FOREWORD

This publication was prepared under contract for the Joint Publications Research Service as a translation or foreign-language research service to the various federal government departments.

The contents of this material in no way represent the policies, views or attitudes of the U. S. Government or of the parties to any distribution arrangement.

PROCUREMENT OF JPRS REPORTS

All JPRS reports may be ordered from the Office of Technical Services. Reports published prior to 1 February 1963 can be provided, for the most part, only in photocopy (xerox). Those published after 1 February 1963 will be provided in printed form.

Details on special subscription arrangements for JPRS social science reports will be provided upon request.

No cumulative subject index or catalog of all JPRS reports has been compiled.

All JPRS reports are listed in the Monthly Catalog of U. S. Government Publications, available on subscription at $4.50 per year ($6.00 foreign), including an annual index, from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

All JPRS scientific and technical reports are cataloged and subject-indexed in Technical Translations, published semimonthly by the Office of Technical Services, and also available on subscription ($12.00 per year domestic, $16.00 foreign) from the Superintendent of Documents. Semiannual indexes to Technical Translations are available at additional cost.

JPRS: 18,315

TRANSLATIONS ON HIGHER NERVOUS ACTIVITY

- USSR -

[Following is the translation of four articles in the Russian-language journal Zhurnal Vysshey Nernnoy Deyatel'nosti imeni I. P. Pavlova (Journal of Higher Nervous Activity imeni I. P. Pavlov), Moscow, Vol 12, No 6, November-December 1962. Additional bibliographic information accompanies each article.]

TABLE OF CONTENTS

PHILOSOPHICAL PROBLEMS IN PHYSIOLOGY OF HIGHER NERVOUS ACTIVITY AND PSYCHOLOGY

/Following is the translation of an article by O. A. Krylov and V. I. Chumak in Zh. Vys. Ner. Dey. im. I. P. Pavlov (The Pavlov Higher Nervous Activity Journal), Volume 12, No 6, November-December 1962, pages 1089-1096./

From 8 to 11 May 1962, the All-Union Conference on Philosophical Problems of the Physiology of Higher Nervous Activity and Psychology was held in Moscow. The conference was called by the Academy of Sciences USSR (AS USSR), the Academy of Medical Sciences USSR (AMS USSR), Academy of Pedagogical Science RSFSR (APS RSFSR), and the USSR and RSFSR Ministries of Higher and Secondary Special Education. The rapid development of physiology, psychology, and philosophy in the natural sciences and particularly the sciences of the physical-mathematics cycle in recent years has placed the scientific community before the necessity of summing up results for the period after the Joint Session of the AS USSR and AMS USSR, devoted to problems of the physiological teachings of Pavlov (1950), as well as outlining plans and ways for the further development of physiology of higher nervous activity and psychology. There is no doubt as to the progressive significance of the 1950 Joint Session. The session attracted the attention of scientists to the rich scientific legacy of Pavlov, conclusively demonstrated the tremendous importance of Pavlov's works for the development of biology and medicine, subjected to criticism the erroneous concepts of foreign and Soviet scientists and outlined ways toward the further development of physiology and related medical-biological sciences. However, the events occurring after this session also had certain negative features. Under the conditions of the cult of personality, the only method acceptable in science, that of conviction and experimental-logical proof, frequently was replaced administrative orders and decrees. Psychology as a science to a great degree lost the right to independent existence and was equated with psyiology of higher nervous activity. Together with the idealistic errors of bourgeois scientists the progressive achievements of foreign science were also rejected.

Of course all of these phenomena were of a temporary nature and could not greatly slow down the degree of forward

development of science. Subsequent years brought new achievements in the development of Soviet physiology and psychology and the elimination of lag in neurophysiology. This corresponded in time with a period when progressive scientists in western Europe and America through the logic of experimentation and the experience of clinical studies came to the recognition of the great wealth of the teachings of Pavlov and to a negation of the view of Freud and other bourgeois idealistic conceptions in physiology, psychology and psychiatry. The conditioned reflex became a generally recognized international concept, the principle of activity of the entire brain, explaining the conduct of animal and man, a method of thinking for modern neurophysiologists. All of this demanded the discussion of vital philosophical and methodological problems of the physiology of higher nervous activity and psychology, synthesis of accumulated factual material and elaboration of further trends and methods of research. This conference was devoted to discussing all of these problems. In his opening speech the director of the Institute of Philosophy of the AS USSR, Fedoseyev, made a profound analysis of the period subsequent to the Joint Pavlov Session, noted the outstanding role played by the works of Pavlov in the development of Soviet physiology, psychology, education and medicine and noted the negative influence of the Stalin cult of personality on the development of science. Fedoseyev focused attention on the fact that among scientists of capitalist countries the ideology of dialectical materialism is becoming more and more popular. This requires a differentiated approach to the works of foreign scientists. New ares now being developed in Soviet natural sciences possess direct succession with the works of our own classic natural scientists. The papers read and the subsequent discussions were devoted to general philosophical problems of correlating the material and ideal, objective and subjective, physiology and psychology, matter and thought, concepts of the structure of reflex and the importance of cybernetics for physiology and psychology and, finally, certain particular problems of philosophy, psychology and physiology.

The rapid growth of factual data in the natural sciences requires modern philosophical synthesis. ". . . Without solid philosophical foundation," Lenin wrote, "no natural sciences and no materialism can withstand the struggle against the pressure of bourgeois ideas and restoration of the bourgeois outlook" (V. I. Lenin, Sochineniya /Works/, Volume 33, page 207). "Therefore we are forced constantly to turn to general philosophical problems of the relationship between material and ideal, objective and subjective, matter and consciousness, thought and brain functions,

physiology and psychology," M. B. Mitin said in his paper, "The Problem of the Material and Ideal in the Light of Dialectical Materialism". He noted that many philosophers, physiologists and psychologists since the Joint Session of 1950, basing themselves on statements by Pavlov on the unity of the psychological and physiological in the conditioned reflex, have embarked toward the elimination of psychology and its dissolution in the physiology of higher nervous activity. The illogical nature of this trend is quite obvious. Pavlov himself never denied psychology as an independent science. "I do not negate psychology," he wrote, "as cognition of man's inner world. Even less am I inclined to deny anything of the deepest inclinations of the human spirit. Here and now I merely defend and assert the absolute and irrevocable rights of natural scientific thought everywhere and as long as it can manifest its power"(I. P. Pavlov, Sobrannyye Sochineniya /Collected Works/, 3, Book 1, page 125).

Biochemical changes, which are studied by a special science -- biochemistry, lie at the root of physiological processes, as is well known. The laws of biochemistry cannot explain all principles of physiological phenomena, which are studied by another discipline -- physiology. We have an analogous case in comparing physiology and psychology. Physiological phenomena lie at the basis of mental processes, but the laws of mental processes cannot be boiled down to laws of physiology. In a number of cases study can be of a border-line nature between physiology and biochemistry or physiology and psychology. Such a border-line zone between physiology and psychology is the physiology of higher nervous activity, which studies the physiological laws lying at the basis of mental phenomena. In this respect we can study simultaneously physiological and mental phenomena with the conditioned reflex as our object of study. Mitin absolutely justifiably focused attention on the fact that Soviet psychologists in recent years have focused their efforts on studying this border-line, although vital, but not the only area of psychology, neglecting on the other hand studies of its other areas, which causes great damage not only to the development of psychology itself but also to its practical application in education, the national economy and military science. The physiological laws which lie at the basis of mental processes, which form the content of Pavlov's teachings, will as formerly serve as natural science foundation for psychology. The problem of the relationship between physiology and psychology played an important part in the paper by Shorokhova and Kaganov entitled "Certain Philosophical Problems of Psychology". Since mental activity is an activity carried out by the brain, the problem of

relationship between the mental and physiological boils down to the problem of interrelationship between various characteristics (qualities, determinations, etc.) of one and the same phenomenon -- reflective activity of the brain. The thesis that mental and physiological are objectively one and the same reality -- higher nervous activity, does not mean that psychology and physiology as sciences have one and the same subject of study. The subjects of these sciences are different. The subject of physiology of higher nervous activity are the physiological laws of brain activity. Psychology studies the laws of the birth and development of the mind in various forms and manifestations, beginning from elementary sensations and ending with consciousness. Consequently, the mental is inseperable from the physiological and yet does not amount to one and the same, but differs substantially from it, which is expressed in the specific laws of psychology. The authors note that the problem of psychology consists in studying the nature of the mind, consciousness, man's inner world as functions of the brain, as reflections of being, of the external world. A study of social influences on consciousness and its regulatory role in conduct and man's vital activities constitutes the central task of psychological study.

The paper by D. A. Biryukov entitled "Primary Philosophical Problems of Evolutional Physiology of Higher Nervous Activity", was devoted to the problem of the evolution of physiological and mental processes. The paper discussed such problems little studied in physiology as those of the evolution of sensations and emotions. But particular interest was aroused by analysis of the relationship between physiological and mental, material and ideal. Weighing the various aspects of study, the author asserts that a study of the human mind should proceed on the one hand according to principles of the first signal system and, on the other hand, according to principles of the second signal system (abstraction and synthesis). It is true that the author immediately stipulates that the concepts of first and second signal system remain for the time being as a scheme, not supplemented by experimental content. Speaking of the first and second signal systems, Pavlov had in mind the possibility of dividing man's perceptions first into perceptions of concrete objects and second, objects transmitted by the medium of word, speech, etc. After the Joint Session all principles of the Pavlovian school were accepted, both firmly established laws and hypothetical structures as well as individual statements, as irrevocable truths. Therefore scientists frequently speak of the first and second signal systems as firmly established facts, while certain morphologists put on a practical plane the question as to where the

first signal system ends and where the second begins in the human cerebral cortex. The existence in man's cerebral cortex of structurally and functionally different systems, connected in their activities only with subject activity, or only with speech and tongue, requires further proof. Word and speech constitute primarily social-historical products which developed together with the development of society with relative stability in the laws of brain functioning. Due to the high degree of organization in the human brain the nature of information processing in it possesses specific peculiarities in comparison with animals, and these functioning peculiarities are manifested independent of whether a word or object stimulus is operating. Unfortunately, an adequate method for studying the qualitative features of higher human nervous activity has not yet been sufficiently developed. However the success of cybernetics and the bringing of psychology and physiology closer to the physical-mathematical sciences gives us hope that this problem will be solved in the near future.

A paper by I. S. Kupalov, entitled "Studies of Reflex and Reflex Action and their Future Development", was devoted to problems which resulted in a lively discussion. The paper contains a detailed analysis of two paths taken in the development of studies of reflex and morphophysiological concepts of the structure of the conditioned reflex. The author carefully demonstrated that the concepts of Pavlov on reflex are considerably broader than those of Descartes and Sherrington. The author noted a close relationship between the latest discoveries of neurophysiology and the teachings of Pavlov, and he justifiably pointed out the fact that further fruitful development of neurophysiology is possible only on a philosophical and methodological basis of Pavlovian teachings. Modern data on the cyclical nervous processes, on preliminary establishment of tonus on the central nervous system and possible action (conditioned stimulation), on the formation of motivation, etc., do not contradict Pavlovian teachings, but rather develop them organically. Great interest was aroused by the studies of Kupalov and his co-workers on situational and shortened conditioned reflexes, on the qualitative nature of conditioned stimulation (positive and negative states of nerve centers) and autoregulation of the brain tonus. Great interest was aroused by the criticism by the author of the basic premises of Sherrington expounded in the book Man on His Nature, which is considered among many bourgeois philosophers to be the natural science basis for the idealistic philosophy of dualism. This criticism aids in correctly approaching an evaluation of the factual material of foreign scientists from the theoretical postion of materialistic physiology Sechenov and Pavlov.

An interesting area of the physiology of the individual adaptation was dealt with in the paper by E. A. Asratyan, entitled "The Conditioned Reflex and Related Phenomena". Individual adaptation occurs at all stages of philogenesis. However, low-organization representatives of the animal world (bacteria, certain plants, the simplest coelenterata and some of the lower chordata) effect individual adaptation on the basis of simpler physiological mechanisms than animals possessing a comparatively highly organized central nervous system. Analysis of factual material contained in the paper points out that in low-organization animals individual adaptation is achieved through the psychological mechanism of the summation effect -- the banung-dominant phenomenon. This mechanism is related to the conditioned reflex, but is not equated to it. The latter is the privilege of highly organized animals. Unfortunately the problem of the role of the summation effect -- the banung-dominant phenomenon, in the conditioned reflex actions of higher animals has not yet been solved. We have already noted that a particularly lively discussion was caused by the problem of the structure of reflex and the reflex principle of activity of the nervous system. The conference devoted great attention to this problem, which is a key problem for methodological analysis of primary problems of physiology and psychology.

From our point of view an important role in this area was played by the paper by P. K. Anakhin, "Methodological Analysis of Key Problems of the Conditioned Reflex". The paper presented an historical analysis of the importance of the discoveries of Pavlov for a profound understanding of conditions connected with the origin and development of reflective properties of living matter. The paper pointed out that the repetitive nature of phenomena of the extenral world has found corresponding reflection in that of physical-chemical processes of living protoplasm both in the first coacervates and in subsequent highly organized organisms. Changes in the environment have caused not only specifically inherent physical-chemical changes in living protoplasm, but also changes which would correspond only to future events in the outside world. This factor of civilization, that is, forewarning of the future, which was introduced to physiology by Pavlov, is of tremendous biological importance, preparing ahead of time plants, microorganisms and animals for imminent favorable and unfavorable changes in environment. The principle of forestalling reflection of actuality, adaptation to future but not yet occurring events of course constitutes a basic sign of the conditioned reflex. Hence we form a conclusion that a forestalling reflection of the external world constitutes a universal quality of living

matter, which has joined all the forms of adaptive behavior -- conditioned and unconditioned, inborn and acquired. Considerable space was devoted in the paper to criticism of the Cartesian reflex theory and philosophical substantiation of the principles of the functional system. The Cartesian reflex in the form of an arc, according to general recognition does not satisfy modern physiology. This is universally accepted now. But no matter how reflex is presented, this central pheonomenon in the activity of the nervous system, at the present level of knowledge, which may replace the old concept of the reflex arc, remains an unresolved problem for many scientists. Therefore they willy nilly depend on the "settled" Cartesian arc in physiology.

