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BIOMEDICAL AND BEHAVIORAL SCIENCES
(FOUO 11/79)

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TRANSLATIONS ON USSR SCIENCE AND TECHNOLOGY

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ECOLOGY

RADIOECOLOGY OF FOREST ORGANISMS

Sverdlovsk EKOLOGIYA in Russian No 6, 1978 pp 97-98

[Review of monograph by R. M. Aleksakhin and M. A. Naryshkin: "Migration of Radioactive Nuclides in Forest Biogeocenoses", Moscow, 1977]

[Text] Forest radioecology has been successfully developed in the last twenty years. Periodicals have published many studies on this problem, and by now there has developed a real need to analyze and generalize the accumulated material. This problem has been solved by the authors of the book being reviewed, who have made a great personal contribution to the formation and evolution of forest radioecology. Research conducted with the participation of these authors was used as the basis for the book. Furthermore, a great deal of literature is analyzed and the leading role of Soviet scientists in solving the problems is reflected.

The book devotes much attention to a justification of the practical and scientific significance of forest radioecology as an independent scientific trend; the specifications of interaction between precipitated radioactive contaminants and forest landscapes are given. Particular attention is called to the exceedingly high retentivity of the arboreal floor for radioactive precipitation. Specific data are given in the book to describe the rate of purification of plant and tree tops from retained radionuclides and translation of the latter to the surface of the forest floor and then to the soil. These data form the basis for evaluating irradiation doses to which many organisms are exposed within the forest biogeocenosis.

One chapter in the book is devoted to a discussion of quantitative aspects of the distribution and migration of man-made radionuclides in forest soils. Forms of discovery of long-lived fission products are examined: Sr^{90}, Cs^{137}, and others; and the transformation of these forms in time due to change in their biological accessibility for the root systems of vegetation. The role of forest soil as an accumulator of radioactive substances reaching the surface of the soil from the tops of vegetation and from the atmosphere is noted. Particular attention is focused on the important role in biogeochemical migration of radionuclides of the corresponding natural chemical macroanalogs--alkali metals for Cs^{137} and alkaline-earth for Sr^{90}. This situation is illustrated by a wealth of factual material describing the distribution of mobile forms in the most common soil types of the USSR of such natural elements as Na, K, Pb, Ca, Mg, and Sr. Results of experiments are cited on the effect on the speed of vertical migration of Sr^{90} leached from the soil by water and by solutions of compounds of its chemical analog, calcium. The data in this chapter are of interest not only to radioecologists, but also to specialists in forest management.

A large section is dedicated to a description of the pattern of transition of major fission products and their chemical analogs into forest vegetation from the soil. The authors justifiably emphasize that it is, in fact, the soil pathway of access which defines the content of a radionuclide such as Sr^{90} in timber. Based on their own experimental data, the authors discuss in detail the relative migrational ability of man-made radionuclides and the corresponding natural analogs, expressed as so-called magnitudes of observable ratios of related element pairs. The kinetics of formation of a quasi-equilibrium state in the distribution of radionuclides and element analogs in the biomass of forest vegetation is examined for the element pair Sr^{90}/Ca. Detailed discussion is given to causes of altered content of Sr^{90} in forest vegetation in time following single introduction of a radionuclide under the forest cover. The factual data cited make a substantial contribution to the biogeochemistry of fission products and natural alkali metal and alkaline-earth elements.

In the concluding chapter of the monograph, the distinctive features of distribution in forests of artificial radionuclides are considered in their zonal aspect. The initial factual data are presented as the results of experimental research and encompasses the basic forest regions of the USSR. A comparative evaluation of the content of fission products in the biomass of woody vegetation and other components of the forest cenosis revealed significant differences in the concentrations as a function of the specimen sampling site, biological aspects of the test objects, and the physical and chemical properties of the radionuclides. These materials permitted the authors to make several important generalizations and to spell out the leading factors responsible for the distribution of radionuclides through components of the cenosis and its time changes; quantitative parameters were obtained to describe the retentivity of the forest floor for individual radionuclides. It should be noted, however, that the numerical data cited in the book concerning the distribution of radionuclides through forest components varies greatly according to the research region. Unfortunately, the authors did not give this a convincing explanation.

The totality of experimental data on the distribution and migration of Sr^{90} in the forest served as the basis for construction of a mathematical model of migration of this radionuclide and a definition of the coefficients of transfer of Sr^{90} between various components of the forest cenosis. A good correspondence was found between the proposed model and factual data, providing grounds to use it to predict the distribution of Sr^{90} in the forest in the remote future. The principles of mathematical modelling set forth in the monograph may be used to construct a model of migration in forests not only of radioactive elements, but also of natural stable ones, and for that matter, any contaminants entering the forest cenosis due to the discharge of industrial wastes into the environment.

The materials presented in the book, as a whole, permitted the authors to formulate important generalizations which show the specifications of distribution and migration of radionuclides in forest biogeocenoses. It was found that the overhead portion of the forest floor, especially in coniferous forests, is characterized by a much greater ability to retain radioactive contaminants which have precipitated from the atmosphere than herbaceous plant communities. A major portion of the radionuclides retained in the vegetation tops remains there for quite a long time: this can cause a rise in the irradiation dose of the assimilating and reproductive organs. The authors formulated a thesis on the exceedingly important sanitation and hygiene role of the forest which is manifested in a reduction in intensity of wind and water migration of radionuclides beyond the boundaries of a contaminated territory after translation of their bulk under the cover of the timber floor.

The vital nature of this monograph goes beyond the framework of purely radioecological problems. The information presented in it can be useful for predicting the consequences of forest pollution by other toxic substances of non-radioactive nature, to evaluate the sanitation and hygiene role of the forests under conditions of environmental pollution by industrial wastes.

The book may offer certain interest for radioecologists, forest management specialists, hygiene specialists and a wide range of other experts engaged in the elaboration of the problem of protecting the environment from man-made pollutants.

Reviewed by F. A. Tikhomirov, Moscow State University imeni Lomonosov

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ENGINEERING PSYCHOLOGY

ORGANIZING OPERATORS' WORK

Moscow ORGANIZATSIYA TRUDA OPERATOROV (INZHENERNO-PSIKHOLOGICHESKIYE PROBLEMY) (Organizing Operators' Work: Engineering Psychology Problems) in Russian 1978 signed to press 22 Mar 78 pp 2, 192-211, 223

[Annotation, table of contents and conclusion of book by V. F. Venda et al, Izdatel'stvo "Ekonomika," 15,000 copies, 224 pages]

[Text] This book is devoted to the engineering psychological aspects of organizing operators' work in different sectors of the national economy (machine building, the metallurgical and chemical industries and transportation). Special attention is devoted to an analysis of the processes of information processing by man and of the interaction between the operator and computer; specific recommendations are cited for selecting the characteristics of operational monitoring and control equipment. The authors describe the engineering psychological methods for evaluating and increasing the efficiency of control centers in order to increase the efficiency and reduce the level of tension in the operator's work.

The book is intended for specialists in the fields of scientific organization of work and management, engineering psychology, ACS [automated control systems], ergonomics and equipment design.

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Conclusion

Long Range Problems of Engineering Psychology in Automated Control Systems

The immense importance of further increasing efficient management of the economic system and of increasing the efficiency of decision making was pointed out in the decisions of the 25th CPSU Congress. Engineering psychology is called upon to play a significant role in implementing these decisions. During a short period--20-25 years--a sufficiently firm theoretical foundation has been created for the science and rich practical experience has been accumulated.

Several stages can be distinguished in the development of engineering psychology. During the first stage, the processes of perceiving the individual elements of instruments (needles, dials, scalar forms and figures) were the subject of research for engineering psychology; during the second stage, the perception of instrument readings as a whole was subjected to study; later, there was a transition to the analysis of the perception of information from information display systems with multiple components. Modern engineering psychological research is devoted to the problem of optimizing the man-operator's interaction with complex information systems which not only include the display equipment but also the methods, algorithms and facilities for preparing operational information, including computer programs and terminals.

At the same time, it is necessary to recognize that, with the exception of those rare cases where psychologists directly participate in the planning of complex information systems, the majority of the research in engineering psychology is lagging behind the rate of development and dissemination of new control equipment and systems. The enormous scale of the scientific, technological and engineering developmental work in the field of automated control systems, the expansion of the operators' functions and the reduction in the time for making responsible decisions have brought about the requirement for an in-depth psychological basis for this developmental work.

