda.

And here is where "common sense" of man, its natural, historically trained tendency toward the study of causative associations of the actual world, must take over.

One of the most difficult chapters of the physiological study of psychic activity is its origin and its development from the elementary manifestations of a most primitive nervous system. Both church and some scientists consider this fact as the main obstacle to build a bridge between the psychic, or higher nervous activity of man and the higher nervous activity of animals. The church seeks precisely at this point the justification of its idea of divine Providence which, having endowed man with conscience and a "thinking soul", denied it to all animals leaving them expedient behavior based on sensation only.

We find even now some representatives among intelligent people who point out the extraordinary accuracy and complexity of instincts in animals and seek in it proof of the great power of "divine Providence" and the inadequacy of science. In order to scatter the cloud which envelops this problem and aid in the understanding of the natural and scientific essence of the instinct, we must elicit the true mechanisms which govern instinctive acts, show the ways of their development and their dependence on the peculiarities of the external conditions of life.

It was not by accident that instinct, as a special form of the expedient adjustment of animals to the external conditions, served religion as proof of the existence of "divine Providence." The philosophy of stoics, the idealistic world conception of the Platonists, etc. considered instinct as the stronghold of religious dogmatism. It was particularly stressed in the Middle Ages. Suffices it to mention that Thomas Aquinas devoted a great deal of attention to the description of the instinctive behavior of animals and pointed out that an impassable barrier exists between animals and man only through the divine will.

The German philosopher and educator Reymarus wrote in the foreword to his interesting book "On the Technical Instincts of Animals" in the 18th century: "In the most important verities of the natural Religion I attempted to show the special designs of God in the animal kingdom, in certain varieties of animal psychic instincts."

It is natural, then, that we can eliminate religious superstitions by explaining the substance of evolution and by eliciting the physiological mechanisms which control instinctive behavior.

D. A. Biryukov, who is a specialist in the field of study of higher nervous activity, cited examples and their analysis which solved the problem of the materialistic interpretation of instincts very satisfactorily. True, there are gaps in our knowledge in such an extensive field, as the physiology of the higher nervous system in all its stages and forms, from a mollusk to a thinking human being. However, they must not make us lose courage; on the contrary, they must instill in us enthusiasm and energy for further investigations on a strictly materialistic basis.

The book of D. A. Biryukov is permeated with this enthusiasm and faith in the power of scientific knowledge of nature, and the reader will entertain no doubt that the "unsolved problems," too, will be solved in due time with the same accuracy and persuasiveness with which the basic aspects of the teaching of I. P. Pavlov of the higher nervous activity in animals and man have been described.

The book of D. A. Biryukov is enjoying definite success judging by the letters and by the critical reviews. Let us hope that other Soviet scientists, too, will contribute to the noble deed of disseminating natural science teachings which are incompatible in principle with superstitions and religious prejudices.

P. Anokhin

Introduction

"...How many millenia has humanity been studying the facts of psychology, the facts of the mental activity of man! Not only the specialists in psychology are engaged in it, but the entire art, the entire literature which depicts the mechanism of human mental life."

I. P. Pavlov

The soul, psyche -- what familiar, well-known expressions, seemingly clear, indisputable, completely accessible to understanding! However, it is quite difficult to give a scientific definition of the psychic. There is probably no more complicated problem than the problem of the psychic, or mental activity. Not in vain is there a proverb saying: "The other's soul is a mystery."

The terms "mental" and "psychic" are similar expressions ("soul" in Greek is Psyche).

If at the present time we are only at the dawn of a scientific explanation of the phenomena of psychic life, it is easy to imagine how obscure was the conception of the soul at the dawn of human history.

When the semisavage man began to differentiate himself from the surrounding nature, the faith in spirits and soul made its appearance. Man observed someone's death. He began to surmise that the soul must have left the body. The state of sleep or fainting also led to the supposition that the soul left the body temporarily. Certain mental illnesses created an impression that evil spirits had entered the body.

The ideas of the primitive man in regard to the soul were very simple and direct. The soul seemed to be like a twin, or the ghost of the individual. The soul is born together with man, eats, hunts, etc. It lives in various organs of the body. In the latter stages of the development of human society, the more complicated social relations, work, and speech led to the development of thought and the ability to generalize. At this stage, the surrounding world appeared to the human imagination as if it were peopled with numerous spirits which had lost contact with the material basis.

"The forces of nature," wrote Engels, "appeared to the primitive man as something alien, mysterious, overwhelming."

Observations of various phenomena of nature (sun, moon, thunder, rain, etc.) gave men the idea that some of them seemed to contribute to his well being; others on the contrary brought him misfortune. This fact strengthened his conception of a world "beyond", which consisted of good and evil spirits. A cult of spirits was emerging and developing, -- the forerunner of future religion and the basis of idealism.

V. I. Lenin said that the feebleness of the savage in his struggle with nature received its reflection in these imaginary ideas.

And Karl Marx: "In ancient times, when people had no idea of the structure of the human body and could not explain dreams, they imagined that their thought and sensations were caused not by their body, but by a soul -- an entity distinct from the body, remaining in the body while it lived and leaving it when the body died; it made them reflect on the relation of the soul to the external world."²

Later, as the natural sciences and philosophy progressed, the scientists and philosophers who had been occupied with the problem of mental activity became divided into two camps. One camp claimed that the soul existed independently of the body; a spirit detached from matter. These were the postulates of the camp of the idealists. They assumed that the spirit originated before nature and that nature itself, according to their point of view, was a creation of this primordial existing spirit. To the camp of materialists belong those who claimed that matter existed always, and what is called soul, or psychic is nothing else but the manifestation of the activity of the highly organized matter -- the nervous system.

The latter point of view was corroborated by numerous facts from the history of the development of living beings, from protozoa to the highest form -- man.

The idealistic conceptions served as a basis for the origin of various religious beliefs, while materialism became the basis for the development of science. It is erroneous to think that the incompetence of idealism is clear in itself and that there is no need, therefore, to occupy oneself with its scientific refutation. In speaking of psychic activity, we realize of course that some primitive beliefs such as, for example, the entry of the soul into the body as a dove and its "soaring" after death, do not have many adherents.

²F. Engels, Anti-During, Moscow, Gospolitizdat, 1951, p. 326.
²K. Marks and F. Engels, Works, Vol. 14, Moscow, Sotselgiz, 1931, p. 643

at present; it is also doubtful whether there are many who believe that God created Adam from clay and breathed the soul into Adam in the form of vapor. One must not forget, however, that with the development and enrichment of scientific knowledge, the idealistic conceptions "perfected" themselves and effected a peculiar adjustment to science. This is explained by the fact that during the entire period of the existence of idealism, its adherents were fighting materialism; while the materialists on their part exposed the anti-scientific nature of idealism.

V. I. Lenin especially stressed the fact that the irreconcilable contest between idealism and materialism which has been going on during the two thousand years of the development of philosophy, has not ended. It must be emphasized that this ideological struggle became particularly acute; when the world divided itself into two opposite camps -- the socialist and the capitalist.

In the modern idealistic philosophy a large number of trends can be discerned which are attempting, under the cover of scientific data, to assert in one way or another the myth of the existence of a soul detached from the body. The legitimate contrasting of the ideal and material aspect of certain phenomena (acknowledged also by the materialists), particularly of the brain and thinking, becomes absolute from the point of view of the idealists; as a result, material and ideal (matter and spirit), which are in reality inseparable, become in the thinking of idealists dissociated, disunited, and leading an independent existence. Such is, for example, the doctrine of a parallel existence of body and soul -- the so-called psycho-physical parallelism. Various philosophers of this trend of thinking may differ from each other; the essence, however, remains the same: it consists of the acknowledgement of two substances in man -- spiritual and material. This idealistic doctrine is called dualism. Those who assert the independent existence of the soul usually deny the possibility of scientific cognition of its manifestations (agnosticism), or admit, to a certain extent, that the methods of cognition are accessible to the observer only. It is the so-called subjective method of study of mental phenomena, or the method of self-observation. Its adherents accept only the certainty of their own feelings and sensations.

Subjective psychology could not detect any fundamental rules of psychic activity during the two thousand years of its existence, though the data which it had accumulated are very extensive. Similarly fruitless proved to be the content of the so-called zoo-psychology and its attempts to understand the manifestations of the psychic activity of animals, when it applied to them the results of observations which it had conducted on itself. The psychologist

subjectivist says in regard to various states of an animal: "The dog, or the cow thinks, desires, enjoys, is offended, etc.". The creator of the objective method of study of psychic activity, I. P. Pavlov, proved the non-scientific nature of these attempts.

I. P. Pavlov, as well as other scientists materialists, denied dualism in the study of psychic activity; he shared the views of materialistic monism. In contrast to dualism, materialistic monism proceeds on the basis of the acceptance of the unity of man's body and soul. The psychic or mental activity of man is one of the functions of his organism; a result of the physiological activity of the brain.

The greatest scientific contribution of I. P. Pavlov is his discovery of a scientific method of the study of psychic processes, and of the basic rules of psychic activity. "He succeeded," as V. I. Lenin said, "to place on a scientific ground the study of facts which characterized various psychic processes."

The subjective method in science denies the recognition of the existence of an external world outside of us and independently of our conscience, as well as all the rules which govern it. This is our main point of view which religion seizes upon. The world is beyond our cognition, assert the exponents of religion, therefore we must not occupy ourselves with hopeless attempts to fathom it, we must not search for laws of nature which exist objectively, but only offer prayers and ask for divine mercy, for a miracle and for mystery. It is obvious that the sphere of psychic phenomena possesses great importance to religion, for it is an abundant ground on which to suggest to religious people the mystery and the inability to apprehend the will and the commands of God.

In describing below the basis of the teaching of I. P. Pavlov on psychic activity, we hope to expose this main legend of religion. We must emphasize that the atheistic propaganda to which this book is dedicated is combatting religious beliefs, and not individual believers. We must explain to the believers that religion chains a human being. The words of K. Marx that religion is opium to the people truly reflect the gist of the matter. Science, on the other hand, opens before humanity truly limitless possibilities of influencing the external world; of conquering the forces of nature and making them serve man -- in bringing relief and beauty into his existence. The basic idea of religion is the enslavement and oppression of man; it does not matter, whether it will be accomplished for the sake of God in heaven, or for His representative on earth.

V. I. Lenin, Works, Vol. 1, p. 127

Idealistic views are quite widely spread in the capitalist countries of the world. The reactionary scientists of the capitalist countries are carrying on a fight against our country and the countries of peoples' democracies with every means at their disposal, and are trying to introduce into our science various idealistic notions.

The presence of complex and still unsolved problems of psychic activity creates a fertile field for the spread of superstitions. These superstitions appear in connection with the phenomena which have not as yet been sufficiently clarified by science. Let us mention some of these superstitions such as so-called premonitions, fate, fateful dreams, mental telepathy, etc. In attempting to explain these phenomena, one often resorts to examples and comparisons obtained from religious legends.

Idealistic notions of the soul and of psychic activity are the foundation of all religious creeds. Therefore, the task of a correct interpretation of the phenomena of psychic activity is of the utmost importance to materialistic science, which is the main antagonist of religion.

In spite of the destruction of the basic roots of religion in our country, namely, the class division into the oppressors and the oppressed, the religious survival in the consciousness of certain strata of our population is still taking place.

The socialist ideology, prevalent in the Soviet society, is based on the Marxist-Leninist philosophy. The possibility of domination of the bourgeois ideology in our country is excluded, for the class basis for this ideology has been destroyed. Nevertheless, the reconstruction of consciousness may lag behind the reconstruction of social relations. This explains the presence of some survival of bourgeois ideology in the form of religious learnings in some Soviet citizens.

The enemies of the Soviet regime, acting from without, from the camp of the capitalist world, are clutching at these survivals in the consciousness and, finding a favorable ground in morally unstable or ignorant people, are attempting to take advantage of these moods. Therefore, one of the immediate tasks of the Communist Party is the unremitting fight for the socialist consciousness, and for the eradication of the dying but still clinging to life bourgeois outlived notions.

The purpose of this fight is that the members of the socialist society develop within themselves a strict, scientific, conscious

attitude toward all complex phenomena of nature in the external world, as well as in their personal psychic activity.

Physich Activity - The Result of the Physiological Processes of the Brain

"You, no doubt, greatly respect the human mind? - Excellent! Then you must remain in awe before the mass of his brain where all mental functions are taking place, whence the nerve threads - the organs of feeling and sensation - spread over the entire organism through the spinal column... Psychology which is not based on physiology has just as little substance as physiology which is not aware of the existence of anatomy."

V. G. Belinskiy

The theory of evolution, or the development of the living world which had been advanced by the English scientist Charles Darwin, is the greatest achievement of the natural science of the past century. Darwin, basing his finding on a great amount of factual data collected during many years of observation, as well as on the experience and opinions of his predecessors, arrived at the conclusion that living nature is constantly developing and perfecting itself. In contrast to the generally accepted views, at that time, that the world is constant and immutable, Darwin advanced a scientific explanation of the origin of animals and plants in the world, and demonstrated the gradual evolution of man himself, from ape-resembling ancestors to the present state of civilized man. The founders of the Marxist philosophy greatly valued the scientific significance of Darwin's discoveries.

V. I. Lenin wrote: "...Darwin put an end to the view that different varieties of animals and plants are unconnected, casual, 'by God created' and immutable phenomena, and placed biology on a fully scientific basis for the first time in the history of science, by means of demonstrating the mutability and successiveness of various species."¹

Under the impact of the Darwinist ideas, the Biblical legends on the creation of man were shattered; however, old beliefs still remain in the conscientiousness of some people.

The foremost representatives of Russian biological science,

¹V. I. Lenin, Works, Vol. I, p. 124

K. A. Timiryazev, I. M. Sechenov, I. P. Mechnikov and others, unhesitatingly declared themselves in agreement with the theory of Darwin. The theory of the evolution of living nature and of the origin of man became also the foundation for the development of the scientific ideas on psychic activity.

Darwin demonstrated that organisms adjust themselves to the changing conditions of their existence, in order to preserve and sustain their life. This pertains equally to animals and plants. Among the conditions which cause this adjustment are climatic changes, difficulty in obtaining food, and the presence of enemies in the food areas of given animals.

These ideas were first advanced by the French scientist Lamarck (1744-1829).

Lamarck demonstrated that the conditions of existence cause the appearance in various animals of various distinguishing characteristics: for example, white fur in polar bears which not only keeps them warm, but also makes them indistinguishable from the ice and snow surface; the long neck of a giraffe developed because the animal had to obtain its food by reaching out for high branches.

Later investigations have shown that such direct correspondence does not always take place; however, the main thesis of this teaching remains correct. The eminent biologist and evolutionist K. Roulier (1814-1898) came to similar conclusions and cited many facts in support of them.

Sechenov and Pavlov, who had concentrated their activity on the study of the brain, indicated that the activity of the nervous system of an individual organism must be studied from the evolutionary point of view.

This conception, however, met with substantial criticism from some physiologists - contemporaries of Sechenov and Pavlov, many of whom did not share with them the Darwinist ideas.

It was essential to refuse the widely accepted idea that the life activity of the organism proceeds independently of the environmental influences.

The theory developed by I. P. Pavlov created a definite change in the development of physiology. The ideas on the activity of the organism underwent such marked changes that it is now customary to speak of a Pavlov and a pre-Pavlov stage in the development of physiological science.

In observing that a heart, removed from the body of the animal, continued its activity for a while, i. e. contracted and dilated, the physiologists came to the conclusion that the heart is capable to carry out its usual function even outside the organism.

Other organs, too, (muscles, nerves, glands) having been isolated and having lost complete contact with the organism, continued to carry out their customary activity for some time.

These facts led to an erroneous conclusion that the organism exists as an aggregate of organs. Equally wrong was the conclusion that separate parts of the organism, or its organs have an entirely independent significance. It was considered sufficient in the study of the organism to know the functions of various parts of the organism. Every one of its component parts was supposed to function according to its own particular rules, independently of the influence of the whole organism, or of the environmental conditions under which the organism lived. These are, briefly, the basic postulates of analytical physiology.

Pavlov demonstrated the complete unfitnes of these ideas. He evaluated correctly the role of separate parts of the organism and demonstrated that a close contact of these parts with each other, their interaction and the interaction of various organs are essential to the normal life activity of an animal. For clarification let us cite one example.

In cases where there is a considerable loss of blood due to an injury of a large blood vessel, a grave disturbance of organic activity takes place and a lowering of blood pressure. In response to it there is an instantaneous mobilization of various organic functions which removes the imminent threat to the organism. Signals originating from stimulation of the walls of the emptied blood vessels, are flashed to the central nervous system. As a result, the blood pressure level begins to rise. However, in view of the fact that the total quantity of blood in the organism has decreased, a number of changes takes place in the activity of various organs which aid in compensating the after-effects of the loss of blood. The cardiac activity is accelerated, and respiration becomes deeper and of a more rapid rate. It ensures the supply of oxygen needed for the activity of organs, in spite of the reduced amount of blood in the organism. A contraction of the spleen also takes place, and the blood reserve, normally present in the spleen, is transferred to the vascular system.

There is a change in the blood supply of various organs. The blood vessels which supply blood to organs less vitally important

undergo contraction and have less blood to carry, thereby ensuring the flow of oxygen and nutritive substances to the heart and the central nervous system. The absorption of water and salts from adjacent tissues into the blood circulation system through minute blood vessels -- the capillaries, is accelerated, and there is an increased activity of the hemopoietic organs. This aids in the restoration of the amount of lost blood. The activity of organs which eliminate water and salts from the organism (kidneys, sweat glands) is reduced.

The most remarkable result of this adjustment is the fact that, even in cases of large losses of blood and considerable oxygen insufficiency, the brain and heart are adequately supplied. This is the direct sequel of the regulating effect of the nervous system.

We cited only one example of various changes in the activity of the organism which are taking place following the disturbance of its normal state, but even this ought to be sufficient to understand that the functions of various organs are closely bound and mutually interrelated.

An organism represents a total unit which consists of closely interconnected organs. "Neither a mechanical combination of bones, blood, cartilages, tissues, etc., nor a chemical combination of elements constitute an animal," wrote F. Engels.

Gertsen expressed himself with complete clarity on the wholeness of the human organism. He wrote: "Life is the maintaining of unity in multiformity, the unity of the whole and its parts, when the contact between them is disrupted, when their unity which holds them together and preserves them is disturbed, then each area begins its process: death and the putrefaction of the corpse -- accomplish liberation of the component parts."²

The idea of the unity of all organic processes and of the most important role of the brain was expressed also by N. A. Dobroljubov. "There is not a single part in the human organism which could exist independently, without a link with other organs; but no other parts of our body is so closely connected with all the rest as the brain. It suffices to state, without going into further details, that it is the central point of the motor and sensory nerves. Therefore, it is clear to what extent the brain activity is bound with the general state of the body."³ I. P. Pavlov, in full accord with above cited

1. F. Engels "Dialectics of Nature" Moscow, Gospolitizdat, 1955, p 168.
2. A. I. Gertsen "Selected Philos. Works," Vol 1, Moscow, Gospolitizdat, 1948, p 100.
N. A. Dobroljubov. Selected Philos. Works," Vol 1, Moscow, 1945, p 172

statements of Engels, Gertsen, and Dobrolybov, advanced the idea of the unity of the organism in physiology. He taught that life activity begins as a result of the interaction and reciprocal effect of various parts of the organism.

In higher animals, this unification of the parts of an organism, or of its organs in one entity is effected by the regulating activity of the central nervous system. Pavlov indicated that the highest center of the nervous system in these animals becomes the "manager and regulator" of all organic functions. This regulating role of the nervous system is effected by means of reflexes.

As far back as 300 years ago, the idea of the reflectory function of the central nervous system began to find its way in physiology. The word "reflex" means reflex action. Even then an idea was formed that the nervous system reflects the stimulations which enter the brain, just as the mirror reflects a ray of light. A simple example will explain it. A man touches unexpectedly a hot object with his hand. The irritation which originates in the nerve centers is transmitted to the motor centers, thence to the motor nerves which activate the muscles of the hand. The reflex of pulling the hand away takes place.

The modern reflex theory is based mainly on the works of I. M. Sechenov and I. P. Pavlov.

The correct ideas in regard to the organism enabled Pavlov to reorganize the entire physiological science and to initiate a new progressive basis of its development to which he gave the name of synthetic physiology. He considered as one of its principles the self-regulating activity of the organism ensured by the nervous system.

The above cited example of the complex reaction organism to loss of blood may serve to clarify what Pavlov understood under self-regulation of the organism.

Pavlov attached to the theory of self-regulation wide biological importance. The idea of self-regulation enables him to create a correct interpretation of the functions of the cardio-vascular system.

It is customary to speak only of the flow of blood in blood circulation, but Pavlov demonstrated that the most important function is the distribution of the blood in the organism, and the self-regulation of the processes of blood pressure, temperature, etc.

I. P. Pavlov further developed the conception of self-regulation and widened it by extending it to various functional organic systems.

He accumulated a great number of observation data relating to various digestive organs, and made an extensive summarization of the functions of the digestive canal as a whole.

He spoke of the chemical acts of digestion as of one unified entity, in which various functions interacted, substituted and aided one another. This concrete synthesis (the unification of separate links of the process of digestion) was considered by Pavlov as the most important general result of the laboratory studies which he and his co-workers had achieved.

The theory of self-regulation was developed by Pavlov not only in connection with his investigations of the vascular and digestive organs systems. He considered also that the glands of internal secretion (hormones) were "associated within the system". Pavlov did eventually extend the idea of self-regulation by including therein the entire organism.

"A man is of course a system," wrote Pavlov, "but a system unique, in the diapason of our present scientific knowledge, in its highest self-regulation... in the highest degree in which it regulates itself, sustains itself, restores, corrects and even perfects itself."¹

One must note that Pavlov made these wide generalizations on the basis of strictly established facts. Pavlov emphasized the fact that explanation is a cheap thing, but that one must take the hat off before "Mister Fact". Every one of his theoretical postulates was based on extensive factual material.

Pavlov spoke particularly often of the interaction, interrelation, and the reciprocal influence of functions, when he dwelt on the activity of the central nervous system.

Pavlov said: "We must assume that all reflexes in each system are constantly interacting and affecting each other. Thus, the system is always something whole."² "...The large hemispheres," he was saying in regard to the functions of the brain, "represent a system - all parts of which are in interaction with each other during the period of activity."³

1 I. P. Pavlov "Complete Coll of Works" Vol III, book 2, 1951, p.187
 2 "Pavlov's Wednesdays" Vol I, Moscow-Leningrad, Publication of the Academy of Sciences USSR, p.134
 3 I. P. Pavlov "Complete Works" Vol III, book 2, Moscow-Leningrad, Publication of the Academy of Sciences USSR, p.398

Thus, we can see, that the theory of the interaction and the reciprocal effect of various parts of the organism, including the nervous system, was treated by I. P. Pavlov in a very systematic manner.

The problem of wholeness is rather popular also among the bourgeois scientists, especially in America. Over there the psychologists and physiologists also speak of the organism as a whole. In particular, the so-called "wholeness" as a special trend of a "whole" study of the organism, is quite popular over there. However, this trend is patently idealistic, as compared to Pavlov's teaching of the organism as a whole. The wholists visualize the wholeness of the organism as something given, indivisible, and not subject to study. In contrast to this, the Pavlov idea of wholeness originated as the result of the study of the interaction and reciprocal effect of organs. Pavlov frequently spoke of the "association of organs" when he referred to complicated forms of interactions and reciprocal effects.

On one of the "Wednesdays" (as the weekly scientific conferences of the laboratory workers were called) Pavlov expressed himself very clearly on the subject of the relationship of whole and parts. He said: "I happen to be reading now a book by a psychologist. What nonsense! Very well -- the organism is an entity. Don't we all know that everything is linked together, integrated. However, no one denies that the system of blood circulation is one thing, digestion -- something else, muscular activity -- something else again. They keep on harping on the structure, forgetting that everything is composed of separate parts! How is it possible to insist on such nonsense -- don't touch analysis! What can you do, fashion! They accept wholeness, accept complexity, and forget that it consists of separate parts, that our understanding of the whole is based on the knowledge of the part."¹

Let us now take up another most important problem -- the relation of the organism to the environment in which it lives.

The Marxist dialectic method enables us to see an organism not in the frame of study of its internal associations only, but in its unity with external environment and in the effect on the organism of the external conditions of its development. V. I. Lenin wrote: "In order to really know the subject, one must embrace and study all its facets, its associations and causations."

¹ "Pavlov's Wednesdays" V II, p 550
2 V. I. Lenin "Works" Vol 32, p 72

We shall never achieve it completely, but the quest for thoroughness will protect us from errors and from inflexibility."

The problem of the effect of environmental conditions on the organism was posed in biology a long time ago. However, it was I. M. Sechenov who first spoke in physiology on the unity of the organism and its external environment and the effect of this unity on the functions. He wrote: "The comparative study of animals further demonstrates that the progress of material organization and of life does not proceed along straight lines, but along branched paths, often deviating in details. It is precisely here, at the organizational crossroads, that the effect on the organisms of the environments in which they live, or, more correctly, the conditions of their existence manifest themselves with particular force... Life is composed always and everywhere from the cooperation of two factors -- the definite, though changing, organization, and the influence from without."¹

The above stated demonstrates that Sechenov's ideas and the teaching of Pavlov have developed under the influence of the materialist philosophy and the theory of Darwin.

Sechenov and Darwin created the materialist theory of the reflex processes which lie at the basis of psychic phenomena (of these we speak in more detail later), of their causative conditioning as the result of the influence of the external world, and of the unity of the organism and the external environment.

This has the closest relationship to the materialist interpretation of the essence of psychic activity.

Scientific data attest to the fact that the psychic faculties of man originated as the result of a continuous and long evolution of hundreds of millions of years. The psychic activity is manifested also in higher animals. Engels pointed out that animals are capable of all kinds of reasoning activity, but he emphasized that this reasoning is markedly different in animals and man as to the degree of its development. Even in the most intelligent animals, such as dogs and monkeys for example, only primitive forms of psychic activity are present. These represent ideas which relate to concrete sensory perceptions.

As will be seen from further exposition, the thinking in ideas,

¹ I. M. Sechenov "Elements of Thought" In the collection *Fiziologiya Nervnogo Systemy*, No. 1, Vol. 1, Moscow, Medgiz, 1952, pp 300-301

i.e., abstract thinking is a form of higher psychic activity of which only man is capable. However, it is very important to emphasize the evolutionary progress of the thinking function of the brain and to indicate its rudimentary origin also in higher animals; for, it confirms the successive development of man from his animals ancestors, and eliminates the idealistic conceptions that only man can be animated, i.e., capable of psychic activity. The latter idea is usually asserted in religious teachings. The teachings of the divine origin of the soul is profitable to religion. God, according to the Biblical legend, in creating Adam, the first human being, breathed in the soul into him, and this distinguished him from animals. Hence comes the absolute power of God over man's soul. Religion asserts that only God is able to cognize man's soul, only He can control it.

Thus, we see that the ideas of Engels, the evolution theory of Darwin, the philosophy of progressive materialists, and the works of the founders of the Russian material philosophy of Gertsen, Chernyshevskiy, and others, created the basis for the materialistic study of psychic activity.

Sechenov and Pavlov, as progressive investigators, solved the main problem of scientific study of psychic activity, which is connected with the necessity of understanding its development from the most primitive properties, present in animals, to its highest manifestations in man, along the paths of the theory of evolution and the paths of materialistic dialectics. Thus, the first principal task was solved, but there remained inaccessible to other task: to find reliable methods of studying the psychic activity.

We have already mentioned that the primitive man created certain primitive ideas of the soul, based on the observation of various experiences of other people and on their evaluation according to the experiences which he himself had gone through.

Thus, for instance, when a neighbor related some dream he had experienced on the previous night, the hearer had an opportunity to compare them with those he had experienced himself. In experiencing fear or grief, he analyzed similar experiences in others on the basis of what he himself had lived through.

Such method of study received later, during the period of scientific attempts of the investigation of psychic activity, the name of the subjective method. According to the subjective method, everything which is taking place around me, whether it relates to the phenomena of human, or even animal life, and to the phenomena of social life, I interpret in the light of how these observed events

appear to me personally. According to this theory, man is allegedly able to interpret the essence of the causes and conditions of the event on the basis of his perceptions and according to his sensations and impressions.

Such an attitude leads to the negation of the role of external, independent of the subject, causes and conditions connected with the origin of a given event, and leads to the negation of the objectively existing laws of the development of nature and of human society, which are independent of man.

This profoundly vicious and unscientific character of the subjective conception of various phenomena was exposed by the founders of Marxism-Leninism. One can state without exaggeration that I. P. Pavlov devoted his entire life to combatting the subjective method of study of psychic activity. A little later we shall describe the essence, and emphasize the significance of Pavlov's objective method which he had developed for the study of psychic activity.

Here it is appropriate to attempt to clarify one misunderstanding which has come up in recent years.

Certain authors, in their zeal to interpret the phenomena of psychic activity from the materialistic point of view, went to extremes in taking the stand of a denial of the characteristic properties of psychics, as compared to the physiological processes which constitute its basis. In their erroneous interpretation of certain statements of I. P. Pavlov, they insisted on the identity of the psychic and physiological phenomena. Such a position is thoroughly false both from the factual and philosophical points of view.

V. I. Lenin, in his philosophical treatment of the problem of the ideal and material, acknowledged the danger of both, the excessive contrasting of the ideal and material, and of their excessive identification.

On his part, I. P. Pavlov, though he spoke of the "fusion" of the subjective and the objective, of the "marriage" of physiology and psychology, at the same time never indicated the identity of the psychic and the physiological. On the contrary, he stressed the special characteristics of the subjective, psychic world of man. Hence, the appeals of some scientists to substitute physiology for psychology seem entirely absurd.

Psychology, same as physiology, is and will continue to be a science which has its subject and its content. The problem is not the

negation of the subjective human experience and conditions -- an attempt rather more harmful than useful to materialism -- but the understanding that the subjective, as reality, is subordinated to the universal law of causation, and that while it is subjective to each separate individual it is objective to others, and is, therefore, subordinated to the method of objective study which had been developed by I. P. Pavlov at the beginning of this century.

Physiology, from this point of view, is engaged in the study of the material processes which are taking place in the nervous system and which constitute the basis for psychic processes as stressed by V. I. Lenin. In this sense, the psychic processes such as thought for example, may be considered material but not substantial. Thought has no temperature, or weight, or length -- it represents an ideal reflection of the objective reality in the cerebral matter. Therefore, the subject of psychology is the study of the psychic content conditioned by the social experience of man and by the special properties of the physiological processes which are taking place in the brain. The physiological and psychic processes are only various facets of the one and the same substance -- the thinking cerebral matter.

In connection with this, it is important to learn certain facts which prove that the psychic functions are a product of cerebral activity.

Let us consider first the general role of the brain in psychic activity.

Toward the end of the past century, the investigators succeeded in preserving the life of higher animals after the surgical removal of the main part of the cerebrum -- the large hemispheres. The results, obtained somewhat later by Doctor G. P. Zeleny in the laboratory of I. P. Pavlov, are of special interest.

Dogs, upon extirpation of the cerebral hemispheres, remained the major part of the 24 hours in a drowsy state. As the time of feeding approached, the animals woke up and commenced to wander around the building. They stumbled frequently against the wall, or a bench placed in the room, because they could not see these objects.

Neither have various sound irritations produced any reaction. If at times one succeeded in obtaining a reaction to a loud sound suddenly produced after a silence, or to an illumination with a strong light which flared up out of darkness, there was still no reaction on the part of the dog to the appearance of his master or the worker who had always fed him, calling his name out.

Physiologists who resorted to a subjective interpretation of their observations came to the conclusion that the dog hears but does not understand, sees but does not recognize.

It was observed also that the intelligence of the animals has been reduced, that there was no understanding or recognition, and no proper reaction and acting. The perceptions as well as their evaluation became very limited. "Generally speaking, the removal of the large cerebral lobes brought the dog to a state of virtual feeble-mindedness," wrote one physiologist. These experiments show that the removal of the higher sections of the cerebrum deprives the animals of the faculty to perform psychic functions.

The cases of malformation (microcephaly) acquire important scientific interest when the child is born with an underdeveloped nervous system and with almost entirely absent cerebral hemispheres. Generally, these freaks do not survive more than a few months; sometimes, however, those children remain alive for several years, perhaps because the malformations of the brain are less expressed.

One of these rarely encountered microcephalic children has been thoroughly studied by a group of Soviet scientists.

A little girl, named "Pita" at the admission to the clinic appeared to be eight years of age. Her hearing was sufficiently developed. From the very first days Pita got used to her new name, she turned around when called, without definitely recognizing the person who called her. The sensations of taste, pain, cold, and heat were markedly depressed. Speech was completely absent. Pita could not pronounce not only words, but even isolated syllables. Her "speech" consisted of a fair variety of sounds which, however, did not pertain to any questions or errands with which the people around her attempted to establish some sort of contact with her.

The greater part of the time Pita passed in a state of complete indifference to everything around her. She sat or stood for hours on the same spot, without so much as to change posture. At times, one could gather that she experienced some sort of enjoyment, judging by the fact that she laughed when observing, for example, other children playing or dancing, etc.

She contracted tuberculosis and pneumonia, became aggressive and mean, and much agitated even when someone of the attending personnel approached. She cried in a shrill voice and attempted to scratch those approaching her.

One can see from this brief description that during the ten

years of her life that she remained in a state of complete idiocy. A post mortem examination of the brain of this girl, who had died from the diseases mentioned above, showed a marked retardation of the brain development: it did not correspond not only to a normal brain of a child of ten, but in many respects, was even below the developmental level of a brain of a newborn baby. This profound underdevelopment of the brain led, as we see, to the complete loss of psychic functions.

There are cases where a fairly rapid atrophy (destruction) of the higher sections of the brain, due to some diseases, takes place also in adults. In these patients one notices, first of all, various signs of the disturbance of psychic activity. The disease starts with a progressive absentmindedness and with the loss of the faculty of intelligent actions. The patient performs some acts deprived of any sense whatever. For example, an experienced housewife performs many acts connected with the preparation of food: cleans vegetables, washes meat, etc., but her actions are deprived of the usual order, continuity, and purposefulness, for she is unable to cook the soup. The progressing illness eventually reduces the psychic state to the level of complete idiocy. Post mortem examination of such patients demonstrates a complete destruction of the higher cerebral nervous centers.

The cited facts of observations on people and, especially, the results of numerous experiments on animals attest to the fact that the content of psychic activity (thinking, memory, the faculty of cognition, etc.) depend in the first place on the normal condition and functions of the brain.

This scientific idea, corroborated at the present time, was expressed in the form of surmises by many physicians and philosophers a long time ago, even before the present era.

Thus, for instance, the Greek philosopher Allmeon said about 2000 years ago that the brain represents the "seat of the soul and of consciousness." The study of various mental diseases offers extensive material which confirms the closest relationship between psychic activity and the normal functioning of the brain.

This relationship manifests itself particularly clearly in intoxication with certain poisons which predominantly affect the nervous system. To these belong, in the first place, alcohol, morphine, opium, cocaine, etc.