In elaborating the theory of functional system, Anakhin introduced to the three-element arc of the reflex a fourth element, the so-called action acceptor, which assesses the completed act through reverse afferentation. Such a concept of the unit of nervous activity is a step forward toward comprehending the behavior and total activity of the brain. The functional system as a principle of activity of the nervous system, its development (systomogenesis) and improvement have been discussed frequently in print. Scientists have long focused attention on the presence of a cyclical interaction in the nervous system. Even in Descartes, in deliberations on the coordination of movements, one can find elements of "inverse relation". Bell described an inverse nervous relationship between the muscles in the central nervous system at the beginning of the 19th century. The circular nature of the movement of stimulus as a principle of nervous system activity was proposed in 1836 by Filomafitskiy. No wonder as Koshtoyants in describing the history of physiology wrote: "The idea of circular movement of the nervous process, it seems to me, belongs entirely to Filomafitskiy" (Ocherki po istorii fiziologii v Rossii /Essays on the History of Physiology in Russia/ Moscow-Leningrad, 1946, pages 114-115).

I. M. Sechenov pointed out the existence of the cyclical path of stimulus movements in explaining the physiological basis of "dark" muscle sense, as did Samoylov in studying the heart and bell of the jellyfish. However, in spite of the fact that scientists long ago noticed this fact, only in recent years, in connection with the work of Anokhin and others, as well as with the development of cybernetics, this type of nervous process was given leading importance in brain activity and behavior of the whole organism. The circular type of stimulus movement received new content and further development in the works of Soviet neurophysiologists.

N. I. Graschenkov and colleagues in their paper

(data of Gel'fand and Tseytlin). The "immaterial" variables are structural and functional reactions of the organism which can in the process of adaptation undergo sharp changes, while the "material" variables remain stable. For example, a cat can always be distinguished from animals of another species by its "material" variables, while an individual cat can be distinguished from representatives of the same species by its "immaterial" variables. Utilization of the above mentioned mathematical idea for analyzing biological parameters of an extremely broad profile will aid in understanding more deeply the processes of evolution, chemism of the tissues and various forms of adaptive behavior. Bernshteyn, in critizing the reflex arc, unfortunately went as far as to deny the reflex principle of nervous activity. For example, an orientation reflex, in the opinion of the author, can never be called a reflex and is viewed only as a reaction. Obviously the author equates the principle of reflex activity to the reflex arc which is merely a particular expression of its structural organization. The reflex is the general philosophical concept of the reflex activity of highly organized living forms carried out by the central nervous system. In the rich heritage of the classics of Russian physiology Bernshteyn could not find sequence with modern physiological concepts and in these works saw practically nothing besides "classical mechanicism" in the form of "mosaicism", "atomism" and "equation of the organism with the environment". Naturally the majority of those participating in the discussion (Asratyan, Gurevich, Chernigovskiy, Zubkov and others) sharply protested against such an unwarranted assessment of the wealth of ideas of the leading representatives of Russian physiological thought, primarily the works of Pavlov. The concept of "physiology of activity" proposed by Bernshteyn also failed to find support. The concept of a relationship between the organism and the environment as "the overcoming of this environment . . . in the direction of a generic program of development and self-provision" forces us to wonder what sort of a generic program of development this is, who has formulated this program and placed it into living matter, as if in a cybernetics machine, was the comment made by Zubkov. The motif of the mechanistic concept of the conditioned reflex of the insufficiency of the ideas and concepts of Pavlovian physiology for explaining new facts, was also heard in a number of other speeches. Bongard believes that the system even of rather complex conditioned reflexes is clearly insufficient for explaining the activities of the living organism. Postulating the competence of cybernetics by verifying with models whether or not to approve various physiological theories and hypotheses and discovering that of the elements forming the

"Dialectical Materialism and Some Problems of Modern Neurophysiology" synthesized the factual material of neurophysiology obtained by modern research methods from the viewpoint of the philosophy of dialectical materialism. They gave an historical analysis of the doctrine of analyzers as communications channels, discussed the problem of coding information in the organism, critically discussed the former concept of the structure of reflex and the reflex theory, presupposing a hard fixation of reflexes. As Anokhin, Grashchenkov introduced into the reflex structure the apparatus of probability foresight (forestalling reflection of actuality). The paper demonstrated the heterogeneous form of reaction of various parts of the nerve cell to the effect of stimulus, the role of various sections of the neuron in the expression of local processes responsible for stimulation or retardation of the cell, the importance of the electrical field orginating from local processes, on total integration, and the capacity of autoregulation in the neuron through reflective axon collaterals. Neuron physiology was presented in connection with the function of the brain as a whole, conduct and nature of general bioelectric activity, regulated in the form of EEG. The leading role of cyclical connections was emphasized for the autoregulating brain activity in the importance of cybernetics as a bridge linking the exact sciences with physiology and other biological disciplines. The concepts of Anokhin and other scientists on the presence of probability foresight in the reflex action of the apparatus, a correction afferentation system and certain other mechanisms of nervous activity from the viewpoint of a number of persons participating in the discussion (Asaratyan, Voronin, Chernigovskiy, etc.) are not original. These facets of reflex activity in their opinion can be completely described in concepts and ideas taken from the works of Pavlov, Sechenov and Samoylov.

The use of cybernetic concepts in studying the functions of the brain form the contents of the paper by N. A. Bernshteyn entitled "New Lines of Development in Physiology and their Relationship to Cybernetics". On the basis of achievements in cybernetics Bernshteyn, as Anokhin and Grahchenkov, tries to prove that the concept of the reflex arc, which has been of great service in physiology, should be replaced by the concept of circular movement of the nerve impulses with control-correction afferentation (inverse afferentation, according to Anokhin) and with the presence in the central nervous system of "a probability foresight apparatus" ("required future model"). Much interest was aroused by the materials of the paper, on the possibility of mathematical grouping of a specific class of functions of a large number of variables into "material" and "immaterial"

conditioned reflex in models, it is impossible to assemble a device copying the process of human learning, Bongard comes to the conclusion that the reflex theory is unfounded in explaining the complex behavior of man. We should note that this chain of logic clearly errs through a lack of comprehension of the interrelationships existing between cybernetic models of physiological processes and the processes themselves occurring in the living organism, and under-estimation of the qualitative peculiarities inherent to the living structure, hence the over-estimation of the possibilities of using models and errors in the conclusions.

E. Sh. Ayrapet'yants in his paper noted the negative role in popularizing the teachings of Pavlov played by the article by Parin entitled "Authority of Facts", published in the Literaturnaya Gazeta (Literary Gazette), on 24 February 1952. Criticizing the theory of cortico-visceral physiology and pathology, Parin, evidently embracing the data in the dissertation by Mansurov and having no personal experience in the area of physiological and pathological studies of higher nervous activity, made the incorrect assertion that changes in the cerebral cortex constitute the effect and not the cause, for example, of such ailments as hypertonia. Without a doubt the disease influences the functional state of the organism and cerebral cortex, but this does not constitute proof that changes in the activities of the cerebral cortex cannot be cause for one affection or another. It is hardly likely that a materialist physiologist would argue the role played by the environment and living situations in the pathogenesis of many diseases of neurogenic origin. Assessment of this situation takes place primarily through the higher sections of the central nervous system and the cerebral cortex. The reaction of the higher sections of the brain determines changes in the vegetative functions and humoral environment of the organism, which under specific conditions can cross the borderline of adaptive effects, from which the disease occurs. The relationship being effected between the cortical elements and various vegetative functions is another matter. Here various hypotheses are possible and much research must be done.

The development of cybernetics and universal automation in production have placed new problems not only before physiology but also psychology. Success in automation has led to a situation whereby more and more not only manual, physical labor is replaced by machinery but also mental operations. Leont'yev and Panov, in their paper entitled "The Psychology of Man and Technical Progress", showed a parallelism in the evolution of production and the problems of labor psychology. The authors postulated the basic

problem of the capacities of modern automatic machinery and the capacities of man. It is a well known fact that the capacities of electronic computers have advanced so far that philosophical problems have been brought to the fore: Is a machine capable of creation, can a machine reproduce all the functions of the brain, and, finally, on the basis of the laws of cybernetics is it possible to create a device possessing all the properties of the "living". The paper postulated the thesis that such mental processes as perception, memory, thinking and in general analytical-synthetic brain activities in humans are carried out according to a completely different principle than in a machine. The language of the machine is the language of numbers. The translation of a text from one language to another is effected by a machine through recoding from one code (language) to another, and not according to the idea content of the words, as is done by man. The creation of a machine capable of carrying out all brain activities at least for the present constitutes just as difficult a task as the creation of an artificial living organism. It is true that just as the laws of mechanics, discovered in building the first machines, are applicable to the living organism, so the general cybernetic laws in a computer can be applied to certain functions of the brain. As was pointed out in the paper, the development of machine technology changes the role of man in production. This process is perceived by some bourgeois scientists as the removal of man from the sphere of production. Leont'yev and Panov conclusively showed that together with the development of technology there is a more rapid growth in human knowledge. The machine frees the human brain from many simple operations and man receives the opportunity to carry out synthesizing operations which are impossible without machine information. Thus the role of man in production is not eliminated but on the contrary is increased in importance. The development of automation and the exact natural sciences makes it impossible to delineate the possible limits for machines, but it is also impossible to delineate the limits of the possible for man, equipped with modern technology.

A paper by A. R. Luriy was devoted to problems of the relationship between the human brain and mental activity. The author demonstrated on the basis of a large quantity of clinical material that any complex "mental function" -- perception, purposeful action, speech, writing, reading, counting -- never "falls out" isolated during damage to a limited section of the cerebral cortex, for always the activity of the most varied functions is disturbed. These data have made it necessary to reassess former concepts of the localization of functions and organization of the brain. The speaker proposed to differentiate two meanings of the

term "function" -- as the function of specific tissue (function of secretion and that of contraction) and as complex adaptive activity carrying out various jobs (the function of breathing, that of locomotion, etc.). Mental activity always relates to the second of the meanings of the term function and is carried out not by limited sections of the brain but by complex systems of constellations, nerve formations, which can achieve one and the same effect by various means. Just as it is impossible to point out a limited section of the elements of a computer which carry out only one complex operation, for example, only the translation of a text from one language to another or merely weather forecasting, etc., it is also to point out limited sections of the brain which carry out merely one form of complex adaptation. The loss of any element inevitably leads to disturbance of the entire system, although in various adaptive reactions this disturbance is manifested in differing ways, depending on which element has been damaged. System analysis of mental processes and their brain organization, as shown by Luriy makes it possible to penetrate deeper into diagnosis of illness and find ways of restoring impaired mental activities, means of replacing lost elements with whole.

S. A. Sarkisov, in his paper entitled "Natural Scientific and Philosophical Problems of the Present State of the Science of the Brain", on the basis of specific morphological, physiological and biohistochemical data developed a theory of the dynamic localization of the functions in the central nervous system and the cerebral cortex. The author also furnished a more efficient classification of the cerebral cortex formations. In particular, studies by fellows of the Brain Institute of the AMS USSR demonstrated conclusively that one part of the insular region has a direct relationship to the olfactory analyzer and the other -- to the cortical end of the speech-motor analyzer (I. A. Stankevich). As is well known all cells of the cerebral cortex participate in mental activity, but their participation is not equal. A particular role in the tracing processes of nervous activity and the processes of memory, in the opinion of Sarkisov, is played the stellate cells. The stellate cell system possesses a great number dendrite branchings and their quantity in philo- and ontogenesis in the cortical ends of the analyzers progressively increases, and there is a particularly large number in the young surface layers of the cerebral cortex in humans. It is interesting that the axons of stellate neurons, in contrast to the pyramidal and spindle cells usually do not go beyond the limits of the cortices of the large cerebral hemispheres, and frequently beyond the limits of one layer. The paper

also introduced electrophysiological data indicating the particular role played by the stellate cells in forming tracer reactions. In conclusion Sarkisov criticized idealistic concepts developed abroad in the area of brain physiology and morphology. F. V. Bassin in his paper entitled "Consciousness and the 'Unconscious'", criticized Freud and the Freudists in their approach to the study of the "unconscious". This problem is dealt with comparatively little in Soviet psychology and psychiatry, although it is of great theoretical and practical importance. The problem of the "unconscious" is presented rather fully in Soviet psychology in the form of the "purpose" theory by Uznadze, while views close to it in physiological literature are those of Anokhin, Grashchenkov, and Bernshteyn on the existence in the central nervous system of a probability foresight apparatus -- programming -- preceeding actual events. The paper demonstrated the importance of the "unconscious" in forming the content side of consciousness and the presence of a genetic link between the "unconscious" and consciousness. Perhaps this is the most serious attack against the Freudian concept which views the "unconscious" and consciousness as two heterogeneous, antagonistic points and which postulates the unconditional subjugation of the consciousness to the "unconscious". This reactionary concept can be successfully overcome, as pointed out by Bassin, by an objective analysis of unrealized forms of higher nervous activity.

The problem of studying typological properties of the nervous system and their importance for psychology was dealt with in the paper by B. M. Teplov. A study of the typological properties of the nervous system is of great practical importance in education, in industry and medicine. The author first demonstrated that the strong type of nervous system possesses a high capacity for work and low sensitivity (reaction), while the weak type of nervous system on the contrary has a low capacity for work and high sensitivity. These typological properties of the nervous system can under some conditions be advantageous for the weak type and under others for the strong type. The author postulated the practical task of finding for each type of nervous system the best ways and means of training, education and labor organization.

The conference totaled up the results of the great amount of work done by philosophers, physiologists and psychologists. In summing up the work of the conference, M. N. Fedoseyev noted a new and higher level of philosophical syntheses and a deep penetration of the dialectical method of research into physiology and psychology. The rapid development and bringing together of cybernetics, mathematical logic, biophysics and biochemistry with the physiology of

scientific elaboration of the rich material obtained by neurosurgeons during operations and during disection is impossible.