The ever increasing complexity of controlling these systems requires an optimal organization of interaction between operators--operators who are jointly accomplishing the control tasks--by means of the collective formation of an adequate psychological model of the actual system. The psychological aspects of the problem of an optimal organization of interaction between different specialists who are jointly creating a multi-faceted model of a somewhat complex reality are not only of current interest for making control systems more efficient but also for solving complex scientific problems (for example, on environmental protection), creating large-scale projects and in many other cases where the solution of a problem is connected with the synthesis of large amounts of diverse information within limited periods of time. A reduction in the efficiency of control systems and work of scientific and design groups frequently occurs due to a loss of information when it is transmitted from one echelon to another.

When solving an operational problem which has arisen--in reference to control systems--the goal of engineering psychological planning consists of the optimal combination and utilization of all its a priori experience which is recorded in the instructions, machine programs and the structure of the information display systems and also of the potential professional and creative abilities of the collective and of each operator based on the selection and coordination of adequate professional (detailed) and universal (integrated) languages and interactive equipment.

The selection of the interactive structure and the technical equipment for the operators' work must be directed at optimizing the importance of psychological factors of work complexity when the most responsible functions are being accomplished. When organizing interactive and control equipment--as when optimizing the information display systems--it is advisable to combine probability methods and multilevel adaptation for the purpose of ensuring that the collective functions as a socio-technical system of adaptive interactive communication (hybrid intelligence). The following are characteristic of such a system:
--an anthropocentric structure;
--a dynamic level of interaction;
--a flexible hierarchical structure;
--common responsibility and prestige;
--the individual adaptation of the interactive functions, structure and equipment to the active participants who are personally performing in the system;
--the selection of active participants by primarily considering the divergent or convergent phases of the work or the common pupose of the system;
--the collection and analysis of information and the formation of an integrated model of the objective situation or the theoretical task which is being jointly conducted by all the system's participants;
--the optimization of individual and systemic psychological criteria and factors for the level of difficulty of the solution;
--the open nature of the system, maximum utilization of all the accumulated knowledge and experience, active interactive communication and a widespread exchange of experience with other systems;
--the existence of highly developed equipment for collecting, storing, transmitting, processing and displaying information--equipment which is built on the basis of the principles of multilevel adaptation to the participants of the system;
--the existence of a common, universal (integrated) language along with narrow, professional (detailed) languages;
--common accessibility to the information and primarily to the integrated information.

We must immediately stipulate that, bv hybrid intelligence, we primarily mean systems of intellectual interaction between employees, including the interaction between scientists and their historical predecessors, and not complex man-machine systems. It is necessary to take into account the fact that the historical wisdom of mankind is not just concentrated in books or other specialized sources of information. K. Marx pointed out that "the history of industry and the objective existence of industry which has developed are the open book of man's essential forces which present themselves to our senses as man's psychology."* It is of interest that, as if justifying the need for a branch of psychology like engineering psychology, K. Marx warned in the same place that "...the psychology to which this book--that is, the most sensitive to our senses and most accessible part of history--is closed cannot become a truly substantive and real science."

We cited the anthropocentricity of its structure as the first feature of systems of hybrid intelligence. On numerous occassions, B. F. Lomov has emphasized the importance of developing and employing an anthropocentric methodology for engineering psychological planning of all "man-machine" systems.

Based on the methods for constructing them, systems of hybrid intelligence are the exact opposite of systems of artificial intelligence. Psychologists sometimes criticize the designers of systems of artificial intelligence for their excessive "machinocentrism." However, in our opinion, this approach is an adequate ideology for this specilization whose goal is the creation of autonomous machine programs for solving intellectual problems. At the same time, it is not assigned the goal of modeling psychological processes; the design of the programs may be based on other principles than man's process of thinking and, moreover, it may surpass the research on the psychology of thought. It is not assigned the goal of optimizing the psychological structure of the activity of a person interacting with a system of artificial intelligence since the person's presence here is considered a temporary, compulsory phenomenon--until programs are designed to automatically accomplish all functions. The strategy for the problems of artificial intelligence is one of improving the machine and its intellectual potential.

To the contrary, in all the versions of the systems of hybrid intelligence, including the man-machine versions, man always remains the central figure and the machine components of the system are only the means for his work. The strategy of the problems of hybrid intelligence is one of improving man, increasing his creative and thinking potential. Thus, by their very nature, the systems of hybrid intelligence are anthropocentric in contrast to the machinocentric systems of artificial intelligence.

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*K. Marx and F. Engles. "Soch.," vol 42, p 123.

In systems of hybrid intelligence, the technical equipment is an auxiliary element which assists the individual in his work. In contrast to this, in the man-machine versions of systems of artificial intelligence, the individual is frequently either an extension of the machine components employed to back them up in case they break down due to insufficient reliability or a supplement to the machine in case the need arises to accomplish an unforseen task or a task which has not yet been put into algorithms.

It is necessary to emphasize that the systems of hybrid and artificial intelligence are not just exact opposites but they also dialectically merge into each other. For example, if the group of creative tasks being accomplished by the individual in a system of hybrid intelligence becomes narrower and if the experience accumulated for their accomplishment is sufficient for a formal description, then reducing this formal description to machine programs assisted by an individual can be formulated as a new task of the system whose work must be reorganized according to the principles of artificial intelligence.

On the other hand, premature attempts to design a system of artificial intelligence for functions which are far from being completely described by algorithms are very frequently observed. The individual's participation in such systems is unavoidable and protracted and it is connected with the accomplishment of complex creative and responsible tasks. At the same time, the machinocentric approach employed for the system which is considered as an artificial intelligence provides for a division of functions between the individual and the machine which is primarily based upon the functional capabilities of the machine. The remaining functions are included in the duties of the individual as an auxiliary, temporary component of the system (until formalized algorithms are collected). It is natural that, in the majority of the cases organized according to the machinocentric methods, the individual's work does not have a comprehensive psychological structure and it is connected with a great deal of difficulty. The norms for the permissible functions, conditions and limitations on the duration of the individual's work in systems of artificial intelligence must be developed and acknowledged.

Besides the differences reviewed above in the philosophical and methodological interpretation of the machinocentric conception of artificial intelligence and the anthropocentric conception of hybrid intelligence, the classification of a system to one of these types also has a purely practical, organizational significance. Engineering and technical requirements serve as the initial, basic requirements for the creators of systems of artificial intelligence while the requirements of psychology serve this function for the designers of systems of hybrid intelligence. The systems method for psychology, which was developed by B. F. Lomov, is highly significant for developing important aspects of the theory of systems of hybrid intelligence.*

From the point of view of our concept of systems of hybrid intelligence, the individual's work with the computer is regarded as a pseudodialog, i.e., the individual's secret dialog with other people during his work, with people who have recorded their knowledge, their forecasted answers and opinions in the machine program (the materialization of the planner's strategy of thinking in the structure of the information display systems is regarded with the same attitude). Moreover, the machine program can reorganize the initial knowledge according to as complex as plan as desired. However, from the point of view of reflecting the social and biological requirements of man--the most important factors for determining the tasks, the intellectual synchronization of people and the individual effect when solving creative problems--the machine cannot add anything new.

At the same time, the large capacity of the computer's memory and its combinatory and calculating capabilities make it possible to efficiently accumulate experience for solving different classes of problems and they make it possible to accumulate data on the individual features of problem solving by separate operators and to develop optimal forms for giving each of them advice, reference data, instructions and partial-answer displays.

Depending on the specific course of the solution and the difficulties encountered by the operator, recommendations on the values of the psychological factors of complexity examined above can be read out on the computer's videoterminal. At the same time, in the event of a delay above the norm or obvious mistakes in preparing information for accomplishing an operational task and also in the event of large shifts in the psychophysiological indices for the operator's state, the ambiguity in the task and the number of levels of freedom in perceptual and intellectual activity are limited right up to producing an algorithm for a certain reserve solution or even removing the operator from his participation in the control process.

During the first stages, advice can be presented to the operator in the following sequence:
--elements of information relevant to the task are visually selected, thereby limiting the area for collecting information;

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*See B. F. Lomov, "The Systems Approach in Psychology," VOPROSY PSIKHOLOGII, No 2, 1975.

--the probable critical elements of the situation are selected more precisely;
--the relationships between elements, including different types of relationships, are reflected. Employing the principle of structure [16] serves to reduce the masking coefficient for the relationships;
--the loops in discrete dynamic interrelationships flash on in sequence;
--distinctive tags are selected for the situations in the event there is a danger of intereference arising.

Combining the elements of information into semantically whole groups--operative perceptual units--is a special task. The principles of autonomy and structure, which we have described, are the basis of the machine algorithms for displaying advice on optimizing the number of operative perceptual units; in many cases, it is necessary to display advice on the probable priority relationships for signals being perceived and the preferred priority order for processing them.

It is important to continue developing methods for visually presenting the algorithms for making and implementing a decision. Using two-way communication between the individual and the computer by means of, for example, a videoterminal with a "light pen" during the process of solving experimental and actual operational tasks and using the special methods of the operator's own account of the course of the solution make it possible to efficiently carry out individual and individual-operational adaptation of the structure for presenting information.