Thus, for example, grave disturbances of psychic activity in the form of alcoholic psychoses may take place as the result of chronic alcoholism. The most known of these is the so-called

"delirium tremens"; This psychosis manifest itself in the form of the disturbance of consciousness, a state of fear and the appearance of various sensory illusions, the so-called hallucinations. The patients imagine that various insects and small animals are bustling and running around; at times they see large animals -- elephants, tigers, and eggs.

The hallucinating patient often attempts to catch imaginary flies and cats, or to drive off his shoulder the tiny imaginary devils. The expression to "drink till you see devils" or "white elephants" is precisely connected with these hallucinations. The expression "green snake" has the same basis. Visual hallucinations can be accompanied by aural ones. The patient hears non-existent noises, cries, music, etc.

Upon recovery (within three to seven weeks), the patient returns to a normal state, but is liable to get a relapse of this psychosis upon further alcoholic abuses.

The causative relationship between profound disturbances of psychic activity and the effect of poisons (in this case -- alcohol) on the brain is perfectly obvious. The abuse of narcotic poisons leads, in a larger or smaller degree, to various pathological deviations from normal mental activity.

The normal functions of the central nervous system may be disturbed by causes other than the above mentioned.

One of the most important conditions of the normal activity of the brain is the normal functioning of the glands of internal secretion. These glands are situated in various parts of the body, for instance near the laryngela cartilages (thyroid gland), near the kidneys (suprarenal glands), at the base of the skull (hypophysis) etc. The substances produced by these glands are secreted into the blood; they have been named -- hormones. They exercise the role of the most important regulators of various organic processes.

Upon entering the blood stream, the hormones are carried to definite brain centers and stimulate them; these centers, then, form one or another type of psychic activity in man.

Thus, for instance, if the thyroid gland supplies an insufficient quantity of its hormone to the organism in its early childhood, profound disturbances in the development of the organism will take place. The child undergoes abnormal development under such conditions and becomes a cretin. The basic signs of cretinism are

midget growth and marked feeble-mindedness.

There is the possibility of improving somewhat the mental development of a child-cretin by means of a surgical transplantation of the thyroid gland from another person, which the Soviet surgeon N. A. Bogoraz succeeded in accomplishing; it definitely confirms the dependence of psychic activity on the effect of hormones.

Instances have been described of the so-called "bronze disease" [Addison's disease] which follows the disturbance of the suprarenal function. In these patients a psychic disturbance is observed, parallel with muscular weakness and smoky-bronze coloration of the skin.

Of special interest are cases of complete change in the sexual behavior of animals which underwent a transplantation of sexual glands.

The facts cited above show that the attempts of idealists to assert that the soul, or the psychic activity allegedly does not depend on the life of the body, contradict the scientific data and are devoid of any basis whatsoever. Numerous facts, on the contrary, prove that thinking is the product of the physiological properties of the brain.

Modern materialistic science is taking the firm stand of materialistic monism.

The materialists consider matter as the basis of everything in existence. The spirit, soul is the product of this material source.

Idealistic monism is the direct opposite of materialistic monism, because the idealists consider the "spirit" as the source of all phenomena. It is conscience, not matter, which is the origin of everything, according to these false, unscientific ideas. Idealistic monism has been, since ancient times, the stronghold of all religious teachings.

Starting on the basis of materialistic monism, we must understand that soul and body, psychic activity and physiological processes of the brain are one and inseparable. One cannot tear away thought from the thinking brain. Psychic and physical -- are only two sides of the single and indivisible life activity of higher animals and man.

The dualists deny the dependence of ideal on material, they acknowledge the materiality of physiological processes in the

brain, but attempt to assert the right of the soul, separated from matter, to lead an independent existence. The founders of Marxism-Leninism fully exposed from the philosophic point of view this absurd and essentially idealistic attempt to conciliate materialism and idealism. Nevertheless, the dualistic efforts are still manifesting themselves in natural science and, particularly, in the science of psychic activity at the present time.

The objective method of investigation of psychic processes and his teaching of higher nervous activity, created by I. P. Pavlov, augurs the complete triumph of materialism in the study of psychic activity. In speaking of the objective materialistic method of study of psychic phenomena, I. P. Pavlov pointed out as follows: "It is now an incontestable fact, it is a powerful and to the highest degree expeditious method. An immense amount of material is constantly being accumulated thanks to this method, which not only includes pure physiological analysis but is now embracing vast problems of neuropathology and even psychiatry, as well as establishing the closest contact with psychology, mental hygiene, and pedagogy."

Scientific Investigation of the Higher Nervous (Psychic) Activity

the laws governing complex nervous activity are developing on a purely objective basis of natural science, and mysterious mechanisms are gradually being clarified.

I. P. Pavlov

The possibility of the study of the large cerebral hemispheres by means of stimulation originated very recently. There were no previous attempts of experimental study of psychic phenomena, i.e., of the activity of the large cerebral hemispheres. This field remained the domain of various guesses, mostly of an idealistic type, directed toward the search for the location of the "soul".

In the seventeenth century, an important event in physiology took place. It was demonstrated for the first time that, upon stimulation of the surface of the brain with an electric current applied to certain areas, various movements were observed in the animals.

These methods of investigations, somewhat modified in their technical use, have reached our times and preserved certain value in the solution of a number of problems. However, it became clear within a short time after their appearance that these methods of stimulation did not open any worthwhile avenues of research. The reason for it was that only comparatively limited areas of the cerebral hemispheres are location sites of the motor centers. One part of the cortical surface of the cerebral hemispheres represents the area where visual, acoustic, and other centers are located. Upon the stimulation of these areas there are no visible changes in the animal's condition observed. Finally, the major part of the cortex pertains to the so-called mute zones where irritation, again, produces no effects which would manifest themselves externally.

The method of irritation enabled the experimenters to establish the correct position of the motor centers only; for a more profound study of the functions of the cerebral hemispheres this method did not prove suitable.

Great hopes and interest were created at about that time by another method which had been developed -- the removal of parts of the brain. Various sections of the cerebral hemispheres were

removed or destroyed surgically, or by means of some chemical substances, also by freezing or burning out. Upon the animal's recovery, observations were carried out of the appearance of functional disturbances. The animal lost its hearing faculty, vision, and sensory properties of the skin. However, this method, too, proved unsuccessful. As soon as the location of the visual, acoustic, or tactile centers has been ascertained, the further use of this method could add nothing to our knowledge of the function of the brain.

We must also point out that the method of removal of parts of the brain caused negative sequels which originated in connection with the damage to the central nervous system.

As one scientist said, a physiologist who is attempting to study the functions of the brain by means of removing its parts, would appear in the same absurd position as a man shooting at a watch from a rifle in trying to learn the mechanism of its works. In inflicting rough damage to the nervous system, he, as Pavlov said, was causing "a veritable ruin of the nervous activity". The scarification of the nervous tissue which followed the damage completed the deep disturbances of the functions of the central nervous system. To this attest convulsions which often appeared in connection with the formation of scar changes in the brain of the dog after the inflicted injury. Even when the area of damage was small, the convulsions were so violent and frequent that the animal perished sooner or later.

Besides, removal of the cerebral cortex invariably leads to disturbances in other parts of the brain.

In evaluating the significance of the methods of stimulation and removal of parts of the brain for the purpose of studying its functions, one must come to the conclusion that neither of them justified the great hopes which had been originally entertained.

At the same time, one cannot deny the fact that with the aid of these methods a number of very important data have been obtained. The location of the higher motor and sensory centers has been demonstrated for the first time; with this, however, the usefulness of both methods has been exhausted.

The main tasks of the physiology of the brain is the study of the processes which are at the base of its psychic activity. The investigation approaches which existed at that time in physiology afforded no possibility of solving this basic problem.

Of even less value in this respect were various anatomical means of the study of the brain. There have been many attempts of this type, but the results proved to be of little value. One can name various scientists who tried to find the dependence between the weight or volume of the brain and its functions, and the relationship between the degree of development of various parts of the brain and the faculties of man. Some thought that the shape of the cranium corresponded to the development of various sections of the brain. The cranium, allegedly, develops certain protuberances, or curvatures. Phrenology, a quack teaching, stating that palpation of the cranial surface and its irregularities enables one to determine the faculties and character of man, became quite popular. The phrenologists claimed to be able to determine the presence of mathematical, philosophical, and the protuberance of matrimonial fidelity, as well as the one of the sense of justice; they could find, of course, one of religiosity.

Much attention was devoted to the attempts of determining the degree of development of cerebral functions by the distribution, shape, and the number of cerebral convolutions. However, scientific data have proven that these structure characteristics (weight, volume, convolutions) are too crude, and that they could not be utilized not only in the evaluation of isolated characteristics, but even of the general level of development of the functions of the brain. This pertains to the average indicators in a normal individual. Of course, the underdevelopment of the brain (mentioned above) which is expressed in its unusually small weight, corresponds also with its insufficient function, as is observed in hereditary idiotism (Oligophrenia). If, however, we speak of the average normal weight of the brain, even considerable variations of this index will tell us nothing as to the functional activity.

In regard to the number of convolution on the cerebral surface, it has been observed, that some singing birds (thrush) have a brain much richer in convolutions than the higher primates. This fact alone indicates that the significance of the convolutions is very relative.

It is interesting to note that one scientist has been saying all his life that the average brain of a woman weighs less than that of a man's. After his death, his brain was weighed; its weight was considerably lower than the average weight of a woman's brain.

We must emphasize, however, that the study of the brain structure bears important significance as to the evaluation of its functions. There are facts indicating that the methods of study of the fine brain structure, which are being developed now, especially

of the relationship of various microscopic elements (histology of nervous tissue, and the cytoarchitecture of the brain) have a great future. Future histophysiology, i.e., the joint study of the structure and functions of the brain, has indubitable perspectives.

We mentioned above the crude anatomical methods of investigation, particularly common in the pre-Pavlov era of physiology. The evaluation of the psychic faculties of man were made on the basis of these investigations. They are now abandoned on account of their unscientific character; still they are not forgotten by some and reappear once in a while. Thus, for instance, certain ideologists of fascism were attempting to utilize them.

One of the theoretical premises of fascism was the attempt to develop the "teaching" of the inequality of various races -- what is called racism. In their aim to justify the aggressive colonial policy of imperialism, the racists advanced an unscientific and inhuman "theory" which boiled down to the statement that humanity is divided into higher races -- masters and lower races -- slaves.

Unable to justify racism scientifically, its adherents are attempting to find "proof" in the antiscientific rubbish of discussions of the significance of the cerebral weight, volume, convolution, etc. long ago relegated to the archives. The racists find it convenient not only because it creates an illusion of a scientific foundation, but mainly because of the extreme complexity of measuring the true volume, surface, and other indexes of cerebral development. Since the brain normally represents a jelly-like mass, one can shuffle the figures at will, in determining the surface volume of a brain removed from the corpse.

We have already mentioned that, within the limits of the normal average of structure and size, no deviations (even considerable ones) in the weight or surface structure of the brain have any significance whatsoever in the evaluation of the level of the perfection of its functions. I. M. Sechenov took a sharply negative stand in regard to such attempts of connecting cerebral functions with the variations of its external, curdely anatomical features. He stated: "...the character of the psychic content is 99/100 conditioned by training in the wide sense of the word, and is only 1/100 dependent on the individuality. This does not mean, of course, that I wish to imply that one can change a fool into a clever man; it would be tantamount to giving his hearing faculty to a man born without the acoustic nerve. My idea is this: an intelligent Negro, Laplandian, Bashkirian, subjected to European training in European environment, can become a man, very little different

in his psychic content from an educated European."¹

The review cited above proves that the methods of study of the physiological functions of the brain during the pre-Pavlov period must be considered unsatisfactory.

Pavlov was well aware of it when he undertook the study of the function of the cerebral hemispheres. It was clear to him that the physiologists of his time did not possess satisfactory methods of study of cerebral hemispheres. This was particularly brought out by the following incident which occurred in the laboratory at that time. In discussing with one of his associates the results of an experiment which had been carried out on a dog, Ivan Petrovich completely disagreed with him. The talk was in regard to the observation of the so-called "psychic" salivation originating not when the dog was fed, but from the appearance and odor of the food when the dog was only shown the food. As usual, an argument ensued. The objections to Pavlov's point of view were based on idealistic positions and guided by the subjective evaluation of the condition of the animal. One man stated that the dog salivated because it was hungry, the other spoke of its agitation. Much later, when reflecting on the nature of the psychic activity in dogs, Pavlov said in recalling this argument: "An unprecedented event took place in the laboratory -- we were in sharp disagreement with each other on the interpretation of this world of ours, and we just could not arrive at some mutually acceptable conclusion."

He remembered one of his associates. Said Pavlov! "There he was, with his keen mind, able to understand the joys and triumphs of the investigating thought. How great was my surprise, when this true friend of the laboratory showed real and profound indignation when he heard for the first time of our plans to investigate the psychic activity of a dog in the same laboratory and with the same methods which we had used up to now for the solution of various physiological problems." The subject matter was the objective study of the physiological reflex processes in animals. Pavlov understood then already that "the contact of the true, experimental natural science with the ultimate threshold of life will not be effected without serious misunderstandings and clashes..." Nevertheless, he decided that the attempt to analyze psychic phenomena by identifying one's own mental state with the alleged mental processes in the dog, i.e., subjective treatment of phenomena, was absolutely useless. The problem could be solved by the objective method only.

The mystery remained unsolved. There was no clearness. One had to discuss conceptions, the investigation of which seemed to be

beyond the realm of possibility:

However the genius of the scientist could not reconcile itself to this state of affairs. There had to be an exit out of this blind alley. I. P. Pavlov wrote that he had soon become convinced that there was no sense, and no exact knowledge to be derived from a psychological approach to this problem -- that to start guessing what the dog feels, thinks, etc. would lead nowhere.

The stirred mind of Pavlov revived with new force an impression which had influenced him back in his adolescent days. He wrote of it at a later date:

"...the main impetus which prompted my decision, though I had not realized it at the time, was the influence of a talented brochure by I. M. Sechenov, the father of Russian physiology, under the title "The Brain Reflexes" (1863), which had impressed me a long time ago, during my adolescence. The effect of a new thought, strong in its newness and faithfulness to actuality, is always profound, especially when one is young..."¹ Pavlov, already then slated to corroborate experimentally the ideas of Sechenov, loved in later years to repeat frequently Sechenov's words:

"The entire infinite variety of the external manifestations of cerebral activity is reduced in the final analysis to a single phenomenon -- muscular motion. Whether a baby is laughing at the sight of a toy, or Garibaldi is smiling when he is being hounded for his excessive love of his country, whether a young girl trembles at the first thought of love, or Newton creates world laws and is writing them down -- there is always the final fact -- the muscular motion."²

Pavlov was the first to advance the suggestion that psychic salivation is nothing else but a typical reflex of the brain.

This thought, seemed to confirm Sechenov's words: "Let us enter the world of phenomena which is born as a result of cerebral activity. It is said that this world embraces the entire psychic life. It suffices to us, physiologists, that the brain is the organ of the soul, i.e., the mechanism which, once put into motion by whatever causes, leads in the final result to the aggregate of external phenomena which characterizes psychic activity..."

¹ I. P. Pavlov, "Complete collection of works" Vol. III, Book 1, Moscow-Leningrad, Published by the Academy of Sciences USSR, 1951, p. 14
² N. M. Sechenov, "The Brain Reflexes" In collection "Fiziologiya Nervnoy Sistemy", Vol. I, Moscow, Medgiz, 1952, p. 146.

Some are under the erroneous impression that it was Pavlov who discovered the very phenomenon of psychic salivation. The so-called "psychic" salivation was well known hundreds of years ago. Still, this phenomenon somehow remained unnoticed. Only the genius of Pavlov could reveal the importance to physiology of this simple, everyday occurrence. Only Pavlov was able to grasp that "any phenomenon of the external world could serve as the stimulation of the salivary gland. If this is the case, then we can obtain the reflection of everything of the outside world in the salivary gland. Obviously, the entire content of the so-called psychic function can be thoroughly investigated by objective means. The entire soul can be squeezed into certain rules governed by such objective study." I. P. Pavlov arrived to this conclusion after numerous laboratory observations.

Indeed, bread is shown to the dog, the dog begins to secrete saliva, though it receives no food. This is an example of the usual "psychic" salivation. Physiologically speaking -- it is a reflex, no doubt, but a reflex intimately connected with "psychic" processes at the same time. If saliva is secreted at the sight, smell, and in humans even at the recollection or imagination of food, can there remain any doubt that in these cases the physiological function -- salivary reflex -- is directly connected with various "psychic" state.

After a persistent reflection on this subject, after a difficult mental struggle, said Pavlov, he decided, in facing this so-called psychic agitation, to remain in the role of a pure physiologist, i.e., an objective outside observer and experimenter dealing exclusively with external phenomena and their interrelations.

Pavlov loved to stress: "To a naturalist everything is in the method."

Thus, the main event happened: a correct method has been found of studying what became known as "psychic activity" and what Pavlov later named "the higher nervous activity".

The strict objectivity of Pavlov's method of conditioned reflexes was inextricably connected with the idea that the entire activity of the central nervous system and all organic functions in general, are caused by certain changes in the external world which surrounds the animal, or by various processes which are taking place within the organism. In other words, all phenomena in the organism, the most complicated psychic processes included, originate and are effected under the influence of certain definite causes which are connected with various changes in the external or internal medium

of the animal.

The necessity of an objective approach to the study of phenomena required also an objective terminology. Terms connected with the idealistic conception of "psychic" were rejected, and "psychic salivation" was named a conditioned reflex. Thus, the group of "psychic" conditioned reflexes was contrasted against the natural (unconditioned) reflexes.

The basic differences between them were as follows: conditioned reflexes, in contrast to the so-called unconditioned natural reflexes, represented reactions which have been acquired by the animals in the course of their individual development. The conditioned reflexes can be as experiments have shown, unstable as compared to the unconditioned reflexes, they could disappear under certain conditions and reappear once more. In the realization of the conditioned reflexes the main role was played by the activity of the higher sections of the brain and its cortex, while unconditioned reflexes manifested themselves even after the removal of the large cerebral hemispheres in the animal.

Placing meat in the mouth of an adult dog invariably induces salivation. This is an unconditioned food salivation reflex. However, if the dog is only shown the meat, and not allowed to eat it (teasing the dog), salivation takes place just the same. This is a conditional food salivation reflex. In this case the mere sight stimulates salivation. A conditioned reflex of this kind is not innate, but is acquired by the dog in the course of its life. If a puppy, who has been receiving only milk and bread since birth, is shown sausage, there will be no secretion of saliva. If the sausage is brought close to its snout, the puppy will turn away and even growl; its attitude will be, as if the sausage were a stick, not food. However, if after showing the sausage, one succeeds in getting the puppy to eat it -- to reinforce, as it is said, the showing of the sausage with the act of eating it -- then the sight and odor of the sausage will invariably produce in subsequent tests a group of conditioned reflex in the form of movements of the puppy in the direction of the sausage, squealing, salivation, etc.

One can complicate the conditions of the experiment and form an artificial conditioned reflex parallel with natural ones. The feeding of the puppy can be accompanied by ringing a bell. If this act is repeated several times, it suffices subsequently to ring the bell only, without giving food, and the puppy will pull itself to the manger, where it usually receives food, will start sticking its lips, and salivate. Thus, the bell-ringing acquired the significance of a signal for the subsequent feeding, and the puppy acquired

conditioned reflexes (the motor and salivation reflexes) to the bell-ringing.

As a result of investigation conducted by Pavlov, the basic conditions were established which were needed for the formation and preservation of various conditioned reflexes. It turned out that any phenomena of the outside world which are capable of stimulating the nerve cells of the brain, can be used as signals for the formation of conditioned reflexes. It has been proved possible to produce a conditioned reflex not only to the action of a certain stimulant (light, sound); but even to the elimination of the continuously acting stimulants (for example, in connection with the onset of darkness after continuous light, or silence after continuous ringing of the bell).

Definite time intervals may serve as conditional stimulants. This was elicited as follows. The animal received food every ten minutes under strictly invariable conditions. After a certain number of these feedings, it was observed that the dog which remained standing quietly in its stand began to turn around, lick its lips, and pull to the manger; it began to salivate, though it received no food. Here was a conditioned reflex induced by a certain time interval. The time element also proved to be a real stimulant which, as Pavlov pointed out, could be subjected to exact investigation.

Following the formation of conditioned reflexes on the activity of the digestive organs, similar reflexes were established on the functions of the kidneys, cardio-vascular system, the processes of metabolism, etc. Thus, it was proven that, by means of a conditioned reflex, one can connect various activities of the organism and the functions of any organ with the cerebral cortex.

The fact that Pavlov investigated conditioned reflexes mostly on the salivary gland was due to the convenience of this procedure, as compared to others. Indeed, it was possible to measure correctly the degree of the reflex (by the quantity of the secreted saliva), and it was easy to evaluate the quality of the saliva (by analyzing its content); besides, the function of the salivary glands is to a large extent connected with the activity of the brain, and depends very little on the state of the organism.

The method of salivary conditioned reflexes was only one of the methods on the basis of which the regulating processes of the cerebral cortex were studied. Other investigators employed, as a conditioned-reflex method, the movements of the animal's extremities in response to a painful irritation. The results showed that Pavlov's selection

was more successful. This was partly due to the fact that the motor conditioned reflexes are less stable and are more difficult to measure quantitatively.

However, independently of the methods used by scientists to study salivary or motor reflexes, the conditioned reflex represents a universal function of the higher sections of the brain. As we have already indicated, any activity of the organism can be included in the conditioned reflex arc.

The conditioned reflex function of the brain is its universal function because it manifests itself under all life circumstances, when the animal and man have acquired experience. So far, we have learned only the most elementary types of conditioned reflexes, the examples of which we indicated above.

Of course, the true basis of psychic activity is represented not by these simple reactions only, but by a great variety of other, more complicated conditioned reflexes, by their most complex associations and combinations. The task of future study is to analyze these reflexes, but even at the present time, we are able to cite examples of some conditioned associations of a more complex character.

We described above an example of a conditioned reflex induced by the simultaneous employment of a conditioned and non-conditioned stimulation. This is the usual conditioned reflex. One can make this reflex, produced for instance by the flash of an electric bulb, a very stable one. In order to achieve this effect, we have to produce, as was pointed out previously, a large number of conditioned and non-conditioned combinations of stimulations. In the end, the conditioned stimulant acquires the stability and force almost equal to that of the non-conditioned stimulant. We can use in this case any other neutral agent, let us say, a bell, and begin to combine sound with light. After the repeated use of the two agents, we shall note that the bell has assumed the role of the conditioned stimulant. With the use of the bell alone, we shall induce salivation though at no time was ringing accompanied by feeding. A conditioned reflex of a second order has been formed. We can visualize the formation of a conditioned reflex of the third, fourth order, and so on; if we had been able to produce a very stable conditioned stimulant in the reflex of the subsequent order. A sort of multi-level conditioned reflexes will originate, of which each subsequent reflex is built on the preceding one.

The so-called associations, which have been long known in psychology but which up to now received no explanation, are closely

connected with these type of reflexes. The associations originate when two or more phenomena which accompany each other in time. A certain contact is established between the centers which affect these reactions. If one of these phenomena assumes the character of a conditioned stimulant, it begins to produce a reaction also under the effect of another stimulant. In this case, this stimulant, which has never been reinforced by an unconditioned stimulant, enters the contact as the second conditioned stimulant.

If we shall call the usual conditioned reflex a conditioned-unconditioned reaction, then in the case of association we must speak of a conditioned-conditioned reaction. Pavlov considered associations as the very basis of mental activity. "Why, this is exactly the way our mind works" he used to say, in observing associations in higher primates.

The complex conditioned stimulants play a very important role in the development of psychic activity. We generally use separate stimulants in the laboratory: bell, electric light, whistle, etc. Under natural conditions, however, the animal frequently comes in contact with a large complex of conditioned stimulants. For instance, the sun is rising -- the light is changing, the temperature and air movement are changing, the degree of humidity varies, the birds are waking up and fill the surrounding space with their cries. This sort of most complex aggregate of stimulants represents the conditioned stimulant for the definite conditioned reflexes of the animal. Even in the laboratory we come across some complex forms of conditioned reflexes, the so-called situational reflexes which originate in response not to isolated stimulants, but to complexes of stimulants which represents the entire setting of the experiment.

We shall finally take up a special group of so-called tracer conditioned reflexes. Up to now we cited examples of reflexes which were produced in response to one or another acting stimulant. Investigations have shown, however, that it is possible to form conditioned contacts not in response to a present, acting stimulant but to its traces. In a case of this type, the conditioned reflex has been formed as follows.

The bell rang for a while, then it stopped. One, two minutes passed, then the animal was fed. At this, the trace left by the sound stimulant, i.e., the residual stimulation in the central nervous system coincided in time with the agitation due to feeding. It turned out that the conditioned reflex could form also on the trace of the previously employed stimulant. It was manifested thus: During the action of the bell, the animal remained quiet, and continued to be quiet for a minute and a half following the ringing

of the bell. However, as the duration of the interval approached two minutes, i.e., the moment when the animal usually received its food, it began to show anxiety, the saliva appeared, the dog pulled itself to the manger.

Obviously, the stimulant in this case was the residual, or trace stimulation left after the ringing of the bell, and not the stimulating effect of the ringing itself.

The cerebral cortex possesses a highly expressed faculty to preserve traces of stimulations which it receives. To explain it we shall call your attention to our memory. The cerebral cortex, as is well known, can retain traces of impressions received by everyone of us even in early youth. These traces may be preserved for scores of years, even during the entire life. At times, these traces come back to life -- we actually live through some or other recollection.

It is easy to see, from the cited above, that the conditioned reflexes which are formed in the cerebral cortex on the traces of various stimulations are of the utmost importance to the processes of psychic activity.

These examples indicate that very complex forms of conditioned reflexes are at the base of psychic activity. Only certain types of these reflexes are known at the present time, many of them remain the task of future studies.

An important characteristic of a conditioned reflex is its mobility; its changeability. To be more precise -- the conditioned reflex can be very constant, or highly unstable, depending on various conditions. It depends on whether the signal significance of a conditioned stimulant is preserved or not.

If the animal receives its food while it is invariably accompanied by some sound, the latter will always retain its significance as a signal of feeding. The sound will produce a complex of food reactions which generally take place only upon feeding, though in this case there was no food present. However, if the circumstances change and the animal stops receiving food with this signal, the conditioned stimulant loses its value as a signal, and the conditioned reflex will gradually weaken, and finally disappear altogether. We witness here the faculty of the cerebral cortex to promptly remove unnecessary activity by means of utilization of its function of inhibition.

The conditioned reflexes are constantly changing under the

effect of the environment. This is the most characteristic trait of the conditioned reflexes which demonstrates their biological role in the adjustment of an animal organism. Indeed, the animal encounters most diverse stimulants in the conditions of its natural environment. There are the effects of light and darkness, sounds and silence, changes in the temperature and velocity of the air, changes in humidity, variations in pressure, etc. These and many other phenomena may, under certain conditions, serve the animal as signals of obtaining food or as warnings of the enemy attack. Any change in the external medium or in the internal state of the animal may become a conditioned stimulant or a conditioned signal. An "alternating signalization", as Pavlov calls it, takes place which is the more mobile the better the animal is adjusted to the environment.

What is described above represents the main thesis of Pavlov's teaching, as evaluated from the biological point of view. The highly important role of the cerebral cortex consists, in this respect, in its property to maintain stable associations with the external medium, with its stimulants which retain their value as signals, and in its inhibiting reaction to the stimulants which have lost their role as biological signals. This ensures the animal the possibility of an unlimited adjustment to the environmental changes. The formation of temporary functional associations corresponds to the conditions of the existing situation. This remarkable property of the central nervous system, reinforced through hereditary acquired faculties, is at the basis of development of the higher nervous (psychic) activity of animals.

The unconditioned reflexes represent reactions which are effected by animals immediately following birth (sucking, swallowing, sneezing, etc.). These reflexes are inherited, they are very stable, and are manifested in a stereotypic manner by all representatives of a given species.

The unconditioned reflex is a comparatively inert function, and undergoes reorganization under exceptional conditions only. It depends, to a great extent, on the stability of the nervous paths within the limits of which these unconditioned reflexes are effected. In case of sudden environmental changes, one seldom observes any adjustments of the unconditioned reflexes which would correspond to the new situations.

It must also be mentioned that the number of unconditioned reflexes which the animal possesses is quite considerable, and they are very diverse in their complexity.

The teaching of conditioned and unconditioned reflexes introduced a materialistic conception in the field of science, which hitherto has been mainly occupied with the study of so-called instincts, of which we shall speak later.

The amazing picture of the mobility of the processes of stimulation and inhibition in the cerebral cortex began to unfold gradually. The observer could study in detail the movement and distribution of these processes in the cerebral cortex. The experiments carried out by Pavlov and his students represented the true triumph of natural science.

It turned out that the process of stimulation or inhibition originating in a limited area of the cerebral cortex is capable of diffusion along its nervous cells (irradiation). As contrasted to this, is the concentration of the stimulating or inhibiting process, when the initially irradiated stimulation again becomes concentrated in a definite point in the cortex.

Remarkable experiments were conducted in the Pavlov laboratory, in order to observe the movement of the processes of stimulation or inhibition in the cerebral cortex. Pressure on various areas of the skin of dogs served as a conditional stimulant. The pressure was effected by means of small touch-devices which were attached to the skin ("kasalka"); and was accompanied by feeding. As a result, a conditioned salivation reflex was formed in response to skin stimulation. A group of such conditioned reflexes was produced by means of placing several of these devices in the skin of the dog's extremities, at some distance from one another.

To each point of contact of these devices, naturally, corresponded a definite point in the cerebral cortex where the corresponding stimulation was projected.

The conditioned reflexes which had been produced were very stable, so that their scope (measured by the quantity of saliva) was very constant under ordinary conditions. One of these skin devices was changed into an inhibition stimulant. It is possible to arrange one inhibition device situated among other stimulating devices. An area of inhibition was formed in the corresponding points of the cortex. By measuring periodically the scope of the stimulating reflexes from the devices situated around the inhibition device, one could easily trace the irradiation of inhibition, first from the initial point, then gradually involving all adjacent points in the cortex, and finally again concentrating itself in the initial point.

Harvey, the famous English physiologist, used the quantitative indicator for the analysis of the conditions of cardiac work for the first time in the history of biology. The genius of Pavlov soared much higher; he subordinated the physiological processes which are at the basis of the "psychic" states to a strict quantitative, numerical calculation. In a field where, until recently supremely, reigned fantasy, mysticism, and chaotic ideas, the experimenter was now able to ascertain the laws which govern the activity of the brain.

The precise quantitative calculation of phenomena, based on a correct systematic foundation, enabled Pavlov to elicit new qualitative regulations in the function of the brain and, particularly, in the interlocking activity of the cortical cells.

As new facts kept on accumulating in connection with the study of increasingly larger number of animals, it became clear to Pavlov that the force interrelation, and mobility of the basic processes -- the stimulating and inhibiting ones -- in the cerebral cortex can be completely different in various animals. This difference manifested itself with particular clarity in the pathological deviations in the so-called experimental neuroses. The genius of Pavlov manifested itself clearly in a new generalization when the teaching on various types of higher nervous activity appeared. The classification of animal types was composed, and the type extremes were differentiated -- the weak and the strong. New facts were brought out which demonstrated that the weak type rapidly loses, under difficult conditions, the faculty of normal functioning. These conclusions were confirmed during a calamity -- the great flood in Leningrad in September 1924, when the dogs had to be rescued from drowning.

The animals reacted violently to the situation. Some time later, when normal conditions had been reestablished in the laboratory room, the experimenter let a stream of water into the room from under the door; the dog, which up to then was resting quietly in its stand, suddenly went into a rage. It lost its faculty of a normal balanced reaction to all stimulants which had been customarily used in the experiments. It refused food and was trying to break out of the stand. Pavlov detected in it the characteristics of a pathological neurotic condition. He conceived the idea of experimental neurosis in dogs. A new fascinating page was opened in the study of conditioned reflexes.

Within not more than a year Pavlov developed the teaching of experimental neuroses.

Neurosis was produced under experimental conditions by means of the juxtaposition of an almost simultaneous action of stimulating and inhibiting agents.

Since the possibility of artificially inducing neurosis in animals by employing various effects became a proven fact -- a new perspective has been opened for the development of another field of study of cerebral activity -- the experimental pathology and therapy of higher nervous activity.

A number of experiments were carried out directed toward the search for methods of treatment of neurotic dogs. Drugs were tried out, among them -- the old favorite, bromide. The latter proved to be very effective in using bromide for therapeutic purposes, one discovered remarkable phenomenon. It turned out that the therapeutic efficacy of bromide depended to a large extent on the type of nervous activity. Positive results were obtained only when the dosage of bromide was adjusted to the individual characteristics of a given animal which corresponded to the type of its nervous activity. It was often necessary to increase or reduce the dosage ten or even hundred-fold in various cases according to the differences in the animal types and characteristics. If the same dose was used invariably on animals of various types, it could prove to be useful, neutral, or even harmful. This led to the important conclusion that measures of therapeutic action must not be used without discrimination, that they must be strictly individualized in accordance with the functional peculiarities of various types of nervous activity.

The subsequent study by Pavlov of the problem of types of higher nervous activity led him to the discovery of still another important phenomenon.

In studying the relationship between the stimulating force and the corresponding degree of excitation in the cerebral cortex, Pavlov noticed that the proportional increase of the process of stimulation effected through the increasing force of the conditioned stimulant lasted only up to a certain limit. When the stimulating force surpassed the limit of excitability characteristic of a given type of nervous activity, instead of a continuing increase of excitation, an opposite reaction would set in -- inhibition. One excitation would reach its limit and change to inhibition. One began to speak in the laboratory of the so-called "post-liminal inhibition."

What could be the physiological significance of this phenomenon / of post-liminal inhibition? In reflecting on this subject, Pavlov recalled some facts which he had observed some

time back, when he was studying the effects of the nervous system on cardiac activity. At that time, back in the eighteenth century, he advanced a suggestion, based on his observation, that cardiac nerves influence the metabolism and the nutrition of the cardiac muscle.

Pavlov visualized an active state of an organ as a reaction which eventually leads to exhaustion. In accordance with this conception, inhibition reduced the activity of the brain connected with excitation, thus creating conditions for the restoration of its capacity to work.

The conception of inhibition and its restorative role was applied to explain the essence of the post-liminal inhibition. As a point of departure, was the idea that the cerebral cortex is subject to exhaustion as the result of excessively strong excitations. The inhibition processes get into action for the purpose of preventing further exhaustion of the cerebral cells which otherwise could be dangerous to their life activity; under these circumstances these processes play an essentially protective role.

"Exhaustion," wrote Pavlov, "is one of the main physiological impulses leading to the emergence of an inhibition process as a protective mechanism."

In dogs of the weak type, it is liable to develop neuroses under trying experimental conditions, the post-liminal neurosis develops especially easy. Further observations demonstrated that post-liminal inhibition can play not only a protective role, but a therapeutic one as well. One began to talk of a protective or therapeutic inhibition. Thus another exceptionally important problem faced practical medicine -- the sleep therapy.

At the beginning of the present century, I. P. Pavlov in collaboration with his students definitely demonstrated that the essence of natural sleep represents one of the forms of cortical inhibition. An idea came to the fore that the regular sleep is a form of inhibition due to the exhaustion of cortical cells following the day's work. Sleepiness toward the evening, according to Pavlov, represents a "legitimate request of the cortex for some rest". Even stimulations of ordinary force, striking the tired cortex, acquired the character of extra strength and induced inhibition sleep.