A study of the process of formation of the neocortex of the human brain at various stages of ontogentic development, carried out in the Brain Institute, reveals the laws of the sequential development of the cortex and its individual areas. Various rates of development have been established for the architectonic formations in embryogenesis. A most complex development occurs in philogenetically new formations of the cortex of the large hemispheres. Depending on the level of philogenesis, at which a given representative of the animal world happens to be, the cortical ends of the analyzers differ by complexity of architectonic structure and area. For example, in respect to the entire surface of the hemisphere the occipital region (according to Filiminov) takes up 24% in lower monkeys, 21% in higher monkeys, 12% in man, and the lower parietal region, having a relationship to the complex forms of brain activity, occupies (according to Shevchenko) 0.4% in lower monkeys, 3.3% in higher monkeys, 7.7% in man; the sincipital region (according to Kononova) 10% in lower monkeys, 13.5% in higher monkeys, and 24% in man. Along with this we note a multiplicity of architectonic structures of these areas, which of course indicates the differences in the functional mechanisms of brain activity. The results of years of research carried out in this area make it possible for us to speak of an efficient classification of formation of the cortex of large hemispheres (Filiminov), which has a direct relationship to the problem of function localization. According to this research the entire cortex of the large brain is divided into five primary zones: new cortex (neocortex), old cortex (archicortex), ancient cortex (paleocortex), connective periarchicortical cortex and connective peripaleocortex. These data established on the basis of studying the evolution of the brain, are of substantial importance for problems dealing with the localization of functions in the cortex of the large brain. The data produced by this research primarily speak out strongly against equipotentialism. If the cortex of the large hemispheres consists of formations of extremely differing structure, beginning from primitive formations of the ancient cortex and ending with exceptionally complex formations of the neocortex, how can we speak of equipotentiality of cortical formations? But evolutionary morphology, establishing connective formations, just as definitely speaks out against the viewpoint of narrow localizationism. It is quite obvious that functional features should correspond to structural features established by evolutionary morphology.

higher nervous activity and psychology requires a creative philosophical dialectical materialist approach. The union of philosophers and natural scientists should grow stronger in its daily work. The conference emphasized also the theoretical and practical importance of psychology as an independent science. The conference demonstrated the solidity of the basic principles of Pavlovian teachings and the reflex principle of nervous activity. Negation of the reflex principle of nervous activity is tantamount to denial of the dialectical materialist theory of reflection, the natural scientific method of research and the materialistic concept of reality. The philosophical principle of reflex activity should differ in a clear-cut manner from the concrete morphophysiological concept of reflex. New views on the structure of reflex are closely linked with the concepts of Pavlov, proceed from them, but are not identical. Quite incorrect is the position of those persons speaking at the conference, who, not seeing the progressive movement of science, continue to assert that nothing basically new has been introduced to the teachings of Pavlov. Sequence and innovation must find correct dialectical materialistic comprehension on the part of research scientists. The conference found that the creative scientific elaboration of problems of psychology and physiology of higher nervous activity in humans should be developed more extensively in the AS USSR, AMS USSR, the Academy of Pedagogical Sciences, RSFSR and other scientific institutions. "The nation expects fine deeds from us, constant work for society, for communism," Fedoseyev said. This job can be completed only under the banner of Pavlovian teachings, under the banner of Marxism-Leninism, under the banner of the scientific method alone -- dialectical materialism.

10,284
CSO: 1873-S

NATURAL SCIENTIFIC AND PHILOSOPHICAL PROBLEMS OF THE PRESENT STATE OF SCIENCE OF THE BRAIN

/Following is the translation of an article by F. A. Sarkisov in Zhurnal Vysshey Nervnoy Deyatel'nosti Imeni I. P. Pavlova, Volume 12, No 6, November-December 1962, pages 985-1000./

(Paper read at a conference on philosophical problems of the physiology of higher nervous activity and psychology on 8-11 May 1962 in Moscow.)

The success of modern natural science has tremendously expanded our concepts of the surrounding world, is arming man with new, scientifically substantiated knowledge in the fight to subjugate nature to man, for creative victories of man, for a happy life. Clear manifestations of modern natural science and technical achievements are the successes of man in conquering space, which are opening up a new era in the history of mankind. Although even before our era certain thinkers spoke of the heart and then of the brain of man as the seat of the "spirit", "soul", real scientific studies on these problems began in the last century and are connected with success in the anatomical, clinical and physiological sciences in studying the organisms of animals and man, particularly success in the study of the human brain. Using the words of Pavlov, we can say that the human brain which created modern natural science has itself become the subject of natural science investigation. Indeed, in the area of knowledge of the structure and function of the brain -- this "highest form of organized matter" (Lenin) -- modern natural science has achieved significant success, equipping specialists in the fields of psychoneurology, physiology, psychology, gnoseology, also expanding our natural scientific horizons in the fight against idealistic and reactionary philosophical concepts in comprehending the basic problem of modern philosophy -- the problem of matter and consciousness.

Historical examination of this problem shows that with the development of science there are more and more followers of materialistic monism, recognizing the brain as the organ of thought and consciousness, asserting that thought and consciousness constitute a property and function of the brain. The adherence of various forms of idealistic and anti-scientific concepts in teachings on the

brain are losing more and more ground. We can trace step by step the struggle between two diametrically opposed concepts, which is at the present time becoming more violent and taking on a particularly aggravated nature. In this struggle modern natural science, armed with Marxist-Leninist philosophy and the successes of science and technology, expanding our knowledge, at the same time enriches the philosophical horizons of Marxism-Leninism with new confirmations. The problems of the structure and function of the brain, problems of localization of functions and particularly of higher neuro-mental functions and their relationship to the brain have occupied for centuries and continue to occupy the attention of large numbers of theoretical, experimental and clinical research scientists.

The classical works of Sechenov first laid the foundations of physiology of the brain, and later the works of Pavlov created a genuine physiology of the large cerebral hemispheres. Creation of the theory of conditioned reflex activity, the concept of analyzers, the first and second signal sytems, establishment of regular processes of complex mechanisms of structure and functions and their interrelations under any conditions that the organism of animal and man, on a basis of the principle of the oneness of organism and environment -- provided further success in the development of brain science. Due to Pavlovian physiological teachings, to new achievements in experimental physiology and success of the area of new methods of studying the intimate mechanisms of brain activity, modern science has become enriched with numerous works by Soviet and foreign scientists on the structure and functions of the brain. Among these achievements an important position is occupied by a study of the complex cyto- and myeloarchitectonic peculiarities of brain structure, the importance of which was discussed by Pavlov in his fight against so-called equipotentialism. "Can all of these numerous variations in the structure of individual sections of the brain be without specific dynamic importance?" he asks and categorically asserted: ". . . All discovered details in construction sooner or later must find their dynamic significance" (Pavlov, Izbrannyye Proizvedeniya /Selected Works/, 1958, page 374).

A major achievement of science in this respect is the determination of architectonic features of cortex of the large hemispheres (Meynert, Bets, Campbell, Brodman, S. and O. Vogt, Ekonomo, etc.). In recent decades, particularly in the works of Soviet scientists, a great stride forward has been taken in studying the great variety of architectonic formations in various sections of the large cerebral hemispheres, as well as in studying their evolution in the process of philo- and ontogenesis. In the comprehension of the dynamic localization of function our old concepts are

changing on the so-called strictly organic "centers". This is furthered by modern research in experimental physiology, electroencephalography and histochemistry. A correct understanding of the problem of localization of functions will be furthered to a great extent by new data on the evolutional morphology of the central nervous system.

This paper contains some results of modern research in the structure and function of higher sections of the central nervous system. These data are viewed in the aspect of methodological and philosophical concepts of the brain as an organ of higher nervous activity. Data are included on the following problems: 1) variability of cytoarchitectonic fields of the cortex of the large cerebral hemispheres of various animals and man in the light of problems of localization of functions, 2) interrelationship between cortex and subcortical formations, 3) neuron structures of the central nervous system and their connections, and 4) functional interpretation of certain neuron structures of the cortex of the large hemispheres.

First of all we shall cite the results of years of research by the scientists of the Brain Institute of the AMS USSR devoted to a study of a variation in the cortical architectonic formations of the human brain. This great job, during the course of the last decade, saw the participation of Filiminov, Sarkisov, Kononova, Gurevich, Polyakov, Preobrazhenskaya, Kukuyev, Stankevich, Minayeva and Tsinda. Formerly, as is well known, we used the architectonic diagram charts of the cerebral cortex given to us by Campbell, Brodman, Ekonomo and Vogt, formed on the basis of studying one or two brains. Our research is based on studying many serial prepared human brains, which made it possible to elucidate individual peculiarities of previously established architectonic fields, and so-called transitional formations occurring between them. These data allow us to speak of individual variations in the structure of the cortex of the cerebral hemispheres, which may serve as a basis for further research in the structural organization of the brain and its importance for higher nervous activity. In addition to theoretical importance this research makes it possible to use in a practical manner quanitative and qualitative features of cytoarchitectonic fields and their transitions and limits for determining the possible variations which can be found in brain surgery. The importance of brain cytoarchitectonics for neuro-surgery cannot be over-emphasized. If cytoarchitectonics constitutes the morphological basis for studying the dynamic localization of functions, it is hardly necessary to point out its role in topical diagnosis of brain affections, in localization of tumors, vascular affections, etc. Without considering cytoarchitectonics fruitful

Numerous experimental-morphological research projects with the application of the conditioned reflex method and data of electroencephalography make it possible at present to establish laws both on the operation of the brain as a whole and on its individual formations in a dynamic relationship, elucidating the mechanisms of individual processes of higher nervous activity as a norm and under pathological conditions, connected with specific structural formations of the brain and its analyzer system.

Study of cortex and subcortex ties from a comparative anatomy viewpoint and in a complex with electroencephalography aid in recognizing importance of those areas of the cortex of the large hemispheres which up to the present have been considered "dumb". This research is directed toward elucidating the position of individual structures in the system of analyzer cortical ends. Research in recent years furnishes a basis to speak of the functional significance of such areas as, for example, the limbic and insular regions, which were terra incognita up until very recently. Now we possess sufficient basis (Stankevich) to view one section of the insular region as having a relationship to the olfactory analyzer, and another as having a relationship to the cortical end of the speech-motor analyzer. The establishment of links between the limbic region and the myelencephalon, comparison of the data of the development of this area in philo- and ontogenesis (Tsinda and Zambrzhitskiy), as well as electroencephalographic data from experimental research in the function of the limbic region (Smith, Ward, Kramer, Lenox, etc.) indicate its importance in regulating visceral functions. Modern experimental technology makes it possible to use the method of electroencephalography (by applying chronic electrodes and micro-electrodes) to register bioelectric phenomena in a dog during the development and later the execution of a conditioned reflex. Experiments by Lyubimov in the Brain Institute demonstrated that when food appears before an animal, an increase in potential frequency takes place in the orbital, front sylvian, cruciform, coronary convolution areas and in specific parts of the hypothalamus, which during the active eating are retained only in the orbital and front sylvian convolution structures. It is interesting to note that the important role played by these structures in unconditioned and conditioned food reflexes was confirmed in morphophysiological research carried out by Kovalenko, who removed these areas from dogs. The EEG method determined changes in potentials under appropriate conditioned reflexes in the motor, acoustic and optic analyzers, in the subcortical and cortical (in individual layers of cortex) sections of the brain (Trafimov,

Rabinovich, Makhova, et al).

Combined research conducted by the conditioned reflex method in combination with surgery on the brain with subsequent morphological verification, made it possible to obtain data on the localization and differentiation of cortical nuclei of the auditory, optic, and motor analyzer and on the interaction between cortical and subcortical sections of these analyzers in dogs (Adrianov, Mering). Clinical observation, a study of fine cellular and fibroid structures (cyto- and myeloarchitectonics), application of the electrophysiological method indicate the functional features of various areas and structural formations of the brain -- in full agreement with the basic propositions in the teachings of Pavlov on function localization.

The problem of localization of functions has always attracted the attention of neuropathologists, psychiatrists, physiologists and morphologists. It is well known that in studying this problem there has been argument between the two basic concepts of scientists, of long standing -- on the one hand proponents of narrow localizationism and on the other hand -- equipotentialism. The adherents of narrow localizationism ascribe exceptional importance to the features of individual local morphological formations of the brain, ignoring the work of the brain as a whole. Some of these scientists believe that it is possible to find in the cerebral cortex a "personality" center, a "social" and "religious ego" center, etc. In contrast to this, equipotentialism, recognizing the role of the brain as a whole, ignores the peculiarities of its special morphological formations. Due to the rich concepts of dialectical materialism, leading scientists, and primarily Soviet scientists, are leading the struggle against both of these one-sided concepts, relying on the physiological teachings of Pavlov, on the laws of evolution of the nervous system and on the latest achievements in studying functional and structural mechanisms of brain activity. From the viewpoint of this research the role of individual structural formations is elucidated, and at the same time the role of the brain as a whole in carrying out simple and complex brain functions. The complexity of the interrelations between the individual structural formations and their role in the total brain activity increase in evolution with the development of the brain in accordance with complexity of the environment. In accordance with this, the problem of function localization is solved. At the lower stages of the animal world there are simpler mechanisms of function localization. But the higher the philogenetic level of an animal, the more complex it is, and the more complex is the mutual relationship between individual formations and other structural formations of the

brain in carrying out functions. Localization of functions in the cortex of the large hemispheres of the human brain achieves particular complexity. Modern electrophysiological methods make it possible to determine complex mechanisms of correlation between various structural formations, the cortex and subcortex in carrying out functions and point out the lack of basis both for narrow localizationism and equipotentialism. Data obtained in this manner make it possible to substantiate objective criteria for the architectonic division of the cerebral cortex.

At the same time some scientists, under the influence of various stylish trends in subjective idealism, primarily neopositivism (Bailey and Bonin, et al) deny the objectivity of dividing the cerebral cortex into fields and deny the diagrams of the cerebral cortex created on this basis. In view of this they must ignore the evolutionary morphology of the brain. However even those who deal in problems of brain evolution frequently are prisoner to idealistic concepts such as psychophysical parallelism (Culenbeck). Study of analyzers constitutes a fine basis for understanding the great quantity of experimental data obtained by world-wide neurology. For example, the presence of fibers in the pyramidal (motor) channel from various areas and fields of the cerebral cortex (Lassek, Metler, our data) becomes understandable in the light of concepts of the nucleus and dispersed elements of the motor analyzer. Ascribing particularly great importance to the problem of analyzer cortical ends, Pavlov frequently returned to the problem of topography, introducing certain changes into former concepts of their localization and limits. He wrote: "As our experiments demonstrated, the former limits (analyzers -- S. S.) are incorrect. The analyzer limits are much greater, and they are not so sharply deliniated one from another, but overlap and are intercoupled. Naturally it is a great and extremely difficult task to determine exactly how the analyzers are placed in the large hemispheres and how and why they overlap (Pavlov, Polnoye Sobraniye Trudov /Complete Works/, 31, Moscow-Leningrad, 1941, page 175).