As we already pointed out, from the point of view of engineering psychology, selecting the level for adapting the structure of information display systems to the functions and psycho-physiological features of the people making decisions in the automated control system is an important requirement for improving the display systems.

In essential cases where especially important decisions are being made based on the information displayed, for example, in controlling an entire sector of the national economy, the individual adaptation of information display systems to the special features of the functions and individual work style of the executives and other employees of the sector's central staff is required.

An analysis of a number of automated control systems for sectors revealed the following typical deficiencies in the methods and equipment for displaying information at the highest levels of sector management:

--the excessively fractionated nature of information which hampers an overall, strategic evaluation of the sector's operational status, the detection of deficiencies and the selection of the most efficient organizational and technological measures by the sector management;
--difficulty in perceiving tables due to their insufficient clarity and small size on the screen of the cathode ray tube;
--difficulty in selecting tables, comparing them to each other, and a lack of trends expressed in an obvious form for the dynamics of production;
--insufficient consideration for the special features of the functions of individual sector executives;
-- a lack of consideration for individual psychological features of information perception and processing and customary and preferred forms of displaying information.

The enumerated deficiencies testify to the fact that the existing forms of information output in the majority of sector automated control systems need to be made significantly more efficient from the point of view of considering the psychology of employees using the information.

We recommend that the methods of multilevel psychological adaptation of information equipment to information users be taken as the basis for making them more efficient; at the same time, special attention must be directed at adapting the information equipment intended for the highest levels of the national economy's sector management.

It is primarily necessary to provide additional specifications for display equipment for integrated, summarized information and for trends in the dynamic indices of the sector's work.

The creation of additional, integrated information equipment within the sector automated control systems--equipment which facilitates the general, strategic evaluation of the sector's status, the trends in its dynamics and the selection of critical links--will facilitate and accelerate decision making in managing the sector. Improving the forms for tables and the conditions for perceiving and analyzing them must promote this.

A more differentiated consideration of the functions of sector executives and employees is required when selecting the forms and makeup of the information to be displayed; more complete processing and preparation of data is required to facilitate their analysis in the precise area which interests each specific executive. In some cases, it is necessary to ensure consideration for the individual features of the sector's senior executives in perceiving and evaluating information. Making information display psychologically efficient--even when accomplished according to this abbreviated plan--will significantly increase the efficiency of sector automated control system utilization at all levels of sector management.

The basic stages of work on making them psychologically efficient must be: an experimental psychological evaluation of the existing forms of information output; developing recommendations for improving the form and makeup of tables and for improving the perception of them; developing principles and equipment for displaying integrated (summarized, strategic) information; developing principles for displaying trends in the dynamics of the sector's work. A plan for making the information equipment of sector automated control systems more efficient should be developed on this basis.

There is no doubt that consideration of engineering psychological requirements in making information equipment employed in all types of automated control systems more efficient will make it possible to significantly increase their technical and economic efficiency. This conclusion is confirmed by the work experience of the engineering psychology subdivisions of the USSR Academy of Sciences Institute of Psychology, the Leningrad State University imeni A. A. Zhdanov and the All-Union Scientific Research Institute for Equipment Design in developing and actually implementing the engineering psychology methods cited above for organizing operators' work.

The development of control systems with a multilevel, engineering psychology adaptation of the implements and conditions of work to the individual will make it possible to increase the efficiency of the operators' work even more.

The "man-computer" system where interaction is designed according to the principles of individual adaptation is unique to the systems of hybrid intelligence. The collective is the most common type of these systems. In this case, all the other participants of the hybrid intelligence can influence the psychological factors of the complexity of the problem solution by the participant who is recognized as the temporary leader in accordance with his ability and the specific course of the solution. In many of these systems, it is necessary to introduce a special group of participants whose role boils down to developing recommendations for controlling the interactive and decision process, distributing functions, changing the hierarchical structure, individually adapting the organization and means of labor to each active member of the system of hybrid intelligence and not decision making. These kinds of functions primarily belong to the field of competence of psychologists who participate in this case as meta-operators.

In our opinion, developing a theory and languages for dialog within systems of hybrid intelligence is one of the most important problems for optimizing interaction [24, 63, 113, 132, 133]. Among the numerous types of dialog, the following are of primary interest: according to the relationship in participants' ranks--hierarchical, equal, didactic and instructive dialog; according to the type of signals used--visual, oral, audio-visual; according to spatial and temporal parameters--remote, direct, delayed, anticipated (hidden). Pseudodialogs, various types of emotional perceptions of the machine as an independent "partner" in interaction,are a special group.

The problem of languages primarily arises in the sense of forming a common, collective, psychological model of the external world [24, 121, 129, 131]. It is especially important to study the processes of sythesizing an integrated model of the problem (for example, an emergency) situation based on the detailed models which various operators have of the individual structures of the facility (for example, a topological model, a physico-technological model, a schematic of static relationships, a schematic of dynamic relationships).

The experience of creating a theory of universal scientific languages may prove beneficial in solving this problem of engineering psychology.

One of the central tasks in realizing the idea of a hybird intelligence is the individual adaptation of the work organization, tasks and equipment to each participant of the interactive system. Experiments have revealed a high level of efficiency for individual- and operational-adaptive information systems equipped with a specialized signal analyzer which distributes them according to priorities and regulates the overall intensity of the stream of information flowing to the operator depending on his individual productivity and psycho-physiological state.

It is anticipated that both of these research directions and the synthesis of adaptive systems will be combined within the framework of the general problems of a hybrid intelligence. The development of a theory of individual adaptation must be directed at discovering individual psycho-physiological differences, studying the special features of their manifestation in the operator's activity and studying technical methods and means for compensating for negative manifestations. The development of a common list of individual differences and means of compensating for them is an important practical and scientific task of engineering psychology.

Concurrently, a research program has been outlined on the problem of individual adaptation of work equipment under extreme conditions. L. A. Kitayev-Smyk's research has shown that the dichotomy of types of reactions under extreme conditions increases the spread between the indices for the operators' behavior by increasing the value of adaptation of work equipment to the individual features of the reaction (passive or active). At the same time, the solution to the problem of adaptation is being simplified due to the small number of types of reactions under extreme conditions.

For normal conditions, it is also necessary to try to minimize the number of variants of adaptive properties of work organization and equipment for each type of operator function. For example, individuals with vividly the pronounced signs of introverts (reticent people inclined to individual work) may be more beneficial within a system of hybrid intelligence as hidden participants of the dialog. It is advisable to assign them the task of first thinking through the situations which the operator will actually come up against. For active interaction with his colleagues and the computer, an extrovert (a person inclined to intensive social contact during work) should frequently be the operator in a system of hybrid intelligence; during the course of interaction, he must report on the selected decision method. Combining the processes of thinking and social contact is required to assist the operator working on a real-time basis.

In principle, individual adaptation of work equipment to the individual can be used: first, instead of vocational selection if all significant individual differences can be compensated for; second, to reduce training time when the level of adaptation compensates for the lack of vocational skills; third, to expand the circle of functions accessible to the operator under extreme conditions and to improve the values of the criteria for evaluating the activity under normal conditions.

In all cases, individual adaptation is directed at reducing the actual complexity of solving operational problems. At the same time, the a priori knowledge on the solution of each problem and the advice stored in the computer or modified by it must be presented to the operator with a degree of absoluteness which is adequate for their level of confidence in each specific case and in a form which takes into account the individual psycho-physiological and personal features of the operator.

The operator training system for industrial facilities with rapid flow processes should be one of the areas of primary dissemination of individual-adaptive systems.

In many western countries, operator neuro-psychological illnesses have become a mass occurrence. Our widespread system of training and selecting operators for high levels in hierarchical control systems played a significant role in the fact that this problem does not exist in our country. For example, as a rule, people who have proven themselves in work as controllers of rayon power engineering enterprises and as duty engineers of electrical power stations become central controllers of power systems in Soviet power engineering. Until quite recently, work experience as a boiler and turbine operator was a mandatory condition for an assignment to a major power unit as an operator. This long and especially empirical method of training operators--operators who frequently have a higher technical education--provides them with a broad and firm foundation, hands-on experience, knowledge and associative relationships between the information model and the actual processes being controlled. When promoted, a gradual increase in the complexity, an expansion in the scale and an increase in the degree of responsibility of the tasks being accomplished take place; the degree of success in accomplishing these tasks serves as the most adequate and natural factor in selecting operators and advancing them to a higher position. Let's point out in passing that this method of practical training causes a relatively low level of significance for the structure of the information models since the operators use large amounts of specific knowledge about the facility, as if it were latent knowledge behind the information model.