Pavlov occupied himself seriously with the problem of the role and significance of inhibition sleep some time later, when he was expanding his studies of various types of neuroses. It came about as follows.

Under the direct impression gathered from the observation of neuroses in animals, Ivan Petrovich turned to an analysis of certain mental diseases in man. He became interested in it first in 1918. The data which he had collected in the study of experimental neuroses enabled him to correctly interpret certain forms of mental disturbances. It became clear to him that the disturbance of sleep has some significance in the understanding of a disease.

In this respect, particularly instructive was the case of a patient K. who has remained in a sleep-like state, a so-called lethargic sleep, almost continuously for 20 years. Cases of a lethargic condition were observed previously, but the observations on K. acquired a particular interest in view of the exceptional duration of this illness. Pavlov himself participated in the observation of the patient. During the process of recovery, the patient would wake up occasionally to take food (he was receiving liquid food during his sleep through a sound which introduced into the esophagus). He would wake up only at night when the daylight noise, slight as it was in the hospital, would completely die down. Under these conditions his nervous system, capable to cope with a minimal amount of stimulation only, retained certain excitability. Even at the slightest, most insignificant stimulus -- slamming of a door, or entrance of the ward attendant -- the patient would again sink into sleep. The post-liminal protective inhibition would assert itself in the cerebral cortex. This reaction served as protection to the patient and his weak nervous system from stimuli which assumed the character of "super-irritations".

"It seems to me," Pavlov used to say, "that while inhibition is present in man, there is no need to lose hope. Here, a man has been lying like a living corpse for twenty years; only inhibition saved his brain from irreparable ruin."

The results of these observations led Pavlov to definite conclusions. Sleep, be it pathological or normal, represents a defensive, protective reaction for the benefit of the nervous system. "A periodical normal sleep," said he, "is unquestionably the result of exhaustion... sleep is a state of inactivity, of rest of the large hemispheres." The logical deduction followed that it is possible to employ sleep as a therapeutic measure in certain forms of mental diseases. The first attempts brought remarkable results in some cases.

Narcotics were used abroad to put patients to sleep. The question in connection with this was whether the therapeutic effect was due to the physiological sleep or to the effect of strong narcotics.

Only the students of Pavlov employed the therapeutic effect of sleep on a correct basis. In using mild soporific drugs, instead of powerful narcotics, they tried to prolong natural sleep.

Pavlov's deductions received full justification when his closest associate, M. K. Petrova, began to employ as a therapeutic measure hypnotic sleep, not connected with the administration of alien to the body narcotic drugs, even if they were given in small doses. The introduction into practice of electro-sleep also represents an important achievement.

The correctness of Vavilov's teaching of sleep therapy has been amply corroborated by the positive results obtained at present in many therapeutic institutions. The sleep treatment of certain mental and nervous disorders proved to be very effective. It is of definite benefit in certain cases of treatment of the so-called internal diseases (hypertonic and ulcer diseases) which develop on account of prolonged pathological disturbances of the nervous system. However, the use of sleep therapy must be limited to a definite circle of diseases: widening it beyond this circle may only be harmful. There are diseases which must not be treated via inhibition (sleep), but on the contrary by means of the stimulation of the central nervous system.

The observations of people placed before Pavlov the problem of the differences in the higher nervous activity of humans, as compared to that of animals.

In continuing his observations on patients at the psychiatric clinic which had been specially created at his laboratory in 1931, Pavlov came upon a new remarkable generalization. In 1932 he drew up the first outline of his teaching of the two signal systems of conditioned reflexes in man. But before we shall come to this special question of the characteristics of the higher nervous activity in man, we must summarize what had been said above.

I. M. Sechenov was the first naturalist-scientist who, with extraordinary courage (particularly for his time), asserted that any manifestation of mental or sensory activity is based on the reflexes of the brain. Experimental proof of this "genial sweep of Sechenov's thought," as Pavlov expressed it, came much later, but even at that time his contemporaries fully valued the great significance of the materialistic ideas of Sechenov. The progressive elements of the community, especially the students and youth, gathered around the name of Sechenov, as if around a banner which inspired them to fight for materialistic science, and against mysticism and obscurantism.

The tsarist officials and the representative of clergy guessed that the essence of Sechenov's teaching was being directed as a powerful thrust against the mythical ideas of the soul, that is, was destroying the very strong hold of idealistic religious interpretations of psychic and psychic activity; they declared an implacable war against Sechenov and his book "The Brain Reflexes".

Valuyev, the tsarist minister of internal affairs, stressed the "harmful" trend of "Brain Reflexes" in stating that, to interpret in a popular book even from a physiological point of view, the internal psychic functions of man as the result of external influences on the nerves and as the reflection of these influences in the brain, means substituting the teaching of the immortality of the spirit with a new teaching which recognizes only matter in man.

The Kiev archbishop Boris published a book "On the Impossibility of a purely Physiological Explanation of the Psychic Life of Man". It is not difficult to see that even the title is directed against I. M. Sechenov. It is known, that Sechenov had to change the original title of his book at the request of the tsarist censorship which had forbidden the title which Sechenov had originally given to his book: "An Attempt to Introduce a Physiological Basis in the Psychic Processes".

Thus, the secular as well as the clerical powers bore down on Sechenov and his book in regard to which the censorship attempted to do all it could to prevent its publication. True, the legal trial of Sechenov did not take place, since the indubitable outcome of the trial would have made Sechenov even more popular; however, the tsarist bureaucrats succeeded in forbidding the publishing of the book in the *Sovremennik* /Contemporary/, a journal edited by N. G. Chernyshevsky. Permission was granted to publish it in the journal *Meditsinskiy Vestnik* /Medical Herald/ which had a comparatively small circulation. At this, the clerics and bureaucrats entertained hope that the new title "Brain Reflexes", in view of its vagueness (in the 1870's) would limit the circle of people who could become interested in this work.

Nevertheless the materialistic views of Sechenov became widely known and popular already at the time when the book was forbidden, and the progressive readers used the handwritten texts of the issue.

In spite of the persecutions and injunctions, "The Brain Reflexes" opened a new page in science -- the materialistic analysis of psychic activity.

Over fifty years of indefatigable research by Pavlov and the

legion of his students corroborated experimentally the correctness of the theoretical premises of Sechenov. Pavlov created an objective method of study of psychic phenomena which put an end to the fruitless attempts of using a subjective method in psychic research. The scientific objective method of study permitted an elucidation and correct description of the basic regularities of cerebral functions.

Within a short time, the method of conditioned reflexes grew into a theory of conditioned reflexes; the teaching of higher nervous activity originated. It was proved incontrovertibly that, in spite of the complexity of the external manifestations of behavior, at the base of it are the mechanisms of conditioned and unconditioned reflexes, in their multiple diversity of combinations and interrelations. There are no other but reflex reactions in the brain. This conclusion, thus, became the mainstay of the materialistic monism of Pavlov. The myth of the allegedly existing soul, a substance self-reliant and independent of the body, which in various hues is invariably the essence of any religious belief, has been completely discredited.

The teaching of Pavlov irrefutably proved that the entire substance of psychic activity can be understood by means of objective methods of investigation.

Having completed the gigantic work of substantiating the materialistic theory of the so-called activity of the soul, Pavlov advanced the study of the most important problem connected with the need of eliciting the causation (the determinant factor) of the psychic phenomena. Hence, the origin of ideas and studies which demonstrated the formation of nervous activity under the effect of external stimuli, depending on their various types.

This very idea of the formation, i.e., development of higher nervous activity and its variability is in itself highly interesting. The causative conditioning, the dependence of the processes of higher nervous activity on external conditions leads to the idea of the possibility of interfering in these processes by means of influencing the external conditions and circumstances.

The Effect of the Environment of Psychic Activity

"Any more or less important change in the living conditions of any species of animals acquires the character of permanence, and causes in the individuals of these species a true change in their requirements. Any change in the requirements of the animals calls for new measures to satisfy these new requirements and thus leads to the formation of new habits."

J. B. Lamarck (1744-1829)

Way back, during his initial investigations, when he studied the physiology of blood circulation, Pavlov advanced for the purpose of experimental study the problem of the unity and bond between the organism and his environmental conditions. This problem in its theoretical aspect was posed still earlier by Sechenov. Sechenov evaluated correctly and profoundly the role of the environmental factors in the life activity of the organism. He pointed out the impossibility of giving a scientific definition of an organism without the idea of the medium in which the animal lives. This theoretical premise required experimental corroboration. And this is what Pavlov and his pupils have done in their investigations in the field of physiology of digestion and, especially, in the realm of the physiology of brain.

The study of a new group of reflexes discovered by Pavlov enabled him to understand thoroughly how the bond between the higher animals and the surrounding medium is being effected. While the interrelations of the lower animals with the surrounding medium can be limited to rather primitive and constant reflexes -- the inherited unconditioned ones -- the diversity and mobility of the reactions of higher animals to their environment requires another type of reflexes. The conditioned reflexes ensure this accommodation of animals to the changing conditions in the external medium. Pavlov, thus, showed the substance of the environmental adjustment of animals which Darwin had postulated.

Pavlov extended the method of conditioned reflexes, as a means of study and explanation of the most complex so-called soul -- or psychic -- manifestation of the activities of the organism, to all

highly organized animals.

Thus came to life the comparative, or evolutionary physiology of higher nervous activity.

As if mapping out the program of further investigations in the field of physiology, I. P. Pavlov wrote at the dawn of our century: "...a new and unlimited field of fruitful study is opening up, the second immense part of the physiology of the nervous system -- the one which established mainly the relationship, not between separate parts of an organism with which we have chiefly occupied up to the present time, but between the organism and the surrounding medium."¹

According to the physiological teaching of Pavlov, evolution was connected with the fact that the nervous system of higher animals ensured their adjustment to the conditions of the external medium on the basis of formation of temporary associations. This is the physiological essence of the evolutionary process. The influence of various environmental factors on the evolution of various organs of the animal were effected accordingly.

The animals are capable of behavior adjustment and are, thus, able to distinguish various stimulants according to their biological significance.

"It is perfectly obvious," wrote Pavlov, "that the entire activity of the organism must be regulated. If the animal were not to use a biological term accurately adjusted to its environment it would sooner or later ceased to exist. If an animal, instead of heading for food would shy away from it, or instead of running away from fire would throw itself into the flames, etc., it would have perished in one way or another. It must react to its environment in such a manner that its reactive activity serve to insure its existence."²

Thus, the study of the problem of unity of higher animal organisms and their environment is, in essence, the study of the balanced adaptability of the higher sections of the central nervous system to the surrounding medium.

The comparative physiology of the conditioned reflex activity consists of the study of the characteristics of the higher nervous

¹ I. P. Pavlov, "Complete Works," Vol III, Book 1, Moscow, Pub. House of Acad. Sci. USSR, 1951, p 28
² I. P. Pavlov, "Complete Works," Vol IV, Moscow, Pub. House of Acad. Sci. USSR, 1951, pp 22-23

activity in various animals. It created certain premises in the development of the direction of the study of higher nervous activity, which emphasize the conditions of existence of various animals, i.e., the so-called ecological factors. Ecology, in its turn, has been enriched by the influence of the teaching of conditioned reflexes;¹ it became possible to demonstrate how the higher nervous activity of an animal is formed under the effect of external natural influences.

The ecological trend in physiology, especially in the physiology of the higher nervous system expresses the unity of the teachings of Michurin and Pavlov. At this, being a comparatively new trend, it is not sufficiently appreciated by all concerned.

Even among ecologists-specialists one can find an incorrect attitude to the ecological trend in physiology.

One can agree with those who are attempting to establish a basic principal difference in the task and methods of investigation in physiology and ecology. Thus, for example, some pointed out that physiology, allegedly, is only engaged in the study of the processes in the organs of the animals, while ecology represents the reaction of the entire animal organism to its environment.

If we have in mind the pre-Pavlov physiology in regard to its relation to ecology, this premise would be true.

But, if we are discussing the new physiological teaching created by Pavlov, especially his idea of the unity of the organism and its environment, then we must emphasize that it was Pavlov who first in physiology showed the need for ecologic studies of animals and for an ecologic approach to the study of the higher nervous system, in particular.

The ecologic studies offer a convincing proof of the unity of the organism and the conditions of its existence. However, the implementation of these studies in physiology meets with a number of serious difficulties; most of them are mainly connected with the fact that the investigations must be carried out under natural, normal conditions. Taking this in consideration, we, in our ecologic laboratory investigations, employed such effects which would as near as possible reproduce certain natural stimulants. We tried to study in this manner the largest possible number of analyzers of the animal, and just as in the study of the largest possible number of various reflexes (motor, cardiac, respiratory, and the gastro-

¹ Ecology -- the science of the interrelation between the organism and its environment.

intestinal tract); we were hoping to obtain the characteristics of various working mechanisms and functions of the organism.

As a method of investigation which justified our expectations, we used a comparative study of representatives of kindred species which lived under diverse environmental conditions (hares and rabbits, wild and domestic ducks, partridges and chicken, etc.). In other instances, we used as objects of study some animals which, in their natural habitat, showed clearly expressed evidence of environmental adaptation (beasts of prey, beavers, etc.).

The results of observations thus conducted attest first of all to the fact that various animals react, depending on the peculiarities of their environment, precisely to those stimuli which are characteristic of their natural habitat. It has been proved, that of various sound stimuli which affected the observed rate of cardiac contractions, only the sound of splashing water caused in wild waterfowls a marked acceleration of the heart beat (from 176 per minute to 250 upon stimulation). Other sounds originating, for instance, upon breaking of splinters, whistle, bell ringing, etc. hardly affected the rate of cardiac contractions, as checked electrocardiographically. The river beavers, the environmental conditions of which are highly original and typical, enabled us to collect hitherto unknown facts of their respiratory and cardiovascular reflexes. Precise methods (electrocardiography and pneumography) were used for the purpose of registration of cardiac and respiratory activity. Stimulations and reactions to sound, light, and smell were observed.

It turned out that the very presence of illumination (the beavers are night animals) caused marked changes in their respiratory and cardiac activity: the respiration is accelerated and assumes a superficial character, the cardiac beat is slowed down.

The beaver leads a doubly life (aqueous and terrestrial). Accordingly, the sound stimuli, connected with one or the other medium (water splashing, breaking of splinters, cracking of leaves) caused marked respiratory and cardiac reflexes.

It seems that, in connection with the night manner of life which requires the ability to orientate oneself in the darkness, the odor analyzer in beavers has a particularly acute sensitivity. A particularly strong reaction in the form of a sudden halt in the respiratory movements were observed in these animals in response to the smell of a castoreum spray. A strong but artificial stimulus like acetone caused only a reduction in the respiration intensity, without a change in its rate.

Very good results were obtained in the experiments with wild ducks.

First, their ability to differentiate olfactory sensations was tested. As indicator of this differentiation, we employed the change in their respiratory movements registered by means of an elastic air chamber. As stimuli we used: tar, ether, ammonium, mint, acetic acid, thymol. All these reagents had no effect on the respiratory movements. A constant and well expressed reflex of accelerated respiration was obtained with rosemary. Of course, only the olfactory stimulus was changed, all other conditions remaining unchanged in the experiment. Presumably, the presence of a selective reaction to rosemary is due to the fact that the ducks fly to the Mediterranean zone for the winter and feed there on grass which contains rosemary in its esters.

In testing various sound stimuli we observed slight, often fading reactions as, for example, to the metronome. The orientation reflexes to the sound of splashing water were more constant. Only in one case, when a so-called "manok" (a little device for imitating the sounds of the natural quacking of ducks) was used, we obtained in response a very stable and constant motor reaction which reflected itself also on the register of respiratory movements. This reflex is so stable that we conceived the idea of utilizing it as an unconditioned "reinforcement" for the formation of the conditioned reflex, which we successfully accomplished.

We collected much data on the formation of conditioned reflexes in various fish. In osseous fish (slabs) the protective conditioned reflexes to light were developed on six-eight combinations of the stimuli with an electric current, and in bottom dwelling fish (sea ruff) the conditioned reflex to light could not be developed even after 345 combinations. In the skate (Trygon Microps) which habitates in shallow creeks, the conditioned protective sound-reflex appeared after five to eight combinations; in thorn-skates which habitate at deep sea bottom the same reflex could be obtained only after several scores of combinations.

The study of various reflexes in rabbits and hares showed that particularly clear and constant respiratory reflexes are formed in these animals only by a definite group of stimuli. Rustle was one of the sound stimuli, the movement of some object in the field of hare's vision was one of the visual stimuli.

Interesting data were obtained in the study of stimuli in touching various areas of the skin. It turned out that, in rabbits, the so-called tactile stimulations either caused no changes on the

pneumogram, or affected it in a significant and similar manner, independently of the area of stimulation. A different picture was observed in hares. Their reflexes in the form of the acceleration of respiration were generally expressed more strongly than in rabbits. Stimulation of the skin of the neck behind the ears elicited very constant reflexes.

We could continue with the description of similar facts which had been observed in other animals and under stimulations of a different character. But even the cited data ought to be sufficient to show that of all environmental stimulants similar in their physical characteristics, the most outstanding are those which bear a particularly close relationship to the hereditary properties of a specific type of animal, and none others.

This is presumably explained by the fact that certain specific stimuli have been present for many centuries in the environmental complex of a given animal, and their effect has been therefore reinforced in the special nervous structures by means of heredity.

The conception of the so-called adequacy, or of the correlation between the conditioned and unconditioned stimuli in comparative physiology, does not, of course, effect one of the general principles of Pavlov's teaching -- that any change in the external or internal medium may act as a conditioned stimulus. However, in acknowledging this fact, we must not doubt the possibility that, in the unlimited number of possible stimuli, one of them may prove to be more effective, and others less effective. This will depend on how close a given stimulus is to the natural environment and manner of life of the animal. Only in this sense can we state that, in comparative-physiological investigations, the most important element is not so much the physical or chemical property of the stimulus as its relation to the specific environmental conditions of a given animal. This relationship determines the final adaptation effect which appears in response to the stimulus used.

The above cited experimental data confirm this thesis. The writings of Pavlov also attest to it. In his very first of the "Lectures on the Function of the Large Cerebral Hemispheres" he cites an example of the natural and not the artificial stimuli. He speaks of the sight and the sounds of a powerful beast and their significance as signals to a small animal. "The essential feature of the higher nervous activity," writes Pavlov, "consists here not of the action of numerous signal stimulants only, but also of the essential fact that these stimuli change their physiological action under certain conditions. The external medium in which the animal lives is so infinitely complex and is in such constant

state of flux, that the complex closed system of the organism can have a chance of balancing it only if it, too fluctuates correspondingly."

In connection with this, the significance of the same stimulus to the animal may manifest itself differently.

All above cited examples referred to the inherited characteristics of the animal nervous system. However this selective attitude to external stimuli may take place also in the case of an acquired, fixed life experience.

When a certain phenomenon has remained for a long time within the environmental circle of the life of the animal, it can very easily assume the role of a conditioned stimulus.

This rule retains its strength in relation to man also. We observed, in the case of a patient, a driver by occupation, that the conditioned reflexes to a flash of a red light were formed instantly.

When we employed stimuli, we noticed that the very sound of a human voice, among other sounds, proved to be most effective even in cases where the words used as stimuli were entirely unfamiliar and not understood by the subject under experimentation.

Thus, the significance of the environment in the formation of the function of the organism must be evaluated not abstractly, but concretely and in connection with the relationship of various animals to the concrete conditions of the external medium.

Pavlov taught it, and the works of Michurin attest to it convincingly.

According to Michurin, the plant organisms possess a selective faculty of accommodation to the external environments. This selective property represents the result of the historic adaptability of the preceding generations to the conditions of the external medium. In its unity with the external medium, the organism manifests an active relationship to environmental effects.

In acknowledging the correctness of this thesis in regard to plants, we consider it even more important to appreciate its significance when applied to the animal organism.

I. I. Pavlov "Complete Works" Vol. IV, Moscow, Pub House of Acad. Sci USSR, 1951, p 30

The complex construction of the animal organism, the inter-connection and interaction of its organs controlled by the nervous system, the multiform effects of the environment on the organism -- all this renders the problem of the interrelation of the animal organism and its environment very difficult to study.

In studying the problem of the mechanism and its environment in the frame of evolution, we stop to think, first of all, of the paths which the organism follows in adapting itself to the conditions of existence which constitute its environment. Keeping in mind especially the higher nervous activity, we often stress the fact in accordance with various statements of Pavlov, that its evolutionary progress is manifested in the acquisition of the property of a finer and more accurate adaptation to the surrounding medium. This point of view is correct but it has an one sided character. The precision and finesse in the functions of various sensory organs do not yet in themselves clarify thoroughly the essence of the problem. Engels pointed out long ago that an eye of an eagle sees much farther than of a man, but a man sews in things much more than does an eagle.

In concentrating their attention on the refinement and accuracy of the work of the analyzers, some scientists are forgetting the following admonition of Pavlov: "The biological essence of the conditioned reflexes consists of the fact that the scanty external stimulants of unconditioned reflexes become connected, under certain conditions (coincidence in time), with the innumerable phenomena of the external medium which serve as signals to these reflexes. Thus, all organic activities -- effects of the unconditioned stimuli -- enter into finer and more precise relationship with the reflexes -- enter into progressively larger regions (spacing of last phrase of D. Biryukov).

The stressing by Pavlov of the progressively increasing regions of adaptation is very important to the understanding of the problem of the evolutionary progress of the animal organism.

There is no doubt that the evolution of species is connected with the direct expansion of the area of habitation. A very legitimate question arises in connection with it -- whether this peculiarity of the evolutionary process does not lead to the phenomenon that the animal, in expanding the circle of its adaptation reactions, is capable at the same time to reduce the "finesse" of the work of separate analyzers. According to the data of the Polish scientist, Ja. Dembowski, a spider accurately reacts to the oscillation of the web when it corresponds to the frequency of movement of the wings of an insect which is its food -- the spider

achieved high skill precisely in this respect.

The results of our investigations brought out many instances of high specificity of animal reactions to the effect of the external medium, even in cases of rather low level of higher nervous activity.

It follows that the degree of the general development of the higher nervous system can not be determined solely by the degree of perfection of one or another organ of sensation.

We happened to carry out observations on an eagle. Our attempts to take down an electrocardiogram were connected with great difficulties, for the eagle was very "aggressive" and, besides, had just been recently caught. An idea came to us to blind his eyes. When this was done, the eagle seemed to have become paralyzed, he did not move and was amenable to any manipulation. It is not surprising, if we recall the ancient manner of falcon hunt. In this type of hunt one puts on the head of a falcon, or the golden eagle a small hood which covers its eyes. It then remained sitting quietly on the shoulder or arm of its master. Upon the appearance of a hare, for instance, the hood was taken off. The bird of prey would swoop down on its victim. Upon retrieving the hare, one would again put the hood on the bird's head.

The elimination of one analyzer, true a highly perfected one, attests to the fact of how insignificant is the role of other analyzers in the relationship between the eagle and its environment. Indeed, the usual habitat of the eagle almost completely excludes the effect of sounds or odors, but the sharpening of vision is vitally important to it.

In connection with the study of the ecologic correlation of stimuli, we came across another important circumstance. In a number of cases we happened to observe the exceptional strength, the "inextinguishableness" of the conditioned reflex which has been formed in response to corresponding stimuli. Certain stimuli, used in the experiments, invariably caused one or another effect: change in respiration or acceleration of heartbeat without a subsequent extinction.

We shall cite a few examples. A conditioned reflex was formed in a hare by means of a conditioned stimulus which in this case was the sound of clucking to the natural one, which accompanies the animal's sucking of the breast. It was "reinforced" by a visual stimulation (movement of an object in the field of vision) and a tactile one -- stimulation of the skin in the area of the neck.

The conditioned reflex appeared after the third combination. For almost two years after formation this reflex was fully preserved, despite the fact that the conditioned reflex was used about 2,000 times without its reinforcing stimuli. When, with the same reinforcement a conditioned reflex was produced using a metronome, it faded out without reinforcement within a comparatively short time -- after ten sances.

Obviously, in the first case a combination of two stimuli, close to the animal, took place -- the conditioned and the unconditioned; as a result, an unusual stability was created in the conditioned reflex.

We have already mentioned a number of cases where the fading of the reflex did not take place. We had examples -- the reflexes on the heart in wild waterborn birds upon splashing of water, the motor reflexes to the sound of "manka" in wild ducks, the respiratory reflexes in hares to the sound of rustle of paper, onto the movement of an object in the field of vision.

Our laboratory received once a brood of baby foxes removed directly from the lair. The use of various sounds, including that of a squeak of a mouse, caused no reaction in the little foxes. However, as soon as the baby fox had eaten a mouse for the first time, a stable conditioned reflex was formed to the squeak of a mouse. These reflexes also proved to be practically inextinguishable.

The examples of "inextinguishable" conditioned reflexes lead to the assumption that the reflexes on splashing, "manka", Beckoning, rustle, etc. are not of the unconditioned reflex type, but represent special conditioned reflexes. Presumably, certain circumstances connected with their origin, some ecologic adequacy of stimuli of a conditioned and of an unknown to us unconditional character, made these conditioned reflexes resemble unconditioned ones in their stability.

The above described facts attracted the most lively attention, for they touched upon a very important problem of the transition of conditioned reflexes into unconditioned ones and, thus, enabled us to approach the study of the physiologic mechanisms of the inheritance of the acquired temporary associations.

The large factual material which we had collected in our laboratory by means of an objective method, as well as the literary data, attest to the fact that the ecologic correlation of the stimuli represents the determining condition for the formation and the stability of a reflex. This has the closest relationship to the

problem of the inheritance of acquired characteristics.

The Michurin biology regards the process of adaptation as the integral element in the inheritance of the characteristics which the organism acquired in the course of its individual development.

Pavlov, too, was in full accord with this view, and thought that some conditioned reflexes eventually change into unconditioned ones, thus becoming inherited reflexes.

The research of the two great modern naturalists, I. V. Michurin and I. P. Pavlov demonstrated the complete inconsistency of the metaphysical ideas of the followers of Weismann and Morgan, who denied, as is well known, the possibility of inheriting acquired characteristics.

Having established the fact of mutation of organisms in the course of evolutionary development, Darwin deviated to a great extent from the task connected with the search of the causes underlying this variability. Moreover, the question of the necessity of active interference in the processes of the mutability of the organism completely escaped his field of vision, which is explained by the limitations of the bourgeois outlook which formed the basis of Darwin's views.

This great task was undertaken by I. V. Michurin and I. P. Pavlov.

Michurin not only conceived the idea, he actually developed the scientific ways of plant mutation. His outstanding practical achievements in this respect are widely known.

The teachings of Pavlov and Michurin, kindred in spirit, developed along the same path; common to both was the striving for an active intervention in the life phenomena which were the object of their study.

This was in accordance with the requirement of the materialistic dialectics which served as the basis on which Michurin and Pavlov were developing their scientific theories. The Michurin teaching interpreted the causes of mutability and, thus, naturally, advanced the most important task of a directed change in the properties of an organism.

The same trait characterizes, in the most brilliant manner, the physiology of Pavlov.

I. V. Michurin improved with great mastery the nature of plant organisms. I. P. Pavlov constantly kept in view the task of improving the functions of the animal organism. Let us cite one example. In developing his teaching of higher nervous activity, Pavlov showed that, in spite of the differences in the higher nervous activity of various animals, one can isolate among them several groups more or less similar as to the properties of their nervous system.

As the basis of his teaching on the varieties of nervous systems, Pavlov enumerated the following characteristics of cortical nervous processes: 1) the force of the stimulating and inhibiting processes; 2) the degree of equilibrium between the stimulating and inhibiting processes; 3) the mobility of the stimulating and inhibiting processes. Questions arose in the study of higher nervous activity, how is the type of higher nervous activity formed in an animal, what in the organism of the animal is dependent upon inherited characteristics of the nervous system, and what is acquired in connection with the conditions of development and life, and what can be changed into the desired direction. These questions were studied by Pavlov in a specially constructed genetic station in the village of Koltushi, near Leningrad.

Conscious of the great value of Pavlov's research, the Soviet Government especially assigned large sums of money for the construction of this scientific combine, the greatest in the world, where, in addition to a large number of laboratories, nurseries were created for the bringing up of animals from known and studied parents.

The construction of this scientific little city -- "the capital of conditioned reflexes" as Pavlov named it, was completed in 1935; Pavlov himself could not expand to the full extent the investigations which he had planned, though some important experiments had already been carried out before his death.

A litter of puppies taken from a female was divided into two groups. The puppies of each group were raised separately. One group was allowed to run around freely, to play together and to meet other animals and humans. The puppies of the second group were raised under the conditions of strict isolation. They were never allowed to leave their cells, they saw no other dogs, etc.

When the animals of both groups grew up, they were subjected to tests by the method of conditioned reflexes. The qualitative differences in the higher nervous activity of the representative of each group were markedly expressed. Puppies raised under normal conditions did not differ from normal animals, while the puppies raised

in isolation cells showed the weakness of their nervous activity.

At each new stimulus, the usual ringing of a bell, for instance, the dog was pressing itself to the floor, trembled; it developed to a marked degree the so-called passive-protective reaction. These tests proved convincingly the role of the environment in the development of higher nervous activity.

In Pavlov's laboratory special observations were carried out which were directed toward the solution of the problem, whether one can strengthen a weak nervous system in an animal, whether one can reinforce its basic processes such as, for example, the processes of inhibition. These tests brought positive results. It turned out that by means of education and training, one can strengthen and reinforce the functions of the brain. On the basis of his own observations and the work of his pupils, Pavlov became convinced of the possibility of improving the weakened functions of the organism.

Pavlov spoke, in connection with this, of his dream to perfect the types of higher nervous activity to the highest possible limit.

At the time of Michurin the servants of religion were indignant at his aim to change the properties of plants with the view of improving their quality. One of the priests demanded that Michurin cease his fruitful experiments in the alteration of plant organisms, even requested the closing of the nursery, "this seat of depravity which corrupted the hearts of believers". One can not refuse a certain foresight to this servant of a cult who was able even at the start of the creative work of Michurin, to realize what a crushing blow can the teaching of Michurin inflict to the religious ideas about the "Divine Providence", which allegedly controls any and all organic changes. It is obvious that an irreparable gap in religious dogmas was created by Pavlov's teaching, in which he stated that the physiologist could actively interfere with the realm of the soul -- this domain since eons of time forbidden to man.

Religion proceeds from the premise that the world itself is unchangeable and passive. Not a single hair will fall off the man's head without the will of God -- so state the theoreticians of religion. Whether one speaks of disease -- it is the punishment by God, of recovery -- it has to be asked of God, same as with drought or rain, fertility of cattle, etc. -- everything is granted, sent down by God. The ideal of a religious man, of a true son of God, or, as the clerics say, "God's slave" is that of an individual absolutely devoid of will, totally obedient to a higher completely unfathomable, and mysterious force.

The teaching of Pavlov inflicted a crushing blow to the religious conceptions of the unchangeable and divine substance of the soul, and demonstrated the possibility of a directed modification of psychic activity as the result of changes in the environment.

Is there Psychic Life in Animals?

"The faculty of consciousness, of systematic actions develops in animals in accordance with the development of the nervous system, and reaches in mammalia an already sufficiently high degree."

F. Engels

The presence of psychic faculties in animals seems rather in disputable to the majority of people.

Can someone doubt the intelligence, ingenuity, and shrewdness of his dog or cat? The same can be heard from the lovers of horses. All these animals, according to their masters, understand when they are spoken to, get offended, deceived, etc.

Let us analyze these conceptions: intelligence, understanding, ingenuity, offense, deceit, etc. irrespective of whom they concern. We shall have to admit that they constitute the basic psychic processes and states which are familiar to us, first of all, on the basis of personal experience and impressions. We should, thus, acknowledge that there are no differences in the psychic processes which are taking place in man or animal. Will this conclusion be correct? In speaking of the theory of Darwin, we have already had an occasion to state that everything living in the world is developing gradually and reaches progressively higher and higher steps on the evolutionary ladder.

This law embraces also those functions of the nervous system which are connected with the so-called psychic processes.

In the chapter devoted to the question of instincts we shall attempt to clarify it as much as possible.

Every function of the organism undergoes a process of evolution, which means that the psychic faculties in animals are also developing and undergoing changes. To attribute to animals, even those of a higher level of development, the faculty of carrying out psychic functions as they are known in the highest living creature -- man, is incorrect. This would mean to pay tribute to that imperfect stage of science when man, unable to analyze the complex peculiarities of animal behavior, would transfer to the animal everything he knew of psychic, as based on his observations of himself.

Though this attitude which virtually identifies the psychic reactions of cat or dog with those of man is not justified scientifically, it is nevertheless firmly rooted in everyday life.

The reason for it can be found in the history of the development of scientific ideas on this subject.

Way back, during the period of the origin of the first scientific observations of the phenomena of psychic activity, two contrasting approaches were traced in regard to this problem.

Democritus, over 2000 years ago, attempted to create a materialistic approach in stating that the soul and its activity is the result of the movement of very fine and perfect particles of matter.

About the same time, Plato was developing a diametrically opposite teaching. The soul, according to him, was an immortal, non-material substance which was different from somatic matter. The soul was not united with the body in one entity, and could separate itself from the body.

We are speaking now of this long past era in the history of the study of psychic activity, in order to remind you that, already in ancient times, two approaches in this field -- the materialistic and idealistic -- were diametrically opposed to each other. According to the ideas of the ancients, there was nothing in common between the psychic processes in animals and humans. Aristotle, the Greek philosopher, was the first to advance the teaching of three steps of psychic activity -- vegetable, animal, and that of reasoning. The first was referred to the world of plants, the second -- to the animal kingdom, and the third -- to man, the only living creature endowed with intelligence and a reasoning mind.

It must be acknowledged that Aristotle tried to introduce the idea of the development and perfection of psychic activity. One can not help seeing in it the prototype of the historic method of study of psychic activity. However, the defective facets of this teaching became visible at once.

Descartes, the most eminent philosopher and naturalist of the 17th century, sharpened the defects of Aristotle's teaching and advanced the teaching that an animal is only capable of reaction of a machine type, while a human being is a creature endowed with a mind. The teaching of the machine characteristics of animals did not correspond to facts, which anybody could see, even in observations at home. This is the reason why the mechanistic point of view of

the animal behavior lost its authority in the eyes of many scientists.

As a sort of a peculiar reaction to it, appeared the zoo-psychological trend in science. Its adherents insisted that animals are, like humans, endowed with a soul. Here, they came across natural difficulties in connection with the problem of the means of studying the soul of an animal, especially when one speaks of the soul of a worm, or a paramecium, and other low-organized animals and protozoa.

The zoo-psychologists replied to this that the method of study which they employ consists of observing various changes in animal behavior as they manifest themselves externally, and of the subsequent interpretation of the causes of these changes on the basis of comparison of the psychic characteristics of animal and man.

Thus, we see here the aim to legitimize the subjective method as a scientific method of investigation against which, as we had indicated above, rose the creator of the objective method of observation, I. P. Pavlov, with all his irreconcilable and absolute determination.