Evolutionary morphological data (cyto- and myeloarchitectonics of the cortex of the large hemispheres) reveal the biological significance of various sections of the cerebral cortex, cortical ends of analyzers in the process of species and individual development. Research in this area points out that the philogenetically newest and consequently the most complex architectonic formations in a functional respect develop embryogenesis toward a particularly strong growth of structures involved in such functions as gnosis, praxis and speech. These data

become particularly significant in the light of the well known principle of Engels to the effect that "at first labor and then together with it articulate speech constituted the two main stimuli, under the influence of which the brain of the monkey gradually became transformed into the human brain which, with all of its similarity to the monkey brain, far surpasses it in size and perfection." Soviet scientists in recent decades have demonstrated the great wealth of various relationships between structural formations of cortex and subcortex in the total brain activity, and they have demonstrated the role of individual analyzers and their correlation in the dynamic localization of functions. With this basic principle, as we have noted above, appears the principle of timing the dynamics of nervous processes in the brain structure, that is a study of the paths of movement and interaction of nervous processes in the cerebrum both under normal and pathological conditions. Study in this area at present makes it possible to approach the problem of localization of functions involved in the most complex processes of the second signal system. Pavlov assumed that "probably, the frontal lobes constitute the organ of this additional, purely human thought process". However it is well known that Pavlov later denied such localization of functions of the second signal system. At present numerous observations by clinicians, comparative-morphological research in the cytoarchitectonic formations of the cerebral cortex make it possible, in spite of the exceptional complexity of the second signal system, to draw more definite conclusions on the cortical structures connected with its functions. These are the architectonic fields: 44-45 of the frontal regions; 21-22 of the upper temporal region; 37, 39 and 40 of the parietal-occipital region. These structures are philogenetically the newest, connected with the cortical ends of corresponding analyzers of the first signal system. Although they exist in monkeys, they differ significantly from corresponding structures in the human brain by complexity of the architectonic and by volume of area occupied. However, it is insufficient to emphasize the principle of the community of laws of higher nervous activity in animals and man and to affirm that the second signal system constitutes the work of "the same nerve tissue". Our job consists in, studying the general laws in the activity of the brain of animals and man, the formations of temporary nervous connections between the first and second signal systems, demonstrating the specific laws of the formation of temporary nerve links, inherent only in man, that is affecting the second signal system and determining its laws in social-

historical development. This principle emanates from the fact that the human brain is not only a natural-biological but social-historical product.

Modern morphological and electrophysiological research is greatly enriching our concepts of the complex mechanisms of subcortical and neural tube formations of the central nervous system, of the influence of these formations on each other and correlation with the cortex of the large hemispheres. This research is quite important in respect to correct comprehension of the link between the internal organs and the central nervous system. New relationships are established between individual subcortical and neural tube formations to chemical substances and medicines, to the products of the endocrine glands, etc. In this research in the last decade research of the so-called reticular formation has occupied an important place. Morphologically it has been studied by many scientists even previous to this time (Kappers, Bekhterev, Mislavskiy, et al), but we have known little of its physiological mechanisms up to recently. Modern electrophysiological research has opened up wide the doors to its study. In numerous physiological and morphological laboratories studies are going on of reticular formation, its links and the regulating role over hormone and vegetative functions. However, in this definitely important and interesting research certain foreign scientists have connected the peculiarities of the neural tube and subcortical formations of the brain chiefly, and in some cases exclusively, with particular activating force on the part of the reticular formation. This frequently leads to an underestimate of the role of other subcortical and neural tube formations, as well as the importance of the inner and outer environment of the organism for brain activity.

The authors proceed from the position that all afferentation of higher sections of the brain consists of specific and non-specific systems. According to their assertion, with a breakdown of the specific system irritation of the remaining non-specific system (reticular formation) causes generalized activation to the cortex of the large hemispheres. With the disintegration of the non-specific system irritation of the remaining specific efferent system, according to data by some scientists, does not lead to generalized stimulus of the cortex of the large hemispheres. The conclusion is made from these observations that the leading role is played by the non-specific system, but is the reticular formation, in activization of the cortex of the large hemispheres. Not treating in detail individual problems of experiment technique, we must however state that an extremely close and rich interconnection, existing

between fibrous cellular structures of the reticular formation and direct channels of the afferent (specific) system at various levels of the central nervous system, particularly in the embryonic neural tube, in general excludes the possibility of isolated "destruction" of the reticular formation alone, without damaging a number of specific channels. Proceeding from concepts of the "activating role of the reticular formation" old concepts are reborn on the sleep center in the area of the ventricle. We regret the fact that in examining and discussing these problems the Pavlov concept of cortical-subcortical bonds and their interrelations is not used. Pavlov wrote: "The subcortical centers to a greater or lesser extent determine the active state of the large hemispheres and in a differing manner change the relationship of the organism to the environment" (Pavlov, Sobraniye Sochineniy, Moscow-Leningrad, 1951).

Arguments on the so-called sleep center and the concept of Pavlov on the sleep mechanism as a cortical process, the role of afferent systems in waking and sleeping states, etc. are completely ignored. The ignoring of the physiological teachings of Pavlov, his concepts of cortical-subcortical bonds, unfortunately leads certain foreign scientists to anti-scientific hypotheses in interpreting new experimental data. These scientists come to the conclusion that higher integration, determining behavior, consciousness and intellect, is effected not in the cortex of the large hemispheres but in the deep sections of the embryonic neural tube, in the diencephalon. It is interesting that in recent years the proponents of the Freudian theory of psychoanalysis have been attempting to utilize these concepts and "prop up" their anti-scientific and reactionary positions in psychoneurology on the deep, subcortical bases of human behavior. The roots of Freudism are spread too deeply and broadly, particularly in America and England. Freudians have used the theory of the centrencephalic system, elaborated by the prominent Canadian neurologist Penfield, for substantiating concepts on the predominant role of the subconscious, subcortical, motivated by base instincts and human attractions, and not the social environment and class consciousness. This is the objective contribution of the theory of the centrencephalic system, and the more quickly the greatest contemporary neurosurgeon Penfield drops it, the more facts of localizations, extracted by him and possessing great practical importance, are acquiring and will acquire greater importance. Due to the rich horizons of dialectical materialism, Soviet scientists have always spoken out and are continuing to speak out against anti-scientific concepts of Freudism. The achievements of Soviet psychoneurological science in this area are finding

more and more adherents among foreign scientists. For example, in England and in France more and more articles and papers are appearing which are directed against Freudism, and a great portion of these papers are based on the works of Soviet scientists.

We shall turn to the question of the finer structure of neurons and inter-neuron links. Of course this problem is not a new one, but recently its study has acquired particular importance in the light of modern exact methods of research in the study of the central problem of higher nervous activity -- the closing function -- the function of temporary bonds. Sherrington, studying the links between cells, gave the designation "synapse" to intercellular ties. Subsequently our concepts of them became greatly enriched. Neurons achieve the greatest perfection, quantitative and qualitative variety in the cerebral cortex. The cortical cellular elements comprise pyramidal, stellate and spindle cells. Substantial success in modern concepts of cellular elements of the cortex of the large hemispheres are determinations not only of the form (pyramidal, stellate and spindle) of the cell body, but particularly dendrite and axon neuron terminals, receiving the greatest perfection and variety in the human cerebral cortex. Research by authors at the end of the last century and the beginning of the present one, as well as our data demonstrate that the dendrites of the neurons of the spinal chord,. subcortical formations, particularly cortex of the hemispheres, possess special so-called "thorn-like" protuberances, or as we call them, "spinae". We believe that these spinae on the dendrites have a relation to the receptor apparati of the cell and aid in expanding contact between neurons. The nerve cells of various layers are characterized not only by the features of the structure of the cell body, its dendrites and axon, but also by the nature of spinae on the dendrites. We should also emphasize the fact that neuron plexes in the higher layers of the cortex (philogenetically newer) are distinguished by much greater fineness, variety than in the lower layers. In accordance with this, the neurons of the upper layers of the cortex possess, according to all data, more complex structural organization of interneuron links. In human ontogenesis spinae begin to appear relatively later -- in the last month of prenatal life (six-eight months) and receive rapid development during the first month after birth. Spinae appear earliest in the earliest maturing primary cortical fields, such as the fields of the precentral region. Among various nerve cells spinae are discovered earlier in the earliest maturing large pyramids of the fifth layer, and then gradually begin to appear in other cortical cells, as the latter mature. The development

of spinae proceeds at an intensive rate during the first months after birth. Studies of neurons in philo- and ontogenesis demonstrate the progressive increase in their quantity and complexity of variety of neuron element structure, reaching the greatest variety in the human cerebral cortex (Polyakov, Shkol'nik-Yarros, Leontovich). Of particular importance in this research is a study of the neuron structure of the human brain in pre- and postnatal ontogenesis. At present we can consider it firmly established that two basic types of interneuron links exist in the central nervous system -- the so-called axosomatic or terminal and axodendritic or collateral. Recently papers have appeared with mention of dendrite (Loos) axoaxonal, as well as axovasal ties (Dolgo-Saburov). Axosomatic ties have been studied rather well (Kakhal,. Lavrent'yev, Smirnov, Razumov, et al). Significant difficulty is presented by a study of axodendritic links due to the lack of fully effective methods of fixation and dyeing. New research in studying the peculiarities of the structure of neurons and interneuron links confirms the previously established principles (S. A. Sarkisov) that while chiefly axosomatic links exist in the spinal chord and neural tube formations, in the cortex axodendritic mechanisms of impulse transfer prevail. These data are substantiated by a number of Soviet and foreign scientists. Chang, Grundfest and Purpura sssume that axosomatic links in the cortex constitute terminations of specific formations, and exodendritic links correspond to the "non-specific" reticular formation. Our observations do not confirm these data. New data on interneuron links, along-side enriching our concepts of intimate morphophysiological mechancism of brain functions, present interest for the clinic of nervous and mental disorders, for understanding the pathophysiology of disturbances of brain functions.

Special experimental studies made by us together with T. M. Mokhova, demonstrated changes in interneuron functions (synapses) with the effect of various toxic substances on the organism. We should particularly emphasize the clearly expressed sensitivity and selective tendency to affection on the part of dendrites and their connections together with the lack of affection of the cell body with comparatively low doses of, for example, physostigmin, introducted into the organism. With an increase in dosage, affection seizes not only the dendrite systems and their junctions, but also the cell body. Similar results have been obtained by M. S. Togskaya, who determined during various intoxications (lead, arsenic, etc.) varying degrees of disturbance of conditioned reflexes and changes in interneuron junctions of the cortex of the large hemispheres. The author observed

that in some cases with a termination of intoxication the damaged conditioned reflexes are restored and fine morphological changes disappear. Experimental data produced acquire particular importance in the light of modern histochemical research on the fine neuron structures of the central nervous system. Histochemical features of various areas and layers of the cortex of the large hemispheres have been established (Grundfest and Purpura, Portugalov, Popova, et al). According to Dixon, glycolytic processes are particularly active in dendrite in comparison with the cell body. In the light of these data, particular interest is presented by research directed toward seeking the numerous chemical and pharmocological preparations which affect specific structural formations of the brain. Particular sensitivity of these substances has been shown toward interneural synaptic formations. At present a large number of chemical substances has been found which act as inhibitors, that is, inhibit the synaptic formations of the nervous system and particularly the synapses of the cortex of the large hemispheres, causing specific mental disturbances.

The Italian scientist Moruzzi, figuratively speaking, claims that the degree of the psychotropic strength of these substances in man is parallel to the degree of their capacity of synaptic supression. A number of experiments provide foundation to assume that neurohumoral mechanisms are also connected with the interneural or synaptic apparatus, which thus constitutes an important mechanism of brain or mental functions. Using such substances it is possible to cause specific forms of mental disturbances. In addition, the number of research projects on studying and synthesizing pharmaceuticals which block the inhibiting effect of these chemical substances is being increased, and consequently means are being created for treating mental disease. For example, a cyclolol preparation has been discovered which blocks the development of psychosis in humans, caused by diethylamide derivative of lysergin acid. The success of modern biochemistry has opened up new possibilities for studying the finest biochemical processes of higher nervous activity. Combined research by biohistochemists, pharmacologists, physiologists, morphologists and clinicians is opening up important and attractive prospects not only for the theoretical knowledge of the intimate mechanisms of brain activity but also the practical application of this knowledge in combating complex nervous and mental illnesses. These data, opening up new ways for treating and preventing serious nervous and mental illnesses, expose the idealistic concepts of the causes of mental illness. Materialistic science equips us with new data on the true nature and cause of mental illness. A

study of the delicate mechanisms of brain activity through modern methods of morphology, physiology and biohistochemistry opens up before us the pathway toward knowledge of the morphophysiological peculiarities of various nervous elements, and primarily the nerve cells and their role in the process of nervous activity. We shall discuss our somewhat assumed interpretation of physiological mechanisms of so-called tracer processes of the basis of morphological, physiological and clinical data. Tracing processes in the brain are important in carrying out memory processes. Sechenov ascribed much importance to these problems. Pavlov assumed that the process of stimulus in the form of a track remains in the nerve cell for a long time: minutes, hours, days and even years. Ukhtomskiy, discussing the problem of heredity, voiced an important proposition: "If the role of traces compels us to consider it in magnets, in colloid histeresis, in a nerve section, we must assume that in the nerve . . . in the cortical transfer of traces from moment to moment it should play a predominant role" (A. A. Ukhtomskiy, Sobraniye Sochineniy, 1, 1950, page 215).