However, this extensive method of training and selection does not meet the modern conditions of the mass nature of the operator vocations.

Courses for training executives and operators are being set up; various kinds of simulators are being disseminated.

Undoubtedly, the use of simulators plays a significant role by supplementing the theoretical training for operators. However, as a simplified and artificial model of the facility, the simulator cannot completely replace training under actual facility conditions. Therefore, upon immediately landing in high levels of the management hierarchy after this kind of training, the operators find themselves in a more difficult straits when problem situations arise than do their colleagues who have gradually been advancing to this level for a long time.

The possibility of spreading neuro-psychological illnesses among the operators as a result of introducing artificial, accelerated training methods which give rise to incomplete and inadequate psychological models of the facilities being controlled, the computers and the abstract display systems makes the problem of individual adaptation of training programs and technical equipment important to the state.

During the process of creating a psychological theory for synthesizing systems of adaptive interactive communication (hybrid intelligence), it is necessary to solve the following basic problems:

1. Study the principles of the stochastic determination of an individual's behavior by the structure and equipment of interactive communication. The primary issues are those of controlling the operator's attention and adequately presenting him with incomplete, a priori data and advice with a limited level of confidence with due regard for the operator's individual features.

2. Create a systems methodology for discovering the psychological structure and for doing a qualitative and quantitative analysis of the factors and criteria on the complexity of solving conceptual and perceptual problems. Specifically, the structural-psychological concept of synthesizing the technical equipment for work can serve as a theoretical basis for solving this problem.

3. Discover the psychological principles for the flow of conceptual, mnemonic and perceptual processes under the conditions of intensive interactive communication.

It is especially important to begin experimental research of the processes for forming multidimensional, collective psychological models of complex situations which are beyond the scope of the individual (for example, when time is scarce). In this way, methods of efficient interaction between participants in solving complex creative problems should be discovered, specifically during the stages of divergence (generating different ideas and approaches) and convergence (jointly carrying out the selected approach; forming the most adequate, uniform objective degree of reality for the collective psychological model). It is necessary to conduct a thorough psychological analysis of the experience of divergent interaction in "brainstorming" groups and of convergent interaction in "synergistic" groups*; these groups bear some of the features of promising systems of hybrid intelligence.

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* See, for example, P. Hill. "Nauka i iskusstvo proektirovaniya" (Science and the Art of Planning), translated from English, V. F. Venda, ed., Moscow, "Mir," 1974.

From the point of view of the concept of adaptive interactive communication which we have developed, it is not so important to study isolated, individual creativity in the research on the psychology of creativity as it is to analyze the effect of interactive communication on the individual's creativity. It is necessary to begin forming requirements for the optimal methods, structure and means of interactive communication in the creative process and it is necessary to begin preparing information and managing the creative work of large formal and informal groups.

The important role of mass interactive communication in the creative process is specifically confirmed by the regular sequence of scientific and technological discoveries.* Moreover, the forecasted increase in the number of discoveries required for scientific and technological progress can occur not so much by increasing the personnel strength of scientists and material expenditures on research as by specifically intensifying and adapting interactive communication between scientists, engineers and society as a whole. By organizing and managing interactive communication, time periods can be significantly reduced for discovering significant requirements, setting important tasks, generating a multitude of possible approaches to their solution, synchronizing the thinking of many scientists and specialists on the most promising ideas (the situation known by the phrase "the idea hangs in the air") and achieving the resounding event of overcoming the next wall of ignorance as the final phase in the routine work cycle of the collective hybrid intelligence; after this, a new cycle begins with the discovery of new problems.

4. Select the optimal levels, methods and means for adapting the structure and equipment of interactive communication for accomplishing various functions under normal and extreme conditions. At this point, it is important to accumulate and systematize factual data on individual behaviorial features and to create an engineering psychological theory of compensation for negative manifestations of individual features from the point of view of accomplishing functions.

Solving this problem will enable engineering psychology to significantly facilitate the psycho-physiological selection for such a prestigious vocation as operator and, in a number of cases, to replace it by individual adaptation of work conditions and implements. In addition, it is possible to expect a rapid increase in the number of vocations which were unsuitable for man or beyond his endurance without this kind of adaptation.

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*See A. G. Ivakhnenko. "Dolgosrochnoye prognozirovaniye i upravleniye slozhnymi sistemami" (Long Range Forecasting and Management of Complex Systems), Kiyev, 1975.

5. Study the biological and social aspects of organizing adaptive interactive communication and the relationships between them.

In this respect, it will be necessary to clarify the fundamental, phylogenetically determined properties of the malleability of the psyche, physiology and biology of men and animals.

The study of the social determination, organization and stimulation of the processes of interactive communication when operational (control), scientific and other creative problems are being solved with the assumption of equal prestige and equal responsibility for all participants; a study of the dynamic nature of the hierarchical structure; the optimal combination of biological and socio-psychological factors--these are the most important conditions for efficient functioning of systems of hybrid intelligence as a single organism in the decision making mode.

Functional systems theory (after significant, additional work) and the methods of social psychology, individual psychology and differential psychophysiology can become the starting point for researching these aspects.

6. Develop the psychological aspects of a theory and methods for storing, reorganizing and reproducing the actual aspects of the knowledge (wisdom) of the human population in order to make maximum use of all current experience in solving each specific problem.

The key for solving this problem is undoubtedly the solution of the scientific and technological problems of creating data banks, an overall state automated control system, a network of computer centers, etc. However, we would like to emphasize the extremely important psychological issues of interactive communication between large groups and complex computer systems under specific conditions, for example, under the dynamic hierarchy and individual adaptation of information equipment which are characteristic of the systems of "hybrid intelligence."

It is necessary to specify that, by hierarchy, we do not mean administrative subordination but the primary direction for joint information support during a particular phase of the system's work depending on the specific course of the problem solution.

The search for general principles and specific features of interactive communication in managing the national economy, in science and in culture is of special interest.

7. The development of physical, mathematical, biological and other models of adaptive interactive communication based on general systems theory is of definite research importance. At the same time, to avoid a repetition of the rapid, profound crisis which befell the so-called simulated modeling of sociotechnical complexes, it is necessary to observe practical and experimental control conditions for the basic elements of the models for their scope (gradually increasing the complexity of the structure) and for their theoretical and psychological substantiation.

8. Develop an engineering psychology theory and methods for synthesizing and forecasting the development of systems and equipment for adaptive interaction.

Overall, it seems to us that developing the problems of organizing adaptive interactive communication during the process of solving complex creative problems in management, science and culture will be an extremely important and promising direction for theoretical and applied engineering psychology research for the coming 30-40 years.

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GENETICS

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EXPERIMENTAL SUBSTANTIATION OF THE PRINCIPLES OF GENE MUTATION MONITORING IN MAN

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 243 No 5, 1978 pp 1313-1316

[Article by Academician N. P. Dubinin, Yu. P. Altukhov, I. I. Suskov, R. I. Khil'chevskaya, K. I. Afanas'yev, T. N. Malinina, M. K. Bol'shakova, A. V. Shurkhal, O. L. Kurbatova, and V. D. Prokhorovskaya]

[Text] Because the biosphere is being contaminated by mutagens, genetics is faced with the urgent task of developing methods for directly evaluating the intensity of mutation and differentiation of different types of genetic loads in human populations. It has been stated that it is apparently impossible to evaluate changing mutability in the contemporary human population (1). In recent years, however, an approach that has led to opposite conclusions (2-6) was developed as a result of research in population and biochemical genetics (7-9).

This approach is based on principles formulated earlier (2,3) and requiring: 1) A search for new mutations not by mass screening of the population but rather within a nonrandom sample of newborn infants and nursing children deviating from the norm in relation to a large complex of characteristics; 2) use, as labels of genetic mutations, of rare variants of monomorphic proteins determined by electrophoretic analysis; 3) use of a sufficiently large assortment of genetically polymorphic proteins and systems of blood groups to identify the segregational load and to exclude cases of debatable parentage. The first studies performed in accordance with this program demonstrated its effectiveness in relation to revealing the segregational load (6). We offer evidence of identification of *de novo* mutations in the present publication.

They were revealed by electrophoretic analysis of blood proteins in a small group of prematurely born children (50 individuals) and children (newborn and up to 1 year old) with congenital developmental abnormalities (177 individuals) under observation in specialized clinics. The "control" group consisted of 500 healthy newborn infants from conventional obstetric hospitals. Concurrently we studied the mothers and fathers of all premature children and of some children with developmental abnormalities, the mothers of healthy children, and 1,300 male donors. The obtained data will be subjected to detailed analysis later. In this publication we will present only the main results of our research.