The above-cited data show that the method of conditioned reflexes of Pavlov does not concur with any previous trend. Each of these trends either identified animal with machine, or, on the contrary, identified animal with man which did not correspond to reality. The presence of psychic faculties in animals which reach a certain level of development caused no doubts under careful observation; therefore the task of science was to find a method of investigation which would exclude the need of employing our own psychic impressions (i.e., to eliminate the subjective method), and which would at the same time enable us to study psychics without denying subjective states.

The Pavlov method of investigation of the psychic functions of an animal by means of conditioned reflexes possessed these possibilities.

It would be erroneous to state that Pavlov denies psychics and fully identifies it with the physiological processes. This point of view did exist in science in general. It has been advanced by certain German and American scientists who insisted that psychic life does not and cannot exist in animals. Pavlov also thought that zoo-psychology as a separate science cannot exist. However, the reasons for such a conclusion by Pavlov were entirely different from those advanced by the above mentioned scientists. These scientists thought that psychics is indigenous to man only. Thus, they supported the idealistic approach that there is a gap between

man and animal in regard to their psychic faculties which cannot be filled.

Pavlov did not deny, he very definitely recognized psychic functions and states. He emphasized that psychic is the first phenomenon which man always encounters. The substance of disagreement was something else. The zoo-psychologists considered it perfectly correct to interpret the behavior of amoebae, worms, fish, and other animals as based on the presence in them of a mind, joy, nobility, and other human qualities! Pavlov, in contrast to it, demanded a systematic objective analysis which would not depend on the internal states and impressions of man. There lies the substance of divergence in the approach to psychic phenomena of Pavlov and the zoo-psychologists; Pavlov denies the right of the existence of zoo-psychology as a science. We shall now turn to the basic results of the study of the animal psychic obtained by means of objective methods developed by Pavlov.

Out of the very large data collected in the experiments with monkeys, we shall describe only some of them which had been carried out under the personal supervision of I. P. Pavlov.

The tests were conducted by means of a specially constructed box. Inside the box some bait was placed for the monkey to see, and the side door was slammed. The upper sliding door on top of the box had an aperture. (On the illustration is shown a triangular aperture, but one can use a top door with a round or square aperture.) Three sticks were placed near the monkey; triangular, round, and a quadrangular stick. When the stick corresponding to the shape of the aperture of the top door is introduced into the opening -- the side door opens up as a result of pressure on a lever inside the box; the monkey, thus, could obtain its food. By means of this experiment, we could determine the ability of the monkey to select the proper stick which it needed to get to the food. How was this problem solved by the monkey?

At first the monkey would get hold of any stick out of those placed before it, and tried to push it into the opening of the top door. When it failed, the monkey would grab another stick and repeat the attempt to push it into the aperture. It lasted till the monkey got hold of the right stick which opened the door. These experiments were repeated during subsequent days. The monkey would spend progressively less time in locating the right stick. It finally acquired the skill to select at once the right stick which opened the side door.

One can make the following deduction as to what guided the

monkey in its progressive improvement in the selection of the right stick: either it learned to correlate the shape of the stick with the shape of the aperture, or the visual, tactile, and muscular stimulants which originated when the monkey grabbed the right stick, were fixed as a signal of correct selection.

In the latter case, the usual conditioned reflex was formed, i.e., the connection between the sensations (taking the stick, and the subsequent reinforcement of this sensation by the obtaining of food). In regard to the first supposition, one should expect the formation of a more complex reaction! In this case, two series of stimulants would be correlated, none of them reinforced by the act of getting hold of the food bait: one of these stimulus would be the shape of the aperture, the other -- the shape of the stick. The animal could not get its food before this association had been established. This type of reaction is of a conditioned reflex nature and must be referred to the type of a so-called association in view of its complex nature.

This problem was solved not zoo-psychologically, i.e., not by means of interpretations, but by means of an experiment. The shape of the aperture in the top door was changed. Instead of a triangular, a top door with a round aperture was inserted. In spite of that, the monkey kept on taking the triangular stick which was good only for the previous top door.

On the basis of that, we came to the conclusion that at the base of the habit acquired by the monkey was a conditioned reflex of the most elementary type. Did it exclude the possibility of the formation of associations? Additional tests were made to answer this question. We began to change the apertures in the box frequently for a period of several months. As a result of these procedures, the monkey learned to select without error the stick corresponding to the aperture. Obviously, more complex conditioned reflex contacts of the type of associations could be formed in monkeys.

Further observations established the fact that, parallel with the above described elementary associations, the monkeys were capable of forming also more complex types of associations. To these belong chain associations, or, as Pavlov called them, associated associations.

Pavlov thought that "our mental activity is based mainly on a long chain of stimuli, or associations." In order to compare the mental activity of apes and man, it was essential to carry out such experiments which could elicit the ability of apes to form chain

associations. The results of these tests were very definite. Raphael (one of the anthropoid monkeys which were under observation by Pavlov) learned to open the door to its room, using the proper key; it learned to put out a fire which blocked its way to food by pouring water over it. Some experiments which had been conducted by a foreign investigator, were repeated with positive results; they corroborated the fact that Raphael, like some other anthropoids, is able to obtain a bait suspended high, by building a pyramid out of cubic boxes which were lying around and climbing on top of it.

We shall cite an experiment carried out by M. G. Batsuro, an associate of Pavlov, who made joint observations with his mentor on Raphael and its sister, Rose.

"On the wide platform of an aviary, at the height of four meters from the ground, hangs a cluster of grapes swinging in the air. Raphael sees it through the laboratory window, but the outside door is closed. The monkey runs to one of the adjacent rooms, finds the proper key and opens the door which leads to a room adjacent to the summer aviary. Here Raphael meets with another obstacle: a box with fire which prevents him from getting out to the aviary. The monkey turns the faucet of a water container placed above the fire, puts out the fire and gets out to the aviary, where it sees many cubic boxes over the floor. The only way to get the hanging grapes is to build a pyramid. Raphael picks up the largest box and places it directly under the hanging bait. Subsequently, in the order of diminishing sizes, it places box upon box, until a high pyramid is formed; then it climbs on top of it. The goal has been achieved, and the monkey eats the grapes while remaining on top of the pyramid."

In another experiment, the monkey had to solve the problem of how to draw up to the cell the food which had been placed for it outside the cell. To accomplish it the monkey had at its disposal several pieces of bamboo cane. They were of various diameters and lengths. However, they could be put together in a certain combination so that with the longer stick the monkey could get hold of the bait.

Of much interest were the experiments with two rafts. We shall again avail ourselves of the description given by M. G. Batsuro in his book: "A Hot Summer Day." Two rafts are placed in the lake at a distance of five meters from each other, and 15-20 meters from the shore. On one of the rafts lies Raphael. The monkey changes its

1. Ye. G. Batsuro. "Pavlov's Teaching of Higher Nervous Activity." Moscow, Uchpedgiz, 1955.

posture constantly, exposing to the sun its sides, or its chest. From time to time the monkey puts its hand in the lake and sprinkles itself with cold water. At other times the monkey gets up, changes its seat for the edge of the float and scoops up some water with a glass jar. At this moment, the experimenter approaches the raft in a boat, places a charged "device with fire" on the raft and a few tied together bamboo sticks on the raft (Raphael generally uses the sticks to move from one raft to the other).

The boat then approaches the other raft; here a container of water is set up. The monkey is looking for a while at the fire, they at a fruit which is visible in the aperture of the "fire device". Three-four seconds pass. Here Raphael gets up holding the jar in its left hand. It approaches the edge of the raft, takes the bamboo stick in its right hand and attempts to fling it over to the other raft. The attempt fails -- the glass jar is in the way. The monkey transfers the jar from the hand to the foot, flings the stick over to the other raft and crosses over using the stick; it fills up the jar with water from the container, goes back to the first raft and attempts to put out the fire. Not enough water. Raphael again returns to the raft with the water container, again fills up the jar and finally puts out the fire in the apparatus."

The results of these interesting experiments lead to two conclusions. In the first place, there is no doubt left of the ability of the monkey to evolve long chains of associations in the form of conditioned reflex connections which are replacing each other. It is not surprising that many who had observed these experiments were left with the impression of conscious reasoning in Raphael's actions.

At that, the question arises: why did the monkey which was perfectly able to draw water from the lake, go through all these complicated actions of moving from raft to raft just to obtain water from the tank? It seems that the animal could have acted much more intelligently had it drawn water from the lake to put out the fire. This is the basic question for the comparison of the intelligence of monkeys and that of a human being.

At the same time, it presents no difficulty to answer it in connection with the present state of science. We shall clarify later the conditions of the origin of thinking in man which was based on the development of the functions of the second signal system (speech and personal contact through speech). The monkeys do not possess this highest evolutionary achievement. The cited facts clearly attest to it. The monkey is able to manipulate water and use it correctly and purposefully for putting out the fire, but is at the same time deprived of the general (abstract) conception of water as such.

The water represents to the monkey a perfectly concrete stimulus only. In this sense, the water in the tank which puts out the fire, the water in the lake with which the animal moistened its body, the water which can fall on the earth in the form of rain, etc. -- all appear in the conscience of the animal as absolutely independent entities.

In order to generalize all these facts from the field of an idea of water, millions of years of evolution of the psychics of animals as well as the appearance of man -- the only representatives of the animal world who turned out to be capable of such generalizations.

The basic conditions for this process will be described later.

F. Engels created the teaching of the evolution of monkey into the direction of humanization, as the result of working social necessities and of the origin of speech sounds connected with it.

N. N. Ladygina-Kots, one of the pioneers of scientific study of the intellectual faculties of monkeys, carried out special experiments in order to ascertain to what extent are higher monkeys capable of the development of occupational actions.

The observations were conducted on macacas. The monkeys were subjected to motor tests of various complexity of opening locks which were put in the cell door: a single hook, combination of hooks, and various latches. As a stimulant to make the monkeys work, food was used which was placed in a locked cell. The combination of locks was brought up to high complexity, including for instance eight hooks, a self-locking latch, pin-bolt, etc. The author pays special attention to the problem of the role of occupational acts in the work processes of monkeys.

In recalling the words of Marx that "at the end of the work process comes the result which was present ideally, i.e., in the imagination of the worker, before the start of the work," Ladygina-Kots arrives at the conclusion that the actions carried out by the monkeys are not work acts. The actions of a monkey are "...narrow, dull, and specifically limited as to the sphere and to the range of their manifestation."¹ It expresses precisely the absence of the idea of the purpose of a given action which, as Marx stated, changes it into a working process.

¹ N. N. Ladygina-Kots, "The Motor Adaptation Habits of Macacas" Moscow, 1928, p. 324

In the experiments described above which Pavlov carried out, on Raphael and Rose, were also included the tasks of the study of the problem whether monkeys are capable of creating work tools.

The results have shown that monkeys do not possess this faculty. They proved that at the base of the behavior of monkeys are the rules of conditioned reflex activity which are prone to acquire a highly complex form, depending on the increasing complexity of the effects of the external stimuli. However, the development of the higher nervous system of monkeys stopped at the level of the first signal system, for the reason that monkeys were unable to produce work tools. The transformation of the stick which the monkey used for self defense, into a tool for tilling the soil was beyond the monkey's intelligence. Its thinking remained on the level of concrete ideas and was deprived of the ability of abstraction and generalization.

There is a widespread opinion among many people that animals understand human speech. True, many facts indicate that dogs or horses, and many other animals carry out errands and orders expressed in words or sentences, just as they know their names. However, an analysis of these instances of "understanding" of speech show that we deal here not with the content of the word, but with a definite combination of sounds which compose the word, and with the intonation connected with its pronunciation. If we shall pick out even some nonsensical but consonant combination of sounds and pronounce it with a certain intonation, the animal will respond to it with the same actions with which it had reacted to the correct word. There is nothing more in this "understanding" of speech than conditions reflexes which are formed in response to complex sound combinations. We must realize that higher animals are able to form very complex and keen reflexes to the most diverse combinations of sounds, intonation, and gesture of man, even to his facial expressions.

The "understanding" of speech by the animal is composed of these elements. It is curious, that in training dogs one frequently uses foreign words according to tradition; the words are even distorted in pronunciation. You can try and ask the trainer, what is the meaning of a given pronounced word -- in a number of cases you will receive no answer. The trainer himself does not know what is "couche", "apporte", etc. The dog, nevertheless will lie down or bring down the thrown object when the command is uttered. You really cannot claim that the dog understand the words, if the trainer himself does not know the translation into Russian, and consequently does not know what they actually mean.

The above stated refers fully also to the speech of parrots, crows, and other "speaking" animals. There is no doubt that the

function of sound formation and imitation is highly developed in some of them. It is just as certain, however, that there is not the least comprehension of the uttered words and phrases. It is another matter when a phrase learned by the parrot can be reinforced as a conditioned reflex. For example, the parrot learned some cussword; by causing the bird pain while we pronounce the word, we are able to produce a conditioned reflex. As a result, this cussword will become associated with the pain stimulus. The parrot will subsequently "respond" with an oath, when subjected to pain. Such cases create a strong impression of the "intelligence of speech" of parrots and make some people think that these birds are capable of real speech.

The above mentioned must not lead to the wrong conclusion that various sounds uttered by animals are not connected with some psychic states. On the contrary, according to numerous observations, most diverse sounds serve as definite means of communication between the animals.

It is sufficient to refer to the signals given by the leader to the herd on the approach of danger, the cries of the female calling its brood, and the cries of the nestlings asking for food, to notice the definite connection of the uttered sounds with the psychic state of the animal. If these sounds are reinforced by some stimulus, they become signals of the adaptation behavior of the animals.

In recent years, scientists succeeded by means of precise scientific methods of investigation to register various sounds uttered by monkeys under various living conditions. These vocal reactions are, of course, diverse and are related to the psychic states of the animals.

However, under no circumstances can we call these sounds speech, which, as we stressed earlier, is inherent only in humans and has originated as the result of the evolutionary development of monkeys in their social workaday practice. This conclusion is the answer to the question put at the beginning of this chapter.

Thus, we do not deny the presence of a certain level of psychic faculties and thinking in higher animals. This thinking, however, is limited and remains basically within the frame of concrete images, of sensory thinking. Animals are not capable of making comparisons, abstractions and generalizations. In other words, they are unable to form ideas.

Higher thinking, i.e., thinking in ideas, is available only to humans, because only man possesses the audible speech, and each word -- already represents a generalization and an idea.

Characteristics of the Psychic Activity of Man

"First, work and, later, articulate speech were the two most important stimuli under the effect of which the brain of the monkey gradually changed into a human brain... Work created the man himself."

R. Engels

In his work "Brain Reflexes" Sechenov came close to the solution of the basic problem of the origin of psychics. He considered sensations connected with the activity of organs (vision, touch, hearing, smell, etc.) as the cause of the origin of psychic activity. The psychic act, he stated, cannot appear in the consciousness without a preliminary external sensory excitation. The origin of thought follows the same rule.

Psychic activity emerges as the result of the effect of the outside world on our sensory organs. The perceptions which accompany it are the only true source of the development of the mind, and together with it, the cognition of the reality which surrounds man.

"...to separate the mind from the organs of sensation -- means to detach a phenomenon from its source, sequel from cause! The world really exists besides the man, and lives its independent existence; but man cannot perceive it without his organs of sensation; because the products of activity of the sensory organs represent the source of his entire psychic life," wrote I. M. Sechenov.

Having determined the basic question of the sources of psychic activity, Sechenov did not stop there and continued the further development of his materialist teaching.

We must mention in connection with this that there were many among the idealist philosophers, too, who recognized the sensations and perceptions of man as the basis of his psychic activity. They, however, considered these perceptions as inherent in the inner world of man, and did not relate their origin to the effect of the outside world. If some of them did admit the effect of the environment, they thought that there was no direct connection and precise relationship

I. I. M. Sechenov "Who is to Develop and How to Develop Psychology" In the collection *Fiziologiya Nervnoy Sistemy*, Vol. 1, Medgiz, 1952; pp 275-276

between the environmental influences and the origin of perceptions. Feyerbach named this trend in philosophy and physiology "physiological idealism". Its founder was the noted German physiologist of the 19th century, I. Müller.

In view of the particular importance of this problem, we shall analyze it in more detail.

The most important problem to the understanding of the unity of the organism and its environment is the one which concerns the qualitative significance of the environmental factors which influence the organism, the stimuli as they are called in physiology. This latter clarified theme has profound philosophical significance; if it is not taken into account, we shall be unable to correctly evaluate the materialistic essence of Pavlov's teaching of the organism and its relation to the environment and to the psychic activity originating in connection with it.

The pre-Pavlov physiology, based on mechanistic and idealistic positions, ignored the entire problem of the quality of stimuli and of the reactions as a whole. This was due to the fact that the mechanistic theory rejects in principle the category of quality and operates solely on the basis of quantitative ideas and definitions. The non-scientific character of these views is obvious, for they create an ahistorical, anti-evolutional approach to a given phenomenon, deny the possibility of true development, and reduce... complex problems to simple ones. In this respect, it is instructive to recall the juxtaposition of the two theories of development: the mechanistic and the dialectic theories, which was made by V. I. Lenin and which demonstrated the insipid and lifeless character of the mechanistic theory.¹

In physiology the mechanistic negation of the category of quality manifested itself in the so-called "law of specific energy". In substance it reduced to this: a reaction, allegedly independent of the quality and the character of the external stimulus will originate in an organ of sensation when it is related to the specific energy inherent in that organ. A blow in the eye, a ray of light, or surgical separation of the optic nerve will always cause only a visual sensation.

Proceeding from correctly described facts, I. Müller, the author of this "law", arrived, however, at a profoundly reactionary, idealistic conclusion the substance of which is the admission of the complete

¹ V. I. Lenin "Philosophical Notebooks" Gospolitizdat, 1947, pp 327-328

separation between the organism and the external medium. The role of the external stimulus is reduced to that of a cock in the rifle, to the role of an actuating mechanism. It is of no importance how and what force is applied to press the cock -- the rifle will shoot with the same force, and the nature of the shot will depend on how much gun powder there is in the charge, what kind of shell it is, etc. As far as the organism is concerned, it means that the reactions of various organs are arranged in advance, and that the external influences only actuate these "specific" reactions. Thus, there remains an unfilled gap between the organism and the environment. This notion of the relationship between the organism and the environment of course eliminates the confidence, which the materialist possess, in the possibility of a sure and complete cognition of the world around us. The odor and the color of the rose exists only as our perception and is originating in our nerves; and the problem of their existence independently of us, thus, remains unsolved.

It is not surprising that Helmholtz (the follower of Müller) began to express openly his disbelief in the possibility of the cognition of the world by means of the organs of sensation, and to discuss signs and symbols of the outside world, which are, allegedly, the only ones we are capable of perceiving.

V. I. Lenin, the creator of the materialistic theory of the correct and complete reflection in our brain of the perceptions of qualitatively diverse stimuli from the external world subjected the "law of specific energy" to well deserved criticism, as an attempt to establish a basis for idealism in physiology. Lenin emphasized the point that "physiological" idealism means only that "a school of naturalists in one field of natural science tumbled down to reactionary philosophy, unable to ascend directly and at once from metaphysical materialism to the dialectic materialism".

The idealism of this physiologist, indicated V. I. Lenin, consisted of the fact that, in studying the correlation between our perceptions and the activity of the organs of sensations, he was inclined to deny that our perceptions are the images of objective reality.

I. M. Sechenov took a very definite position in regard to this problem. He stated that the similarities and differences which men find in sensations originating from diverse objects, reflect the true similarities and differences of these objects. He thought that the properties of the sensations of light, sound, etc. like the color

V. I. Lenin "Works", Vol 14, p 299

of various objects, the height of musical tones, etc. fully depend on the actual excitation characteristics which originate in our organs of sensation under the effect of external stimuli.

Pavlov insisted upon the introduction of the idea of the role and significance of the quality of stimulations and reactions. Starting with initial work on the physiology of blood circulation, and, later, in the study of digestion, and particularly during the period of investigation of the physiology of the higher nervous activity, he turned indefatigably again and again to the qualitative characteristics of the stimuli. In this respect, the persistent quest of Pavlov for the most precise materialistic approach is highly significant. At first, following centuries old traditions, he searched for the explanation of the observed objective phenomena in their quality of salivation in its dependence on the "pleasure-sensations" and on the "psychic states" of the animal. However, having soon become convinced of the sterility of this approach, he turned determinately to the path of the objective physiological interpretation of all animal reactions. This was not accidental, of course; on the contrary, in the case of Pavlov it was organically bound with his ideas of the unity of the organism and its environment.

Pavlov subordinated this problem in its entirety to experimental analysis, but its most important component part remained the question, how is the higher nervous activity of animals and man formed under the effect of various qualitatively different external stimuli.

At first, Pavlov carried out the study of higher nervous activity in animals only. However, his constant task in these experiments was the aim of finding ways to explain the processes of psychological activity in man. Accordingly, at the first opportunity, he included in the circle of his studies the direct observations of the higher nervous activity in man, which he carried out in the psychiatric clinic.

Pavlov's observations of higher nervous activity in man brought forward the question of the analogy and differences in the psychics of animals and man.

In approaching it from a straight methodological position, Pavlov was able to find the right path in the study of this most difficult problem. Taking into account that the environment is the main prerequisite which determines the character of the reactions of an animal, Pavlov arrived at the following conclusion: The natural, biological or, as Pavlov called it, "the general natural" medium is common to both, animal and man. At the same time, man lives

under direct influence of a social and public medium which is inherent to him only, and which is largely absent in the animal kingdom. These circumstances must serve as the key, Pavlov thought, to determine the similarity and differences of higher nervous activity in animals and man.

The biological medium influences the eyes of animal and man with a light stimulus, the organ of hearing with a sound stimulus, their skin with heat and cold. Parallel with these external body stimuli we can think of the diverse effects which the body and its organs have on the central nervous system. Muscular sense, the sensation of hunger and thirst, satiety, pain sensation, etc. all originate in the internal organs, and are examples which prove the possibility of the stimulating effect of the organs of the body. Any one of these actions may acquire the character of a conditioned stimulus, as has been indicated above.

All conditioned reflexes which are formed after a direct effect on the eye, ear, skin, and other organs of sensation, Pavlov designated as the activity of the first signal system. This system is, to a certain extent, common to animals and man, especially in the early period of maturity of man.

"To the animal," Pavlov wrote, "reality is signalized almost exclusively by means of stimulations and their traces in the large cerebral hemispheres, which penetrate directly to special cells of the visual, audial, and other receptors of the organism. These signals are the same which we receive via our receptors as impressions, perceptions and images from the external environment -- the general natural, as well as the social, with the exception of the word, heard or read. This is our first signal system of reality, common to us and animals."

Pavlov emphasized that the social and public environment is specific to man and differentiates him from animal. In accordance with the ideas of Engels, Pavlov concluded that work, created by social customs, represented a new characteristic in the formation of the human society.

"Work created man," said F. Engels. In the practice of work contact primitive people felt the need of saying something to each other. The articulate speech appeared, a tongue was formed. A foundation was created for the development of thinking.

I. I. Pavlov "Complete Works, Vol. III, Moscow-Leningrad, Published by Acad. of Sci. USSR, 1949, p. 568

In underlining this characteristic element in the evolution of the higher nervous system of man, Pavlov used to say that man is a talking creature.

Word as a conditioned stimulus, speech as a conditioned reflex activity, and the innumerable quantities of conditioned reflexes taking place on this basis specifically, according to Pavlov, the second signal system.

Having acquired in the course of evolution the second signal system, man mastered also the higher qualities of thinking connected with the faculty of abstraction and generalization.

Animals (especially the higher ones -- dog, monkey) also possess intelligence of which we shall speak later. However, the thinking function of an animal is limited within the range of the first signal system. It means, that it consists of concrete, image-like, or as some say, sensory thinking. One can speak of an idea of the image of a sparrow, chicken, or goose in the mind of a monkey, but the monkey is totally incapable of a generalized conception of a bird. Thinking in ideas requires a generalized abstract approach; it can only emerge on the basis of speech.

In the idealistic teachings about the soul the problems connected with the origin of speech and its relationship to thought always occupied a very important place. It is not by chance that those same problems attracted the most vivid attention of the servants of the church. In contrast to the Marxist materialist teaching of the origin of speech as a social phenomenon conditioned by work practice, religion feels that the gift of tongue has been granted us through Divine intervention.

The idealistic notions regarding the soul and speech concur in substance, for one of the most important signs of spirituality, i.e., the presence of the soul, is speech. Animals are speechless creatures, for, not having received a soul from God, they have not obtained the gift of speech either, the clerics say.

The teaching of the first and second signal systems of conditioned reflex activity and of the close connection and inter-relationship between the two systems, indicates instances of transformation of thinking in concrete images into thinking in ideas and abstractions. The data of natural science obtained by the Pavlov school, thus, corroborate the ideas of V. I. Lenin who had pointed out the gradualness of the development of the process of consciousness.

Lenin wrote: "From a live observation to abstract thinking,

and from there to practice -- this is the dialectic path of knowledge of truth, and of knowledge of objective reality."

The philosophical teaching of the classicists of Marxism and the physiological studies of Pavlov destroyed the religious and idealistic ideas of the divine origin of human consciousness.

The problem of the development of psychics in connection with the development of the entire live world was posed in Russian science a long time ago.

N. G. Chernyshevsky pointed out the fact of historical relationship between the psychic phenomena in the animal world and the phenomenon of consciousness in man. He underlined the fact that, if this historical succession of phenomena is disrupted, the consciousness of man may appear to us as a sort of miracle, something isolated, just the way it is imagined by the idealists.

Later, I. M. Sechenov advanced the task of study of the historical development of psychic processes in the frame of evolution of the entire animal world.

Of the utmost importance in the fight against idealistic ideas is the materialistic teaching of the causal dependence of the origin of speech and tongues on the work practice in human communities, as well as the discovery by Pavlov of the physiological and material processes which are at the base of speech.

The origin and development of mental faculties from the lowest level to the highest forms of thinking -- all this have now become open to scientific materialistic investigation. The idealistic teaching of the soul has been till recently the most inaccessible fortress of idealism and religion. The Marxist philosophy and the materialistic science destroyed this fortress and scattered the Biblical myth of the soul without leaving a trace.

One of the greatest achievements of Marxist philosophy is the development by Lenin of the theory of cognition, which has been named the reflection theory. The material processes of the outside world which exist independently of us are impresses (reflected) in our brain. We must emphasize the fact the Pavlov's teaching of conditioned reflexes in animals, and the two signal systems of the human brain, represent the corroboration by natural science of Lenin's theory of reflection: the cerebral cortex ensures man's faculty, as Pavlov taught, to reflect correctly and precisely the objective reality which surrounds us.

V. I. Lenin "Philosophical Notebooks", 1947, pp 146-147.

Instincts

"From the physiological point of view there is no substantial difference between what is called instinct and reflex. The complexity of the acts cannot be considered such a difference."

In the behavior of animals, especially such as birds and insects, their amazing adaptation to environmental conditions attracts our attention.

The transmigrating birds are able, having flown thousands of kilometers, to return to the village which they had left in the autumn, even to the same nest which they had forsaken half a year previously. It is well known how easily the carrier pigeons orientate themselves. The life of bees and ants in large colonies has since ancient times excited the most vivid interest. Indeed, how many most diverse acts and organizational orders can be observed in beehives and ant-hills!

During the first twenty days of its life, the bee carries out work connected with the implementation of various functions which correspond to six specialities. During the first five days following its birth, the bee works as a cleaner in the beehive, later as a distributor of food. During that time the bee intensely develops special glands which are adapted to the feeding of larvae whom it starts feeding on the sixth day. While carrying out this function, the bee simultaneously acquires the ability to produce wax, and starts building honeycombs. For the next 8-10 days the bee carries out a few more functions in the beehive. It acts as a guard and as a receiver of honey, and toward the 20th day of its existence it leaves the beehive and starts collecting honey.

We traced the development of the function of one bee, the so-called worker. The interrelations between the bees which compose a beehive are very diverse and complex. We shall cite an example of a bee-scout which, by means of a "dance", signalizes all other bees that it had found a source of food, often located within 100 meters distance, or even within many kilometers away from the beehive. It is not surprising that the behavior of bees since long ago has been not only a subject of study and observation, but a subject for discussions as to their intelligence and acts of volition.

And was not the surprise and admiration of people, who had

observed for the first time the marvelous dams built by the "river-engineers" -- the beavers with their cleverly constructed habitations -- the little houses -- well founded? The beavers build excellent dams, measuring two to five meters, which block the flow of water and raise its level to that of the shore. This enables them to flood the food stores, ensures a hidden approach to their habitations, and makes it easier to transport food to the little houses. At times, the beavers create large flooded areas, by constructing a whole system of dikes and embankments, with a flooded area as large as two hectares. Besides building the dikes, the beavers ensure the preservation of a constant water level through various devices (drains, or a roller superimposed on the entire dike). If the casing of the dike is damaged in one section or the other, the beavers perform complete repair work the following night. Thus, these remarkable little animals ensure the completion of construction work and the thorough preservation of the dikes.

Many phenomena of nature, truly appearing as marvels, were long ago noted by people who observed the life of fish, birds, and insects; these phenomena required explanation. It was natural to assume that the animals were endowed with intelligence. However, there were many facts which spoke against it.

The matter did not seem much clearer when the idea of instincts was brought forward. This idea remained vague and involved until the materialistic bases of the so-called mental activity had been elucidated.

The teaching of the soul and instinct differentiated at once the conception of the mental activity of animals and man. A special designation was needed to emphasize this difference. The literary heritage known to us enables us to assume that, as far back as two and a half thousand years ago, this difference between the mental functions of animals and man had been alluded to. The animals were described as possessing blind, unconscious impulses and propensities which had been given the name of instincts (the word "instinct" means a natural impulse).

There is no need of dwelling on the description of other idealistic points of view, whose representatives attempted to find an explanation of the instinctive activity. They were not only based on unscientific premises but actually contradicted the facts. Thus, one of the characteristics of instincts which made them so enigmatic and mysterious was their alleged high purposefulness. However, some actual facts demonstrated that the instincts, while preserving under certain conditions an undoubted purposefulness, continued to function after these conditions had changed, thus

becoming senseless and absurd.

As an example, we can mention the hatching of "eggs" by a bird, when the real eggs have been removed from the nest and replaced by a egg-shaped stone. If we remove the eggs of an eider and put them aside, the eider would sit down on the former spot, warm it with its body, and "hatch" an empty spot on the rock, though its eggs are lying not far away. The bees continue to seal with wax the cells of the honeycomb from which the honey has been taken out. A hatched baby chick will start pecking at once. However, it will peck not only at food but at everything in sight, even sunlight spots, beads, and other non-edible objects. The true pecking for food develops later as the chick grows up and as the reinforcing effect of the food stimulus asserts itself. Thus, the purposefulness of instincts is relative and appears only at a certain stage of maturity.

A true scientific, i.e., materialistic analysis of the question of instincts was made for the first time to a full extent by Charles Darwin.

In his first important work "The Origin of Species", C. Darwin clarified numerous facts which are connected with the instinctive activity of various animals, and gave them a materialistic interpretation. He demonstrated that this seemingly startling purposefulness of instincts is a result of the environmental adaptation of animals. Thus, Darwin raised the question of the origin of instincts. In stating thus the question, he had to follow it up by criticizing the assertion of the immutability of instincts. He showed, in citing a number of facts, that certain instincts were subjected to change under changed environmental conditions. These changes of instincts occur with great difficulty. Darwin indicated, for example, that wolves, foxes, jackals, and other animals even when domesticated, still attack chicken, sheep and pigs. Their puppies transferred from the locality of domesticated animals, could not be broken away from the habit of attacking pigs and sheep. Obviously, one generation was insufficient to suppress this instinct. At the same time it is well known that our domestic dogs, as a rule, remain indifferent to other domestic animals and attack them in exceptional cases only.

Darwin came back to the problem of instincts in his book "The Manifestation of Emotions in Man and Animals". In this he completely refuted the idealistic and religious ideas of the independence of the animal behavior from the material conditions of its habitat. He contrasted this idea with his biological teaching of evolution, which shows the gradual development of psychic, as well as instinctive actions of animal and man. In regard to the material

causes of the expression of perceptions which lead to various manifestations of diverse sensory states in the animal (the state of fear, joy, etc.), Darwin wrote: "There is no doubt that as long as we continue regarding man and all other animals as independent creatures, our natural aim to investigate as much as possible the causes of expression will be considerably inhibited. By means of this doctrine (the teaching of divine origin -- D. Hiryukov) one can equally well explain virtually anything under the sun; it proved to be just as ruinous to the science of expression, as to any other branch of natural science. Those who will accept the basic premise that the organism and habits of all animals have been developing gradually, will see all problems relating to expression in a new and interesting light."

In studying the origin of psychic phenomena (sensations, habits) in man and animals, Darwin thus refuted the legend of the creation of the world by God and of the immutability of humans and animals which he had created. However, though the views of Darwin on the nature of instinct represented undoubtedly a step forward from the biological point of view, still they did not explain the substance of the instincts. Darwin could not do it, for the contemporary level of the development of physiological science did not make it possible. This possibility presented itself only when I. M. Sechenov and, particularly, I. P. Pavlov developed the physiological science of the acquired reflex reactions which ensure the adaptation of the animal to its environment.

Pavlov related instincts to the most complex unconditioned, i.e., inherited, reflexes, and in connection with this did not even use the term "instinct".

We must point out that, depending on the level of the evolutionary development, the mechanisms of instincts may differ to a considerable extent, and no one will seriously identify the instincts of a higher primate with the instinct of a rainworm. However, there is a certain community in these functions which relates primarily to their reflex nature. Thus, instincts same as other functions are determinate, i.e., are manifested in connection with certain definite causes originating in the animal's environment. This fact must be stressed, for there were attempts by some scientists to attribute to the instincts the role of the inner force of the organism, of the inner imperative stimulus which is not controlled by the organism as a whole. In analysing the instincts of higher animals, we can visualize their mechanism more or less schematically as follows.

1 Charles Darwin "Expression of Emotions in Man and Animals", Works, Vol. 5, Moscow, Ed. Acad Sci USSR, 1953, pp 698-699

As has been mentioned already, the basis of instinctive action is the most complex, or as it is called, the chain reflex. It means that the complex instinct is composed, like a chain, of separate links which represent simple reflexes.

The links of the complex instinct are closely tied together and are acting reciprocally on one another. One link activates the next, and, as a result of such successive change of separate phases of the developing chain reflex, some very involved action of the organism is taking place.

This can be illustrated by an example of the development of the phenomenon of vomiting -- one of the instinctive acts.

When something harmful enters the stomach, a protective ejection takes place, the discarding of the gastric content, which prevents poisoning of the organism. This process is effected as follows.

First, the entrance to the stomach becomes patent, while energetic muscular contractions of the abdominal wall and of the diaphragm are simultaneously getting into action. The contractile movements of the stomach proper are also increased. The exit aperture of the stomach closes up and the gastric content is pushed upward to the entrance. The larynx and tongue are raised which prevents the possibility of the entry of the vomit material into the respiratory paths. The ever increasing contractions of the abdominal wall, and contractions of the stomach -- the latter taking place in an unusual, reverse direction, also the onset of oesophageal contractions, all combine in the ejection of the gastric content.

An analogous complex chain reflex is represented in the act of swallowing. We are effecting it instinctively, not realizing its complexity. However, the instances of entry of food particles into the nose, or trachea, as for example in laughing while we eat, remind us of the importance of coordination of separate reflexes during the normal act of swallowing.