A study of characteristic structural formations of neurons and interneuron junctions of the cortex of the large hemispheres makes it possible for us to speak of the morphological bases of that "extraordinary capacity for reaction and impression, which constitutes a permanent and characteristic property of this section of the central nervous system" (Pavlov). All cortical cells -- pyramidal, stellate and spindle-shaped -- of course participate in the process of cortical activity and primarily in the mechanisms of track phenomena. We must also assume that various forms of neurons have general functions of perceiving nervous processes and also possess specific features. At one time, on the basis of our own observations, we brought forth the assumption of the role of various types of neurons in the cortical processes. The system of pyramidal and spindle neurons obviously plays an important role in these processes. However, as is apparent from the peculiarities of their axon system, these neurons apparently provide chiefly transfer of brain impulses to the effector systems of subcortical formations and other areas of the cortex of the hemispheres. The stellate cells are viewed by us and certain other authors as the area of switching of impulses of the various cortical neurons. We assume that these cells, interacting with other structural formations of the cortex, play a special part in tracer processes of impulses coming into the cortex. Our suppositions are based on the following data. The system of stellate neurons with rich dendrite branchings in philo- and ontogenesis progressively increases in the cortical terminals of the analysors particularly in

the human cerebral cortex. Stellate neurons make up a considerable portion of all cellular elements of the cortex of the large hemispheres of the human brain. The dendrite and axon terminals of the stellate cells, particularly in the upper layers of the cortex, that is in the philogenetically newest brain formations, are extremely varied and rich in branchings. The axons of the stellate neurons, in contrast to the axons of the pyramidal and spindle cells, as a rule do no go beyond the limits of the cortex of the large hemispheres, and frequently beyond the limits of one layer. Our assumptions on the specific role of stellate cells are confirmed by a number of experiments. Electrophysiological research (Lyubimov and Trafimov) in the electrical activity in the optic and auditory analysors to rhythmic light and sound stimulus demonstrated that the potentials induced in the optic analysor are more expressed and continue for some time after the termination of the light stimulus. In the auditory analysor changes in electrical activity are expressed less and disappear with the termination of the sound stimulus. Research by Adrianova, Mering, Popova and others has demonstrated that phenomena of "after-effect" during the processes of stimulation or inhibition are retained in the optic cortex for a longer time than in the auditory. It is well know that the optic cortex is characterized by the presence of more numerous and varied forms of stellate cells. Extremely interesting are data acquired from studying the neuron structures of the areas of the cortex of fields 44-45 (Kononova), fields 21-22 (Abovyan, Glezer and Mokhova) and fields 37, 39 and 40 (Stankevich). These authors confirmed the wealth and variety of stellate cells in these philogenetically new areas of the cortex of the large hemispheres. These experimental, morphophysiological and clinical data allow us to speak of the role of the finest morphological formations, and in particular of the role of so-called stellate cells, interacting with other structural elements, in trace phenomena. As is well known, the latter constitutes one of the primary mechanisms of complex memory processes.

There is no doubt about the fact that we are the witnesses of major success in studying the complex processes of higher nervous activity through objective research methods. However even at the present time, in spite of new success in studying the structure and functions of the brain, the concept struggle continues between consistent materialism and various forms of idealism -- dualism in the concept of "spiritual life", consciousness and human thought. In addition, dialectical materialism is leading the fight against the philosophy of older materialism, which boils down human consciousness and thinking to simple brain secretion, in analogy to liver bile secretion. The most widely believed

at present are various forms of dualistic concepts. The prominent American philosopher Wells in his book Pavlov and Freud, correctly writes as follows: "Literally for thousands of years mankind has been taught to view the mind as the 'soul', as some kind of supernatural and miraculous phenomenon requiring extra-natural, omniscient explanation. This mysterious and mystic approach to the mind is deeply sequestered in each of us and is difficult to eradicate . . . Pavlov did much to deprive the mind of its mysterious nature, while Freud actually deepened and complicated this mysteriousness . . . From this viewpoint we can begin to understand the philosophical, scientific and historical importance of these two men. In a philosophical respect Freud was an example of an anti-scientific, subjectively idealistic framework of concepts and methods." The followers of these anti-scientific concepts refuse a natural scientific examination of the brain and its operation, and they attempt to block the road for objective study of higher nervous activity. One of the participants of the Brain and Consciousness Symposium at Oxford (1954), Kyubi Khangen openly made the statement that "consciousness is an abstraction and cannot be the object of scientific research."

"The trouble is," Pavlov wrote, "that in all of us that dualism in which the soul and body constitute something divorced one from the other, remains too firmly within all of us: naturally in the eyes of natural science such a division is impossible." In order to demonstrate how at present the dualistic concept is expressed in the minds of many foreign scientists, we shall give several examples. Not too long ago the famous British neurologist Sherrington quite openly defended religious-mystic views on the operation of the brain, on the human mind. Recognizing the complexity of the organization of the structure and function of the brain, Sherrington insisted that the mechanisms of brain activity are put into operation and operate due to some sort of "psychic principle", existing outside the brain, knowledge of the laws of which is not a matter for science but the subject of "natural theology". The activity of the brain, according to Sherrington, has no relation to cognition, to thought, and therefore these processes are outside the realm of science. An even more indicative example in this respect is given by the concepts of a famous modern American neurologist. We are talking about Baily in his article in the journal Prospects of Biology and Medicine for 1959 entitled "A Place for the Soul". At first the author gives a survey of various concepts on the localization of "soul". He makes a survey from the statements of various theologians, from Foma Akvinskiy to Pope Pius XI. Citing Pius's encyclical

letter, which states that man possesses an "immortal soul", Baily asserts: "This principle (of the immortal soul) constitutes the fundamental axiom for our western civilization. Therefore," he says, "we should carefully examine this problem."

One of the great contemporary representatives of neurophysiological science, Eckles, famous through his fine experimental research in the physiology of cellular elements in the central nervous system, attempts to go even further in the endeavor to remove the processes of consciousness and thinking from the brain. Eckles attempts to prove that the connection between consciousness and the brain occurs only under specific states of "material-energetic cortical system", when the "spirit" operates on the brain, mechanically shifting and bringing closer interneuron junctions! This is how an eminent physiologist interprets the present-day success in neuron structure and its fine junctions in the concept of brain function! One cannot say that the idealistic concepts of Eckles are new or original. Descartes and others recognized such a "soul", substantiating how the "spirit" mechanically moves the small gland gl. pinealis -- the container of the soul, deep within the brain, upon which human behavior depends!

The prominent American neurologist Herrick correctly assumes that the grey matter of the brain nerve centers consists, in addition to nerve cells, of an exceedingly dense plexis of nerve threads (neurofibrillae). But Herrick for some reason or other believes that although these fibers are joined with cell appendices, they are of independent importance. It is noteworthy that Herrick views this nerve system which filled the space between the nerve cells as a material substratum of the mental brain functions! Neurofibrillae, in the opinion of the author, possess the capacity of autostimulus and spontaneous activity, independent of the effect of external stimuli on the organism. Due to the unique views of Sherrington or such contemporary scientists as Eckles, Herrick, Bauer and others, we should note the remarkable statement by Engels that ". . .Empirical contempt to dialectics is punished through some of the soberest empiricists becoming prey to the wildest of all superstitions -- modern spiritualism" (F. Engels, Dialektika Prirody /Dialectics of Nature/, 1950, page 36).

Recently in the weekly American magazine America an article appeared by the chairman of the department of anthropology of the University of Pennsylvania, Lorrento Isaly. In his article Isaly, just as Wallace (contemporary of Darwin), believes that the human brain was formed during the transformation of ape to man so rapidly in comparison with the "snail's pace" of the development of the rest of the

animal world, that its formation cannot be explained by natural causes from the positions of Darwinism. In his opinion this is a "miracle", and therefore " . . . Some spiritual factor must direct brain development". We should emphasize that in the modern science of the brain, alongside numerous forms of dualism, "under which," as Pavlov wrote, "one feels, in spite of all scientifically proper stipulations, the same dualism with animism, directly divided among the masses of thinking persons, let alone believers", there is also an open acknowledgement of the leading role of God in brain activity.

The success of modern evolutionary morphology, physiology, physics, chemistry and other sciences to a great degree is aiding in establishing complex laws of nervous-mental activity, opening up attractive prospects for the knowledge of even finer and more intimate mechanisms, for knowledge of the true nature of higher nervous activity under normal and pathological conditions. However, neither philosophers nor natural scientists should forget that physiological research dealing with the discovery of the material basis of thought is one thing, and the primary philosophical problem of the relationship between matter and thought, consciousness is another thing, which is primarily a philosophical problem, and the correct solution to this problem cannot be replaced by any separate field of knowledge. Such attempts, as the history of philosophy and natural science show, lead to simplification and vulgarization. This premise of Marxism was developed by Lenin in fighting idealism and vulgar materialism. In Materialism and Empirocriticism Lenin, criticizing the statements by Dietzgen to the effect that a sensual concept is material, that the spirit does not differ more from a table, light, sound than these things do from one another, says: "It is true that thought and matter are 'actual', that is exist. But to call thought material means to take a false step toward mixing materialism with idealism" (Lenin, Sochineniya, 14, 1947, page 231).

Under present-day conditions of studying the more delicate mechanisms of the processes of brain activity it means that no matter how deeply we penetrate into the structural and functional peculiarities of the brain (we have in mind new successes in physiology, morphology, biochemistry, electronics, leading to discovery of mechanisms and material principles of the process of consciousness) -- we shall never bring together to them the very essence of consciousness, which is revealed only through the relationship of these nervous-brain processes to objects and phenomena of social reality reflected in the brain. The idea of completely attributing the essence of complex brain

phenomena to physical-chemical processes would lead the scientist to the views of vulgar materialists (Büchner, Vogt, Molechot et al) and their modern variety, the bichevioristes.

Marxist-Leninist scientific philosophy makes it possible not only correctly to elucidate and assess scientific achievements of modern natural science in the area of science of the brain, but also to forewarn natural scientific thought from idealism, empiricism and vulgar materialism in elaborating these problems. It is well-known that Pavlov opened up a new chapter in the physiology of animal and man -- the chapter of physiology and pathophysiology of higher nervous activity. The teachings of Pavlov opened up the way for objective study and determination of the laws of the complex processes of brain activity. In addition, the discoveries of Pavlov, due to his objective method of studying the behavior of animals and man, dealt a devastating blow to popular idealistic, mystical and dualistic concepts of the brain and human behavior. However, it is well known that there are still some scientists who are followers of mystical, various types of idealistic and dualistic concepts, viewing existence independent of brain -- "soul", "spirit", directing human behavior (we have given examples of such concepts above). There are also some scientists who are firmly convinced in the impossibility of cognizing and making a scientific study of the processes of the subjective world of man (Sherrington, Coulenbeck, Kyubi, Rumke et al).

Without a doubt this type of concept exists to a significant degree due to many as yet unsolved problems in respect to complex mechanisms of the structure and function of the brain, the lack of exact methods of objective study of the most intimate processes of higher nervous activity. We are going through a period of remarkable successes in physical-chemical discoveries in the area of cognition of living nature and the processes of living matter, making it possible to discover new properties of living matter which were unknown up to the present. Research in this area allows us to state that the matter of living organisms possesses certain new and unknown physical-chemical properties, determined by the "interactions of highly organized molecular structures" (N. N. Semenov). Of course this premise is particularly true if we are speaking of the brain, of the organ of thought and consciousness. There is no doubt that Pavlovian physiological teachings on higher nervous activity, enriched by present-day successes in physics, chemistry and electronics, equipped with new and sophisticated methods of studying the primary properties of the structure and function of

the highest form of organized matter -- the brain, opens up the way to cognition of the primary and most intimate mechanisms of brain activity, which are still viewed by many as inaccessible phenomena to scientific study, as "the inscrutable subjective world of man".

A study of molecular properties of proteins, nucleic acids and others, unknown to us up to the present, make it possible in the future to comprehend the sophisticated mechanisms of matter exchange in the brain and opens up new possibilities for discovering the laws of the finest biological processes in the brain. Already at present Soviet and foreign scientists are finding new physical-chemical properties of proteins and nucleic acids, etc. The Soviet scientist Blyumenfel'd discovered new magnetic properties of desoxyribonucleic acid and complexes of nucleic acids with proteins, that is, substances which evidently play an exceptional role in the delicate biological processes. Thousands of times more dialectric constants have been discovered in desoxyribonucleic acids than in known organic substances. As physicists assume, it is probable that the magnetic and electrical properties are somehow interconnected. This link between the primary biological process and magnetic properties indicates the basic importance of magnetic properties of nucleinoproteins in the higher forms of biological processes. Basing curselves on data obtained from this area of research, on searches and discoveries of new physical-chemical properties of complex protein and nucleic acids in the processes of the central nervous system, we are sure that new pathways and possibilities are opening up for further penetration into the cognition of mechanisms of the most intimate processes of higher nervous activity.

Dialectical-materialistic concepts as applied to this scientific research provides a genuinely materialistic interpretation to the primary laws of biological and ideological processes of brain structure and function in contrast to mystical and idealistic concepts on the one hand, against simplified concepts in these problems on the other; in addition, we are witnesses to the fact that new successes in science of the brain enrich to an even greater extent problems of Marxist-Leninist philosophy, primarily the basic gnoseological problem of the primary nature of matter and secondary of consciousness.