We studied the following gene loci, which encode synthesis of proteins and erythrocyte antigens: LDH_A, LDH_B, MDH, PGM_1, PGM_2, erythrocytes Es (4 loci), EsD, PGDH, ACP, GPT, GLO_1, ADA, SOD_A, Hb (2 loci), Hp, Gc, Tf, Alb, ABO, MNSs, Rh(CDE), P.

Protein variants--ordinary and rare--were revealed by electrophoresis in polyacrylamide and starch gels (15) with some modifications. Blood groups were determined by standard serological methods.

Inasmuch as new gene labels were added in the genetic screening as our program developed, not all children were studied in relation to the entire set of loci. Table 1 reflects only some of the data we collected, the volume of which will continue to grow. It follows from the table that there are obvious differences between the two groups being compared in relation to the frequency of rare protein variants: While only five variants exhibiting altered electrophoretic mobility can be found in the control group, there are 15 among premature children and children with developmental abnormalities. This means that in the latter case the average frequency of rare genes is about one order of magnitude higher than in the former case.

These data alone, which establish that rare electrophoretic protein variants are encountered quite frequently in the group of abnormal individuals, have fundamental significance. They confirm the earlier hypothesis (9) that a correlation exists between genetically monomorphic characteristics and the individual's viability, and it would seem that they permit us to assert that the dominant share of electrophoretically determined rare protein variants is not inherited from previous generations.

In fact, analysis of the blood of the mother and father of a premature child with a variant genotype in relation to LDH_A (Figure 1) clearly showed that this variant was absent from the parents, while parentage cannot be excluded in relation to 16 polymorphic loci.

For understandable reasons it was extremely difficult to obtain blood samples from the parents of children with multiple abnormalities. Nevertheless we were able to study four families in which the child exhibited a rare protein variant, and to reveal that the same pattern is observed here as well: The variants of erythrocyte esterase (two cases), phosphoglucomutase (one case), and albumin (one case) found in the children were absent from both parents (Figure 1).

Here as in the case of mutation in relation to lactate dehydrogenase, parentage cannot be excluded in relation to a number of polymorphic genes (Table 2), and consequently there are substantial grounds for believing that the identified mutations arose *de novo* and were not inherited from previous generations.

Table 1. Frequency of Rare Electrophoretic Variants of Protein in Healthy Infants, Premature Children, and Children with Developmental Abnormalities

(1) Электрофоретически исследованные белки	(2) Здоровые новорожденные дети		(5) Дети с пороками развития и недоношенные	
	(3) величина выборки, чел.	(4) число лиц с редким вариантом	(3) величина выборки, чел.	(4) число лиц с редким вариантом
(6) Лактатдегидрогеназа эритроцитов	498	1 *	227	1
Малатдегидрогеназа эритроцитов (7)	498	1	227	0
(8) Фосфоглюконатдегидрогеназа эритроцитов	504	1 *	226	2(1 *)
(9) Эстераза эритроцитов	498	1 *	227	4(1 *)
Фосфоглюкомутаза эритроцитов (10)	427	1	193	3
(11) Кислая фосфатаза эритроцитов	298	0	143	1
Супероксиддисмутаза эритроцитов (12)	207	0	133	0
(13) Глютаматпируваттрансаминаза эритроцитов	156	0	82	0
(14) Гемоглобин	498	0	227	2
Трансферрин сыворотки (15)	504	0	222	1
(16) Группоспецифический компонент сыворотки	499	0	223	0
(17) Альбумин сыворотки	498	0	227	1
Средняя частота на локус на индивидуум (18)	0,000312±0,000140		0,002035±0,000525	

* Variants discovered in the same individual.

Key:

1. Electrophoretically analyzed proteins
2. Healthy newborn children
3. Sample size, individuals
4. Number of individuals with rare variant
5. Children with developmental abnormalities and premature children
6. Erythrocyte lactate dehydrogenase
7. Erythrocyte malate dehydrogenase
8. Erythrocyte phosphogluconate dehydrogenase
9. Erythrocyte esterase
10. Erythrocyte phosphoglucomutase
11. Erythrocyte acid phosphatase
12. Erythrocyte superoxide dismutase
13. Erythrocyte glutamate-pyruvate transaminase
14. Hemoglobin
15. Serum transferrin
16. Serum group-specific component
17. Serum albumin
18. Average frequency per locus per individual

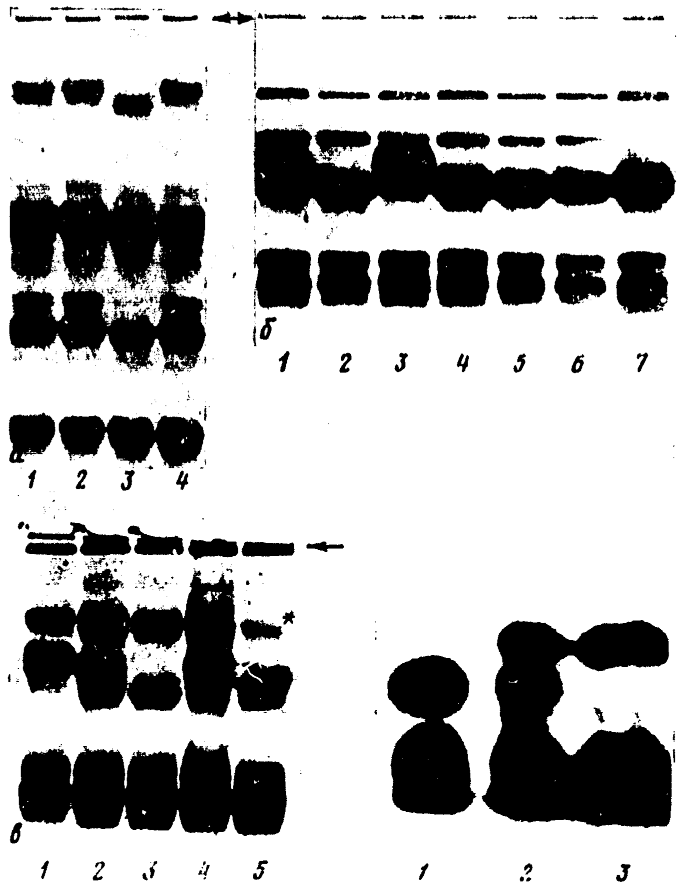

Figure 1. Examples of "Rare" Electrophoretic Protein Variants Detected in the Blood of Children with Developmental Abnormalities: *a*--Zymogram of erythrocyte lactate dehydrogenase: *3*--Child with mutant genotype; *1,2*--child's mother and father respectively; *4*--child with normal genotype; *b,c*--zymograms of erythrocyte esterase. Figure 1*b*: *7*--Mutant genotype; *4,5*--child's mother and father; *1-3,6*--normal genotypes. Figure 1*c*: *5*--Phenotype with sharply weakened activity of one of the esterase zones (noted by *); *1-4*--normal genotypes. Electrophoresis in polyacrylamide gel; *d*--zymogram of erythrocyte phosphoglucomutase: *3*--phenotype with sharply reduced activity in one zone; *1,2*--phenotypes of parents (mother and father respectively). Electrophoresis in starch gel. In all photographs, the cathode is above and the anode is below. Arrow points to start position.

Table 2. Genotypes of Children Carrying Mutant Genes and of Their Parents, Polymorphic Loci

(1) Исследованные семьи, в которых обнаружена мутация	(2) Эритроцитарные антигены				(3) Белки крови									
	ABO	MNSs	Rhesus	P	PGD	Tf	Gc	ACP_1	SOD-A	PGM_1	EsD	GPT	ADA	Hp
(4) Ребенок (μLDH_A)	B	MNss	ccDEe	P−	AA	CC	1—1	AB	—	1—2	1—1	1—2	1—1	1—1
(5) Мать	B	MMSs	ccDEE	P−	AA	CC	1—1	BB	—	1—1	1—1	2—2	1—2	1—1
Отец (6)	B	MNss	ccDEe	P−	AA	CC	1—1	AA	—	1—2	1—1	1—2	1—1	1—2
Ребенок (μPGM_1)	B	MNSs	ccDEe	P+	AA	CC	1—1	BB	1—1	1—0	—	—	—	—
Мать	AB	MNSs	ccDEe	P+	AA	CC	1—1	BB	1—1	1—2	—	—	—	—
Отец	A	MNSs	CcDEe	P+	AA	CC	1—1	BB	1—1	2—2	—	—	—	—
Ребенок (μEs)	A	MNss	CcDEe	P−	AA	CC	1—2	BB	1—1	1—2	—	—	—	—
Мать	A	MNss	CcDEe	P−	AA	CC	1—2	BB	1—1	1—2	—	—	—	—
Отец	OO	MNss	CcDee	P+	AA	CC	1—1	BB	1—1	1—1	—	—	—	—
Ребенок (μEs)	OO	MM	Rh+	P+	AA	CC	1—2	—	—	—	—	—	—	2—2
Мать	OO	MM	Rh+	P+	AA	CC	1—2	—	—	—	—	—	—	2—2
Отец	OO	MM	Rh+	P+	AA	CC	1—2	—	—	—	—	—	—	1—2
Ребенок (μAlb)	A	MN	Rh+	P−	AA	CC	—	—	—	—	—	—	—	1—2
Мать	OO	MN	Rh+	P+	AA	CC	—	—	—	—	—	—	—	1—2
Отец	A	MN	Rh+	P+	AA	CC	—	—	—	—	—	—	—	1—2

Key:

1. Studied families in which mutation was detected
2. Erythrocyte antigens
3. Blood proteins
4. Child
5. Mother
6. Father

The fact that rare electrophoretic variants of monomorphic proteins have a negative influence on morphogenesis and development makes the conclusion undebatable.