We cited, as an example, one of the comparatively simple instinctive acts. Of course, some of the instincts, the sexual for example, are connected in animals, especially in birds, with some peculiarities of habit and even of the external appearance (the color of plumage), characteristic vocal reactions, special games, or, on the contrary, fights, they can be much more complicated in their composition; however, the substance of the matter does not change, and we see at the basis of this instinct primarily the same complex unconditioned reflex.

On the example of the sexual instinct we observe with particular clearness another characteristic of this function, which is present in various degrees in other instincts. That is, that the instinct is a manifestation of the functions not of the nervous system alone, but is closely connected with diverse chemical influences in the organism.

Thus, for example, the change in the chemical composition of the blood and other fluid in the organism in connection with hunger ("starved blood") plays a very important role in the manifestation of the food obtaining instinct. The changing chemistry of the blood is the cause of manifestation of reflexes which effect the act of respiration.

The above mentioned glands of internal secretion and the hormones which they secrete play an extremely important part in enhancing the manifestation of instincts.

We know that castration, done at an early age, inhibits the manifestation of the sexual instinct.

We must mention another point for the complete physiological characterization of instincts in higher animals.

Let us visualize a dog eating from a bowl placed before it. The dog seizes the pieces with certain frequency. If at this time we shall try to distract the dog from the food container, we shall easily observe that the animal, instead of turning around in response to the new stimulus, will continue to lap its food with greater frequency and avidity.

The same physiological phenomenon can be observed in the manifestation of the defense instinct. Let us observe two dogs engaged in a fight. Our experience has taught us that the best way to separate them is to pour water over them. It means that only a very strong and unusual stimulus is able to stop their fighting. An attempt to drive them apart, to separate them by means of gentle pulling will virtually lead to the increase of the aggressive reactions of the animals.

What do we see from the point of view of the physiology of the central nervous system? The substance of this reaction was ascertained by A. A. Ukhtomskiy, the eminent Soviet physiologist and academician, who named this function of the central nervous system a dominant function /"dominants"/. Under dominants we understand a group of nervous centers which entered into reciprocal action and which determines a certain behaviorist reaction of the animal. The

peculiar characteristic of the dominant group of centers is its faculty to collect, so to speak, the stimuli which at the moment are affecting the organism and to become stronger at their expense. This is precisely what happened in the two cited examples. The stimulation which originated in connection with pulling the dog by its collar would under usual conditions, have caused the animal to turn around in the direction of the pull, or perhaps to wiggle its tail, etc. But, since under the described circumstances a food dominanta in one case, or a defense dominanta in the other has been formed in the central nervous system of the dog we shall find that there is no reaction to the new stimulus but a definite enhancement of the reaction to the previous stimulus.

The analysis of many instincts shows that at their basis lie the reactions of the dominanta which may dissolve naturally, i.e., disappear upon the satisfaction of the instinct (for example, satiation in the case of the food instinct), or may be "switched over" to another dominanta under the effect of new and stronger stimuli (the suppression of the food dominanta and the appearance of a defense syndrome in case of threat to life).

A dominanta, formed in the central nervous system, may acquire the role of a factor which determines the direction of the animal's reactions and with great force at that. In the male frog during the spring period appears a dominanta of embracing which manifests itself in hugging the female.

If the male frog is subjected to other stimuli, the "embracing reflex" increases, it becomes stronger even after the removal of the higher brain centers from the male.

We have already indicated that the higher centers of the brain in the more developed animals (the cerebral cortex) may affect and change the unconditioned reflexes to a considerable degree. This is important to the understanding of the mechanism of instinctive functions in higher animals. In this case, the conditioned reflexes, or the dominant nucleus, which has originated in the higher brain centers may exert their effect.

The understanding of this very important question will enable us to learn to what extent the instincts of the animal can undergo changes. In the old physiology and psychology this problem could not appear. There, the general consensus of opinion was the acknowledgment of the immutability of instincts.

This was, to a great extent, due to the absence of knowledge of the nature of instincts, as well as to the lack of understanding that

in higher animals the regulatory and directing functions are effected by the most developed areas of the central nervous system -- the cortical centers of the brain.

Lately, experimental data have been obtained which attest to the fact that the instinct is not a mysterious property of the organism, and yields to objective study as well as to mutation under the effect of changes in the environmental conditions of existence. To corroborate this statement one may refer to the experimental results obtained by one of the Soviet investigators, M. Ye. Lobachev.

Proceeding from the fact that the duration of the light period during the day determines the egg-laying of chicken, M. Ye. Lobachev decided that, by using artificial light stimulation corresponding to daylight strength, he could make two "days" and two "nights" out of 24 hours. As a result of this alteration of the regime, hens which experienced two six-hour days and two six-hour nights increased their egg laying faculty. The resulting eggs had perfectly normal properties. Even such a stable instinct as the food instinct can be changed under definite external conditions. Here is one experiment. A pike and a crucian were placed in an aquarium, which had been previously divided into two parts by a glass partition; in one section the pike was swimming, in the other -- the crucian.

Stimulated by the food instinct, the pike is trying to attack the crucian and knocks itself repeatedly against the glass partition. The pike, of course, received other food to satisfy the food instinct. After repeated unsuccessful attempts to get hold of the crucian and constant collisions with the wall, the pike finally lost its appetite for the crucian. Shortly after, the partition was removed, and now the pike was swimming together with the crucian without attacking it.

The causes which effected the change in the instincts in both of the above described instances are different. The egg-laying faculty of the hen was increased through the change in the principal environmental condition -- the duration and shift of the night and day periods. In the case with the pike we have a change in instincts under the influence of the newly created and much stronger conditioned reflexes of a protective character (the knocking of the pike against the partition).

One could cite many examples which attest to the possibility of changing the instincts. We have already mentioned the importance of the body chemistry in this respect and, especially, its hormonal functions. The Soviet scientists conducted remarkable experiments in "sex alteration". Everybody knows that the differences in the

external sex characteristics of roosters and hen are very marked. If the ovary in a hen is removed and replaced by the seminal vesicle of the rooster, or if the sex glands of the rooster are removed and replaced by the ovary of a hen, one can observe how the rooster loses the characteristics of its comb, plumage, and vocal reactions; and how it begins to resemble a hen; the hen, on the other hand, acquired the characteristics which make it indistinguishable from a rooster. It is of particular interest that not only the external appearance but even some behavior traits (belligerence) are lost by the rooster, and are acquired by the hen.

These facts clearly attest to the possibility of changing the instincts in animals. This conclusion is very important. It corresponds to the basic teachings of Darwin, Pavlov, and Michurin; it refutes the idealistic and religious ideas of the immutability of the existing world without the intervention of God. It is important to emphasize the fact that this conclusion equally relates to the sphere of psychic activity.

Instincts are also characteristic of man. However, it was precisely this field which harbored many idealistic theories and attributed to man a kind of "personality in depth" controlled by his instincts. These instincts were considered a force not subject to any influence whatever, acting in some fatal manner, and constituting, in the last analysis, the "fate" of man, independent of him, and predestined from above.

On this false basis originated attempts of a theoretical justification of sexual looseness, and reprehensible amoral acts, attempts to justify drunkenness, gambling, etc.

We must definitely condemn and refute these attempts which are contradicting scientific positions. As to the matter of man and his instincts, its solution is perfectly feasible and unequivocal.

Higher animals and especially man differ from other animals in that their brain has reached the greatest development. Its sections which have acquired the faculty of the distribution and direction, as Pavlov said, of all organic functions (the cerebral cortex) achieved in man the highest development. On this basis appeared, as explained above, the second signal system of oral and speech conditioned reflexes, inherent in man only, which ensured the faculty of higher thinking, of forming new conceptions such as honor, duty, patriotism, etc. Therein lies the source of many examples in history and in our present life, in the recent experience of the Great Patriotic War, when the strongest sensations of fear, pain, and physical suffering became subordinated to the conscious, volitional

direction by man. Let us recall Aleksey Marts'yev, Aleksandra Matrosova, the hero flyer Castello, Zoya Kosmodem'yanskaya, the Komsozols of Krasnodon, the immortal Panfilovs, and many others. We could cite many thousand examples from the immediate actuality of our days. These facts leave no doubt that the instincts -- food, defense, self-preservation, the fundamental problem, whether to live or not, were decided not the way they are being decided in the world of animals; thanks to the intervention of higher social stimulating motives, the instinct was depressed, inhibited, and the scene was taken over by the consciousness of responsibility, humaneness, and patriotism.

"I've not the way you want, but the way God ordered" -- taught one of the proverbs of the prerevolutionary Russia. It reflected the philosophy of doom, hopelessness, and of the impossibility of resisting "fate" which is hanging over man.

The teaching of the scull and its roots in the form of instincts, allegedly, enslaving man is fully refuted by modern scientific data. One cannot any longer dispute the assertion of Soviet psychology and physiology that the instincts of animals are subject to changes under the effect of various external and internal conditions. As far as man is concerned, the right to bear that name so that "it wounds proud", as A. M. Gor'kiy used to say, depends to what extent man is able to control his instincts, his will power, and to what extent he dedicates himself to "serve noble purposes".

On the Psychics of Man

Nothing -- neither words, nor thoughts, nor even acts -- express ourselves and our attitude to the world so clearly and so correctly as our sensations: in these we discern the character not of a separate thought, or a separate decision, but of the entire essence and order of our soul!"

Ushinskiy

At one public lecture devoted to the problem of scientific and atheistic propaganda, I received a note: "Here, you atheist claim that there is soul. Yet in the newspaper *Pravda* in an obituary it was said of the deceased: "He was a man with a great soul."

I agreed with the author of the note that he had a certain right to underline the seeming contradiction between our special approach to the problem of the soul and our practice of using this conception, more correctly, this term.

Indeed, expressions such as "a man with a great soul", "souful person", "pure" or "luminous soul", and inversely "a hard soul", "man without a soul", etc. are very frequently used in our everyday life.

In denying most definitely the existence of some mental substance separate from the body, or of a soul existing parallel to the body (which is the essence of the idealistic ideas), we acknowledge at the same time the presence and manifestation of the so-called psychic activity.

Let us try and analyse what we understand under the idea of a soul, and under the conception of the so-called psychic faculties of man.

We have already mentioned that the brain is the organ of mental activity and that the objective method of conditioned reflexes created by I. P. Pavlov is the means to study the physiological basis of this activity.

Right then we stated that such a position does not exclude the possibility and the necessity of analysing that complex branch of science -- psychology. We shall adhere to the physiological plan of stating the problem and proceed with the juxtaposition of the

psychological and physiological conceptions.

Psychology ("logos" -- teaching, "psyche" -- soul) -- the teaching of the soul -- originated a very long time ago. This is normal, since our subjective sensations are the first reality with which man comes in contact.

The numerous trends which constitute modern psychology in Western Europe and in the United States of America can be reduced to two basic theories.

One is behaviorism. "Behavior", an English word, means conduct. The supporters of this trend deny any inner content of psychics. They regard man's conduct as automatic activity which carries out mechanically various activities depending on external stimuli.

Herbert Woodward, a noted member of the American Psychological Association, exposed this point of view very clearly. He suggests that we do not demand of the psychologist that he penetrates "through the skin" of the investigated subject and that we regard psychology as a science of "surface behavior", for only this kind of behavior can be evaluated quantitatively. His program is aimed at the mathematical interpretation of psychic phenomena and laws.

However, upon careful examination, this reasoning attests to the author's tendency of refuting the materialistic thesis that consciousness is a function of cerebral matter.¹

The other trends of foreign psychological science are based on Freudianism and are only seemingly contradictory to behaviorism. Freudianism is named after its founder -- the Austrian psychiatrist Freud and is, probably, the most widespread school at the present time in the European and American psychology.

While behaviorism principally puts under the very fact of the existence of consciousness, the characteristic tendency of the followers of Freud is their attempt to represent consciousness as a certain screen which only temporarily and incompletely obscures the real essence of human individuality, its depth, and its instinctive tendencies and aspirations.

Consciousness, according to Freudianism, is subordinated to occult and unconscious psychic forces which exist as some sort of destiny and predetermine fatefully the behavior and ideology of the

¹ H. Woodward "Experimental Psychology", Moscow, Ed. Foreign Lit., 1950, p. 45

individual.

In analyzing various and fairly numerous trends in modern European and American psychology, it is easy to establish the origin of all of them from these two basic roots -- behaviorism and Freudianism.

J. Bernal, the progressive English scientist, in his evaluation of the modern European and American psychology, arrives at the following conclusion: "Modern psychology represents either a new version of the ancient Greek medical psychology or a more or less aviscerated Freudianism with, usually, a considerable admixture of mysticism. The role of psychology in the capitalist world...consists of the attempt to give a scientific justification to the economic and political institutions. It also serves to discourage people from the attempt to change these institutions and to scorn these attempts as a bad emotional adjustment."¹

"The final conclusion of Freudian psychology," continued Bernal, "is reduced to the statement that man is virtually controlled by his own subconscious instincts of his prenatal period..."²

At the first look at may seem that Freudianism and behaviorism are opposed to each other. However, a more thorough study of the substance of these two theories brings out their complete ideological kinship. It is evident, first of all, in the denial of the fact that consciously posed aims are at the basis of the behavior and actions of man. While to us the essence of psychology consists of problems of consciousness which are determined by the social existence and interrelationships of man, to all trends of bourgeois psychology consciousness represents a category which is ignored or compromised in every possible way. Man is represented either as a machine, a robot or an automat subordinated to external stimuli only, or a pitiful slave of his own desires and instincts.

We must give these "teachings" their due: they are very convenient in attaching people to some religion, also in justifying the fascist ideology of "anything is permissible", "anything is accessible", which is fashionable in the modern bourgeois society.

The juxtaposition of the basic theses of Soviet psychological science with the bases of psychology as cultivated in the United States of America and in Europe shows their direct antithesis.

¹ J. Bernal "Science in the History of Society", Moscow, Ed. Foreign Lit., 1956, p 613
² Ibid., p 612

As we mentioned earlier, the problems of consciousness are at the root of understanding psychology. Consciousness, which is the reflection of the environment, is regarded by our scientists not in itself but as a result of the effect of the social medium.

It means that, while the mental faculties of man always remain determined, they do not at the same time make him a slave of his instincts. The psyche of man is formed under the influence of the environment and the social medium, but at the same time actively influences this medium and changes it. The immense experience of the history of mankind attests to it. The most convincing examples can be found in the practice of socialist construction in our country. In changing the social relations and in actively influencing nature, the Soviet citizen acts not as a slave of his instincts, but as a conscientious master pursuing a clearly defined goal.

K. Marx compared the outstanding skill of the bee in the construction of honeycombs with that of an even mediocre builder-architect, and stressed the advantages of the latter, since man always has a plan at the start of construction of what he is going to do. Hence, the infinite possibilities of perfection in man and the definite limit of possibilities in the animal.

The tasks which man assumes are dictated not by personal needs only, but by social and universal ideals as well. The immortal facts from the experience of the struggle for building Communist society, and the general efforts for peace among nations, are the most shining examples of this.

We have already cited examples which attest to the fact that man, inspired by high ideals, is capable to suppress even such powerful instincts as, for example, the instinct of self-preservation.

The Soviet people cannot accept the views of some foreign psychologists who assert the inevitability and, even, necessity of wars which allegedly meet the need of people to satisfy their belligerent and militant instincts. The Marxist-Leninist philosophy inexorably reveals the social causes of wars based on the nature of the capitalist system.

The Soviet psychological science regards the problems of consciousness and sensations not in their separation from each other, or in a contrasting light, but in their unity and reciprocal conditioning. The faculties of cognition, will, and sensations of man participate harmoniously in the formation of an individual.

"...Without "human emotions" there never was, is, or ever will be

a human quest for truth," wrote Lenin.

The mental faculties are not some dark, mysterious forces, but real manifestations of human actions, and are determined by the conditions of his social environment and by his intellectual and emotional qualities.

Such ideas as an image of a man of great soul are close and dear to us. The ideas of a crystal pure, luminous soul are real to us and illustrate the truly harmonious blending of the intellectual and moral in man.

The scientific task, connected with this, is the necessity of establishing the basis and forms of the mutual relationship of the so-called psychic and physiological functions.

V. I. Lenin, the founder of the modern scientific theory of consciousness -- the theory of reflection, correctly interpreted the interrelation between the material and the ideal, spiritual and physiological. He warned of two possible errors in this respect. One of these he related to the identification of the material and ideal, the other error could arise from the unlimited contrasting of these two facets of the one and the same material phenomenon.

Psychology, as well as physiology, as was previously mentioned, have their particular paths of development, their specific content and methods of study. At the same time they have a common basis in that they are engaged in the study of the same phenomenon -- the function of the brain and nervous system.

The most important subject of psychological science is the problem of the nature and the role of emotions. In dealing with the nature of emotions we must analyze two problems from the physiological point of view. The first relates to the origin of emotions, the second -- to the physiological phenomena of which the subjective part is perceived by us as sensations of emotion.

I. M. Sechenov, whose famous book "The Brain Reflexes" has been cited above, was the first physiologist who subjected the conditions of the origin of emotions to a materialistic analysis.

Let us recall his basic theses. Sechenov stated that the infinite diversity of external manifestations of the cerebral activity is reduced in the final analysis to muscular motion.

He advanced also the exceptionally courageous for his time suggestion that the entire cerebral activity is based on reflex action.

A very close analysis of various reflex actions which were taking place under diverse conditions, enabled him to distinguish several

1 V. I. Lenin, "Works", Vol 20, p 237

types of reflexes. In some cases the reflexes having originated, proceeded in such a manner that their terminal link (motion) became inhibited, in others the terminal part of the reflex, on the contrary, became enhanced.

We shall cite some examples of the first group. We know that at a strong unexpected sound even a non-nervous person startles, unexpected pain makes one shout, getting unexpectedly under a stream of cold water causes a multiple reaction (exclamation, arrest of respiration, etc.) But if the individual is prepared for these stimuli, he will be able to withstand considerable amount of pain quietly and without any external manifestations, he will quietly react to a strong sound, etc. A person, used to cold ablutions, will easily tolerate the effect of an ice cold shower, etc.

The inhibition processes of which we spoke in connection with the teaching of conditioned reflexes, are the basic condition which ensures the retardation of the final link of the reflex act.

The reflexes of the second group take another course, whereby their effect is not retarded, but enhanced. Many circumstances can contribute to this.

L. N. Tolstoy describes an interesting case which happened to one officer during the war. This officer was quite brave during the battle when bullets and shells were flying around. However, after the battle when, in the ensuing silence, a bang of a cork from a champagne bottle pierced the air, the officer fell in a dead faint.

We know the tension a man experiences when he is anxiously waiting for someone to arrive. He looks at the watch repeatedly ("time is dragging"), any silhouette appearing at a distance seems to him to be the person he is awaiting, etc. The functions of inhibition are markedly reduced in this case.

Sechenov explained the nature of these states. Later, Pavlov wrote on the basis of numerous experiments.

"Our sensations of agreeable, disagreeable, lightness, hardship, joy, torture, triumph, despair, etc. are connected either with the transfer of the strongest instincts and their stimuli to the corresponding reflex acts, or with their inhibition..."¹

The dependence of the strength of the reaction (reflex) on the condition of the centers of the nervous system are convincingly demonstrated in many cases taken from life.

¹ I. P. Pavlov "Complete Works", Vol III, part 2. Published by Acad Sci USSR, 1951, p 335

Let us visualize a very hungry man. He is grabbing food, any kind of food. In the case of prolonged hunger, the even usually non-edible objects are consumed (grass, bark of trees, etc.).

"Hunger -- is hunger," wrote K. Marx, "however, the hunger which is satisfied with cooked meat, eaten with a knife and fork, is a different kind of hunger than the one which forces one to swallow raw meat, to grab with fingers, nails, and tooth."¹

Now, let us visualize a man under usual, normal conditions. One of his most important vital emotions is appetite. We must dwell in detail on the physiology and psychology of the emotions of appetite. These sensations are known to everybody, have been studied in detail, and on them can be convincingly demonstrated the unity of the physiological and psychic. The analysis of the origin and changes in the emotions of appetite is very instructive, because it shows the common traits of development and the course of many other emotional states of man.

Appetite is a complex emotion. It consists of a number of diverse sensations. A part of them originates in man some time before eating, the other part -- during the very act of eating. To the first group belong the sensations which appear in man about four to eight hours following the last intake of food, and which he begins to feel, first as a light, and later as ever increasing sense of attraction to food, the sensation of hunger. The presumption is that these sensations originate on account of the emptying of the stomach and the increased peristalsis in which the empty stomach and the intestines participate. These movements increase gradually and resemble convulsive spasms of the stomach. At this stage the slight sensation of hunger, which is close to the sensation of appetite, may change into painful sensations of hunger. This is the state in which some people experience the sensation of "gnawing in the pit of the stomach," others -- a dull, gnawing pain in the region of the abdomen or chest.

"Rumbling" in hunger is the result of forceful peristalsis of the stomach and intestines. This sound originates in the intestines because, even when they are empty of food, there is always a certain amount of digestive juices and mucus present.

With the exhausting of the store of food substances which had been consumed with the previous meal, the properties of the blood and other organic fluids are changing, and the excitability of the nerve centers is undergoing a certain change. I. P. Pavlov used to call the blood which underwent changes due to hunger, the "hungry" blood.

1. K. Marx and F. Engels "Works", Vol XII, part L, p 182

All these changes are reflected in the activity of the nervous system, with the result that we perceive it as the appearance of appetite, or the sensation of hunger. An appetite may appear even when man sees no food, does not smell it, etc. It is presumed that it is the manifestation of the food instinct which periodically asserts itself in craving for food. A nursing baby sleeps most of the time, but awakens under the effect of the food instinct, and having taken food from its mother falls asleep again. The satisfaction of the demands of the food instinct in an older child, or in an adult takes a different course. Thanks to the more developed psychic activity and the presence of various visual, aural, olfactory, and other sensations, the older children possess, besides instincts, a more conscious relation to food. A nursing infant feeds on its mother's milk, while older children and adolescents are familiar with a large variety of types of food.

When the smell of food penetrates from the kitchen, the children will unmistakably determine whether fried fish with onions is prepared, or a fancy vanilla pie is being baked. Likewise, in examining the display of food in a store window, children will not confuse the taste of hearing and ice cream, oranges or salmon.

It follows, that in their choice of food they are not guided by instinct any more. The activity of the consciousness connected with the recollection of taste and smell of food is now playing an important role. When a nursing infant starts crying under the stimulation of hunger, it will suck anything which gets into its mouth, as long as it resembles its mother's nipple, is warm and moist (the use of an empty rubber nipple is based on that). Perhaps, the taste sensations play some role, but the substance of the nipple, odors, etc. certainly takes no substantial part in it.

It is different with an older child. He will not eat an egg which is not fresh and has an unpleasant odor, even if he is very hungry. On the other hand, pleasant odors and tasty meals may divert his attention even from onerous games and make him ask for food, though he had not thought of it earlier.

In spite of the fact the brain works as a unit, its function can be classified in accordance with various characteristics of its separate parts, as follows:

The posterior part of the brain stem: medulla oblongata (1), pons and cerebellum (2). In this section are located the groups of reflex centers of the basic biological functions (nutrition, metabolism, respiration, blood circulation, and the primary environmental orientation

/Numbers in parenthesis refer to figure at end of translation/

The mid-brain (3): Its basic function -- maintenance of correct orientation of the body in space and the preservation of the normal body posture.

The anterior part of the brain stem: Thalamus opticus and the hypothalamus area (4) -- the central perceiving section of the brain stem; its functions are connected with the formation of emotions and sensations. From this section of the stem impulses are directed to all other subcortical centers, as well as to the cerebral cortex. Here, also, are situated the higher regulating vegetative functions -- the centers of the hemispheres of the brain. The motor, visual, aural, tactile and other centers are located here.

The conditioned-reflex (higher nervous) activity is effected in the cerebral cortex.

It follows that, in addition to the food instinct with which it is born, a grown child manifests a high degree of psychic activity relating to the acceptance of food. On this basis, many personal habits and preferences to various types of food are developed and reinforced, as the child grows older.

An agreeable appearance and odor of food is directly connected with its gustatory qualities. There are special taste buds on the tongue connected with nerves and, through these, with the central nervous system. When these gustatory buds are stimulated by food substances, man is able to distinguish acid, sweet, salty, bitter, and other food qualities. The manifestation of appetite is not the result of the food instinct only; it depends also on personal preferences, habits, and training. The psychic state of an individual plays a particularly important role in the manifestation of appetite. Under the effect of various influences on the nervous system the appetite may be disturbed, the secretion of digestive juices retarded, etc. By influencing the psychics of man, one can produce marked changes in the manifestation of appetite. Such frequently used expressions as "to spoil the appetite", "to interrupt the appetite", "to develop an appetite", etc. correctly represent the gist of the matter.

Various psychic emotions like fear, for instance, can have a marked reaction on the activity of the digestive organs. An interesting method was employed in ancient India for the purpose of ascertaining the guilt of the suspected criminal. He was given pinch of rice and told to chew it and to spit it out. If the spit out rice proved to be dry, a conclusion was reached that the fear of being detected had stopped his salivation, and the man was declared guilty. Of course, this method of "legal proceedings" is more than naive, but the story reflects the keenness of observation in people who have taken notice of the fact that psychic disturbances exert a marked

effect on salivation and on the secretion of other digestive juices. Under strong excitation, many will show the same effect -- a drying up of the mouth.

The above mentioned proves the fact that diverse effects on the nervous system while acting negatively on the appetite, at the same time exert an unfavorable effect on the function of the digestive organs. It relates particularly to children and adolescents, whose psychic and nervous activity are less stable and more subject to changes than in adults.

Any trifle which has some relation to the consumption of food, or to the character of the food itself, may affect the appetite. The parents are therefore expected to exert special care in this respect in the maintenance of a good appetite in the child. The consumption of food "on the go", dirty table, dirty clothes or hands, unpleasant appearance of the food, bad odors, speaking while eating, etc. easily "spoil", "interrupt" the appetite, even in one who had a good appetite before seating himself at the table.

Everything which affects the psychics of a child and its mood may have a strong influence on the state of the appetite and, consequently, disturb the digestive processes.

Fright, or various aggravations have a depressing effect on appetite and digestion. Even thoughtful parents frequently make mistakes in this respect. For example, the child must be reprimanded or scolded for some transgression. The mother wishes that father participates in this act. The reprimand is postponed till dinner time, when the entire family is usually present. Right here at the dinner table the child receives a stern reprimand. To the impressionable nature of a child this is very often a sufficient stimulus to spoil the appetite.

Having analyzed in detail the emotions connected with appetite, we can see the inseparable, integral part which the psychic states play in the physiological processes. The examples with appetite are typical also of other human emotions. To each of these correspond very complex physiological reactions at the basis of which are formed subjective impressions.

In previous chapters we learned somewhat briefly of the functions of the higher section of the central nervous system, the so-called cerebral cortex, citing as examples various conditioned reflexes.

The problems which emerge in connections with emotions require a more detailed analysis of the function and structure of the central nervous system as a whole.

The Cortex and the Subcortical Centers

In the space of many millions of years of human evolution his nervous system has been constantly perfecting itself, and has finally occupied the dominating position in respect to functions and has achieved a high complexity of structure. Fourteen to 15 billions of cells, according to estimates, constitute the cortex of the brain, which attests to the exceptional complexity of the structure of the nervous system.

The past century showed the remarkable progress of physiology in the development of numerous experimental methods of the study of the functions of the subcortical centers of the brain. Among them we shall mention the methods of surgical removal of the cortex and of the large hemispheres, as well as electrical, chemical, and mechanical stimulation of various sections of the brain. The discovery of its electrical impulses in the brain (electroencephalography) contributed considerably to our knowledge of the functions of subcortical centers. The modern technique of experimentation enabled researchers to plant electrodes in the cerebral mass, even within the limits of microscopic cellular areas (micro-electrodes), and to carry out regular observations.

All this led to detailed investigation of various sections of the subcortical formations with the view of determining the functional consequences which originate after stimulation of various centers. However, the main and most convincing mass of information has been obtained in another way.

Various disturbances of nervous functions in diseases affecting the central nervous system, especially in cases where clearly defined areas of the brain had been involved (epidemic encephalitis, hemiplegia, etc.), brought out data the study of which enabled physiologists to arrive to fairly substantiated conclusions on the role of the subcortical centers in the formation and course of the emotions and instincts of man.

The field of the so-called micro-vegetative reactions or the expressive motions presents great possibilities in the study of emotions. These include changes in facial expressions, body postures, and many vegetative reactions such as, for example, constriction or dilatation of the blood vessels, reddening of the face or turning pale, changes in cardiac activity or in respiration, etc.

Leonardo da Vinci, the great Italian painter and scientist, gifted with exceptional faculties of observation and a perfect knowledge of the characteristics of the anatomical structure of the human body, attempted to determine the constant interrelation between the facial expressions and the corresponding emotional state.

We shall mention here that I. M. Sechenov devoted one of the last chapters of his book "The Physiology of the Nervous System" (1866) especially to the analysis of facial expressions. According to his general theory of the reflex activity of the brain, Sechenov, after a detailed analysis of the connection between various emotional states and the changes in facial expressions, arrived at the conclusion that each facial expression should be regarded as the end of a reflex which had been complicated by psychic elements.

A few years later came out the above mentioned book of Charles Darwin "The Expression of Emotions in Man and Animals." Darwin collected in this book an immense factual material. The juxtaposition of the conclusions of Darwin and of the theoretical views expressed earlier by I. M. Sechenov brings out clearly that Sechenov anticipated many thoughts of Darwin.

Thus, the constancy of relationship between facial, or expressive motions and definite emotions can be accepted as fully substantiated. On the strength of this, the observation of these expressions can be used as one of the methods of the study of emotions.

We have already indicated that in certain diseases of the central nervous system fairly typical disturbances appear in the emotional sphere. Let us cite some examples.

= Numerous clinical observations on patients who have recovered from encephalitis (inflammation of the brain, mainly of his subcortical areas), showed the most intimate connection of the brain stem with psychic activity. The patients manifested a highly exacerbated sense of the agreeable and disagreeable. A highly increased excitability (emotionalism) was observed. At this, profound disturbances of the facial vegetative reactions were taking place.

In hemiplegia patients (one-sided paralysis) it was found that stimulation of the affected parts of the body caused marked emotional reactions. Heat was perceived as a highly pleasurable sensation, while puncture with a needle caused an extremely painful sensation.

The affliction of the central nervous system with multiple sclerosis may be likened to an experiment whereby, in some way or other, the effect of the cortex on the subcortical centers has been eliminated, as a result of which these centers manifest their inherent independent functions *[without the control of the cortex]*.

In this illness a state of enhanced excitability and sensitivity is often observed. The patients manifest increasing gaiety which is expressed in facial motions which bear no relationship whatsoever to

Their physical condition. It amounts at times to a forced, compulsive reaction of laughter which is not caused by environmental conditions, or factual internal stimuli. The results of experimental data in animals, after the removal of the higher sections of the brain, show an exacerbation of manifestation of certain reactions which we can relate to emotions (anger, fright, etc.); these results correspond to the phenomena described in multiple sclerosis patients.

Very important data were obtained in clinical observations of patients afflicted with lesions in some highly important subcortical areas as, for example, the thalamus opticus and the hypothalamic regions.

On the basis of the comparison of observed disturbances of the emotional manifestations in these cases, a conclusion has been arrived at that the thalamus is the main, or general center of sensation:

Thus many consider the thalamus as the center, the function of which consists of switching all external and internal stimuli into facial-vegetative reactions of a negative or positive type, and imparting a definite emotional tone, according to the circumstances, to the orientation, food, sexual, defensive, and other reactions.

We arrived at the following conclusions on the basis of numerous results obtained in the study of the sequelae of affections of the cerebral subcortical centers.

A weakening, even complete fading away of the expressive facial reactions. The manifestation of affects and emotions such as, anger, fright, hunger, love, curiosity, etc. is markedly decreased. The patients can be characterized as "insensible" in their external behavior, and resemble manikins, dolls with a very monotonous, inexpressive facial expression. A weakening of many instinctive tendencies: the sense of self-reservation, the maternal sense, etc. The patients lose interest in the environment and in themselves. Indifference to everything, the lowering of purposefulness and initiative -- such is the background of sensations which characterizes the emotional state of these patients.

It is worth mentioning that, depending on the various character and degrees of affection of the nerve centers, the emotional disturbances may assume a reverse trend, when certain emotions and tendencies are contrarily highly enhanced (marked sensuality, suspiciousness, egotism, belligerence, etc.).

The cited results of clinical observations correspond fully to

experimental data. As has been pointed out, a particularly rich material was obtained in experiments on animals with permanently planted electrodes adjusted to various sections of the brain.

The first investigators who have used this method already observed the reaction of "rage" and "anger" in animals after an electric stimulation of their subcortical centers.

We shall cite verbatim the description of an experiment by an American physiologist, Gerard.¹ The brain stem below the thalamus was separated in a cat, following which the cat carried out perfectly well but in an entirely automatic fashion various coordinated motions. But if the separation is made a few millimeters higher and leave the hypothalamic region connected with the brain stem, the behavior of the animal assumes an entirely different character. As soon as the effect of narcosis wears off, the animal gets into a highly excitable state, tries to break away from those holding it, and, when finally at liberty, assumes an alertly cautious attitude.

A light touch, like caressing the fur, causes an angry reaction. The cat begins to hiss and to bit, bares its claws, flexes its spine, hits with its tail in all directions, its pupils dilate, and the fur stands up. The animal acts as if it faced a vicious dog. Weak whistling and hissing sounds cause the cat to manifest signs of fear -- it runs away at once, with the head and tail lowered, and moves pitifully.

Parallel with aggressive reactions, one can stimulate under such experimental conditions other reactions in these animals, defensive and sexual, for example.

Of particular importance are the results of the latest studies which indicate the possibility of an artificial stimulation of reactions complicated by a sensory element such as appetite and thirst.

At the International Congress of Physiologists in Brussels in 1956, remarkable data were presented in regard to the possibility of an experimental control of appetite and thirst.

By means of the method of electrodes planted in various sections of the brain stem and of stimulation of various centers, the authors of these interesting tests demonstrated some animals (rats) which at the will of the experimenters drank so much water that they blow up like balloons, or ate as much food as they could physically swallow.

¹ See Ralph Gerard "The Functions of the Human Body", Pub. of Foreign Lit., 1947, p 275

These laboratory experiments fully corroborated the above cited considerations of the dependence of hunger and thirst on the functional status of the nerve centers.

In describing various data obtained in the tests with planted electrodes, we cited the basic results which showed the origin of negative emotions (anger, rage, fear, etc.).

Very important are other experimental facts which attest to the fact that, parallel with negative emotions which are the result of the disease of the brain or of an experiment, one can also induce positive emotions. We can refer to the experimental results with planted electrodes in cats which showed the manifestation of a definite positive reaction (pleasure) when the animal was stimulated in its hypothalamic region.

The above cited facts indicate that emotional states take their course on the basis of complex processes in various areas of the brain (cortex and the subcortical area). Many peripheral organs participate in the formation of emotions, among them -- the vascular, respiratory, digestive, and other systems.

Let us now discuss the functions of the so-called sympathetic or autonomous nervous system which has a close relationship to emotional states.