10,284
CSO: 1873-S

INTERACTION OF ANALYSORS DURING FLIGHT ON BOARD AIRCRAFT AND SPACE VEHICLES

/Following is the translation of an article by V. V. Baranovskiy, M. D. Yemel'yanov and A. G. Kuznetsov in Zhurnal Vysshey Nervnoy Deyatel'nosti Imeni I. P. Pavlova, Vol 12, No 6, November-December 1962, pages 1,001-1,010./

Human activity during flight on board modern flight equipment (aircraft, space vehicles) involves the receipt and processing of a large amount of various types of information by the central nervous system. Of great importance is that section on the basis of which the concept of the position of the vehicle in space is formed. In aviation much material has been accumulated on the occurrence of disturbances of spatial perception on the part of pilots during flight, occurring in the form of various types of illusory sensations, such as the false sensation of heeling, diving, being turned upside down, frequently leading to complete spatial disorientation. Apparently all fliers to one degree or another are susceptible to these phenomena and during various periods of their professional activities experience illusory sensations during flight, which have a negative effect on the quality of piloting and in approximately 15% of cases constitute the cause for flight accidents. It is logical also to assume the appearance of such sensations in man under space flight conditions, where the cause may be the factor of weightlessness, the lack of customary earth orientation points, as well as the rotating movement of the spacecraft, caused by incomplete stabilization during flight. A basis for this is presented by numerous materials gained by observations for the study of the influence of weightlessness on board aircraft on the human organism (Kas'yan, Yuganov, and Yazdovskiy (9), Beck(16),Gerathewohl (6), Gerathewohl and Stallings (17), Whiteside (18)) and reports by the first astronauts on their sensations in space. Astronaut Gagarin gave a rather favorable evaluation of his general condition and sensations on board the space ship Vostok-1. The condition of weightlessness in orbit and in transitional phases from increased gravitation to weightlessness and back, was borne well by him. Unpleasant sensations of dizziness, optic disturbances and disturbances in coordination, observed in parabolic weightlessness flights,

were not noticed in Gagarin. He assessed his sensations under weightlessness conditions as unusual, not having been experienced before, but rather easily overcome and not hindering the execution of the flight assignment. Titov, who made 17 orbits around the earth and was in a state of weightlessness for more than 25 hours, presented a more complex picture of sensation change. While going into orbit, changing from increased gravitation to weightlessness, for a short time he felt as if he were upside down. But Titov bore the first few orbits well. The unaccustomed sensations did not hinder his work and great effort was not required for dealing with the unpleasant sensations which infrequently occurred. Later, as the flight continued, sensations of discomfort regularly were felt, which were accompanied by symptoms of vegetative disturbances of vestibular origin; these disturbances became intensified when the astronaut carried out sharp movements of the head. It was possible to suppress or inhibit these sensations by maintaining a specific position, eliminating quick movements of the head and forming conditions for carrying out the mental and physical efforts required for the flight program. The results of observations on the Vostok-2 gave reason to expect that on longer space flights the phenomena caused by weightlessness will be expressed in astronauts in a more severe form than occurred with Titov, and this may constitute an inhibiting factor in expanding space exploration. But these fears and suppositions were not justified. Astronauts Nikolayev and Popovich, who spent four and three times as long in space, did not note any expressed disturbances of spatial perception nor unpleasant sensations caused by the influence of weightlessness. Throughout the entire flight the astronauts retained their capacity to carry out coordinated actions under conditions of weightlessness and control their position and the position of the space vehicle. The capacity for evaluating the spatial position was lost only when the astronauts close their eyes.

A positive role in respect to maintaining spatial orientation during space flights was played by stricter measures adopted after Titov's flight for selection and training of astronauts. This circumstance is worthy of serious attention. However, without any doubt the significance of individual peculiarities of astronauts remains in effect. Naturally success achieved does not make it less imperative to penetrate deep into the problem of weightlessness. The developing possibilities of conscious, purposeful activities by man under conditions of a lengthy flight in space should constitute a stimulus for a further expansion of the program of research toward elucidating the physiological mechanisms of spatial perception under conditions of weight-

lessness and the search for measures of preventing possible disturbances of this activity of the organism in space flight. We have reason to believe that illusory sensations and other forms of space perception disturbances observed on board aircraft and spacecraft have much in common in their origin and should be viewed in the course of studying them from both theoretical positions. As is known, there is no separate, special analysor which controls the perception of space. This complex function is carried out by a number of analysors, primarily the optic, vestibular, proprioceptor, auditory and others, between which a certain interaction is established during the process of spatial orientation of the organism. Under conditions of weightlessness, with the absence of an adequate gravitation stimulus, without the perception of conventional earth reference points, the functions of many elements of the afferent systems are dropped, the interaction of the afferent systems changes and the execution of normal activity of the central nervous system in maintaining position and spatial orientation becomes difficult or impossible. The principle of analysor coordination, in the opinion of Orbeli (13), constitutes the dominant principle in the activity of the central nervous system. In general and experimental physiology this principle finds wide recognition and study (Ayrapet'yants,(1), Anokhin (2), Asratyan (3), Beritashvili (4), Volokhov,(5), Granit (8), Gershuni (7), Kravkov (11), Kekcheyev (10), Lebedinskiy (12), Ukhtomskiy (14), Chernigovskiy (15) , while in applied physiology, particularly in aviation and space physiology, as previously views predominate which are based on facts from the isolated study of individual analysors. However, it is in these areas of human activity, where the external coordinating effects on the organism frequently are of an extreme nature, that study of the coordination of the sensory organs (analysors) takes on exceptionally great importance.

Proceeding from the principles of these teachings, we carried out experiments to elucidate certain physiological laws of interaction of the optic, vestibular and motor analysors under conditions approximating flight. We elaborated methods making it possible to cause in subjects at will various illusory sensations under laboratory conditions. The work was carried out on specially designed experimental laboratory apparatus. The following were used for affecting the organism: a rocking chair, a rotating chair on an unstable base, a cylinder with black and white stripes on the inside, rotating around the subject. During these effects the motor reactions, biopotentials of the skeletal muscles, pulse, respiration, blood pressure, EEG were registered. The experiments were done in two variants: in one the subject was placed on a firmly anchored chair, and in the

ther -- on a chair with unstable support. The experiments conducted on the subject sitting on a fixed support demonstrated (Figure 1) that in the absence of optic control over body position in space static muscular tensions in the form of inclined positions of the head and trunk, as well as efforts carried out through manual and particularly stative dynamometry, exert expressed inhibition of vestibular and vestibular-spinal reflexes. This is particularly evident in tensing muscles to the side, opposite the excited labyrinth. At the same time there is a point of decrease of vestibular sensitivity threshholds, determined by chronaximetry. If we used adequate excitation of the vestibular apparatus by rotation, in addition to the above phenomena, we observed a decrease in the duration of anti-rotation sensation an average of 8 seconds.

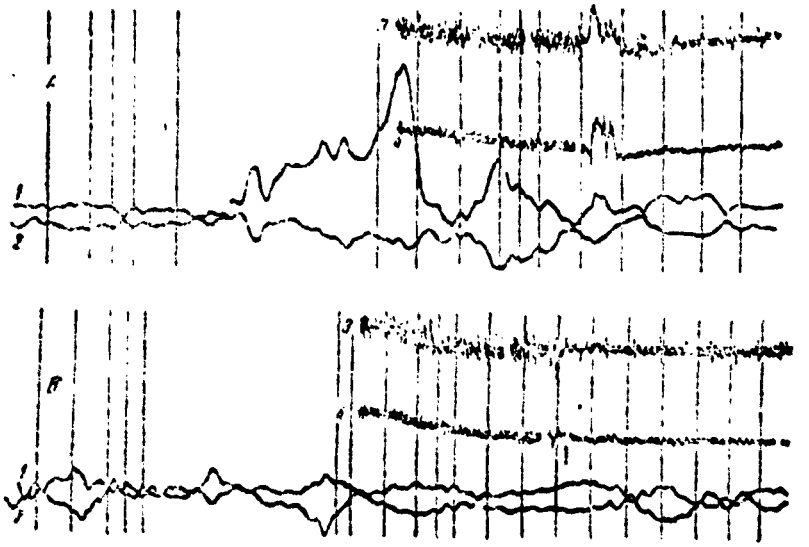

Figure 1. Trunk movement registration curves with the aid of tensofeeders. Subject G-v. A -- excitation of the vestibular apparatus to the right by threshhold force electric current; B -- the same with active inclination of head to left. 1 -- trunk movements to right and left, 2 -- forward-backward. 3 -- myogram of neck muscles to left, 4 -- right. Vertical lines -- one second time indicators. Break in vertical lines -- period of excitation.

An entirely different picture is seen in a subject in a state of balance on an unstable base, whereby the muscle contractions for maintaining position became unstable

and jerky (Figure 2). In this case an increase of all types of vestibular reactions was observed, and they became more expressed the less the support was or degree of stability of the subject. This is quite apparent in Figure 2, which shows the trunk movement curve of the subject after five rotations on a Barani chair at a rate of one revolution every two seconds and the result of subsequent transfer of subject to unstable base. It is apparent that even five-time rotation on a base with an area of 625 sq cm did not cause noticeable motor reactions and anti-rotation sensations. But when the area of support was cut almost to half (289 sq cm) and deviations from the vertical during balancing increased sharply, the influence of the same irritant led to complete spatial disorientation, accompanied by vegetative reactions in the form of paleness of the face, nausea, perspiration and a quickening of the pulse. Under balance conditions the vestibular sensitivity threshhold decreases by two to three times and the motor analyser reacts to lesser deviations of the center of gravity. As the degree of instability increases, changes in the EEG registered from the temporal sections of the head (Figure 3) increase.

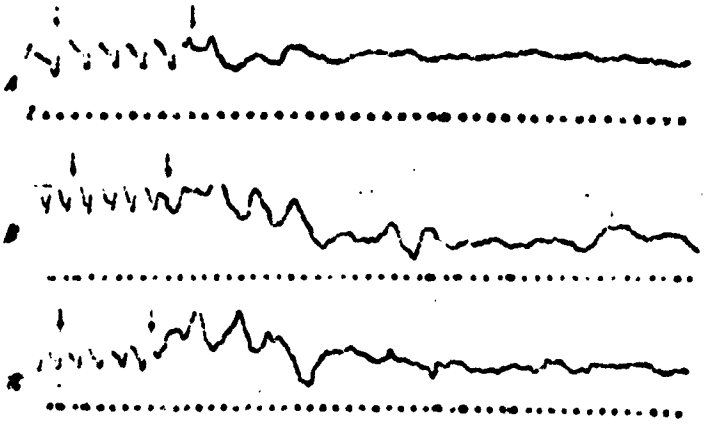

Figure 2. Trunk movement registration curves after rotation five times in Barani chair. Subject z. Unstable support. A -- support area 625 sq cm, B and C -- 289 sq cm, B -- movements to left and right, C -- forward-backward, 1 -- trunk movement curve, 2 -- time 0.5 seconds. First arrow -- beginning, second -- end of rotation.

Depression of the alpha rhythm is observed, the appearance of beta rhythm and peak-like fluctuations, testifying to a decrease in the activity of the inhibitory processes in the cerebral cortex, facilitating irradiation of stimulus

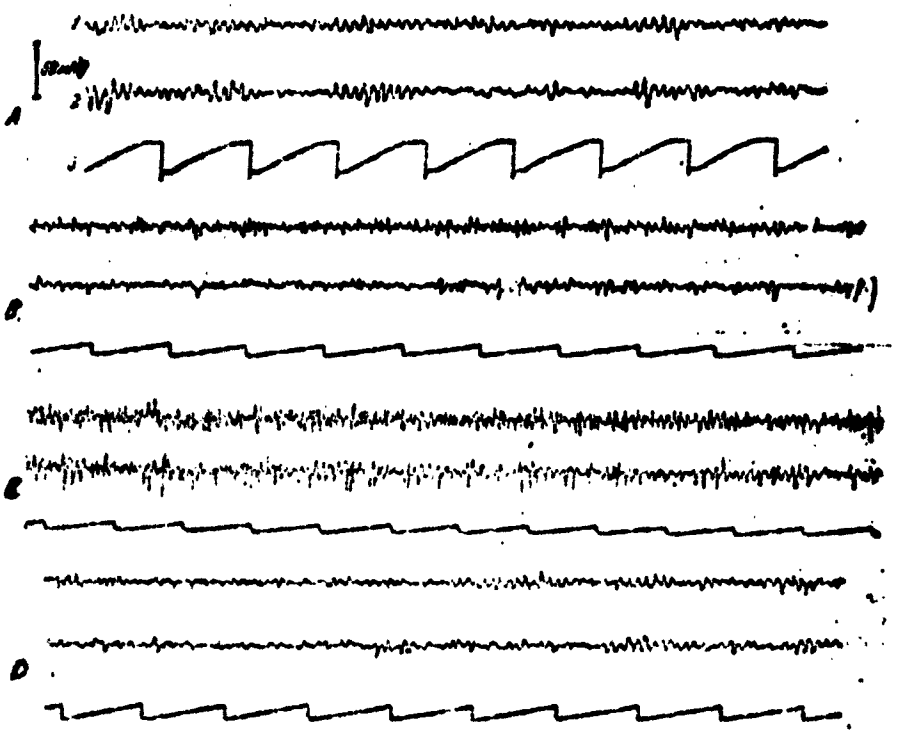

Figure 3. EEG of subject N under balance conditions, A -- in seated position on solid support (control), B -- balance conditions on unstable support 625 sq cm in area, C -- same on support of 289 sq cm, D -- after-effect on solid support. 1 -- EEG, temporal connection, 2 -- occipital, 3 -- time one second.

from the vestibular centers to the motor zone of the cortex and vegetative centers. The fact that chloral hydrate significantly decreases vestibular activity under conditions of unstable equilibrium and removes changes on the EEG, indicates the cortical dependence of processes occurring in the brain.

Up until the present we have observed phenomena of interaction between vestibular and proprioceptor analysors. Influences running from the eye to the vestibular instrument present independent interest. It is known from work in otolaryngology that reflexes from the vestibular instrument are expressed to a lesser degree in a case whereby the eyes are open. Previously it was assumed that this is the result of the effect of a light stream, but we learned that light by itself does not play a part. If the light stream creat-

ing illumination up to 160 lx on the pupil has come from "non-oriented" space, its effect on the function of the vestibular instrument was not revealed (Figure 4.)