Cases of detecting *de novo* mutations in serum proteins and erythrocyte enzymes in large population groups have not been described yet. Harris et al. (10) generalized the results of many years of research on Europeans in whose blood rare electrophoretic protein variants were revealed. They showed that arisal of the rare variant in the given generation could not be ascribed to mutation in any of 77 families, none of which were related; in all cases the variant was found in either the mother or the father--that is, it was inherited from previous generations. Such variants can in fact be classified as selectively neutral. Their "compatibility" with ontogenesis is possibly associated with the concrete state of the environment and (or) particular features of the integral structure of the genotype. There might also be differences in the nature of amino acid substitutions. The authors (10) attempted to make a probabilistic assessment of the upper limit of the mutation rate for genes encoding synthesis of serum and erythrocyte enzymes, and they showed that a mutation rate greater than $2.24 \cdot 10^{-5}$ per gene per generation must be excluded with a probability of $P \geq 0.95$. According to a recent estimate made by Nei (11), who used Neel's data (12), the mutation rate for genes responsible for synthesis of blood proteins is about $7.2 \cdot 10^{-6}$.

If we assume that only five of the variant protein types shown in Table 2 can be classified as "new" mutations, then the average gene mutation rate for this group is about $2 \cdot 10^{-3}$ per locus per generation, considering that only a third of the individual amino acid substitutions are revealed electrophoretically. This estimate might increase as the set of analyzed proteins is expanded.

Thus while Neel (13,14) suggests mass electrophoretic analysis of blood samples from hundreds of thousands and millions of persons, the data we obtained showed that selective screening within the framework of the formulated approach (2-4) is all that is necessary for the purposes of monitoring the mutation load in human populations.

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PUBLICATIONS

COMPUTERS IN NEUROPHYSIOLOGICAL RESEARCH

Moscow EVM V NEYROFIZIOLOGICHESKIKH ISSLEDOVANIYAKH in Russian 1978 signed to press 21 Jul 78 pp 2, 3-8, 239

[Annotation, introduction and table of contents from book by V. D. Trush and A. V. Korinevskiy, Izdatel'stvo "Nauka", 1400 copies, 239 pages]

> [Text] This monograph is concerned with the use of laboratory computers in neurophysiological research. Topics include the genesis and statistical structure of the total electrical activity of the cerebral cortex and mathematical methods for its study. A detailed presentation is given for computer-generated methods of multiple spectrum correlational analysis and evaluation of the amplitude-time organization of cerebral processes according to EEG data. The distinctive features of neurophysiological research hardware and software are elaborated with a description of an operational systems supervisor oriented to carry out such experiments, and the architecture of the computer which inplements this system. 6 tables, 60 illustration, 496 references.

Introduction

Research on the brain's electrical activity has been actively developed for more than five decades and is becoming even more vital. The foundation for this research was laid by the discovery of the fluctuating voltages which comprise the so-called fundamental electrical activity of the brain, first recorded by Prawdicz-Neminski (1925) in animals; and by Berger (1929) in humans. Later on, as techniques for sensing and amplifying biopotentials and methods of registration and analysis of electrograms were improved, a large number of forms of electrical brain activity were described. In some classifications, there are several dozen forms (Sokolov, 1962; Kozhevnikov, Meshcherskiy, 1963; Gusel'nikov, 1976). All bioelectrical activity of the cerebrum is customarily divided into two extreme groups: pulsed and total slow activity.

During the entire evolutionary history of electrophysiology of the CNS, the most widely employed method of total registration of the brain's electrical potentials has been dubbed "electroencephalography." Total registration of electrical voltages is used to study the brain's ontogenesis and phylogenesis; to reveal the mechanics of conditioned reflex connections and the actions of narcotics and other drugs; to analyze the formation and interaction of the brain's functional systems which implement higher mental functions; and to study and diagnose various CNS lesions in neurosurgical and psychiatric clinics.

The method of electroencephalography is applied to solve a wide range of problems (although the list of them is far from complete), since it allows us to observe processes occurring in various sections of the human and animal nervous system and is the most direct, and currently the sole, means of obtaining information about these processes.

The initial optimism expressed by researchers that simple relationships could be established between the processes of information handling and the EEG was found to be unjustified. In spite of the fact that electrophysiology is replete with a great deal of wide-ranging factual data aimed at describing EEG samples in different physiological states, the variegation of these data and its frequent contradictory nature do not imbue it with the ability to reliably define general patterns linking electrical reactions of the brain with the physiological functions of the organism.

The problems found in defining these patterns are particularly associated with the inadequate theoretical and experimental level of development of the nature of total electrical activity of the brain and its connected structural links. This in turn makes it impossible to extract the most meaningful elements and fragments of recordings from complex and deceptive EEG curves.

The comparatively slow progress in resolving fundamental questions of electrophysiology seems to be related to the fact that the study target is much more complicated and deceptive than that in other sciences, such as astronomy, physics or chemistry. In addition, electrophysiology (and biology in general) is much slower than the "strict sciences" noted above to adopt quantitative methods of study. Due to the enormous complexity of the phenomena being studied, many physiologists are still uncertain of the broad application of mathematical methods. For this reason, and for a number of objective reasons (state of the art of registering and processing large quantities of data, development of methods of applied mathematics), the overwhelming majority of facts accumulated by electrophysiology come from visual analysis and oral descriptions of electrograms. A natural outcome of this is the current feeble faith in the data being described and problems of comparison. A similar situation may be encountered, it would seem, in any branch of scientific research if we are dealing not with evaluations and comparisons of subjective impressions, but with objective analysis of phenomena in the real world; the language of quantitative measurements and comparisons must be used, at that. No matter how strange it seems, these natural considerations do not appear to be unconditionally evident in modern physiology. This is particularly clearly shown by the fact that in recent years works have continued to be published and to enjoy popularity in which a wide, convincing justification is given for the effectiveness and necessity of using mathematical methods in biology in general and in electrophysiology in particular (Beyli, 1970; Fomin, Berkinblit, 1973).

Electrophysiology, at the same time, is a clear example of a field of natural scientific research where it is theoretically impossible to do without the language of mathematics. In fact, a rather typical example of a single experiment with EEG inspection is the registration of hundreds of meters (at the standard rate of EEG recording) of the more complex curves. If recording is done (or interpreted) in digital form, the problem of analyzing these data contains an extremely large number of interrelated factors, each of which is subject to variation within limits which are not always accessible to experimental control. Under these conditions, human intellect seems unable to survey this "ocean of data" and explain and study the entire set of interdependent measurements. The oral description of these observations is even less promising.

Progress is clearly only possible when factual material is produced to reveal its informational value. That is, EEGs must be objectively, quantitatively analyzed using mathematical methods of analysis.

The tendency to use analytic methods which allow quantitative definition of unknown functions arose at almost the same time as the birth of electroencephalography. The initial use of mathematical methods was begun by Dietsch (1932) and Livanova (1934) in studying the frequency composition of EEGs. Such works were, however, for a long time rare episodes in the physiological literature mainly due to the labor-intensiveness of the methods. The development of mathematical methods received a significant push in electrophysiology in the late 1940s when computers first appeared.

It was expected that the use of mathematical methods and high-speed computers would permit rapid decoding of information contained in the EEG; and a correlation to be found between the nature of electrical activity and behavioral acts. But progress was quite modest in this area.

It appears that it is now still impossible to exhaustively explain the fact that in the 30 years of existence of the computer (a unique technical invention which is one of the most powerful and all-purpose devices in research activity) so little has been contributed to the evolution of physiology. But some problems standing in the way of effective utilization of computer technology in electrophysiology are obvious. For example, we could show such factors as the need for the physiologist-researcher, when attempting to use digital computers in his work, to solve a multitude of problems which are unfamiliar to him. In particular, for each computer with a given set of technical characteristics there are problems of data input, screening superfluous material, excluding artifacts, a convenient method of presenting the end result of processing, programming, and so forth. As a rule, physiologists have been unprepared to solve these problems. Disappointment now awaits even those researchers who feel that they only need time and tedious labor to overcome problems. This is especially linked with a "shortcoming" of computer technology such as its exceedingly high speed, the frequent updating of computer types and generations, software, and programming. This all makes the user feel that computers are "obsolete" as soon as they start up, so you have to hurry as fast as you can not to fall behind, but you still remain in the very same place (Hamilton, 1971).