The term "sympathetic nervous system" originated a long time ago. The authors of this designation were not such in the wrong, for they seemed to have anticipated the connection of this section of the central nervous system with the manifestation of sympathy, i.e., feelings. However, since the conception of feeling directed the scientific thought toward the realm of the subjective, while the aim of experimenters drew them to possible objectivization of studies, other terms such as, the vegetative or autonomous nervous system made their appearance. The designation "vegetative" has its origin in the Latin word "vegetativus" meaning plantar. The scientists erred to such an extent that they tried to divide the organic processes into animal processes -- animals (the muscular activity, as well as that of the organs of sensation, and of the central nervous system), and vegetative -- plantar (the functions of the internal organs, respiration, and metabolism). The unrollable basis for this assertion was the alleged identity of these vegetative processes in animals and plants, also the faulty idea that notion and feeling are inherent to animals only.

The term autonomous nervous system originated in connection with the known facts which indicated that these forms of nervous regulation

are not always subordinated to influences arising in the higher sections of the central nervous system. It is impossible, for instance, for the great majority of people to retard or accelerate by the effort of the will the rate of cardiac contractions, to stimulate gastric motions, or to stop the motive activity of the intestines. Only isolated individuals (including the famous Indian fakirs, could accomplish this feat. These "miracles" can be reasonably explained. Most frequently we are dealing here with cases of a pathologic nervous system with manifestation of hysteria, in particular.

At any rate, the emergence of these terms signifies the aim of the investigators to underline the characteristics of this branch of the nervous system.

Modern science assumes that the autonomous branch of the central nervous system was formed and acquired its specific characteristics earlier than the corresponding areas of the higher sections of the brain and of the cortex, in particular.

The autogenous nervous system attracts our attention in connection with the fact that it participates directly in the formation and realization of emotional reactions.

The experimental results demonstrate that certain emotions (hunger, fear) are effected through the obligatory and active participation of the autonomous nervous system. We must also add that the autonomous branch of the nervous system is conditioned in its functions to a much larger degree than the higher areas of the brain by various chemical stimuli of the organism which originate as a result of the metabolism and the life activity of the special organs.

These chemical stimuli are represented in the organism in various forms. This is due to the fact that, before the origin of the nervous system, the regulatory activity of the organs was effected by means of chemical substances. The latter were distributed in the body through the blood. Based on this fact, there are two approaches in modern physiology to the problem of the regulatory activity of the organism. One of these types of regulation, the most differentiated, is the mechanism of the nervous system, the other is through the blood stream and was designated as the "humoral" type of regulation ("humor" in Latin means fluid; this term often means blood). The most important role among humoral regulators is played by hormones -- the products of the glands of internal secretion. We mentioned previously some facts which indicated the effect of thyroid, adrenal and other hormones on the psychics of man.

The investigations of Cannon, the American physiologist, and others present large experimental data, which attest to the joint participation of the nervous system and the glands of internal secretion in the formation and manifestation of emotions.

The administration of certain hormones to the animal organism of man may create various emotional states. In addition to Cannon's experiments on animals, this is corroborated by numerous facts from observations on humans. Some facts indicate the effect of various emotional states on the activity of the internal organs. Thus, for instance, it has been demonstrated that under the influence of anxiety and excitement the normal gastric circulation was disturbed and its normal activity was reduced.

Also, under conditions of emotional stress, there have been wide variations in the secretion of the gastric and pancreatic juices observed.

Widely known are the easily observable changes in the respiration and the rate of cardiac contractions under the effect of emotional experiences. The national folklore and poetry accumulated many epithets which attest to that. It will suffice to cite examples relating to the changes in cardiac activity under the influence of emotion. "The heart sings," the heart "groans in misery," the "heart is tearing itself out of the chest," it "froze from fright," or "hatred," "blew," "tearing itself to pieces in grief," "full of love," or "warm heart," "gentle heart," "stone heart," "man with no heart," etc.

These expressions indicate correctly the inseparable connection and reciprocal relationship of emotions and bodily functions of the organism.

The Physiology and Psychology of Sensations Induced by the Stimulation of Internal Organs.

In discussing this subject, we shall touch upon the problem of the sensitivity of the internal organs -- a problem long overdue in practical medicine, but still highly contradictory theoretically.

In interpreting the conditions of the origin of various associations in man, I. M. Sechenov mentioned a special group of stimulations and sensations which enter the brain from the internal organs.

"To the category of the phenomena of consciousness," he wrote, belong the vague and obscure sensations which accompany the processes taking place in the areas of the chest and abdomen. Who does not know, for instance, the sensations of hunger, satiety, and fullness of the stomach? An insignificant disturbance of cardiac activity is liable

to lead to a change in the man's mood; the nervousness and irritability of a woman nine times out of ten is connected with the pathological condition of the uterus. Such facts, in which the pathology of man abounds, clearly indicate the association of these vague sensations with those created by the organs of sensation. Unfortunately, all problems relating to this subject are extremely difficult to interpret, their solution, therefore, is the task of the future.¹

Some time later, Pavlov advanced the problem of the study by the physiologists of the signals coming to the brain from the internal organs, parallel with the study of the reactions to the external stimuli. He said that he considered "more than probable that they exist within the tissues, as well as within separate organs."²

The basic mass of observations carried out in this direction belongs to K. M. Bykov and his students. Bykov, in association with Ivanova, carried out the following experiments. They poured carefully a certain quantity of water through a tube previously planted in the stomach, and caused, as a result, an increased urination, the extent of which could be determined precisely by means of repeated tests. Water was then poured into the stomach for only a brief period of time -- one or two minutes -- and the stomach was emptied after that. The water could not be absorbed in this test or enter the blood stream and stimulate the kidneys. However, the facts demonstrated that, even under these conditions, urination increased to the same extent as if the water had remained in the stomach for a longer period of time.

Thus, a conditioned reflex of enhanced urination has been formed under these conditions, with the role of a conditioned stimuli played, in this case, by the irrigation of the internal lining of the stomach with water.

The results of these experiments substantiated the correctness of Sechenov's and Pavlov's theory that, under certain conditions, impulses from the internal organs lead to the higher sections of the brain.

Subsequently, Bykov's associates carried out many and various experiments which fully corroborated this statement. The possibility of formation of conditioned reflexes was demonstrated by stimulating the intestines, urinary bladder, salivary gland, etc.

Sechenov's conjectures that "obscure internal sensations" leading

- 1 I. M. Sechenov "Brain Reflexes", Publication of Acad Sci USSR, 1952, p 136
- 2 I. P. Pavlov "Complete Works", Vol III, Book 2, Pub. Acad Sci USSR, 1951, p 156

from various internal organs are associated in the sphere of consciousness, thus, were fully confirmed.

Probably since its early origin medicine advanced the problem of the relationship between psychic and corporeal phenomena. Centuries have gone by, the technique of the examination of patients continues to improve, the methods of investigation of internal organs become more precise, but the physician remained aloof from the analysis of the psychic state of the patient, though he was well aware of its important, even leading role. The inability of penetrating the psychic sphere limited the possibility of a correct determination of the character of the disease. This, in its turn, led to new complications and to the aggravation of the patient's condition. Here, the important elements were the lack of attention, ignorance, or the rude frankness of the physician.

The doctor's reason for his rude frankness, directness, and tactlessness in his attitude toward the patient, was frequently his fear of accepting the patient's ability of a psychic influence on the course of his disease. In order to avoid being accused of ignorance, mysticism, and tendency to expect miracles, the doctor would rather ignore obvious facts.

These misgivings were quite understandable, considering the fact that in those times only idealistic approach was the path to psychics, and there were no facilities for the scientific analysis of psychic phenomena.

The situation has radically changed in modern science. The teaching of Pavlov and his school pointed out not only the ways and mechanisms of the influence of the cortex on the activity of all internal organs to the higher centers of the brain. The principle of the unity of organic functions, introduced into physiology by Pavlov, manifested itself in its highest form.

The realm of the conscious, as well as the enigmatic frequently full of mystic ideas phenomena of the subconscious which are generally perceived as moods only, became the subject of a materialistic physiological analysis.

It would be incorrect to state, in regard to modern medicine in Europe and in the United States of America that their physicians are inclined to ignore or to underestimate the significance of the mental attitude of the patient in the evaluation of his condition. The psychic and mental represent the direct subject of their attention. Lately, there has been a special trend in medicine of these countries - the so-called psychosomatics. The word "soma" means body, that is, one deals with the effect of mental conditions on body functions.

It seems that in posing the question, our views are identical; the ways of its solution, however, are different. The notices of the bourgeois countries, resort at best to generalizations which found their expression in the newest theory of "stress." Stress is a concept of the reactions of tension in the organism which are originating in response to most diverse factors, starting with mental shock, personal offenses, and the contradictions of social interests, and including the effects of hunger and cold. The authors do not seem to have any real idea of the mechanism of these influences and of the ways and means of their realization.

The followers of Pavlov are on a much firmer ground, because the mechanisms of temporary connections between the external and internal stimuli which Pavlov interpreted, as well as the forms of interrelationship and interconnection of cortical and subcortical centers of the brain, and the laws of the origin and course of the basic processes of stimulation and inhibition in the central nervous system which Pavlov discovered, offer a stable foundation for the solution of the problem of the body and soul from materialistic positions.

Numerous facts obtained by Soviet and foreign scientists show that emotional reactions are not only accompanied by body changes, but that they themselves originate only in that case, when the nervous and humoral regulatory systems of the organism ensure various changes in the functions of many organs of the body.

In studying the physiology of the autonomous nervous system, the Soviet scientist, Academician L. A. Orbeli, developed the trophic adaptation theory based on data which he had obtained. Its substance can be explained by a simple example.

Let us imagine an animal - a cat, which encountered a vicious dog. The cat's fur bristles, the cat hisses, snorts, lets out its claws, etc. It is obvious that the animal goes through emotions of fear and rage. If we engage in an experimental analysis of the condition of the animal, we can establish a consecutive succession of changes in the animal, we can establish a consecutive succession of changes in the functions of the autonomous nervous system (its sympathetic branch, in particular) and of the glands of internal secretion. There is an acceleration and deepening of respiration and blood circulation which ensures supply of oxygen and there is a change in the chemistry of the blood which supplies an increasing quantity of nutrition to increase the work capacity of the muscular system - all these mechanisms are triggered by the nervous system and the glands of internal secretion.

We know from our personal experience that the emotions of anger coincide with the acceleration of heartbeat, deepening of respiration, and muscular tension - in anger we tighten our fists - in other

words, just as our distant animal ancestors, in anger we act as if we were preparing for a fight.

In citing these facts, we must clarify the inadequacy of one of the old theories (James and Lange), according to which emotions, as a subjective condition, originate on the basis of already realized body changes -- we are sad because we cry, cheerful because we laugh.

As facts show, there is no reason to support this one-sided view. On the contrary, there are facts which show that it is possible to reproduce experimentally an external, bodily state of emotion in the absence of the usually corresponding psychic experience.

Similarly, we knew cases when definite emotional states proceed without any visible external manifestations. The entire problem is much more complex than it may appear at the first glance.

The Unity of the Psychic and the Physiological

The basis of modern ideas of the activity of the organism is the Pavlov principle of the wholeness, interconnection, reciprocal conditioning and reciprocal effect of the functions of body organs.

In speaking of the influence of the psychic on the physiological, we must not assume that psychic, as such, affects certain organs mechanically. To accept this point of view would mean that we consider psychics as something bodily existing per se, i.e., to go back to an idealistic position. We must remember that certain changes which are taking place in various physiological processes are subjectively perceived as psychological experience. The psychic states influence the physiological processes and vice versa.

The unity of physiological and psychic phenomena, within the continuous interconnecting frame of the wholeness of organic functions, leads at times to certain states when their inner content is very different, despite the uniformity of the external manifestations.

Crying and tears may, for example, accompany various emotional states of sorrow or joy. Not in vain do we speak of a state of "pleasant sadness", or of "tears of relief, joy, or tender emotion", etc. Same refers to "mean laughter", "having, cold, deprecating smile," etc.

We spoke of expressive, facial-somatic reactions as a method of study of emotional states. This thesis does not lose its significance; however, we must make a reservation that in certain cases we do not always observe the parallel manifestation of facial-vegetative reactions and emotions.

There are instances when we observe a divergence, even a reverse relationship between the facial expressions, expressive motions, and the state of emotions.

The above stated constitutes an added reason for the critical evaluation of the peripheral theory of origin expostulated by James and Lange.

The complexity of the problem is redoubled by the fact that the bases of emotional states, including, to a great extent, the unconditioned reflex mechanisms, at the same time are "overgrown" with conditioned reflex associations. Let us visualize a man who had visited a dentist. The characteristic sensations which originate in dental manipulations, as for instance with the drilling apparatus, and the considerable pain experienced in the opening of the pulp of the tooth, cause in the patient an unconditioned reflex effect on respiration, blood vessels and heart, contraction of the body muscles, vertigo at times and even a fainting spell -- all of it subjectively associated with the sensation of pain and disagreeable emotions. If, after a fairly long lapse of time, the man has to go to the dentist again, even for a treatment involving little pain, the mere fact of sitting in the dental chair, seeing the drilling device and the doctor arranging the instruments, may revive the greater part of the complex of previously experienced reactions (on the part of respiration, heart, etc.), and the negative subjective state will be reproduced with new force much before the dentist starts his manipulations. We have here the picture of reproduced conditioned reflex emotions.

Offense, insult, humiliation, experienced at a certain place, will cause conditioned reflex negative emotions, when we encounter stimuli reminding us of the previous experience.

A person we love creates in us emotions of a positive nature not through his person only, but also through many other associations connected with him. The meeting places where love first originated, things connected with the tastes and habits of the beloved -- all this is colored with the feelings of sympathy which converge around the source of the positive emotions -- the person dear to us.

One can also imagine circumstances, when a certain part of the emotional complex is reproduced as a result of the recreation of the traces of previous experiences. The question of the role of traces has already been discussed in connection with the analysis of the mechanism of dreams. It turns out that a similar phenomenon may be the result of certain definite emotional states originating on the basis of more recollections, which relate to some exceptional experience. The example mentioned above in the description of the state of man who

had previous

had previously experienced disagreeable emotions from a visit to a dentist, in a case in point. All these emotions represent, in the final count, conditioned reflex associations. Their origin, however, is not connected with external stimuli, since we deal here with a recollection, but with stimuli caused by changes in the internal state of the organism.

The most important inference with which we have every reason to make from the above stated, is that the emotional experience can originate on the basis of definite functional changes in the nervous and humoral systems only. Much of it is still obscure. We cited experimental facts relating to the simplest emotions only -- hunger, fear, etc. No doubt, in spite of the importance of these emotional states, the problem as a whole cannot be limited to their analysis only. The sphere of man's psychics is immeasurably wider. Suffices to refer to the higher emotions originating under social influences, most typical to man. Examples of these emotions are patriotism, humanity, humaneness, esthetic emotions, etc. We shall remind you here of the chapter in this book devoted to the second signal system which is specific to man. Its role in the formation of psychics and mental states is exceptionally great.

"...the most inspired feelings will remain unknown to people, unless they are clearly and precisely molded in words".¹

"The pupil will perceive your soul and your thoughts not because he knows what goes on in your mind, but because he sees you, hears you."²

The most important inference from the above stated leads us to the conclusion that emotional states, as well as intellectual activity (closely connected with them) represent the result of material processes which are taking place in the nervous system of man and are conditioned by environmental influences.

We have already spoken of the correlative significance of the higher centers of the brain (cortex) and subcortical formations in the psychic activity.

This problem is not an easy one.

I. P. Pavlov very definitely formulated his thesis on the role and interrelations of the cortex and subcortical centers. He spoke

1 N. I. Kalinin "On Communist Education", Pub. Molodaya Gvardiya /The Young Guard/, 1947, p 98
2 L. S. Zakharovko "Selected Pedagog. Works", Uchpedgiz, 1946, p 120

of the stimulating "trigger" role of subcortical area in relation to the cortex. He visualized the mechanism of this influence in the form of mutual induction: a strongly stimulated cortex has a negative effect on the stimulation of the subcortex, i.e., has a depressing effect on its activity, and, inversely, a considerable stimulation of the subcortex may have a negative effect on the excitability of the cortex.

Accordingly, the inhibition of the cortex "liberates" the subcortex from the restraining effect of the higher centers of the brain, with the result that the functions of the subcortical centers may in extreme cases be on the level of "violence," as Pavlov named it.

"The higher nervous activity is composed of the activity of the large hemispheres and of the adjacent subcortical nodes," wrote Pavlov, "and represents the unified activity of these two most important areas of the central nervous system. These subcortical nodes are...centers of the most important unconditioned reflexes or instincts of food, defense, sexual, etc., thus representing the basic aims, the most important tendencies of the animal organism."³

In summarizing his thoughts which Pavlov expressed in regard to the correlation of the activity of the cortex and the subcortical areas, he emphasized the fact that "the subcortex is the source of energy for the entire nervous activity, and the cortex plays the role of the regulator of this blind force, in skillfully directing it and controlling it."

In addition to this form of interrelationship of the cortex and subcortex, there are other forms of their interaction. We have in mind spreading of the processes, their direct transfer from one level to another. The stimulation or inhibition may spread from the cortex to the subcortex and vice versa.

This is the true dialectic idea of the interrelation of the processes of stimulation and inhibition between the basic sections of the brain.

As demonstrated above, various experiments by Pavlov and his numerous followers showed that the physiological processes, which are at the basis of conscious activity, are taking place in the cortex of the brain. These views seem to be unacceptable to some foreign scientists.

1 I. P. Pavlov, "Complete Works", Vol III, Book 2, Pub. by Acad Sci USSR, 1951, p 402-406

Thus, for example, the greatest English physiologist, Ch. Sherrington, in his book "Man and Nature", published in 1932, expressed doubt at the premise that the consciousness of man is connected with physiological processes taking place in the cortex.

Pavlov subjected to very severe criticism the idealistic position of Sherrington.

Lately, we have been witnessing a certain relapse of these attempts. We shall mention, for example, the assertions of the eminent Canadian neurosurgeon, Penfield and his associate, the noted electrophysiologist, Jasper, who are trying to substantiate their theory that consciousness originates in connection with activity of the subcortical area and not in the cortex.

One of the basic reasons for this view is the fact of the disruption of conscious activity in surgical damage of the subcortical areas, but not in the case of cortex. Even considerable damage to wide areas of the cortex did not disrupt the conscious activity in man.

These facts are true but they received incorrect interpretation on the part of Sherrington.

If we shall adhere to Pavlov's point of view and shall remember especially his views on the powerful restorative and compensatory properties of the cortex, the fact of the unchangeability, more correctly the restorability of consciousness despite considerable damage to cortical areas, will cause us no surprise.

It is easy to understand why a damage to the subcortical areas leads to the loss of consciousness.

According to Pavlov, the subcortical region represents a powerful accumulator of energy which stimulates the activity of the cortex. It is not surprising that the disruption of this powerful stream of stimuli originating in the subcortex, reduces the tone of the cortex and may lead in certain cases to the complete inhibition of its function, and subsequently even to the loss of consciousness. As a contributing element is the fact that the restorative and compensatory function of the subcortex is presumably developed less than that of the cortex.

Lately, there has been a tendency of some scientists of England and the United States of America to "lower" the functions of consciousness down to the subcortical area. It is connected with a theory, which has received quite a following in recent times, of the network (reticular) formation. Essentially, it has to do with some

subcortical formations the significance of which had already been treated by Pavlov and his school.

If we shall cease trying to solve this problem unilaterally by ascribing various functions of consciousness to the subcortex or cortex only, and follow the Pavlov point of view of the harmonious unity of the cortex and subcortex apparatus, there will be no new problem. Though the cortex and subcortex may exist under conditions of variance in their interaction, nevertheless, in the final count, they always act in concord under normal circumstances.

"We would separate physiological, or somatic from psychic, i.e., from impressions, powerful emotions of hunger, sexual urge, anger, etc., in the most complex field of unconditioned reflexes." Thus spoke Pavlov, who was, at the same time, the creator of the teaching that the cortex plays the part of "manager" and "distributor" of all body functions.

These remarks fully reflect the Pavlov conception of the relations and bonds between psychic and physiologic phenomena.

One cannot completely separate two sides of a unified process of life activity -- the psychic and physiological ones.

We might add that in its correct point of view the Pavlov teaching of the leading role of the cortex does not presume the slightest possibility of its separation from the functions of the subcortex.

The essence of the problem is that we do accept as corporal only the material substrate of psychic activity -- the cerebral tissue. The processes which are taking place in it can be viewed from two aspects -- the physiological and psychological, and both of these aspects can be examined either simultaneously or consecutively.

K. D. Ushinskiy, an eminent psychologist and pedagogue, wrote: "The history of our sensations is the most intimate history of our soul." It is obvious that the essence of man is best manifested in clearly expressed emotions, impressions, and relations to the environment. A man must be judged not by what he says or thinks of himself, but by what he feels, and how he acts.

This correct and practical formulation of the approach to the nature of the psychic characteristics of man receives its interpretations and substantiation in the light of Pavlov's teaching of the coordinated, though dialectically contradictory, activity of various parts of the brain.

1. I. P. Pavlov "Complete Works", Vol III, Book 2, p 335.

2. K. D. Ushinskiy "Works", Vol 9, Pub. Acad. Sci. USSR, p 118.

Science versus Superstitions

"...while we do not know the law of nature, it nevertheless exists and acts besides us, without our knowledge, and it makes us slaves of blind necessity. But, as soon as we have learned of this law, which acts (as Marx repeated thousands of times) independently of our will and our consciousness, we become the masters of nature."

V. I. Lenin

One of the perfidious methods used by the servants of the church to stupefy people consists in utilizing various phenomena which have not as yet been investigated sufficiently by science. Taking into account that science is not yet capable to interpret the cause of these phenomena, the religionists present them as miracles which are performed by the will of God.

However, the steady progress of science is more and more restraining the adherents of religion from the utilization of insufficiently studied phenomena for the purpose of creation of legends and fairy tales of the "mysteries of nature" which allegedly are of divine origin and are, therefore, unexplainable and unfathomable. The Pavlov teaching of higher nervous activity played an immense role in this respect. Having determined physiological bases of psychic processes, Pavlov exposed many superstitions which had been most frequently connected precisely with the psychic activity of man. To these belong the so-called telepathic phenomena, or the belief in thought transmission over distances; spiritism -- the legend of the possibility of summoning spirits and communicating with them; the myth of the resurrection from the dead, the belief in prophetic dreams, the mystery of hypnosis, etc. The erroneous belief in the transmission of thought over distances seemed to have received lately some sort of support in the electro-physiological investigations of the brain. As far back as 1912, Pravdich-Noninskiy in Russia, and later Berger in Germany (1925), registered for the first time the fluctuations of the electric potential of man's brain. By means of highly sensitive instruments these currents are deflected from the surface of the cranium and, after multiple magnification, may become as strong as to cause the movement of a small mirror or a cathode ray in a cathode tube. This circumstance makes it possible to register these currents on photopaper. Hence, the assertions that, if the apparatus which registers the bio-currents of the brain be made more

precise and sensitive, there might be a possibility to read the thoughts in the brain while observing the minute fluctuations of brain currents. These assertions lack a scientific foundation.

Electric currents of the organism (bio-currents) can be observed not in the brain only, but in any organ of the body, though they are of different rate and form in various organs. At the present time, the bio-currents of the heart, nerves, and the skeletal muscles are well known. It has been found that bio-currents accompany the life activity of animal as well as plant organisms. One can deflect the electrical currents from a leaf of any plant and detect a difference in the potential, if one half of the leaf is exposed to the sun while the other half is darkened. The difference in the potential in this case has its basis in the different physico-chemical states of the two observed areas of living tissue, which depend on the metabolic level of these two areas. Thus, the bio-currents of the brain do not represent anything supernatural, and are the natural characteristics of its living tissue, just as are the bio-currents of any other organ.

The bio-currents of the brain, like other physical and chemical phenomena, are at the basis of the most complex physiological processes which compose the life activity of the brain. Any one of its indexes -- the temperature of the cerebral tissue, its vitamin content, and many other chemical reactions could be employed on the same basis as the bio-currents in the attempt to find a method of "reading" the thoughts. However, one can easily see the absurdity of the attempt, for example, of determining the content of oxygen or carbons in the brain for the purpose of thought "reading". The same can be said of the bio-currents of the brain. There is not the least basis for the "reading" or "transfer" of thoughts by means of bio-currents. Reflexion, thought -- represent a function of the cerebral tissue which has reached a high degree of perfection and which is absolutely inseparable from the tissue itself. Marxism teaches us that thinking is the product of matter which has achieved in its development a high degree of perfection, namely the product of brain tissue. The brain is the organ of thought; one cannot separate thought from matter, without committing a serious error.

The founders of Marxism called the naive ideas of some philosophers of the 19th century, who asserted that the brain produces thoughts just as the liver secretes bile, crude and vulgar materialism. If we consider this mechanistic point of view correct, then we must further infer that thoughts represent something material, that they can be gathered, weighed, measured. Philosophy and physiology completely deny this absurdity. Hence, it becomes perfectly clear that telepathy is the fabrication of charlatans which neither in our time, nor in the future can have any scientific basis, the advance

in the technique and precision of the electrophysiological experimentation notwithstanding.

Lately, the sciences of "divining" thoughts became popular. Wolf Messing acquired quite a reputation in this respect.

Messing developed a fine faculty of "reading" thoughts. It is not difficult to establish that this faculty has a perfectly scientific foundation. Whoever visited the sciences of Messing is well aware that he "reads" thoughts exclusively connected with the ideas of some motor actions. To go to some row of the theatre hall, take the wallet out from somebody's pocket and put it in someone else's pocket, etc. -- these are the things Messing usually guesses. Any other thought, not connected with the idea of motion, Messing is unable to guess.

What is the secret of Messing's success?

The so-called ideomotor muscular motions were known in physiology a long time ago. One of Sechenov's assistants observed that a man, thinking of some motion, reproduces it to a certain degree. "When I think, for instance, of a circle," Pavlov used to say, "my hand makes a hardly perceptible circular movement, which can be registered by an instrument."

It has been observed and scientifically proved that, in thinking of a certain definite motion, i.e., when you have a kinesthetic idea, you are reproducing it without being aware of your motion. Doctor Sechenov conducted such experiments in the laboratory of V. K. Bekhterev.

The thought "divining" Messing must always hold the hand of the person who is charged with carrying out some particular errand of the spectators. Messing developed a fine faculty of catching the ideomotor motions of his partner unnoticed by others. By supplementing it with observation of the partner's facial expressions, Messing is able to make fairly correct deductions of where he is to go. In approaching the row, of which the partner is thinking, Messing determines, in the same manner, near whom he is to stop and whether to take his wallet, or eyeglasses, etc. The highly developed faculties of Messing are beyond doubt. However, an attempt to see in it a miracle, even to try to explain the guessings of Messing by his ability to "read" thoughts, i.e., to consider it a transmission of thought over a distance is an unscientific and harmful idea.

Spiritism (Latin word "spiritus" -- spirit, soul) is a "teaching" which states that certain persons (mediums) are capable to summon (usually by light knocking) the spirit of a deceased and engage into

a communication with it, by asking questions.

F. Engels in an article "Natural Science in the World of Spirits" subjected spiritism to a scathing criticism. In describing the sciences of "spirit-knocking" and "spirit-sooting" popular at that time, Engels showed that all of these were based on charlatanism. Very earthy, individuals played the part of "spirits"; and for a sufficient remuneration impersonated the role of various summoned representatives of the "other world".

Engels is completely derisive of the naive and irresponsible scientists who are ready to seriously accept this fraud on the part of the "spirits" impersonated by young women who were decidedly not different, as Engels said, from earthy women.

In describing the spiritist sciences and the summons of "spirits," and citing examples of certain individuals, some of them noted scientists (Wallace, Crooks, etc.) who became dupes of these fakers, Engels pointed out that this trend was the result of neglect of theoretical, philosophical thinking.

In the 19th century, the conviction prevailed among many scientists that the task of a scientist is to observe facts, and nothing more. This empiricism, in its turn, led to a negative attitude toward philosophy, and dialectics in particular. Engels pointed out that some of the most sound empiricists became the dupes of "the wildest of all superstitions", as he called spiritism.

Spiritism was much in vogue in America and England during the end of the past century; followers of spiritism appeared in Russia, too. The Physical Society at the St. Petersburg University even had to assign a committee to check on the authenticity of the spiritist phenomena. Among the members of this committee was the famous chemist D. I. Mendeleev, noted physicist L. D. Kravovich, and others. After a year's study, the committee came to the conclusion that the "spiritualist" phenomena are caused by unconscious movements or by a conscious fraud, and that the spiritist teaching is superstition.

The conclusions of the committee were published in the newspaper Golos /The Voice/ in 1876.

The religious beliefs often use stories of resurrection from the dead. This fiction could not stand any criticism whatever.

The life and death of man is a subject which deeply and intimately agitates everyone of us. However, in contrast to the phenomena of life which we can analyze on the basis of self observation, everything pertaining to death remains in the realm of conjecture and fear,

which broods stories of fairy tales or mysteries. Therefore, before we speak of the "resurrection of the dead", we must define the concept of death from the scientific point of view, which presents a certain difficulty. Death of man is usually diagnosed by external signs. The man stops breathing, his heart ceases to beat; the doctor determines the fatal exit and informs the family that the patient is dead. From the point of view of everyday evaluation, death has arrived.

But, if we shall try to analyze this condition from the scientific point of view, we shall come to the conclusion that death has not as yet arrived. The phenomena of life and death are constantly intermingling. A nursing baby, just born, commences to die at once, biologically speaking. This is due to the fact that life activity itself requires the expenditure and change in the very substance of body cells. In observing an elderly man and noticing his gray hair and falling hair, wrinkled and flabby skin, carious teeth, etc. we see the obvious signs of an aging organism -- in other words the signs of death. However, the fading away of the organism during its life is not expressed in these external signs only. Any life process is carried out on the basis of destruction. Our organism is built of tissues and organs which consist of cells. The organic life depends on the activity of its cells. If we search for the basis of life activity, we shall find that the cells live to the extent that parallel with constructive functions, various processes of destruction are taking place. One cannot imagine a life process in cells whereby they would remain unchangeable. The more tense the activity of a cell, the more manifest are its disintegration processes.

The French physiologist, Claude Bernard, back in the 19th century, expressed this thought in a rather paradoxical statement: "Life -- is death." He, thus, wanted to emphasize that the phenomena of life are inexorably and inseparably connected with the processes of death. F. Engels in his book "The Dialectics of Nature" said: "We are beginning to understand the unscientific character of a physiology which does not regard death as the essential element of life, which does not understand that the negation of life is contained in the substance of life itself, so that life must always be considered in conjunction with its necessary result, already inherent in the embryo -- death. The dialectic understanding of life is reduced to this very conception. Once it is understood, there can be no more talk of the immortality of the soul... Thus, it is sufficient to simply clarify to oneself, by means of dialectics, the nature of life and death, in order to eliminate this old superstition. To live means to die."¹

This conception of the nature of life leads us to the conclusion
 1 F. Engels "The Dialectics of Nature", Gospolitizdat, 1955, p 258

that the moment when the physical diagnoses the onset of death does not yet signify, from the physiologist's point of view, that there is an absolute cessation of life activity of the organism. It is only the so-called clinical death that arrived; the process of dying is continuing.

The scientific conception of the nature of life and death attests to the fact that, just as life is permeated with elements of dying, so is the initial state of death showing certain manifestations of life, as the observations of a cadaver prove. Unfortunately, this period is comparatively brief, it lasts not hours, not hours but a few minutes. Nevertheless, even measured in minutes this period is truly precious, for during this period dying represents a reversible state and, in a number of cases, life can be restored. We speak, of course, of accidental death, when the organism is not worn out, as for instance in case of death of a young man which came as a result of a wound. The conception of clinical death is contrasted by the conception of the true death, the biological one. Now the flashes of life are gone, and death comes as an irreversible phenomenon. The latest achievement of Soviet science made it possible to prolong the state of clinical death in which revival is still possible.

Thus, under conditions of refrigerating the corpse, there were successful results of revival even after 30 minutes, as reported by the Soviet physiologist, V. A. Negovskiy.

Biological death is an obligatory continuation of the clinical death, unless some measures of restoration of life have been taken in cases of accidental death. If death has been caused by a grave illness (tuberculosis, cancer) which had destroyed some vital organs, the moment of clinical death coincides with that of the biological death.

In many instances the death of healthy people is accidental and arrives prematurely.

As has already been mentioned, during the period of clinical death one can observe a number of signs of continuing life. Nails and hair keep on growing. These are, of course external and insignificant signs of the continuing process of life; however, they gave the physiologists a reason to seek means of restoring life which soon concentrated on the restoration of life activity in separate organs. Experiments were carried out, and the results showed a "survival" of some organs. Upon the removal of some organ from the organism, it was possible, under conditions of independent existence, to preserve its life activity for a certain time. We shall call these experiments

in the future text conditionally as "revival" experiments.

In 1895 the first attempt to revive the heart was made. First experiments were conducted on the hearts of the simplest, so-called cold blooded animals. Upon the removal of the heart, conditions approximating its natural nutrition were created. A special fluid was substituted for blood; it contained salts and certain nutritious substances. The heart carried out its normal function under these conditions. Later, one succeeded in keeping alive hearts of higher animals. A "dead" heart acquired the property of complete restoration of its activity. Heart, removed from a cadaver, at first remained quiescent, then began to contract. This was sufficient proof that the heart was revived. The success of these experiments encouraged the Russian physiologist, A. A. Kulyabko, in 1902, to undertake a very daring, at that time, experiment -- he decided to revive the human heart. The heart of a child which had died of an infectious disease was used in this experiment. The little corpse remained on ice throughout the night, and in the morning Kulyabko began his experiment. The above mentioned conditions were created, i.e., a fluid substituting for blood was passed through the cardiac blood vessels; this fluid was carrying salts, nutritive substances and oxygen, it had the normal body temperature. After some seconds had elapsed, Kulyabko observed that the "dead" heart showed signs of reviving, then it began to contract. This outstanding fact led to many similar experiments. Their results showed that the revival of the heart, an extraordinary event in those days, became a common occurrence in our times. There are many reports in the scientific literature of cases of heart revival not only in children but in adults, as well. There is no doubt left at the present time that a heart removed from the corpse of a previously healthy individual can be revived and returned to its normal functioning. The Soviet scientist S. V. Andreyev succeeded in reviving a heart five days after the death of the individual.

The attention of the experimenters was concentrated on the heart not by accident. The heart is one of the main organs of our body, which is the reason why the first experiments of revival had been tried on the heart. However, the life activity of the organism is not connected with the function of the heart only. The organism consists of many organs; it was important to extend and find out whether other organs of the body will prove as successful under conditions of isolation, as had been the experiments with the heart. In this respect, since the end of the past century, many experiments have been carried out. The studies of Sechenov, Kravkov, and those of the American investigator Carrell proved that isolated organs of the body (various glands, intestines, even a finger), when removed from the body of a corpse, were also under certain conditions to continue their functions. How to determine whether a finger is alive or not?

There are criteria which make it possible to establish it. We have in mind the condition of the blood vessels. These are able to change their lumen in life. When the blood vessels are patent, a larger quantity of fluid will pass through, while a constricted opening will limit the flow. Kravkov demonstrated that a finger, removed from a corpse, is capable to preserve its vitality for many days. The presence of such functions, as the reaction of the blood vessels, sweat glands, growth of nails, etc., attest to it.