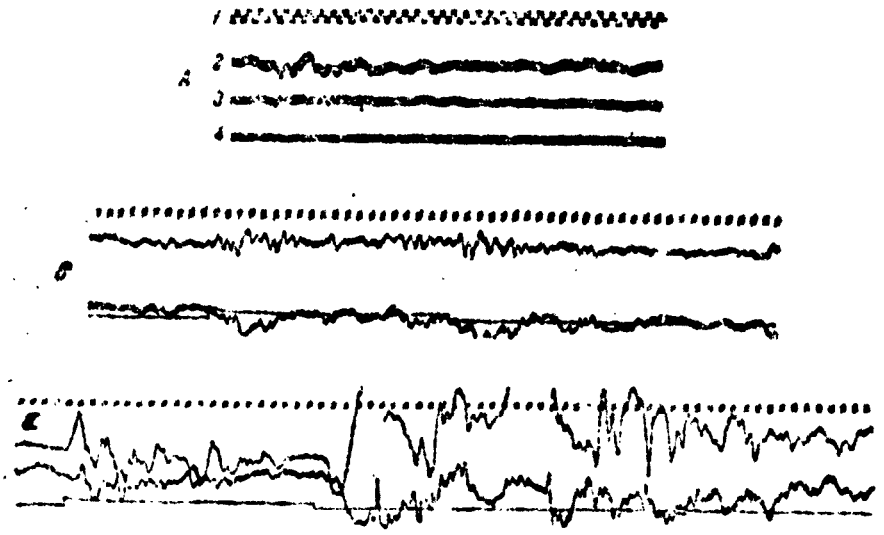

Figure 4. Trunk movement curves with the aid of tenso-feeders. Subject Sh. on unstable support. A -- control, B -- irritation by electric current of threshhold force of the vestibular apparatus from the right. Subject fixes gaze on lighted bulb. Light value 160 lx. C -- the same, light value 160 lx with absence of objects in field of vision. 1 -- time marker 0.5 seconds, 2 -- movements to right and left, 3 -- movements forward-backward, 4 -- irritation marker.

As with closed eyes, irritation of the vestibular apparatus in combination with eye lighting led to the usually observed phenomena of loss of equilibrium and lengthening of the period of irritant after-effect. Under the same conditions another effect could be observed if various objects were placed in the field of vision of the subject. The fixing of the gaze on fixed objects causes the same influence on the vestibular apparatus as the effect of static muscle tension. On the other hand, the following of moving visual objects increases vestibular sensitivity. In these experiments as in preceding ones, most clear data were obtained from subjects under conditions of stable balanced equilibrium in a chair. We further learned that not any gaze fixation on an immovable visual object inhibits vestibular and motor reactions not connected with irritations to the vestibular apparatus. The maximum inhibition occurred when

the object is 40 to 100 cm from the subject along a center line at eye level. Objects placed closer or at an angle of more than 30 degrees, do not exert any inhibiting effect on the vestibular reactions or the inhibition is insignificant. Inhibition of vestibular reactions by stimuli passing from the visual analysor is stimulated not by the peculiarities of the object but by its position relative to the observer and its immobility. This circumstance makes it possible to assert that in inhibition mechanisms the main role is played not by light as an adequate irritant of the optical instrument, but eye reactions involved with the activity of the eye muscles, fixing the object in the field of vision. The laws of interaction of vestibular, visual and motor analysors lay at the basis of methods elaborated for reproducing experimental spatial illusions -- heeling over, bending forward and backward, and false sensations of turning upside down under laboratory conditions.

These illusory sensations are the result of irritation of the vestibular apparatus and can be attributed to cortical reactions occurring through insufficient or distorted information on the position of the body in space by the visual and motor analysors. They can occur with irritations close to the threshold and even sub-threshold. In the latter case false sensations occur as a result of summation of weak irritations in the centers of the vestibular analysor under conditions whereby the factors of vestibular reaction inhibition have been weakened or are lacking. This is a typical case of conflict situations within the first reality signal system. Illusory sensations develop both at the moment of irritation and during the after-effect period. Their objective expression is a complex motor reaction occurring in response to the false sensation. With strong illusory sensations vegetative disturbances are observed: dizziness, nausea, pulse acceleration, etc. In some cases a phase nature was noted in the illusory sensations: a seeming list to one side was replaced by a false sensation of a list to the other side. Experimentally caused illusions in essence were approximate to false sensations occurring at the moment of changeover from visual flights on aircraft to instrument flights and during distraction of attention of the pilot from the instrument panel under conditions of short duration weightlessness during flight on a Keppler trajectory.

Illusory sensations can occur not only under the influence of the direct effect of external factors on the organism, but also during the viewing of cinerama films, demonstrating the movement of an aircraft or automobile carrying out sharp turns and veering, or movements of a boat rocking heavily in the waves. The viewers experience sensations analogous to those which occur under real conditions of such a flight or journey. In sharply expressed cases the

Sensations inadequate to the situation are accompanied by unpleasant symptoms of dizziness, nausea and vomiting. Motor reactions are observed to the side opposite the turn, and corresponding changes in the activity of heart and respiration. As an example we include trunk movement curves, oculograms and EMG of the back muscles of subject Kh-v, made during watching a film showing various evolutions of a plane in the air (Figure 5).

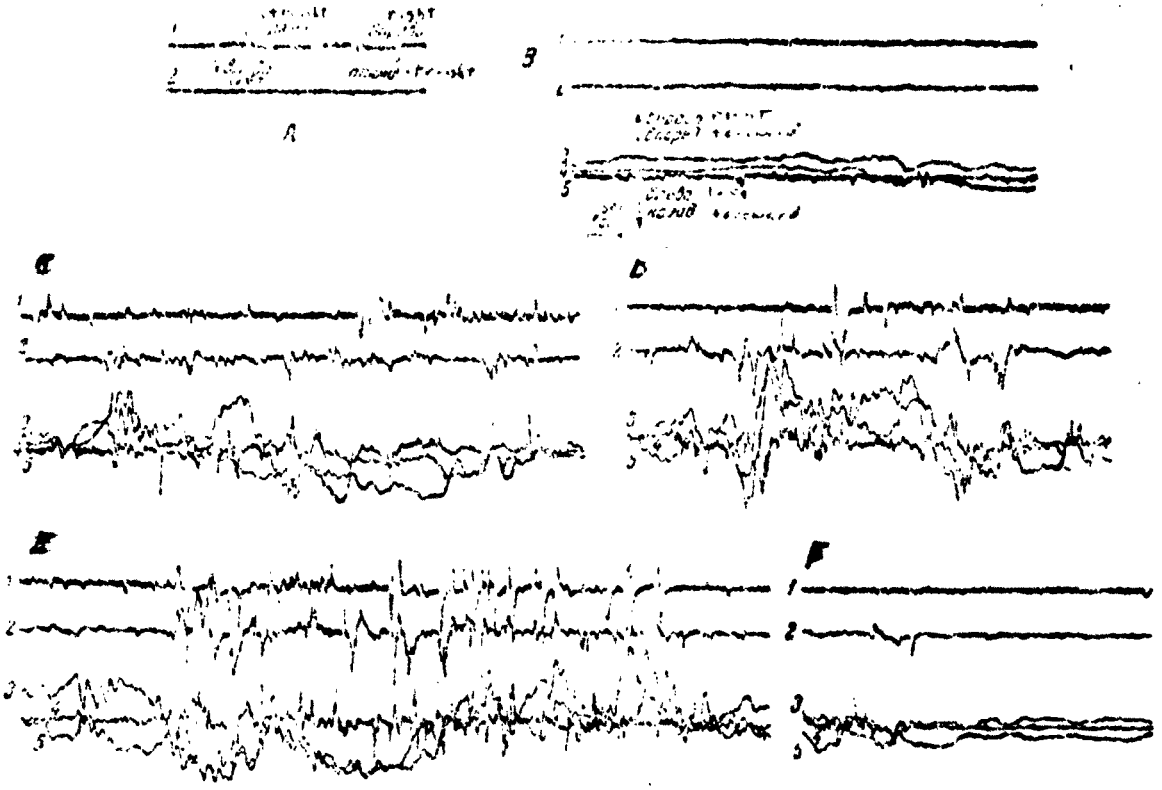

Figure 5. Subject Kh-ov, 20 February 1959. A -- control oculogram, B -- balanced equilibrium, C -- "flight in clouds", D -- "air pockets", E -- "movement" of automobile along winding mountain roads, F -- fixed gazes on motionless point of screen. 1 -- oculogram, 2, 5 -- EMG of back muscles, 3 -- movement to right-left (tensometric curve), 4 -- movement forward-backward.

This phenomenon, under the designation "phenomenon of participation" is experienced by a relatively small number of viewers. The situation changes when the viewers shift into chairs with unstable support. The number of persons experiencing unpleasant sensations increases sharply, and the

sensations themselves for a certain number of persons become unbearable, forcing them to leave the auditorium. These observations once again indicate that illusory sensations are the result of change in the interaction of analysers controlling spatial perception. They demonstrate that illusions occurring with adequate irritation of the vestibular apparatus can be caused in effecting conditioned reflex connection through the optical analysor. Finally they testify to the exceptionally important role in phenomena of spatial analysis and synthesis of the motor analysor, normally exerting an expressed inhibitory effect on the reaction of the vestibular apparatus.

Spatial orientation during flight on board modern aircraft and spacecraft is effected only according to the readings of instruments, signals from which are addressed to the second actuality signal system. Experience indicates that mastery of this method of handling an air or spacecraft makes a flight more reliable and safe. In addition, signals from other analysors stimulated by physical flight factors pass into the central nervous sytem alongside signals from instruments through the optic analysor. Under normal flight conditions analysors and instruments furnish readings which correspond in significance and a correct concept is formed in the pilot of the position in space. But frequently a situation arises during flight whereby the indications of analysors, for reasons which are not known yet, inaccurately portray reality, which serves as a cause of illusory sensation. Such a type of phenomenon as we know now, can occur during space flights. It is important to keep in mind that the occurrence in astronauts in flight of unusual or unpleasant sensations and reactions is caused by physiological factors occurring due to the peculiarities of the functions and interaction of afferent systems of the organism. The degree of expression will depend on a number of causes, primarily on the general condition of the organism, typological peculiarities of its nervous system, on the level of preparation and training of the astronaut, and in particular, on the duration of the flight under weightless conditions.

Science does not yet possess reliable methods of selection, making it possible to determine ahead of time the degree of stability to weightlessness in a future astronaut. Much time and work will be required in order to achieve success in this. Therefore weightlessness, as a natural phenomenon, as a factor of the environment under space flight conditions, remains as one of the major problems of space physiology and medicine. Examination and solution of this problem from the viewpoint of studying analysor interaction is extremely important from the viewpoint of conquering space.

Bibliography

1. E. Sh. Ayrapet'yants, Mater. nauchn. soveshch. po probl. vospr. prostranstva i prostranstv. predstavl. (Materials of the Scientific Conference on Problems of Space Perception and Spacial Concepts), Leningrad, 1959.
2. P. K. Anokhin, Trudy (Papers) of the 9th Congress of the All-union Society of Physiology, Biochemistry and Pharmacology, 3, 1959, page 36.
3. E. A. Asratyan, Fiziologiya tsentral'noy nervnoy sistemy (Physiology of the Central Nervous System), AMS, Moscow, 1953.
4. I. S. Beritashvili, Nervnyye mekhanizmy povedeniya vysshykh pozvonochnykh zhivotnykh (Nervous Behaviour Mechanisms in Higher Vertebrates), AS USSR, Moscow, 1961.
5. A. A. Volokhov, Zakonomernosti ontogeneza nervnoy deyatel'nosti (Ontogenetic Laws of Nervous Activity), AS USSR, Moscow, 1951.
6. Z. Geratevol', Psikhologiya cheloveka v samolete (Psychology of Humans in Aircraft), Moscow, 1956.
7. G. V. Gershuni, Fiziol. zh. (Physiological Journal), 35, 542, 1949.
8. R. Granit, Elektrofiziologicheskoye issledovaniye retseptsii (Study of Electrophysiological Reception), Moscow, 1957.
9. I. I. Kas'yan, Ye. M. Yuganov and V. I. Yazdovskiy, Izv. AN SSSR (AS USSR News), Biological Series, No 4, 1960.
10. K. Kh. Kekcheyev, Nochnoye zreniye (Night Vision), Moscow, 1946.
11. S. V. Kravkov, Vzaimodeystviye organov chuvstv (Interaction of the Senses), AS USSR, Moscow, 1948.
12. A. V. Lebedinskiy, Fiziol zh., 19, 945, 1935.
13. L. A. Orbeli, Voprosy vysshey nervnoy deyatel'nosti (Problems of Higher Nervous Activity), Moscow, 1949.
14. A. A. Ukhtomskiy, Sobr. soch., 4. Leningrad, 1945.
15. V. N. Chernigovskiy, Interotseptory (Interoceptors), Medgiz, 1960.
16. H. Beck, J. Aviat. Med., 25, No 3, 235, 1954.
17. S. Gerathewohl and H. Stallings, J. Aviat. Med., 29, No 7, 504, 1958.
18. I. Whiteside, Aerospace Med., 8, 719, 1961.

10,284
OSO:1873-S

FOURTH GAGRY CONFERENCE

/Following is the translation of an article by O. S. Adrianov and M. Ya. Rabinovich in Zhurnal Vysshey Nervnoy Deyatel'nosti imeni I. P. Pavlova, Vol 12, No 6, November-December 1962, pages 1085-1,088./

The conferences in Gagry, or as they are called, the "Gagry Talks," organized by the AS Georgian SSR at the initiative of academician Beritashvili, has become a fine tradition. The limited number of participants and fine organization to these conferences further an extensive, creative discussion to all problems on the agenda. Between 15 and 24 January 1962 the Fourth Gagry Conference was held. The conference was devoted to the structure and function of cortical neurons. In addition to the papers on the agendum, interesting reports were heard by Y. Buresh and Ye. N. Sokolov on memory mechanisms, as well as a report by P. G. Kostyuk on the work of the neurophysiological laboratory of Eckley in Canberra. The conference was convened with a brief introductory word by academician Beritashvili, who greeted the participants in the name of the presidium of the AS Georgian SSR. Beritashvili noted that, in spite of certain success in the field of brain study, up to the present the problem of mental activity and consciousness has been examined little in the light of the latest data of neuromorphology and neurophysiology. A lively discussion was prompted by the paper read by Beritashvili entitled "Structural and Physiological Bases of Mental Activity". Particular attention in this paper was devoted to newest structural and physiological data for laying a basis for certain theoretical principles. Analyzing these data, the author concluded that cortical stellate neurons with short axons are unified into a functional system, which, in close contact with insert and association pyramidal neurons, plays an important role in the differentiated sensations and perception, as well as reproduction of images of the external world. The author assumes that the unification of stellate neurons of the primary zone of one analysor is effected apparently with the participation of pyramidal neurons of its secondary zone. If optic sensations take place in field 17 of the cortex (first optic zone), the unification of optic images occurs chiefly with the

participation of fields 18 and 19 (secondary zone). Beritashvili introduced data from the literature on electrical irritation of the human cerebral cortex to bolster this conclusion, as well as facts obtained in the author's laboratory in removing various areas of the cortex of the optic analysor in a dog. One assumes that neurons, carrying out lengthy, rhythmic discharges in response to one peripheral impulse, constitute stellate cells with a circumcellular axon network. This latter, in the opinion of the author, creates conditions for neuron autostimulus. Stellate neurons of the second group with axons, which are removed far from the body of the cell, possibly serve for transmitting stimulus impulses from the thalamic afferents to association and insert pyramidal neurons. The production of differentiated sensations apparently is a philogenetically elaborated property of nerve cytoplasm. Each functional system consists of closed nerve rings of varying complexity, where a stimulus may rotate for some time after the irritation is stopped. The author assumes that lengthy retention of images is caused essentially not by the features of sensory or other neurons of the primary zone but due to the features of the neurons and their synaptic junctions in the secondary zone. The orientation reaction, the excitor mechanism of which is firmly joined to the functional system, providing perception of the external world, is of great importance in the perception mechanism.