The abundance of current and planned computers also creates a difficult problem of selecting a computer to "hook up" with one's studies. The primary question here is whether to use a specialized or all-purpose computer. The decision can involve a compromise between the technical possibilities of the computer selected and the expenditures of acquisition and maintenance. Choosing an all-purpose computer in turn gives rise to an alternative: a laboratory-type mini-computer or a large central processor of the institute or interinstitute type? The certain advantages of large computers (evolved software, high speed, and memory capacity) can be offset by such deficiencies as difficulty in access to the computer, longer maintenance periods, the need for large amounts of clerical and administrative work, problems of changing programs and transmitting data from the laboratory to the computer room, and so forth.

But the solution of all technical, administrative and financial problems is only a prelude to the primary question: what can be solved with the computer and how? The popular opinion that "computers can do everything" is not always connected with an understanding that the lack of a clearly stated problem can make the computer (like mathematical methods in general) useless.

We should still bear in mind that even the most thorough formulation of problems and a correct application of mathematical methods will not guarantee rapid success and will not spare researchers from disappointment if they expect too much from the "mechanization" of physiological research. And this is not a matter of partial errors and underestimates or shortcomings of the computer or methods used. The main cause could be the wrong choice of approach to the entire problem of analysis of physiological data. It can not be excluded that algorithmic methods may theoretically not be applicable to decode this kind of data. An analogy is suggested here with problems encountered by researchers involved with machine translation. We know that the problems encountered have made them totally revamp their entire approach to language structure (Taube, 1967). When analyzing "brain language", especially electrograms, time may prove it necessary to make basic changes in current approaches.

With the transition to computer analysis of data, electrophysiology is now using more or less traditional mathematical methods borrowed mainly from the storehouse of the technical sciences: information theory, signal processing, operations research, pattern recognition, etc. The increased quantity of factual data is growing at very fast rates. The number of studies (articles, dissertations) done using computer is also rising. At some laboratories and institutes, for several years since the acquisition of computers, the number of these studies has greatly exceeded the volume of research in which "machine" methods were not employed (Ivanov, Kleshchev, 1975). It seems we can say that the computer has been turned from an exotic device--powerful, unfamiliar, obedient only to a small group of devotees--into a common instrument of physiological research.

Nevertheless, in spite of the almost daily use of computers and the wider arsenal of mathematical methods, until now the pictures of EEGs and the mechanics of various EEG rhythms still remain greatly unclarified. It is still unknown which EEG parameters are associated with information processes in the brain, and how much is reflected in electrograms of the brain of "physiological provision of mental functions" (Bekhtereva, 1974). Finally, one of the main problems in electrophysiology has not been surmounted: the absence of direct effector manifestations of EEG phenomena.

Problems of improving methods of EEG analysis, finding more meaningful parameters, studying the nature of individual forms of electrical activity and their connection with the basic aspects of CNS activity are thus as urgent as before.

Attempts to solve some of these problems were investigated by the authors for the past 10 years and more. This study is a generalization of some of the results obtained in that time. The studies were not aimed at examining and comparing the meaningfulness of various methods of EEG analysis or efficient use of computers in electrophysiology. A more modest task was set: to evaluate the functional significance of spectral-correlational parameters of EEGs and amplitude-time characteristics of voltages simultaneously sensed from many points on the brain. These questions were resolved by successive application of methods of spectral-correlational theory of random processes and the use of a control digital computer. The results of the work presented in this book, we feel, rather convincingly prove the effectiveness of using computers to solve similar problems, and are evidence of the meaningfulness of some EEG indicators which can only be evaluated with computer data processing.

In the course of research many secondary problems had to be solved, of course: organization of computer data processing in real time, statement of controlled experiments, hardware and software, studying the statistical structure of signals being recorded, distinctive features and error of the variables being analyzed, etc. All of these problems were reflected in this book. Diverse literary data have been drawn upon in presenting the material. But the authors have not aimed at giving an exhaustive literary review of all studies touching upon the questions of interest.

Research was carried out from 1964 to 1975 at the human and animal conditioned reflex laboratory of the Institute of Higher Nervous Activity and Neurophysiology of the USSR Academy of Sciences. The authors are indebted to supervisor M. N. Livanov and to all the laboratory co-workers for their constant aid and support. We feel obliged to express our sincere thanks to colleagues who collaborated on inidividual portions of the research: T. A. Korol'kova, I. N., Knipst, G. A. El'kina, L. A. Potulova, M. N. Zhadin, T. M. Yefremova, N. S. Kurova, L. V. Tishaninova, I. V. Misochko, P. N. Dubner, A. M. Sherstov, Ya. A. Vasil'yev, Ye. M. Belyavskiy, V. P. Markin, and O. V. Afanas'yev. The authors also thank N. A. Lazareva for the great assistance rendered in preparing the manuscript.

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SCIENTISTS AND SCIENTIFIC ORGANIZATIONS

USSR ACADEMY OF SCIENCE ANNOUNCEMENTS OF MEDALS AND PRIZES

Hero of Socialist Labor

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 10, 1978 pp 139-140

[Article: "Academician P. N. Fedoseyev, Hero of Socialist Labor]

[Text] For great services in the development of the social sciences, for active social and political work, and in connection with his 70th birthday, Vice-President of the USSR Academy of Sciences, Academician Petr Nikolayevich FEDOSEYEV was awarded the title of Hero of Socialist Labor and the Order of Lenin by the Ukase of the Presidium of the USSR Supreme Soviet of August 21, 1978.

P. N. Fedoseyev is a prominent Marxist scientist, a specialist in the field of dialectics and historical materialism, and the theory of the building of communism. He has made profound investigations into questions of Marxist-Leninist philosophy, theoretical problems of contemporary social development, sociology, present day problems of the building of communist society, and the education of the new man. Of special significance are his works devoted to investigating fundamental questions and patterns of the development of socialist society and the struggle against contemporary bourgeois ideology, reformism and revisionism. Academician P. N. Fedoseyev has made a considerable contribution to solving the philosophical problems of contemporary natural sciences and strengthening the union of representatives of the concrete sciences, especially naturalists and philosophers.

As one of the leading soviet social scientists, P. N. Fedoseyev is constantly engaged in solving problems in the creative application of materialist dialectics to investigating fundamental problems of social development, and, to analysis of the properties in the manifestation of basic Marxism-Leninism laws during transition from capitalism to socialism and during the building of socialism. Problems of the philosophical basis of scientific communism, together with current problems of the application of Marxism-Leninism--as an integral system of philosophy, economic and social-political views--to the theory and transformation of present day life, were the subject of P. N. Fedoseyev's scientific quest during almost a half century of research activity.

Many years of P. N. Fedoseyev's scholarly activity were devoted to working out basic categories in historical materialism. He has made a great contribution to the development of knowledge on productive forces and relations of production and to the resolution of problems related to material conditions of social life. His articles and books on problems of socialism and proletarian humanism and works on the historical development of Marxist-Leninist ideas and their relation to the present are widely known.

Major works were noted in the creative work of P. N. Fedoseyev during the 1960's and 1970's. At that time his books on analysis of and generalization about major tendencies in contemporary social development were published: "Kommunizm i filosofiya" [Communism and Philosophy], "Marksizm v XX veke" [Marxism in the Twentieth Century], "Dialektika sovremennoy epokhi" [The Dialectics of the Present Epoch] and others. These works are characterized by profound understanding of the multiform changes occurring in the world, the ability to discern in their contradictory intertwining the main line of the socioeconomic development of mankind--the abolition of the exploitation of man by his fellow man and affirmation of the free and all-around development of the individual--and detailed theoretical analysis of problems of the contemporary liberation movement.

The works of P. N. Fedosoyev examine the basic tasks of political scientists, the major trends of the scientific quest. They touch upon the basic trends of political science, from questions related to increasing the social and economic effectiveness of production, the perfecting of the mechanism of the national economy and the introduction of program-focused methods of planning, to working out of a conception of the fundamental rights and freedoms of man and problems of perfecting forms of socialist democracy, analysis of the content and structure of scientific ideology, and questions of communist education and the socialist way of life.