The results of the above described experiments proved that not only the heart but a great number of other organs are able to continue their vital functions when removed from the corpse. These facts enabled the physiologists to advance the problem of the revival of an entire organism. Indeed, if it is possible to revive separate organs, starting with the heart and ending with other organs, there is a probability that the same can be accomplished in regard to the entire organism. An important problem had to be solved -- whether the central nervous system is capable to restore its functions after clinical death. This problem was solved mainly by Russian physiologists. Professor Kulyabko, having succeeded with the revivification of the heart, proceeded with an experiment of revivification of the head of a fish. A fluid substituting for blood was passed through the blood vessels. As a result, it was observed that the fish moved its eyes and fins, closed its mouth -- in a word, all signs indicated; that the head was alive.

These experiments, as well as the results of other similar experiments, which had been carried out with the head of a dog, and even with the head of a man who had just died, encouraged our compatriots -- the physiologists S. S. Bryudhonenko and S. I. Chechulin, to occupy themselves especially with the problem of reviving the central nervous system. In 1928, at the Congress of Physiologists in Moscow, these present had an opportunity to observe remarkable experiments. Bryudhonenko and Chechulin accompanied their report with the demonstration of a dog's head separated from the body. Then a piece of cotton moistened with an acid was placed on the tongue of the head, one could observe all signs of a negative reaction: grimaces, smacking of lips and an attempt to throw out the cotton. Then a piece of sausage was placed on the tongue, there were signs of licking. A whiff of air, directed to the eyes, caused winking.

In recent years, the French scientist Bremer succeeded in obtaining a completely isolated brain, deprived of all connections with the central nervous system, but nourished with the blood of the same organism. Minute electrophysiological investigations have shown that the life of the brain is inseparable from the continuous production of electrical energy. The death of the brain leads to the cessation of electric phenomena; subsequent revivification of the

brain causes reappearance of the biocurrents.

Thus, the experiments of Soviet and foreign scientists demonstrated that the brain can also be revived. The basic problem of the possibility of reviving the entire organism, thus, could be solved in a positive way. If the heart, intestinal segments, glands, and the central nervous system can be revived, there were no doubts left that a whole organism can be brought to life in a similar fashion.

The pioneer in these experiments was F. A. Androyov. During the first decades of this century he set about to revive an entire organism. He and, later, Bryudhononko, carried out their investigations on dogs. The dogs were killed by means of desanguination. The onset of death was calculated from the moment when the respiration and cardiac contractions ceased, and the winking reactions of the eyelids upon touching the cornea disappeared.

After the lapse of a certain period of time from the moment of clinical death, the experimenters started the work on the revival of the organism. The attempt of revival of the whole organism is connected basically with the action of the heart and blood circulation.

A special apparatus, called "autojector", was built which was used in pumping blood into the vascular system, stimulate the heart and respiratory organs. The results of Bryudhononko's experiments were completely satisfactory. He succeeded in reviving dogs which had been dead for seven-eight minutes.

During World War II, a group of physiologists under the leadership of V. L. Negovskiy carried out numerous attempts of restoration of life of battle casualties under the battlefield conditions.

We can state that the results of their work were highly satisfactory. In a number of cases where the physicians diagnosed the onset of clinical death, the physiologists succeeded to restore the deceased to life. This was done in a large number of cases.

The following data are cited in the material collected by the Negovskiy group. Revivification was performed on 51 corpses, twelve were restored to life. Thus, the results were successful in 25 percent of the cases. When we speak of restoration of life to man, 25 percent of successful cases must be considered as a very good result.

In order to illustrate the conditions under which they worked, we shall quote from one of their reports:

"Cheropanov, Valentin Dmitriyevich, infantryman of the n. guard rifle regiment. Born in 1923. Admitted to a field hospital on 3

March 1944. Diagnosis: Shell splinter blind wound of the median third of right femur, with the severance of the femoral artery and vein and injury of n. ischiadicus. Third degree shock. Brought to the hospital two hours following injury in a critical condition. Pulse filiform, respiration irregular, feeble, the patient is semiconscious."

The wounded was given immediate surgical aid, but it was useless. Patient died after the operation.

The chart history states: "Death was attributed to shock and acute loss of blood on 3 March 1944, at 1441 hours. The wounded is in the state of clinical death. Pulse not palpable, heart stopped, no respiration. Pupils maximally dilated."

A few minutes following the patient's death, one commenced the revivification measures described above. "One minute later, the heart began to beat, after a few more minutes the spontaneous breathing appeared. On the 22nd minute the patient reacted with blinking to the eye touch. One hour later appeared the first signs of returning consciousness. "At 2300 the general condition of the patient still very serious. He sleeps, awakens easily when addressed to, answers questions, asks for water, complains that he cannot see. The following day his vision became normal."

Cheropanov was eventually evacuated from the hospital and regained his health. An article was printed in the central press at the time which described this case of revival and a photograph shown of the "resurrected" made during his walk in the park.

After his recovery, he was visited by newspaper reporters. It is interesting to cite the content of one of their interviews.

"Then the former "deceased" was asked by a reporter: "Do you know what was the operation they had performed on you?" Cheropanov replied: "Yes, they pulled me from the other world, I was dead already. "What did you see in the other world?" "I lost consciousness before the operation, and came to when the operation was over. All that time I was as if under an anaesthetic. I slept through my death."

We shall cite another case of "revival" already under post-war conditions.

On 28 March 1948 a woman, 24 years old, with a gunshot wound of the right femur was brought to the surgical clinic of the medical institute of the city of Stalino. She was not breathing, pulse was not palpable, and the heart sounds would not be heard. According to the statement of the field doctor who brought the patient, her respiration ceased when he was transferring from the ambulance to the stretcher.

Thus, about five-six minutes had elapsed since the cessation of respiration. There was no way to ascertain correctly when the heart had stopped. The physician on duty, Candidate of Medical Sciences, G. P. Utkin at once started forcing blood with adrenalin into an artery. Simultaneously artificial respiration was resorted to. One minute later, irregular cardiac contractions appeared, and two minutes later the patient began to breathe. Five minutes after the start of the arterial blood pumping, the cardiac activity became rhythmic. The necessary surgical measures were resorted to. The patient regained consciousness ten minutes after the start of breathing; she was transferred to the ward. On the 22nd day she was discharged.

Hundreds of such "revived" persons in the Soviet Union are alive and happily at work.

Not long ago, in one of the Leningrad clinics, a successful attempt was made to restore to life a person almost frozen to death. The patient spent 18 hours under snow in a forest at a temperature of 16°C. He was brought to the clinic with feeble signs of life.

The application of the latest methods of scientific medicine led to the complete recovery of the patient. He regained his consciousness after an eight days' lapse.

The patient was demonstrated as completely recovered at a meeting of the surgical society.

The examples of revival, the restoration to life of clinically dead people are a convincing proof that there is no soul existing independently of the body.

Not only death but the life of man are in the hands of God, according to religious teachings. Religious people ascribed to God's wrath the appearance of fatal epidemics. Plague, cholera, and other mass epidemics were rampant and carried off thousands of people.

The progress of medicine put an end to these calamities. Plague and cholera disappeared, malaria disappeared in the majority of regions in our country, child mortality from scarlet fever, dysentery and other widely spread diseases of recent history have been markedly reduced.

The struggle for health and a happy old age is not a dream any longer, but a real task which is being fulfilled by the Soviet state and Soviet Science.

* * *

Sleep and, especially, dreams represent almost the most frequent topic of discussion when the conversation turns to the phenomena of psychic activity.

Man sleeps away one third of his life on the average, i.e., approximately 25 years. No doubt, dreams, often of a fantastic character, bright as a fairy tale, and at times, on the contrary, very close to reality, appeared to everybody. Herein lies the interest in dreams, discussions of their content, their significance, and attempts to prophesy events on the basis of the character of the dreams which trace their beginning to the early stages of the history of mankind.

The scientific approach to the nature of sleep and the interpretation of dreams are a very recent achievement. During the long period which preceded it, a multitude of superstitions, idealistic legends of the mysterious, unknowable nature of sleep, prophetic dreams, etc. have accumulated in regard to the subject of sleep and dreams.

The lack of scientific knowledge in any field is generally utilized by the religious teachings. The same happened in regard to dreams --- the frequent subject of various religious legends, as well as of various superstitions.

Since ancient times there has been a tendency to find an interpretation of the causes and nature of sleep and dreams. One would begin with very simple things.

Thus, for instance, the names of very large blood vessels passing through the neck to the head --- the carotid arteries --- is not accidental. It reflects the attempt of the ancient times to connect the causes of the origin of sleep with an insufficient supply of blood to the brain. We must add that this point of view now lost its value, for there are contrary facts which show that, during sleep, the cerebral blood vessels dilate, and that the brain receives a sufficient supply of blood.

With the progress of natural science in the 19th century, when the science of chemistry made particularly large strides, a number of attempts appeared to interpret the sleep phenomena from the chemical point of view.

One of these, the least successful, was connected with the idea that a certain substance is being accumulated in the brain during the waking hours; this substance was named hypnotoxin (sleep poison). It was presumed that a certain degree of accumulation of this hypnotoxin causes the onset of sleep in a man or animal. This theory of some French physiologists did not prove successful though it made quite a

bit of noise at the beginning of the present century.

The tests which had led to those conclusions consisted of the following. A dog was compelled to remain without sleep for a long time. It was disturbed and annoyed constantly, at night the guards were dragging it with them on a cord. It was found that the spinal cord fluid which washes the nervous system, and which had been examined after a long period of lack of sleep, possessed soporific properties. Upon its administration to animals, they fell asleep. This test gave the experimenters the idea that a special toxic being hypnotoxin. The presence of such serum seemed to open wide perspectives, for is a toxin was found one could look for and discover an antitoxin. These hopes, however, were not justified. In the first place, the very premise on which the tests had been based, i.e., to find some substance the action of which would induce normal sleep, was incorrect. As we shall see later, sleep represents a general functional state of the central nervous system. It is true, some chemicals may aid in the onset of sleep, but they cannot induce it. Such was the case with the experiments described above. A profound fatigue which was the result of the dog's "insomnia" created certain changes in the chemistry of the blood and spinal fluid. The effect of these changes on the animals, unaccustomed to them, was evaluated as a specific action.

More successful and more recent was the attempt made in 1930's to connect the onset of sleep with the formation and accumulation of bromide in the blood, the same bromide which in the form of sodium bromide is administered to patients at the physician's advice. It turned out that bromide is produced in the organism.

The formation of bromide in the organism and the knowledge that the action of bromide is really connected with its tranquilizing effect on the nervous system and predisposes the organism to the state of sleep made this theory more or less feasible.

We could mention also some other theories on the origin of sleep from the chemical point of view. However, these, too, will have to be refuted.

The state of sleep is a functional property of the central nervous system, and the onset of sleep is the result of the activity of the nerve centers, and not the primary effect of some chemical substance.

Many facts contradict the chemical theory of sleep.

Everyone knows, without the need of special laboratory tests, that the states of sleep and wakefulness can be very transitory and often mutually alternating. One can feel very tired (fatigue

predisposes one to sleep), and feel refreshed after a five minute sleep. It is difficult to assume that within this short period of time a complete liquidation could take place of the profound chemical changes mentioned in connection with the various chemical theories.

These theories are also contradicted by facts resulting from the comparison of the sleep of nursing infants and old people.

We all know, that nursing infants remain in a sleepy state for almost two-three days, while old people have a brief, superficial, easily interrupted sleep. These facts contradict the chemical theory of sleep, according to which the "substances" producing sleep increase proportionally to the work of the nervous system.

Yet, there is no doubt that the nervous system of an old man is much more taxed and carries on a much higher activity than the one taking place in an infant where the load on the underdeveloped brain and sensory organs is relatively very insignificant.

Another well known fact: A tired man falls asleep easily, but a man who is overfatigued often cannot fall asleep at all. As a result of extreme fatigue, a state of insomnia may set in.

P. K. Anokhin, the Soviet physiologist, carried out remarkable observations on Siamese twins. They had separate heads and common circulation. Were the causes of the onset of sleep connected with the changes in the chemistry of the blood, we could expect a simultaneous onset of sleep in both twins. This, however, was not the case. One could remain awake while the other was asleep. These interesting facts are sufficient basis to refute the theory of the chemical nature of sleep and search for an explanation elsewhere.

Other approaches have been found which led to fairly satisfactory solution of this problem. It came with the study of the physiological processes in the central nervous system.

Not all attempts were entirely convincing. I shall cite one unsatisfactory attempt of the Swiss physiologist, Hess, who advanced the theory of a special center of sleep. Hess thought that there must exist a center of sleep just as there are centers of cardiac activity, of respiratory activity, and many other centers in the brain. He based this on the fact that, in stimulating the brain in a certain area with an electric current, he caused a sleepy state in animals. The fact is correct, and cannot be disputed. But the interpretation is wrong in the assumption of the existence of a special center of sleep.

The best approach to the solution of this problem was found along the path of Pavlov's teaching. In outlining his teaching of higher nervous activity, we pointed out that the basic forms of the activity of the central nervous system are the processes of stimulation and inhibition. The deeper study of the processes of inhibition in the brain established the presence of various forms of inhibition. One of these forms which Pavlov separated into special groups is the sleep inhibition form.

The processes of stimulation and inhibition undergo certain changes during the activity of the brain. One of these is connected with the movement of stimulation and inhibition along the surface of the cortex.

There are circumstances when stimulation or inhibition are strictly localized in one particular area of the brain; but more frequently the stimulation or inhibition, having originated locally, spreads out as if flowing over the cerebral cortex and involving at times the entire surface of the cortex. This phenomenon has been called the diffusion ("irradiation" -- the latin word) of the processes of stimulation and inhibition over the surface of the brain. The diffused wave of inhibition can again concentrate at the initial point; this constitutes the concentration phenomenon.

The very extensive experimental data obtained by Pavlov on dogs, and, later, on humans, enabled him in the early years of this century (1911-1913) to advance the theory of sleep as one of the forms of inhibition which is taking place in the cerebral cortex.

What prompted him to arrive at this conclusion? Mainly because Pavlov and his associates noticed that all cases of inhibition which had taken place in the experiments, led to the development of a sleepy state in dogs. The sleep of animals in Pavlov's laboratory became the curse of experimenters. Later, when they surmised that inhibition and sleep might be of the same origin, sleep became the subject of study, but it still interfered much with the carrying out of the tasks needed for the solution of other problems.

The phenomena of the diffusion of inhibition over the cortex, which are the basis of the onset of sleep, are easily observable in experiments and in observations on humans.

When the dog falls asleep in the laboratory stand, one can already note the very stages of the inhibitory sleep process, while the general condition of the dog does not yet indicate the approaching sleep. These initial signs are connected with the retarded movements of the tongue when the dog is eating. Then comes

the difficulty in moving the jaws; next stage -- difficulty in closing the eyes, weakening of the muscles of the neck which results in the lowering of the head, and finally, the whole animal is drooping in its straps. This is the stage of complete sleep.

Thus, it can be deduced, that the inhibition first originated in the centers connected with the tongue movements, spread to the centers of the head, finally -- over the entire surface of the cerebral cortex. The same gradual process of falling asleep we can observe also in a man who is forced to remain in a seating posture while falling asleep.

First, the eyes close, then the man experiences difficulty to hold his head up, he "jacks with his nose", and a little while later his head "hangs down" on the chest. In the next stage the entire torso is unable to retain an upright posture and is constantly bending down. A man in profound sleep can easily fall off the chair he is sitting on.

One can observe interesting phenomena in a very young child which is falling asleep. During the initial period, the child makes grimaces, shows sudden starts, and at times general motor unrest. This indicates that the inhibition is spreading over the cortex, but has not as yet involved the subcortical centers. The grimaces and starting motions are due precisely to the continuing activity of the subcortical centers.

During the latter period of his work Pavlov differentiated two forms of sleep: the active and the passive sleep. That we described above as inhibition which originates in the cortex as the result of certain type of stimulations (monotonous, repeated sounds, etc.) is regarded as active sleep.

The example of the unusual length of an infant's sleep which we cited above can be regarded as a form of passive sleep.

While active sleep appears as a result of a definite character of stimuli, passive sleep appears as the result of the absence of stimuli.

We shall cite the following examples of cases of passive sleep. There are patients whose sensory organs are affected for some reason or other.

A man may have only one normally functioning eye, or ear, he may be blind in one eye, deaf in one ear, the tactile sensation is absent, his olfactory sense gone. In such cases one could observe the following phenomenon: if we approach him, close his normal eye

and block his ear, he will immediately fall asleep. His cerebral cortex remained without stimuli, he lost, what Pavlov called "the variety of activity in his cortex"; the absence of this activity is the main cause of his sleepy state. One of Pavlov's associates, V. S. Galkin, carried out the following interesting experiment: by means of surgery, animals were deprived of vision, hearing, and tactile sensation. These animals slept most of the time.

There is another possibility of inducing passive sleep experimentally. If the large hemispheres are removed surgically, the animal will survive, but will sleep most of the time, and wake up only when the intestines, or urinary bladder are full, or the animal is hungry. In the latter case, the dog will wake up, start barking, but will fall asleep again as soon as it has been fed.

However, it is important to prevent misunderstanding in connection with the fact of the development of passive sleep under experimental conditions, after a simultaneous separation of the optic and aural nerves together with the nerves connected with tactile sensations. When these operations are performed gradually, i.e., one type of sensation is eliminated first, followed by the elimination of other sensations -- the passive sleep will not develop; a reorganization and adaptation of the nervous system will take place. This explains why some individuals who had retained the function of one eye, or one ear, or had completely lost the functions of vision or hearing, are still in full possession of their intellectual capacities.

The case of the remarkable Soviet woman, Olga Skorokhodova, is known. She lost in her early childhood, following some ailment, her vision, hearing, and speech. Nevertheless, she learned to read at some special school (the Braille method), graduated from the Pedagogical Institute, wrote a book "How I perceived the external world", many good verses, and was a good komсомолец.

The example of Skorokhodova is not the only case in our country. We are dealing here with the compensatory function of the central nervous system which has sharpened to an extraordinary degree the remaining organs of sensation: the olfactory and the vibration sensations, and enabled the individual to perfect his psychic faculties and his mind by means of the remaining sensory faculties.

This, we can assume that at the onset of sleep is inhibition which originates, first, locally, and gradually involves the entire cortical surface with more or less speed.

The diffusion of inhibition is not limited to the higher sections of the brain, i.e., its cortex; it also involves its subcortical centers when the sleep is normal and deep.

To attest the fact that a person in deep sleep not only loses consciousness and sensation, but the capacity of motion and other motor functions. Parallel with the phenomena of normal sleep, other forms of sleep resembling states and certain forms of incomplete sleep are known. The simplest form of incomplete sleep -- the superficial sleep is the cause of dreams. This statement can be made without hesitation. When the sleep is complete, i.e., deep, there can be no dreams. At the basis of dreams we find an incomplete, partial sleep.

Here are some instances. A partial sleep can be observed in a mother who falls asleep at the bedside of her sick child. She is able to continue sleeping in spite of fairly loud noises coming from the street, or the next room, but let the child cry, even in a very low voice, or make a move, the mother will awaken instantly. A miller sleeping to the monotonous noise of the grindstones will awaken instantly when they stop.

Presumably, in these forms of sleep, as generally in all cases of superficial sleep, there are, parallel with completely inhibited areas, some non-inhibited areas, and a certain number of them in various transitory states form wakefulness to sleep.

Thus, we observe that the brain may continue to be in a state of activity to some extent even while we are asleep. What are the causes which contribute to this activity of the brain during an incomplete sleep? These can be stimulations from various sources (sounds, odors, tactile irritations, or internal stimulations coming from various organs: overfilled stomach, urge to urinate, etc.). An important role in the origin of dreams is played by traces of stimulated cortex which had taken place not long before the onset of sleep, and, at times, traces from impressions and experiences which had happened long ago. In the latter case we are dealing with the so-called "revival of traces". The faculties of our memory may help to explain this phenomenon. We can usually remember various impressions from very early age. At the same time, we do not always remember what happened to us in subsequent years and what undoubtedly left its impression in the cortex of our brain.

Under certain circumstances, as for example when meeting someone or engaged in conversation or looking at a photograph, and at times as it seems to us without any reason, we shall suddenly recall a certain event in our childhood. In this case, the revival of traces under wakeful conditions is taking place. The same, to a more marked degree, takes place also in the areas of the brain which are still awake during our incomplete sleep.

Various external and internal stimulations may create conditions which will contribute to the revival of traces during sleep. Changes in the blood circulation of the brain: increased influx, or outflow of blood, temperature changes of the blood, and various very important qualitative changes in the composition of the blood -- all these can play their part in the revival of traces of sleep.

In speaking of trace revival as the basis for the origin of dreams, we must emphasize that not all stimuli, which leave their traces in the cortex, are perceived by us clearly. We may meet someone on the street, in passing take a look at him without any noticeable impression, especially when we are concentrating on some thoughts; the trace of the face will remain, however. This trace may at some later time come to life, and an individual, seemingly totally unknown to us, may clearly appear in a dream. This is one of the causes of the origin of some "prophetic" dreams as they are erroneously evaluated.

Let us say you met someone on the tramway. He resembles your brother. The encounter was a fleeting one, the impression of his face was clearly perceived. You have had no letters from your brother for a long time, and you are worried. During your sleep, the trace of the individual's image is revived, and your brother's face appears in your dream by association. Next morning the postman delivers a letter from your brother written of course without any connection with your dream. Some people in such cases will be firmly convinced that your brother "appeared in your dream" as a premonition of the arrival of the letter.

One of the reasons which make up the content of various dreams may be the desires, fears, or suspicions which composed the experiences of the waking hours. Since they were in some way or other connected with actual circumstances, they could, of course, be realized occasionally. The dreams connected with it are also referred to by some as "prophetic dreams", since they, in a way, "foretell" the events.

A great deal of work has been carried out in the field of study of dreams. There were some experiments done, as follows. A bottle with ice water was applied to the heel of a sleeping man; this was accompanied by the ringing of an alarm clock. When the man woke up, he related the content of his dream. It turned out that he had dreamed of a ride in a "troyka" with bells, that he had enjoyed it very much, except for the freezing of his feet.

Here we have the simplest conditions for the origin of a dream.

Sometimes a certain sound, like coughing behind the wall, can cause a very marked sensory perception. Since the incompletely inhibited cortical cells experience special conditions, the reaction will not correspond to the stimulus, there will be no possibility to differentiate the sound as coughing, and the man will dream that a lion was growling and that the animal was tearing him with its claws, etc.

In the analysis of the causes leading to a dream, we are at times deceived by the fact that we are not always able to check on the impossibility of traces in our nervous cells.

An interesting episode was experienced by one scientist.

He was descending the stairs in the house where he lived and noticed that a decorative bell-glass on the banisters was broken. He paid no attention to it, but once he had a dream in which he saw a new copper ball decoration on the banisters. In the morning as he was descending the stairs he was amazed to find a copper ball on the banisters; when he related the story to his family, they in turn were surprised that he had not noticed it before, since it had been there over two weeks. Obviously, he had seen the copper decoration several times, but never paid any attention to it, but the trace of the impression remained with him and in his dream he saw the stairs with the new copper ball on the banisters.

Medical observations include data that the character of dreams at times depend on the developing illness.

A husband of some woman was often telling her that he dreams his swallows various objects: forks, spoons, spoons, etc. Being an intelligent and sensitive person, she became alarmed at the constancy of this sort of dreams and consulted a physician. It turned out that her husband had a malignant tumor of the pharynx.

Another example of a similar dream. A man who considered himself healthy, had a dream that he had been bitten in the chest by a snake. Subsequently it was found that an abscess had been developing in that particular spot, which required special treatment.

People with impaired cardiac activity which still did not manifest itself as a disease, often experience frightening dreams (various nightmares). As a rule, this indicates the beginning of some ailment relating to heart. Obviously, after the fatal exit, some members of his family recall these dreams and are inclined to consider them "prophetic".

In the majority of cases one can establish the causes of origin of some of these dreams; this is not always easy to do, however; for the psychic life of a man is complex and is often not amenable to a thorough analysis. Nevertheless, the insufficiency of our knowledge in this respect does not give any justification to see in some of these dreams something supernatural or mystic. Only idealists and religionists, to whom dreams always served as basis of obscure superstitions, attempt to present the problem in this light.

This idea was helped by the fact that dreams often are of a bright, picturesque and fantastic character, they are detached from the reality of time and space. Man is able in his dream to "relive his entire life, to circle the earth" within a few minutes' time.

The teaching of Pavlov offers the possibility of a materialistic interpretation of these obscure and mysterious peculiarities of dreams.

In the chapter devoted to the description of the qualitative characteristics of the higher nervous activity of man, we became familiar with the work of the second signal system.

During the process of falling asleep it is precisely the inhibition of the second signal system which is taking place, while the first signal system is still functioning to a sufficient degree. During the awakening process, on the contrary, the second signal system is switched on somewhat later. In connection with this, all higher forms of thinking, including the faculty of logical deductions, are markedly impaired and, to a certain extent, lost. There lies the explanation of the inherent characteristics of dreams -- their unlimited element of fantasy, bright picturesque-ness, separation from the everyday images of time and space. During the waking hours, the second signal system not only ensures a critical evaluation of circumstances, but also inhibits to a certain extent the first signal system.

The cortical cells which change from a state of stimulation to complete inhibition, are characterized by special physiological states. The most important in this respect is the disturbance of normal correlation between the force of stimulation and the degree of reaction to it.

For instance, certain unusual reactions of the cells in the state of sleep may take place when the cells do not respond to a strong stimulus, whereas a weak stimulus causes a full reaction. It may even happen that the positive stimulus will cause no reaction,

while the inhibitory stimuli which always had a depressing and restraining effect, will now induce a reaction in full force. This is factually accomplished in the following manner: an irritation from a fly crawling on the cheek of the sleeping person may create a dream of a lion tearing the man with its claws; a slight sensation of cold, when the blanket slides off the sleeping person, may be perceived as a sensation of falling into an ice-hole. These types of weak stimuli may produce the stimulation of many areas of the cortex which have not as yet become inhibited.

The elimination of the functions of the second signal system and the impairment of the normal reactions of the first signal system during the sleep serve as a basis for the physiological interpretation of the peculiarities of dreams.

Finally, we must take in consideration the fact that the revival of traces which is, as we had already stated, one of the basic causes of dreams, is effected under certain conditions during the state of sleep. We pointed out that, at the background of the inhibited cortex, during sleep, there are only isolated, unconnected with one another areas which are in a state of wakefulness or sleep. This situation creates conditions which do not correspond to environments and are illogical, which we encounter in dreams. Logical thinking is the result of the correlated activity of all sections of the brain.

The inhibition phenomena of the brain which Pavlov investigated may manifest themselves in various forms. Incomplete inhibition in the brain leads to dreams. When inhibition involves only isolated areas of the brain, it can manifest itself in various states, as for example in hypnosis, lethargic sleep, lunatism. All these phenomena are fully explained by the Pavlov's theory. Hypnosis, in particular, represents a partial sleep where inhibition involves only some of the areas of the cortex of the cerebral hemispheres and is not spread to the centers of the subcortical region. This is the reason why the hypnotized person carries out various acts at the command of the hypnotizer, without actually coming out of the hypnotic state. There remains an uninhibited area in the brain on which the hypnotizer's words exert a certain effect. The closeness of a hypnotic and normal sleep can be seen from the fact that the manner of falling into a normal or hypnotic sleep is identical. In both cases a restful posture is essential which permits the relaxation of the body muscles. In hypnotizing, one generally creates a semidark atmosphere. Various monotonous stimuli are used to produce the hypnotic state. Often the subject is asked to look at some shining object (medical persuasion hammer, an electric lamp of low voltage, etc.); The hypnotizer

strikes the skin gently (passes), quietly issues an order to fall asleep. Obviously, all these conditions fully correspond to the circumstances which generally accompany the onset of normal sleep. However, in the case of hypnosis as indicated above, the inhibition is concentrated in the cortex only, but it does not involve the entire cortical surface, and leaves areas through which the hypnotizer will communicate with the subject and order him to carry out various actions or suggest certain sensations. A perfectly normal and balanced individual may not succumb to hypnosis if he so wishes. Only persons unbalanced emotionally, with a weakened nervous system, are easy subjects to hypnosis.

In order to make hypnosis mysterious, ignorant people or charlatans keep on repeating that a hypnotizer possesses some magic force which flows from his eyes or from the tips of his fingers in the direction of the subject. But there are no magic forces in general, including the act of hypnosis.

Any physician possessing the necessary knowledge and technique can become a hypnotizer. Of course, a certain air of authority, an impressive, as is customary to say, countenance of the doctor-hypnotist has its value and may accelerate the onset of the hypnotic sleep; however, as stated above, the basic conditions for the development of hypnotic inhibition depend on something else.

Let us outline now some sleeplike states. To these belong automatism and the lethargic sleep.

Lunatism, or sleep walking, is manifested by getting up from bed, while asleep, going to another room and lying down again. Upon awaking, the individual generally does not remember what happened to him during the night. At times, these individuals, (they are called lunatics) -- /sonambulists/, take more extended walks in their sleep; it often coincides with a full moon (hence the appellation -- lunatic). If we take in consideration that the sleepwalkers are capable to effect complicated movements (to climb to the roof, to walk along the edge, or the ledges of the wall, etc.) we can readily understand the horror and anxiety of those who happen to observe this phenomenon. Precisely these sort of events created many legends of the mystery and miraculousness of this phenomenon which was readily utilized for their own purposes by the servants of religion.

Actually, we are dealing here with one of the forms of the pathological impairment of sleep. While normal sleep is connected with the diffusion of inhibition along the cortex and the subcortical areas of the brain, in lunatism the inhibition is taking place in the

cortex only; the subcortical centers remain unaffected. The faculty of the complex reflexes of walking and maintaining equilibrium represents functions which are fully effected by the subcortical centers. This is the reason why a sleepwalker is able to carry out complicated acts.

The phenomena observed in lethargic sleep are similar to it. We described earlier a case of prolonged lethargy which lasted in the patient K. twenty years. Even such vital functions like metabolism, respiration, and cardiac contractions are effected on such a low level that an inexperienced eye may not notice them (respiration, for instance). As a result, the patient may be diagnosed as dead. Let us imagine that such supposedly dead person comes out of his state of lethargy during his funeral; he begins to move in his coffin, and raises himself. Consider the horror of the people present, provided they know nothing of the existence of such diseases which, by the way, are quite rare and insufficiently studied as yet.

One such case suffices to cause rumors for scores of years, from generation to generation, as some "miracle". Obviously, those interested in religious propaganda will always aim to color and twist this event and all its accompanying circumstances.

The state of sleep and hypnosis have been subjected to thorough study. This enabled the scientists not only to interpret it from the materialistic point of view but to utilize it for therapeutic purposes. Sleep and suggestion are widely used in Soviet medicine; they are now being employed in anaesthesia with particular success. In cases where we deal with the impairment of certain functions (motor paralysis, blindness, pain, etc.) which are due to the functional pathology of the central nervous system, oral suggestion and hypnosis may prove therapeutically valuable and lead to complete recovery. A patient, who has been bedridden for a long time as the result of a hysterical paralysis, may rise and walk at the command of the physician, a man suffering from hysterical blindness -- will suddenly recover his vision, etc. Naturally, many such facts served as the basis for various stories of miracles, wonder-workers, etc.

It is interesting that the powerful force of therapeutic suggestion was discovered under circumstances when the person who used it was not even aware of the reason why he was able to achieve such remarkable therapeutic results. We are speaking of the now almost forgotten Austrian physician Mesmer (18th century). Having become interested in the then popular "teaching" of magnetism, Mesmer decided to use a magnet for the treatment of his patients.

He was successful. A common magnet placed on the body of a patient effected a cure. Mesmer continued his seances of magnetic treatment; in a number of cases he obtained a remarkable therapeutic effect; blind people recovered their sight; lame people who had come to him leaning on their crutches, threw their crutches away and went back home in perfect condition. The fame of Mesmer's skill grew; soon he was unable to attend to all his patients who had been coming to him from near and far. Confident that he possesses "magnetic power", Mesmer "transferred" his influence to water in which his patient had been immersed. He thought that special "magnetic fluids" flow from the tips of his fingers and was certain that, by touching the water, he passed to it his curative power. Thus originated the "buckets of health", the magnetized Mesmer trees the touching of which cured some sick people. One did not notice failures, while the fame of successful cures was spreading far and wide.

We are well aware, from the present scientific achievements, that there are no fluids, or magnetic powers, and that the magnet placed on the patient's body had no effect whatsoever; nevertheless, we cannot deny some instances of cure which had been achieved by Mesmer.

The explanation of these cures is to be found in suggestion and hypnosis which Mesmer had unconsciously employed. It is not by accident that confidence in the doctor, in the drug, and in the therapeutic means which are used, represent even now one of the basic conditions of recovery. There is a proverb -- "every new remedy helps". Indeed, when a new drug appears on the market and the circumstances are such that it is spoken of far and wide as a very effective preparation, one notices frequently that this new drug will bring positive results in many instances. Time passes, the new miracle prescription loses its miraculous power, and is soon forgotten.

To a considerable extent, the success of these remedies is based on the inflated confidence in them; in substance, however, it is based on suggestion.

We must add that suggestion will be most successful in cases where the illness is not of an organic character but of a functional one (hysteria, neuroses, etc.). These diseases are quite frequent. This is the reason why even now, in spite of the progress of scientific medicine, there are so many fake healers.

The possibilities of materialistic science are great and limitless. We are confident that, in turning its achievements

toward peaceful development and a constructive goal, mankind will create a truly happy life for all.

The basic law of the Soviet state is the care for the well being of man. Therefore, science with its efforts directed toward the strengthening of the economic and spiritual power of our country, is receiving the most extensive development. The Soviet people are happy with the achievements of our scientists, they appreciate and support them highly.

In the reactionary bourgeois science a discovery of a "miracle" is frequently preferable to a true scientific discovery. Insofar as even in the bourgeois countries, where the influence of religion is still strong, it is almost impossible to admit the progress of science by direct measures, still one or another field of science is declared "unfathomable", inaccessible to science and the realm of the mysterious acts of the almighty Creator -- God.

John Bernal, the progressive English scientist and public figure, stressed this typical trait of modern reactionary bourgeois science. Taking advantage of the fact that many phenomena have not as yet been sufficiently explained, some bourgeois scientists concentrate their attention not on what science has already achieved but on what it "can not achieve".

The insufficiency of scientific data on the structure and development of the universe gives them the right to conclude that the universe was created by the All-wise Creator. Science is not able to recreate life, ergo -- the origin of life is a miracle. "Thus," concludes Bernal, "modern science is transformed into an ally of ancient religion, and even more -- into its substitute."¹

We have already outlined the causes which had led to the origin and spread of religion. It was shown that it is connected with the conditions of the material life of the people. The Marxist-Leninist philosophy gives a scientific substantiation of the thesis that various forms of social consciousness, one of which is religion, represent in themselves the result of conditions under which people live, that these forms are the reflexion of these conditions and of the socio-economic relations. The attempts to see the reason for the origin of religion in the allegedly existing in man necessity for it, are deeply erroneous. Some even claim that it represents an instinct, i.e., some sort of an inherent attribute of man.