The paper by Adrianov and Popova made an attempt to compare data obtained on differences in movement and interaction during stimulus and inhibition in various analysors in dogs, both with the general scheme of structure and development of the cortical and subcortical levels of these analysors and with the features of their cytoarchitectonic and fine neuron structure. In analyzing the physiological material obtained, it became clear in the first place that there was a greater temporal rate, and in the second case, more extensive irradiation of the nervous processes from the auditory analysor to the optic and to a lesser degree -- to the cutaneous. One of the possible explanations of these facts apparently consists in an extensive prevalence of subcortical formations of the auditory system over subcortical formations of the optic and cutaneous analysors in predatory animals. This possibly creates favorable conditions for a transfer of stimulus to the efferent formations of the neural tube at the level of the rhombencephalon as well as for linking the auditory system with ascending sections of the reticular formation, along which afferent impulses may reach a broad expanse of cortex. In analysing facts revealed on the decreased mobility of nervous processes

and longer retention of the nervous process of this category and subsequently in the optic and cutaneous analysors in comparison with the auditory, the authors primarily have in mind the peculiar features of the cortical structure (cytoarchitectonic and neurons) of the analysors under comparison. The abundance in the central optic field of the cortex of stellate cells with circumcellular axon network and pyramids with arc-shape axons, may form fine conditions for circular stimulus circulation.

Shkol'nik-Yarros wrote a paper introducing original material in respect to the varying forms of fine structural mechanisms and synaptic junctions between neurons in the cerebral cortex. The variety of structure of axodendritic and axosomatic contacts leads us to assume the existence of a large group of functional ties, differing in their delicate mechanisms, origin and form. Typical cortical pyramidal cells constitute obviously the substratum of the greatest convergence of stimulus in the cerebral cortex. By nature of synaptic interrelationships in the pyramidal neuron more than ten types of bonds can be distinguished. Synapsis with dendrites and stellate cell bodies are differentiated depending on the variety of cells. Cells with ascending axons, possessing abundant introcortical junctions, apparently play an important role in stimulus circulation in the cortex itself. Delicate structural mechanisms of juncture between the neurons differ greatly. No less than 15 different sources of synaptic terminal can be discovered by origin in the optic cortex.

An interesting paper was read by A. B. Kogan on studying the tie-up of function with chemism of the cortical neurons. The method of single count of electrophysiological, histochemical and structural neuron changes elaborated by the author made it possible to elucidate certain histochemical correlations of change in the functional state of the neurons of the optic cortex of a cat with the action of rhythmic light flashes. The author was successful in fixing a rapid increase in the activity of succino-dehydrogenase, chiefly in the region of the basal dendrites of the nerve cells, and a stable increase in ribonucleic acid concentration in neuron cytoplasm. Certain reactions were also noted in the sulfhydril groups, phosphatase and bound potassium. The desoxyribonucleic acid content remained constant. Stimulus of the motor analysor neurons caused analogous effects in altering exchange.

Differences in the chemical organization of nerve cells in the brain formations of varying phylogenetic age were demonstrated in the structures of cortical nuclei of the motor and optic analysors of a hedgehog, rabbit, dog

and monkey in the paper by Portugalov, Busnyuk and Gershteyn, with the aid of histochemical methods of elucidating functional groups of albumen nature in various formations of the cutaneous and motor analysors of a cat and with the distribution of certain oxidizing ferments (succino-oxydase system, cytochromoxydase, DPN-diaphorase). Materials were introduced which confirmed the viewpoint that a shift of processes of matter exchange must take place in the evolution of the nervous system from the body of the nerve cell to its appendices. The cortical nuclei of the cutaneous, motor and optic analysors of various animals differ in their chemical architectonic. There is a correlation between the morphological and chemical differentiation of the structures of the cortical nuclei. Within the limits of the analysor, formations carrying out various functions differ by histochemical indicators. This is spread to the chemico-architectonic of the entire formation as a whole, and to the chemical organization of individual neurons. Kupalov, Obukhova and Khananashvili in their paper introduced the results of their systematic studies of structural ties and functional features of various sections of the optic analysor in a dog. The paper confirmed the viewpoint that individual fields of the occipital region differ in their efferent associational and projection channels. The authors devoted particular attention to a study of the features of fields 18 and 19 of the occipital region in the function of vision. It was demonstrated that with the removal of these fields only the most complex optical function is disturbed -- differentiation of conditional stimulators close in form, while deep differentiation of forms is not disturbed. Disturbances of complex optical function occur also with damage to the posterior sections of the sincipital region (field 7). Disturbance of conditioned reflexes on complex stimuli is expressed more strongly than in eliminating fields 18 and 19. The authors assume also that the frontal region in dogs may participate specifically in the complex optical function and in cooperation with the optical and auditory analysors.

Ye. N. Sokolov devoted his paper to analysis of the results of studying the processes of model making in the central nervous system of animals and humans. The processes of modeling the nervous system of some properties of external effects were examined in the examples of extinguishing orientation reflexes. With much experimental materials the author convincingly demonstrated that the orientation reflex occurs not on the stimulus itself but as a result of collation of the characteristics of the operating stimulus with traces of its previous applications -- with the "nerve model of the stimulus". According to the author's idea,

the orientation reaction occurs when incoming afferent impulses cease to correspond to the "nerve model" of the previous stimulus. Thus the excitor of the orientation reaction is not the same afferent stimulus but "disagreement" between the present impulses and the previous traces. The author introduced data which testified to the presence of special neurons capable of effecting extrapolation of real afferentation and the comparison of extrapolation with present impulses.

A paper by N. N. Dzidzishvili expounded the results of research on the electrical activity of the cortex and the large hemispheres of a rabbit after switching off the optic function both at maturity and in the early post-natal period before the animal can see. In sexually mature rabbits, after their eyelids being sewn, electrical activity throughout the cortex was not changed. After enucleation of the eyeballs of rabbits several days before sight came, spontaneous activity differed almost not at all from the spontaneous activity of a control rabbit with normal vision. Some time later sound jolts caused a desynchronizing influence on the rabbits of both groups on rather well-expressed cortical activity of various regions. Only in the optical regions of the blinded rabbit was relatively low activity noted. The absence of differentiated responsory actions to peripheral stimuli was noted in the rabbits with partially switched off optical function by sewing the eyelids, if the lids were sewed shut not long before the normal time for eyesight. Morphological studies of the cerebral cortex carried out five months after eye enucleation demonstrated that the cytoarchitectonic of field 17 of the cortex was relatively preserved, but in layer 5 regions were discovered which were missing cellular elements. These phenomena were not observed in cases whereby the eyelids of the rabbit were sewed together, but through which dispersed light could penetrate in a diffused form.

Ya. Buresh (Prague) reported the results of his (jointly with O. Bureshova, Fifkova, Ryudiger, and Veys) research on the tonic influence of the cortex of the large hemispheres on the activity of subcortical formations. For analysis of cortical-subcortical relations the method of functional removal of the cortex was used, through spreading depression. Studies of changes in the phonal activity of potentials and reactions of various neurons of a number of diencephalic and mesencephalic formations during spreading depression caused the author to come to the conclusion that the influence of the cortex on diencephalic formations is of a stimulant nature in the inhibiting influence on the cortical-reticular junctions of the midbrain. A study of the influence of spreading depression on the conditioned reflex

activity of rats demonstrated the effectiveness of application of this phenomenon for functional dissociation of cortical and subcortical components of the conditioned reflex.

A. I. Roytbak and S. M. Butkhuzi devoted their paper to the still unclear mechanisms of the reaction of "awakening" during the effect of peripheral stimuli. The authors assert with great substantiation that the reaction of awakening during peripheral stimuli is effected by specific afferent impulses coming into the auditory cortex and is connected with arousing the neurons of the fourth and third cortical layers. In confirmation of these premises results are given of experiments with stimulus of the medial elbow-shaped body and reticular formation of the midbrain. Stimulation by electric current of the medial elbow-shaped body causes in the auditory cortex the EEG reaction of awakening, accompanied by corresponding behavioral acts which are not distinguished from analogous sound effect. Cooling of the auditory cortex with chlorethyl inversely inhibits the waking reaction during stimulation of the medial elbow-shaped body; cooling does not influence the activity of other regions of the cortex, reticular formation of the midbrain and the medial body itself. At the same time stimulus of the reticular formation of the midbrain as before causes a wakening reaction. A relatively more rapid dying out of the waking reaction during stimulus of the medial body in comparison with stimulus of the reticular formation of the midbrain also testifies in favor of the cortical origin of this phenomenon. Judging by results obtained we can presuppose the existence of two structural-functional mechanisms of waking reaction, the activity of which can be independent under certain conditions.

A paper by M. Ya. Rabinovich was devoted to characteristics of the electrical reactions of certain layers of the cortex, occurring in response to the effect of various stimuli, and analysis of the functional importance of these reactions. The experiments elucidated local increase in amplitudes and frequencies of oscillations in the fourth and second layers of the cortex of the sound analysor in response to sound, of the optic analysor in response to light and the cutanecus analysor in response to electrical stimulus on the paw of an animal. Local layer activation is connected with the structural peculiarities of these layers, in which stellate neurons with short axon are concentrated, upon which the primary section of the cortical afferents terminate: in the fourth layer afferents from the subcortical elements of a given analysor, in the second layer -- association afferents from other cortical territories. Prolonged application of stimuli leads to the

appearance in the EEG of the cortical layers persisted activity, chiefly in those layers of the cortex which selectively reacted to the effect of adequate stimulus.

A paper by G. D. Smirnov was on certain principles of the functional organization of the nervous center. Based on studies of induced potentials and reactions of various midbrain roof neurons of lower vertebrates, the author came to a number of theoretical conclusions in respect to the mechanisms of neuron activity. The main conclusion of the author consists in the fact that reaction of various neurons is determined by the nature of postsynaptic stimulus, created in the dendrites. This is confirmed by the following basic facts: the surface-negative potential of the midbrain roof of lower vertebrates, reflecting dendrite postsynaptic activity, always precedes the reactions of individual neurons, which are causally linked with them. Placing gamma-amino butyrous acid on the surface of the midbrain roof causes inversion of the polarity of induced potential with subsequent decrease in the activity of individual neurons. Comparing latent periods of induced potential and the reaction of individual neurons, the author came to a conclusion on spread of stimulus along the dendrite and calculated the speed of this spreading, which is 5 cm per second. Of interest also are data by the author to the effect that inversion of polarity of induced surface potential of the roof with acid introduced depends on the opposite orientation of the layer of neutrons placed under the surface layer, whereby the acid depresses the reaction of the surface layer and unmasks the reaction within. In spite of data found in the literature, the author did not find in the roof of lower vertebrates special synapses creating postsynaptic hyperpolarization.

A paper by A. I. Karamyan demonstrated the stage principle of morphophysiological evolution of the central nervous system, at the basis of which lies the layering of physiologically young forms of nervous activity over older forms. In the lancelet various sections of the nerve tube with identical intensity react to various exteroceptive stimuli and primitive temporary connections can be obtained and eliminated through stimulus of various sectors of the nerve tube after their complete dissociation. In cyclostomata elements of diffusiveness are retained in respect to perception of light stimuli, although, as electrophysiological data indicate, the functions are already concentrated in specific regions of the brain. The process of concentration of exteroceptive afferents in specific systems of the brain is concluded in plagiostomi and bone fish. Beginning with amphibia, the hemispheres of the forebrain participate in integration of nervous activity

of exteroceptive systems. In reptilia and aves this role of the hemispheres is even greater, although for them also the tectocerebellar system of integration is the basic form of integrative activity. Exchange of this form of integration takes place in mammals, in whom phylogenetically old forms of connection are either eliminated or completely reorganized.

V. M. Okudzhava reported on the results of research on the dendrite activity in the cortex of the large hemispheres. The primary conclusion at which the author arrives is that the apex dendrites of the pyramidal neurons of the cortex of the large hemispheres are provided with a postsynaptic membrane and do not have a membrane generating peak potential, and that the apex dendrites also have depolarization and hyperpolarization synapses. In the opinion of the author, this hypothesis explains well the nature of the influence of a number of pharmacological substances on dendrite potentials, posttetanic potentiation of dendrite activity and influence of polarization of the cortex surface on dendrite potentials.

A paper by T. D. Dzhavrishvili analyzed the induced potential of the cortex of the large hemispheres. According to the author surface negative potentials reflect the activity of the nerve elements placed on the top level of the diameter of the cortex. The author, applying gamma-amino butyrous acid in studying the nature of changes of potentials under the effect of this acid, came to the conclusion that these changes are not caused by activity of hyperpolarizing axodendritic synapses. Of interest also is the conclusion drawn by the author that the results of studying readings of potentials from deep within the cortex do not agree with the hypothesis of interrelations between "sources and flow-offs" of electric current applicable to the cerebral cortex.

All the papers read at the conference were subjected to deep, businesslike and critical discussion, which will undoubtedly aid in a further creative elaboration of the complex problems of experimental neurology.

10,284
OSO: 1873-S

-END-