P. N. Fedoseyev is engaged in important scientific organizational work. He was director of the Institute of Philosophy of the USSR Academy of Sciences, academician secretary of the Economic, Philosophic and Legal Sciences Department and later of the Philosophy and Law Department of the USSR Academy of Sciences. In 1962, P. N. Fedoseyev was, for the first time, elected vice-president of the USSR Academy of Sciences and chairman of the Social Sciences Section (he held this position until 1967). From 1971 to the present, Vice-President of the USSR Academy of Sciences P. N. Fedoseyev has again headed the Social Sciences Section of the Presidium of the USSR Academy of Sciences.

P. N. Fedoseyev has successfully combined research and scientific organizational work with social, political and governmental activity. For many years he worked in the apparatus of the CC CPSU and was editor-in-chief of the periodicals BOL'SHEVIK and PARTIYNAYA ZHIZN' Party Life. From 1967 to 1973, he occupied the post of director of the Institute of Marxism-Leninism of the CC CPSU. P. N. Fedoseyev is a member of the CC CPSU, deputy of the USSR Supreme Soviet, the chairman of the National Education, Science and

Culture Commission of the Council of Nationalities of the USSR Supreme Soviet and chairman of the Society for Soviet-Hungarian Friendship.

P. N. Fedoseyev's many years of selfless work for the good of our country is highly esteemed by the Soviet government. He has been awarded three Orders of Lenin, three Orders of the Red Banner of Labor, the Order of the Patriotic War, first degree, and many medals.

P. N. Fedoseyev's many-sided activity in the field of science has won the recognition of the international scientific community. He was elected an honorary member of the Hungarian Academy of Sciences and a foreign member of the Bulgarian, Czechoslovakian and Polish Academies of Sciences and of the Academy of Sciences of the GDR.

P. N. Fedoseyev has devoted all his powers and talents to selfless service to science, social progress and to the triumph of communism.

Gold Medals and Commemorative Prizes

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 10, 1978, pp 140-141

[Text] The USSR Academy of Sciences announces competitions for 7 gold medals and 18 commemorative prizes.

Gold Medals

The I. P. Pavlov Medal is awarded to soviet scientists for their work as a whole in the development of the teachings of I. O. Pavlov (deadline for submission of works - October 24, 1978).

The A. P. Karpinskiy Medal is awarded to soviet and foreign scientists for a body of distinguished scientific work in the fields of geology, paleontology, petrography and minerology (deadline for submission of works - October 7, 1978).

The D. I. Mendeleyev Medal is awarded to soviet scientists for distinguished works in the field of chemical science and technology (deadline for submission of works - November 7, 1978).

The S. I. Vavilov Medal is awarded to soviet scientists for distinguished works in the field of physics (deadline for submission of works - December 24, 1978).

The D. K. Chernov Medal is awarded to soviet scientists for distinguished works in the fields of the physical chemistry of metallurgical processes and metallurgy (deadline for submission of works - August 1, 1979).

The S. P. Korolev Medal is awarded to soviet scientists together with a monetary prize of 2000 R for distinguished works in the field of aerospace technology (deadline for submissions - September 30, 1979).

The A. N. Tupolev Medal is awarded to soviet scientists together with a monetary prize of 2000 R for distinguished works in the field of aeronautic science and technology (deadline for submission of works - August 10, 1979).

Commemorative Prizes (awarded to soviet scientists)

The I. P. Pavlov Prize (2000 R) is awarded for the best scientific works in the field of physiology (deadline for submission of works - October 24, 1978).

The A. P. Karpinskiy Prize (2000 R) is awarded for distinguished scientific works in the fields of geology, paleontology, petrography and minerology (deadline for submission of works - October 7, 1978).

The K. M. Bykov Prize (1500 R) is awarded for scientific works in the fields of physiology: cortico-visceral physiology, the physiology of digestion and balenology (deadline for submission of works - October 21, 1978).

The V. V. Dokuchaev Prize (2000 R) is awarded for distinguished scientific works in the field of soil science (deadline for submission - December 1, 1978).

The S. A. Chaplygina Prize (1000 R) is awarded for the best original work on theoretical research in the field of mechanics (deadline for submission of works - January 5, 1979).

The K. A. Timiryazev Prize (2000 R) is awarded for the best works in the fields of plant physiology and general biology (deadline for submission of works - March 3, 1979).

The V. G. Belinskiy Prize (2000 R) is awarded for the best scholarly works in the fields of literary criticism, theory and history (deadline for submission of works - March 13, 1979).

The N. G. Chernyshevskiy Prize (2000 R) is awarded for scientific works in the social sciences (deadline for submission of works - April 24, 1979).

The S. N. Vinogradskiy Prize (2000 R) is awarded for the best works in the field of general microbiology (deadline for submission of works - June 1, 1979).

The L. A. Chugaev Prize (2000 R) is awarded for the best works in the field of the chemistry of complex compounds (deadline for submission of works - July 5, 1979).

The A. M. Butlerov Prize (2000 R) is awarded for the best works in the field of organic chemistry (deadline for submission of works - July 30, 1979).

The A. E. Fersman Prize (1000 R) is awarded for the best scientific works in the field of minerology and geochemistry (deadline for submission of works - August 8, 1979).

The P. N. Yablochkov Prize (2000 R) is awarded for the best works and best new constructions in electrotechnology (deadline for submission of works - August 17, 1979).

The A. O. Kovalevskiy Prize (1000 R) is awarded for the best works in the fields of general, comparative, descriptive and experimental embryology of invertebrates and vertebrates (deadline for submission of works - August 19, 1979).

The N. I. Vavilov Prize (2000 R) is awarded for distinguished research in the field of genetics, selection and plant breeding (deadline for submission of works - August 26, 1979).

The G. V. Plekhanov Prize (2000 R) is awarded for the best works in the field of philosophy (deadline for submission of works - September 11, 1979).

The N. S. Kurnakov Prize (1000 R) is awarded for distinguished works in the field of inorganic chemistry, physico-chemical analysis and its applications (deadline for submission of works - September 6, 1979).

The E. S. Fedorov Prize (1000 R) is awarded for distinguished works in crystallography (deadline for submissions - September 22, 1979).

General Provisions

With a view to encouraging scholars for distinguished scientific works, scientific discoveries and inventions having great significance for science and practice, the USSR Academy of Sciences awards gold medals and prizes commemorating distinguished scientists on the basis of competitions.

Gold medals are awarded for distinguished scientific works, discoveries and inventions or for a body of work of great scientific and practical significance; individuals may participate personally in the competitions for gold medals.

Commemorative prizes are awarded for the best individual scientific works, discoveries and inventions and also for a series of scientific works on one subject; as a rule, the works of individual authors may be submitted in competition for these prizes. When collective works are presented, only the principal authors are indicated, but no more than three persons.

The right to nominate candidates in the competition for gold medals and commemorative prizes is granted to: academicians and associate members of the USSR Academy of Sciences and of the academies of sciences of the union republics; scientific institutions, institutions of higher education; scientific and engineering societies; scientific and technical councils of governmental committees, ministries, departments, technical councils of industrial enterprises; design offices; scientific councils of the USSR Academy of Sciences and other departments on major problems of science.

In nominating a candidate for competition for a gold medal or prize, one must submit to the USSR Academy of Sciences (117901, GSP [Special City Postal Service], Moscow B-71, Leninskiy Prospekt, 14) no later than three months before the award date, with the superscription "For the Competition for the ______________ Gold Medal (Prize)":

a) Reasons for the submission, including the scientific character of the work, its significance for the development of science and the national economy;

b) The published scientific work (series of works), materials of scientific discovery or invention, in triplicate;

c) Information about the author (list of basic scientific works, discoveries, inventions, place of work and position held, home address).

Works awarded the Lenin Prize, the USSR National Prize and commemorative prizes of the academies of sciences of the union republics and branch academies are not accepted in the competition for gold medals and prizes commemorating distinguished scientists.

Scholars awarded gold medals and prizes are granted the right on publication of the works to note in the headline "Awarded the ____________ Gold Medal (Prize) of the USSR Academy of Sciences for 19__."

Each of these medals and prizes are awarded once every three years on a significant date in the life of the scientist whom the medal or prize commemorates.

The decision of the Presidium of the USSR Academy of Sciences on the awarding of gold medals and prizes and short annotations about the works awarded gold medals or prizes are published in the VESTNIK AKADEMII NAUK SSSR and IZVESTIYA AKADEMII NAUK SSSR of the corresponding series. VESTNIK AKADEMII NAUK SSSR contains portraits of the scientists awarded gold medals and prizes.

The published scientific works examined during the session of the Presidium which are awarded gold medals or prizes are transmitted for keeping to the Library of the USSR Academy of Sciences.

The gold medals and award certificates for gold medals and prizes are presented at the annual General Assembly of the USSR Academy of Sciences (during the first 10 days in March).

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