¹ J. Bernal "Science and Society" Moscow, Foreign Literature Edition, 1953, p 121

Others feel that the cause of the spread of religious beliefs lies in the ignorance of people or in their susceptibility to the suggestions coming from the servants of religion. Of course, both elements may play a part in the strengthening of religious moods. However, to reduce the question to only these points would be incorrect for the reason that it would detract attention from the main point, i.e., the social roots of the origin of religion.

Science and Religion are Incompatible

"The essential contrast between science and religion is obvious. While science is based on facts, on scientific experimentation, on deductions confirmed by life, religion leans on Biblical and other legends, on fantastic tales. The modern scientific achievements in the field of natural and social sciences convincingly refute the religious dogmas."

From the decision of the
CC CPSU of 11 Nov 1954

With the establishment of a class society where the majority of people are subjected to the cruelest exploitation and carry the yoke of slavery, the desire to find a rescue from oppression created in the working masses the belief in a better life beyond the grave, the belief in miracles. This was utilized by the exploiters to strengthen their power over the workers. They disseminated and spread by all possible means various religious superstitions, built magnificent temples, subsidized the servants of the cults, and aided them in the arrangement of luxurious and solemn religious services. All this had one goal -- to distract the man from earthly cares; to imbue the worker with the faith in the existence of a paradise life which starts after death, and to convince him of the unshakable firmness of the power of the exploiters.

The religious doctrines and idealistic philosophy have one goal -- to destroy in the consciousness of people the correct idea of the unity of nature in man, to present it in the form of allegedly independent substances, the sacred, God-given soul and the fragile, sinful body. There lies the basis of any religion or any idealistic teaching of whatever shade.

The need of exploiting the subjugated masses makes it particularly important to the exploiters to employ such legends as the belief in the creation of the world by God, the myth of the soul, and the life after death. If we pointed out that the ignorance of the masses is only one of the conditions of inculcating various religious ideas, it does not mean that we wish to belittle the importance of the development of materialist science in the fight against religion. It must be understood that the very development of true science can be fully possible only under the conditions of

complete liberation and release from subjugation of the masses of workers. Nevertheless, even under conditions of the regime of exploiters, the great discoveries of science played an prominent part in the undermining of religious dogmas.

The history of science and religion shows the constant struggle between two opposite world outlooks, - the idealistic and the materialistic.

At various stages of the development of science, the forms and contents of idealistic concepts, as well as the methods of combating materialism are changing. However, in solving any scientific problem, especially one like the problem of the soul, it would be incorrect to forget for a moment the possibility and probability of the effect of idealistic concepts. V. I. Lenin repeatedly called attention to the fact that science and philosophy can never be impartial, particularly in our time. A scientist can never limit himself to the accumulation of facts only. The data obtained require analysis, i.e., the methods of thinking which are dictated by a certain world outlook. This outlook, in its turn, reflects the characteristic traits of a particular social order.

As an excellent example which confirms our statement we may cite the status of Darwinism in our country and in the capitalist countries like England and the United States of America.

We have mentioned already that it had been definitely accepted by a number of progressive Soviet scientists. During the Soviet era, the teaching of Darwin underwent further development in our country. His teaching was not only the subject of numerous scientific investigations, but also became the required part of the natural science curriculum of the Soviet youth.

An entirely different picture can be seen in the USA. The attempts of obscuring or even persecuting one of the most important trends of materialistic natural science are not ceasing even at the present time. In the United States of America it is not denied that the main reason of Darwinism being considered harmful is its denial of the divine origin of the white man. We know that the Biblical myth states that God created Adam and Eve as white people, and as far as the black people are concerned they represent a race of animal origin.

In 1925 in one of the states (Tennessee) a young teacher of a local school, Scopes, mentioned the theory of Darwin in one of his lectures and stated that it has been proven fully scientific and correct. Scopes was subjected for that to police persecution

After a legal process and a great deal of publicity for the purpose of anti-Darwin propaganda, Scopes was incarcerated. In the state of Tennessee a law was passed forbidding the teaching of Darwinism which denies the divine origin of man and spreads the idea that man originated from animal ancestors.

Many years after this shameful incident we happened to visit Canada. During the conversation with local science workers we found out that the theory of Darwin is not being taught in their schools even at the present time. To our question why this is taking place, we received a very unconvincing answer that the subjects of school instruction are only the indubitable scientific theses and ideas. We also were told that reading of the Bible is a required school subject. While in England, we decided to visit Dawn where Darwin had lived and worked for a long period of time. Dawn is a small village situated at about 30 kilometers from London. We felt sad and hurt to note that the estate-museum of the great naturalist is in an almost complete neglect. The museum is visited very little, and there is hardly any scientific work being conducted. The entire place is under the care of an old watchman.

The injustice and neglect to the memory of Darwin was particularly underlined when the watchman, seeing before him a delegation of Soviet scientists, pulled out from somewhere "under cover", the carefully hidden even from a casual visitor, volume of the "Capital" of Karl Marx with his personal, very cordial autographed inscription to Charles Darwin. The great Marx foresaw the immense materialistic significance of Darwin's ideas which imbued him with profound admiration for their author. Some of his compatriots in modern England have an entirely different evaluation of Darwinism.

Of course, there are in England progressive representatives of science.

In this respect, a great interest represent the work of Morris Cornfort published in London recently.

Two of his books have been translated and published in our country. In 1948 the Foreign Literature Publishing Office published Cornfort's book "Science against Idealism", and in 1951 the same office published his book "In the Defense of Philosophy."

Both works present considerable interest.

In evaluating certain philosophical scientific trends in modern England, Cornfort characterizes them as reactionary. He stresses the fact that various forms of religious obscurantism

are still popular at the present time. Millions of people are still under their influence, but the redeeming feature is that a large number of people have already escaped this influence. Cornfort gives a conclusive clarification of one of the most important characteristics of the present state of the campaign of idealism and religion against science.

It is the fact that, under the pressure of new scientific discoveries, such as for example the theory of Darwin and the teaching of Pavlov, the most important tenets of religion are gradually being destroyed.

Having understood and having come to the conviction that prohibition of materialistic teachings will not lead to their annihilation, some servants of the church and bourgeois scientists are more and more assuming an entirely different approach.

This approach is the attempt to reconcile science and religion.

By the means of various distortions they are trying to reconcile various scientific facts with religious beliefs, and are attempting to utilize the achievement of modern science to prove divine presence and to strengthen religion.

After analyzing various philosophic trends in English philosophy, Cornfort arrives at the conclusion that their content "consists of the development of philosophy along the lines of reconciliation of science and religion, and that it represents a complete distortion and misinterpretation of the significance of scientific theory and scientific methodology."¹

Cornfort's statement again confirms the fact which had been proved by Marxism that the idealistic philosophy substantiates religious concepts by covering them up with seemingly scientific forms.

In pointing out this characteristic trait of modern idealism, Lenin noted that open and crude manifestations of contradictions between the dogmas preached by religion and the immoral acts of its servants are less dangerous, and are easily understood by the masses, than "... the refined, spiritual concept of the God-little father dressed up in all kinds of "ideal" costumes."²

¹ M. Cornfort "Science against Idealism" Moscow. For Lit. Pub., 1948, p. 319
² V. I. Lenin "Works", Vol. 35, p 90

The science in the United States of America particularly abounds in this type of "theories." The unique organizing center which united the forces of the reactionary theoreticians is the Vatican -- the seat of the "representative of God on earth" -- the Roman Pope. The Vatican, being most closely connected with the most influential capitalists of America and with the reactionary Catholic parties of Western Europe, virtually represents a miniature state with its own diplomatic corps, ambassadors and "scientific institutions." The latter are called upon to fabricate "theories" the purpose of which is to correlate scientific data with religion, and to interpret anew the Bible and other holy books. They are engaged in a "scientific" interpretation of miracles and religious prophecies.

In our philosophical literature were cited many instances of such "scientific" revelations. Thus, for example, in the works of a certain Remi¹ the miraculous transformation of animal ancestors of man into the original couple of humans -- Adam and Eve -- receives a purely "scientific" explanation.

According to Remi, God induced the mutation (something akin to an explosion) of the hereditary rudiments of exceptional force. As a result of this mutation, the first humans were created from the primitive anthropoid soulless apes; these two humans -- Adam and Eve -- were the first humans who had received a soul from God. There you have a typical sample of the "reconciliation" of the Bible and of science.

The main element has been preserved -- the legend of the gift of soul by God, to animation of man. Since it cannot be taken seriously in this age that God molded Adam from clay, and created Eve from Adam's rib, the entire legend is embellished with science, even with Darwinism. So, Adam and Eve did have ancestors in the form of apelike people. But, not having been divinely animated, these ancestors were not real humans. Therefore, from the depth of bourgeois science is pulled out one of the theories of the origin of new characteristics of the organism via mutation of inherited characteristics, and the "scientific substantiation" of the Biblical legend of the creation of man is ready. This, of course, is one of the numerous examples of the religious falsification of science. Taking account of the above cited, one must be especially watchful in regard to certain theories of reactionary foreign physiologists and psychologists whose task it is to undermine the bases of Pavlov's total materialistic teaching of the soul, i.e., of the higher nervous or psychic activity. The representatives of religion are particularly prone to get hold of the obscure and unclarified problems of which there are still many in the field of psychic phenomena. Therefore, 1. Voprosy Filosofii /Problems of Philosophy/, No 4, 1954, p 229,

there is an urgent task of development and dissemination in every possible way of the teaching of Pavlov.

In our country we can still find the survival of religious tendencies among various people, and it is, thus, necessary to constantly and actively disseminate scientific knowledge among the widest layers of the population. The materialistic science arms man with the knowledge of the laws of nature, offers him the possibility to systematically utilize and employ them and to foresee the course of events. In studying the laws of nature and using them skillfully, men are able to limit the sphere of action of the elemental forces of nature. They are able to turn in a different direction these destructive forces and employ them for the benefit of mankind. The skillful utilization of these laws by man ensures him the mastery of nature. We have already indicated above the industrial use of atomic energy in the USSR, as contrasted to the psychosis of atomic war in the United States of America.

Religion and idealistic philosophy are in complete contradiction with the materialistic ideas. The religionists assert that the world and the entire nature are created and ruled by God. The concepts of the religionists are echoed by bourgeois scientists and by the idealists of various shades and directions. Under the guise of science they promulgate the idea that the universe is immutable, that the laws of nature are non-cognizable, and that the man is only a blind tool in the hands of the divine source.

Religion and the idealist philosophy are battling on an united front for the continuance of the slavish subordination of people to the capitalist order, and are aiming to suppress every thought of the possibility of changing or destroying this order.

Lenin wrote in one of his letters to Maxim Gorkiy: "The idea of God always dulled and lulled the 'social senses', substituting dying ideas for live ones, and was always synonymous with the concept of slavery (the worst, the hopeless slavery). The idea of God never 'connected the individual with society', and always bound the oppressed classes by means of faith in the divinity of the oppressors."¹

* * *

It is appropriate, in conclusion, to outline the personal attitude of I. P. Pavlov to religion.

I. V. I. Lenin "Works", Vol 35, p 93

We hear quite frequently of statements by some people that I. P. Pavlov was allegedly a religious man. When it is pointed out to these people that this supposition is incompatible with the profoundly atheistic substance of his teaching, the usual rejoinder is that, quite frequently, prominent scientists in various fields of science remained idealistic or even religious. The history of science knows of such cases. Leibnitz, for example, an eminent mathematician, remained an idealist in philosophy. English scientists, Wallace and Crookes who had caused such derision of the part of F. Engels for their spiritual preoccupations, had unquestionable scientific merits.

The eminent English physicist Shrodinger published a book in 1944 "What is Life from the Point of View of Physics" (Russian translation by Foreign Literature Publication, Moscow, 1947). Parallel with his aim to present the causative conditioning of life and substantiate the closeness of the physical, chemical and biological phenomena, he comes out in the concluding chapter of his book as a confirmed idealist. In attempting to reconcile his ideas with the idea of the existence of God and of the immortality of the soul, Shrodinger states that consciousness is independent of matter and dominates it. Many such examples can be cited. Religious people are eager to refer to these facts, in their attempt to prove that I. P. Pavlov, too, was religious.

This is not the case with Pavlov. He has been persistently studying for a period of 30 years the problem of the soul, i.e., the problem which is the crux of every religious movement. He exposed consecutively and without pity the useless and scientifically absurd idealistic concepts of the soul, and, in outlining the materialistic bases of the teaching of the soul, he could not help being an atheist.

Speaking of his youthful experiences, Pavlov recalled how he had broken away from the views indigenous at that time to his family, and how he had concentrated his attention on the study of natural sciences, under the influence of the foremost thinkers of his time. Later Pavlov was saying: "I myself am a rationalist and I am through with religion." In a letter to a priest, E. Kondrat'yev (1928), Pavlov wrote with perfect clarity: "I am an unbeliever," and described the following episode. "You are asking whether there are eminent scientists-believers," he wrote to Kondrat'yev, "of course there are, there were and there are. I well remember my embarrassment a few years ago when I was standing near the famous English chemist Ramsay during the service at Westminster Abbey on the occasion of the 250th anniversary of the Royal Society of London and attempted to divert him with some casual remarks, while he was in such a religious mood."¹

¹ From the personal archives material of Prof. E. P. Mayorov

Not long ago were published the stenographic protocols of the meetings at the psychiatric clinic in which Pavlov participated. In connection with the discussion of some patient's chart, Pavlov recalled the irresistible effect which the works of N. G. Chernyshevskiy had had on him. Already then in his youth, Pavlov's religiousness, his world outlook had undergone radical changes. Obviously the influence of Chernyshevskiy on young Pavlov could only have been in the atheistic direction.

Facts are often cited which refer to the alleged religiousness of Pavlov. For instance, upon arrival in Ryazan in 1935, Pavlov went with his family to the cemetery where he participated in the mourning service at the grave of his parents. It was pointed out that during religious holy days church rituals were performed at Pavlov's home. The gist of the matter is that Pavlov, being an atheist, was like many others of his generation a tolerant man. "Religion is the business of weak people, let them believe if they wish," he said once in a personal conversation. We must mention that his wife, S. V. Pavlova, was fanatically religious. Not by accident did Pavlov say on another occasion, "Here, S. V. is a sensible woman, yet she understands nothing in regard to conditioned reflexes."

Only this benevolent attitude to the convictions of his kin can explain the participation of Pavlov in some religious ceremonies. His profound scientific atheism is beyond doubt. It is precisely for this reason that he always remained, in his scientific discussions and convictions, irreconcilable in principle to the slightest vacillation when it concerned the interpretation of psychic activity.

In speaking of Pavlov's outlook on life, we must stress one fact which manifested itself constantly and clearly throughout his entire creative activity. It can be rightfully called the Party orientations of Pavlov's materialism.

V. I. Lenin pointed out, "...materialism includes, so to speak, the Party element, since it obliges us in every evaluation of an event to assume directly and frankly the point of view of a definite social group."

The study of the entire socio-scientific activity of Pavlov demonstrates that he has always sided with the most progressive element of society. The proper conditions for the manifestation of this trait appeared during the Soviet period of his life. Many reports and articles of Pavlov, his heated polemics of many years

V. I. Lenin "Works", Vol. I, pp 360-381

at the conferences of the Society of Russian Physicians, his special polemic articles aimed at a number of psychologists, all this represents a true picture of the truly militant materialism of Pavlov.

At one of his "Wednesdays" Pavlov said: "Now...from peaceful matters let us switch to, shall we say, military ones, in regard to Mr. Keller. We are at war with him. It is a serious fight with the psychologists." On another occasion Pavlov said: "I am engaged in a serious battle with Pierre Jean in his capacity as a psychologist. I shall try next time to break him to the best of my ability."

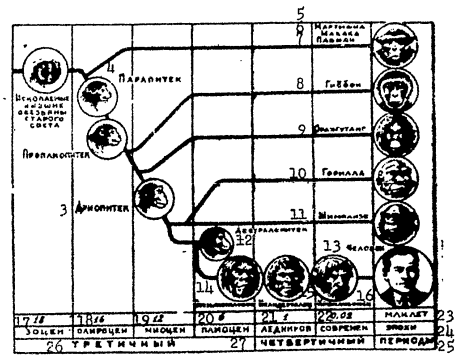
We could cite many instances of this kind.

Pavlov utterances of a fighting character are not accidental of course. This is the way he felt compelled to act in order to win the battle for materialism against various idealistic misleaders. In discussing the inimical attitude of the reactionary German psychologist Keller against the materialistic teaching of conditional reflexes, Pavlov explained that by the fact that Keller lectured on psychology at the theological faculty: "There... you cannot expound our point of view," he used to say, in emphasizing the contradictions between theology and science.

At one of his "Wednesdays", Pavlov spoke of the fate of Descartes and pointed out that the religionists compelled Descartes to make an admission of the existence of a soul in man. Had not Descartes done so, "...he would have been put away, burned," added Pavlov. These words indicate clearly his evaluation of the contradictions between the church and religion and the scientific ideas.

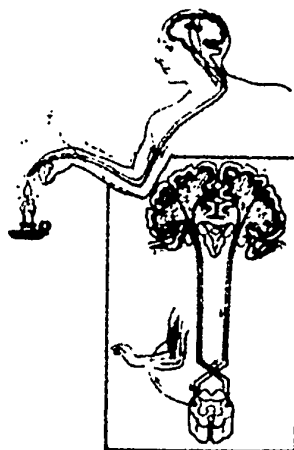
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The physiological teaching of Pavlov which had subjected to analysis the "most sacred precincts" of religion -- the human brain which the churchmen and the adherents of idealism call the "seat of the immortal soul"; rendered an invaluable service to mankind and to materialistic science. It clearly demonstrated the truth that not the fairy tales about the soul but the real life activity of highly developed matter in the form of the cerebral mass is at the basis of the psychic activity of man. Science attests to the fact that nature is not a product of divine creation but the result of the progress of matter, which is in constant evolution, and is the only true primary cause of all phenomena and laws of the universe. Pavlov's teaching expelled the idea of God from its most secluded and mysterious seat where religion and philosophers-idealists had tried to hide it.



Scheme of the origin and development of man

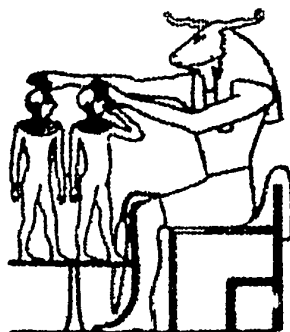
1-Унаследованные приматы Старого Света; 2- Пропанопитhec; 3-Дриопитhec; 4-Парапитеc; 5-Мартосет; 6-Макака; 7-Павиан; 8-Горилла; 9-Орангутанг; 10-Горилла; 11-Шимпанзе; 12-Аustralопитhec; 13-Человек; 14-Человек-обезьяна; 15-Неандерталь; 16-Кроманьон; 17-Эоцено; 18-Олигоцен; 19-Миоцен; 20-Плиоцен; 21-Ледниковый; 22-Современный; 23-Миллионы лет; 24-Эпохи; 25-Периоды; 26-Третичный; 27-Четвертичный



Nervous processes originating when a finger is burned, reach the brain and are transformed into impulses which cause pulling away of the hand.



Religious conception of the separation of body and soul in death
(from an ancient gravure).



According to the ideas of the ancient Egyptians, god Khnum sculptured the first human beings from clay on a potter's wheel.



Normal psychic activity is possible only in a normal state of the brain. In case of malformations connected with the under-development of the brain (microcephaly), idiotism develops.



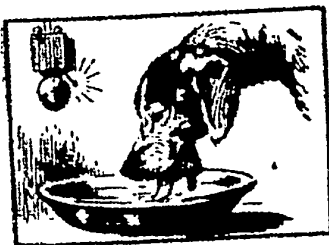
Location of the main nervous centers in the brain: yellow - the
speech center of speech; red - center of motion; green - center of
hearing; sky blue - center of vision



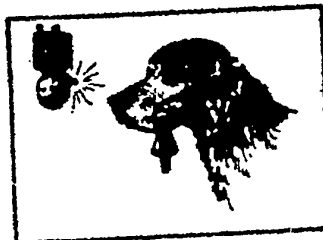
The act of eating causes salivation
(unconditioned reflex)



Only the sight of food causes
salivation (natural condi-
tioned reflex)

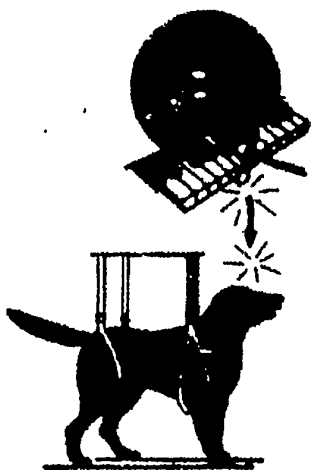


When a bell ringing accompanied feeding, ringing acquired the
property of causing salivation (an artificial conditioned reflex)

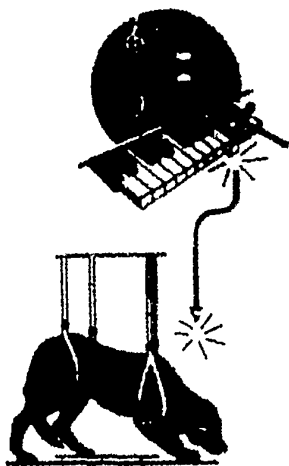




The most important function of the brain-inhibition has several ways of manifesting itself. One of the types of inner inhibition is retardation. The dog was fed only two minutes after the bell rang. The conditioned salivation also began only after two minutes had elapsed since the start of the ringing of the bell.



The conditioned reflex sleep of a dog -- the dog wakes up only to a definite musical sound (tone "fa")



This sleeping dog can react (wake up) to a definite sound. The dog does not react to a sound on which no reflex has been formed.

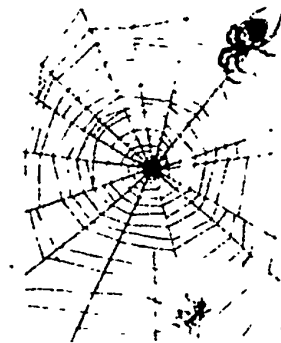


The Evolution of the Brain

Psychic activity is being effected on the basis of physiological processes which are carried out in the higher sections of the brain. The illustrations show that the cerebral cortex is absent in fish that its elements appear in birds. The cortical development increases intensively in higher animals and reaches its highest degree in man.



The instincts represent the most complex inherited reflexes. One of the examples is the building instinct of beavers which erect dikes and small dams in rivers. This adaptation reaction developed in water-inhabiting beavers is connected with the vitally important need of sustaining a certain level of water near their habitat.



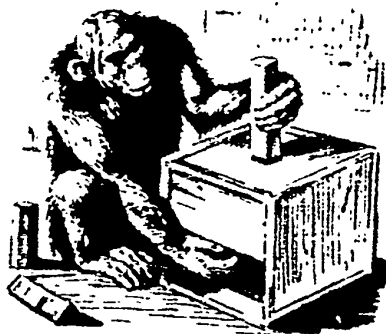
The instincts achieve at times a high degree of adaptation to the character of the stimulus. A spider will react to the vibration of the web only in accordance with the frequency of the fluttering of the wings of the insect.



Life conditions of an animal determine the degree of development of his sensory organs. In high flying birds it is sharp vision. Closing of the eyes with a little cap causes immobilization of the golden eagle.



The immobilization of the golden eagle is utilized by hunters. After the removal of the little hood near a running fox, the golden eagle swoops down on the animal the moment it sees it.



The higher animals possess the elementary faculties of reasoning activities. Raphael selects the proper stick to open the box with food.



Higher animals easily master complicated motor habits.



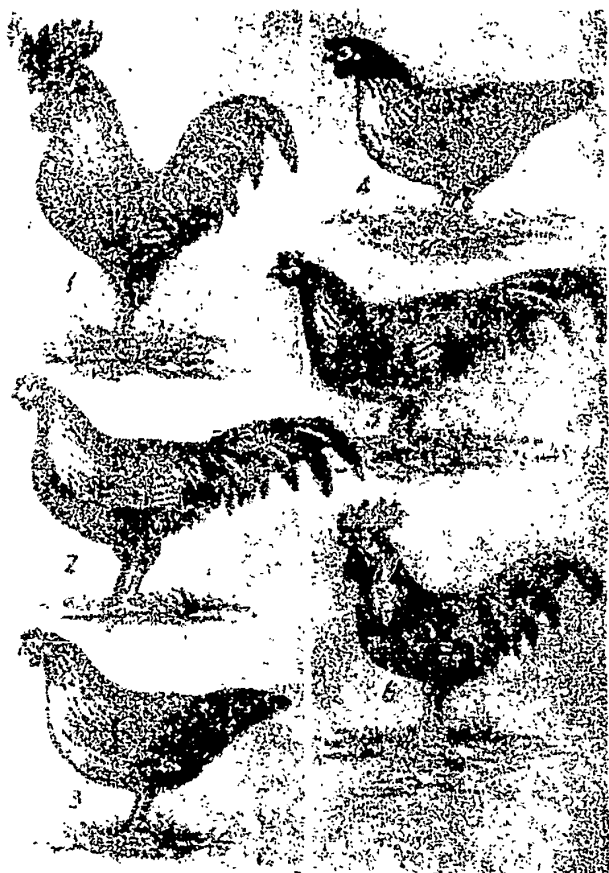
The invention of labor tools and the emergence of speech were the prerequisites of the humanization of the monkey.



Word, representing to man a real signal of actuality, easily becomes a conditioned stimulus. From its very early age, a baby forms many conditioned reflexes to various words: sit down, drink, go, no, etc.



The thinking of man differs in quality from the psychic activity of even the most advanced animals. This is connected with the function of speech which is possessed by man only (the second signal system of conditioned reflexes). The use of words develops thinking in ideas and abstractions. A child seeing for the first time live creatures which resemble his toy "birdie" learns to generalize the conception "bird" for the first time in his life.



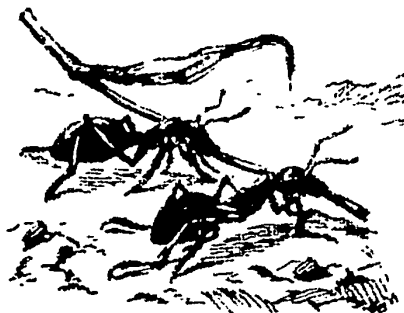
Science enables one to change at will the sexual characteristics of chicken. 1 - normal rooster; 2 - rooster after castration; 3 - castrated rooster after transplantation of ovary; 4 - normal chicken [hen]; 5 - castrated hen; 6 - castrated hen after transplantation of the seminal vesicles.



Immediately following birth, an animal manifests certain instinctive actions which are carried out unconsciously. The above illustration shows a sucking reflex typical to mammalia.



The food-obtaining instinct in chicks hatched is manifested in pecking at any visible objects, even sunlight spots.



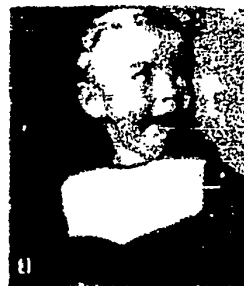
The purposefulness of animal reactions consists of their correct adaptation to the environmental conditions. Two ants united their "efforts" to push a blade of grass, a task too difficult for one ant.



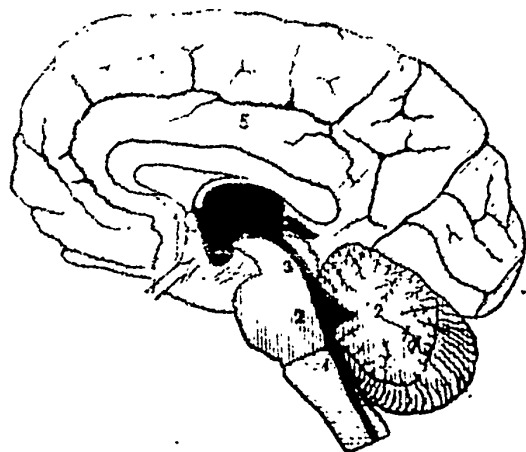
One of the complex forms of the instinctive activity of birds is their faculty of orientation in space. Some of them return to their old nests after flying very long distances at times.



The instincts (the most complex unconditioned reflexes), as distinct from the conditioned reflexes can change only slowly. The illustration shows that an eider, following its instinct, hatches an empty nest from which the egg has been removed and placed in front of the bird.



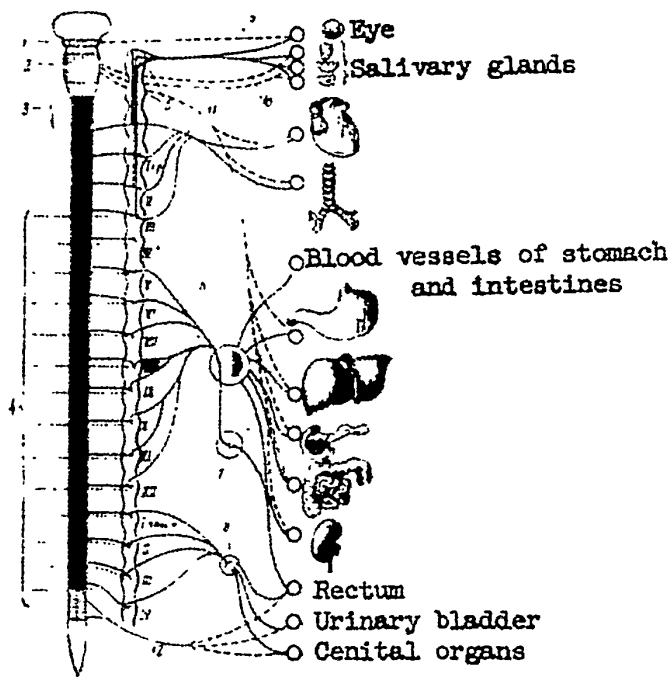
At an early age (A -- one and a half year, B -- two years) of a child there is a marked change in sensations and impressions as revealed in facial expressions, and corresponding to changing environmental influences.



[This figure refers to page 97 above; anatomy of the brain]



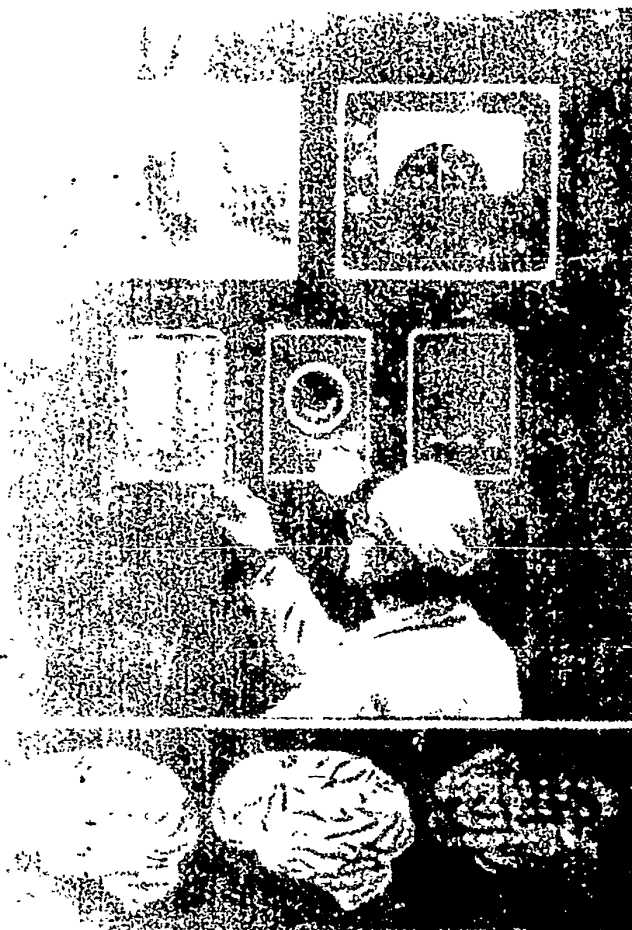
In stimulating various brain centers with electric current by means of an electrode planted in the cranium, one can cause definite forms of expressive motions in an animal. a -- before excitation; b -- upon excitation; a passive defensive reaction; c -- reaction of caution, the animal walks "stealthily"; d -- active defensive reaction, fur "stands up".



Scheme of the autonomous nervous system



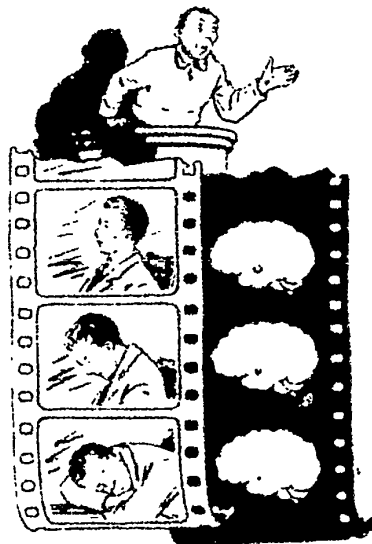
Monkeys are Able to form long chains of associations. Raphael learned to draw water from lake and sprinkle itself in hot weather (1). An "apparatus with fire" is placed in front of Raphael with fruits underneath, and bamboo sticks are put nearby which he uses to move from one raft to another (2). The monkey goes over to the adjacent raft where a container with water is placed (3). Raphael draws water from the container, puts out the fire on the first raft and gets the bait (4). These experiments prove that even the higher anthropoid apes do not possess the property of forming ideas. This, for example, Raphael has a concrete image of water in the lake, water in the container, but could only use the water from the container to put out the fire (according to the training which he had received), but did not form the idea of using the water from the lake. (The experiments of E. G. Batsuro)



Registration scheme of the brain biocurrents according to the method of M. I. Livanov and V. M. Anan'yev. Upper left -- the subject with electrodes on his head; upper right -- television screen with illuminated dots. Second row, from left to right: control panel of the preliminary increase of biocurrents, commutator for the consecutive switching on of biocurrents and booster. Below, from left to right: the brain biocurrents before solution of a problem; flashing dots during the process of solving a problem; the problem is solved.



Science has obtained much proof of the possibility of controlling various life phenomena. A head of a dog separated from the body but supplied with blood or its substitute fluid, heated and saturated with oxygen and passed through the head's blood vessels, such an "isolated" head can live for two and a half hours. As controls, we observed the reactions of pupil dilatation, winking, respiratory motions, etc. (Experiments of S. S. Bryukhonenko and S. I. Chechulin).



Sleep represent inhibition of the cortical cells. A monotonous, dull talk by a lecturer first creates an area of inhibition in the cortex which spread and gradually embraces the entire cortex. Parallel with it, man passes from a dozing state to the state of complete sleep.



The process of inhibition of the central nervous system represents the basis of sleep. This is especially proven by the phenomena of complete and partial sleep. The octopus in the illustration has only one extremity which is not inhibited. The animal is asleep. However, in the event of danger, the warning signal originates in this arm which is "keeping guard".



Dreams are connected with distorted images. Buzzing of an insect is perceived as the growling of a wild beast.



External stimuli, for example the cooling of the feet, cause the sensation of freezing [in a dream].



An eminent French materialist Lucilio Vanini was burned at stake in 1619 in Toulouse, France, by the decree of king's court for the propaganda of atheism.



The great Italian scientist Giordano Bruno was burned at stake in 1600 in Rome by the verdict of the Catholic inquisition, for the dissemination of the teaching of the multiplicity of worlds and the rotation of the earth around the sun.

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FOR REASONS OF SPEED AND ECONOMY
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