# FIFTY YEARS OF SOVIET EXPERIMENTAL BIOLOGY AND MEDICINE

The Great October Socialist Revolution took place 50 years ago. It marked the beginning of a new epoch in the history of mankind, the date of birth of the first socialist state in the world.

The victory of the socialist revolution laid the foundations for the rapid development of Soviet science.

Russian biology and medicine before the October Revolution had many scientific achievements of world-wide importance to its name, and even today the work of I. M. Sechenov and I. P. Pavlov, of I. I. Mechnikov and K. A. Timiryazev, of S. P. Botkin and N. I. Pirogov has not lost its importance. However, the material basis and opportunities for large-scale experimental research were restricted to a few universities: the Military Medical Academy, and the only research center – the Institute of Experimental Medicine. By the 1920s the young Soviet republic had begun to take steps for the development of science: new higher educational establishments had been opened, including some in the national republics, and a network of research laboratories and institutes was created: the Institute of Experimental Biology (Narkomzdrav), the Institute of Physiology (Narkompros), the Laboratory of Experimental Biology at the Zoological Gardens, the Laboratory of Experimental Zoology and Morphology of the Academy of Sciences of the USSR, the Institute of Experimental Morphogenesis (Narkompros), the Medico-Biological Institute (Narkomzdrav) and others. During this period the physiological school of I. P. Pavlov and the pharmacological school of N. P. Kravkov flourished, and new trends in science were set by the eminent physiologists N. E. Vvedenskii and A. A. Ukhtomskii, A. F. Samoilov, I. S. Beritashvili, L. A. Orbeli, K. M. Bykov, L. S. Shtern; the pathologists A. I. Abrikosov, N. N. Anichkov, A. A. Bogomolets', I. V. Davydovskii, and A. D. Speranskii; the biochemists A. N. Bakh, V. S. Gulevich, E. S. London, and A. V. Palladin; the biologists M. M. Zavadovskii, A. A. Zavarzin, N. K. Kol'tsova, and D. P. Filatov; and the oncologist N. N. Petrov. These trends largely determined the path of development of Soviet experimental biology and medicine.

In the 1930s, when considerable progress had been made in the national economy, scientific opportunities grew sharply. Many new universities, medical schools, and agricultural institutes were established, and the largest scientific center for that time was organized – the A. M. Gor'kii All-Union Institute of Experimental Medicine, subsequently serving as basis for creation of the Academy of Medical Sciences of the USSR. Investigations in the field of experimental biology and medicine were extended, the number of scientific research workers in this field was considerably increased, the scope of subjects studied was expanded, and the technical level of investigation was raised. A new journal was needed for providing constant information and improving the exchange of experience, and in 1936 our journal – the "Bulletin of Experimental Biology and Medicine" – began to appear. In the subsequent 30 years it has published short reports describing investigations in most branches of experimental biology and medicine.

Within the scope of this paper it is impossible to give a full account of even the most important advances in such a wide field. Only a brief survey of the main advances can be attempted, based mainly on material published in this journal.

In the physiology of the 1930s the study of higher nervous activity developed. During this period the principles governing formation of conditioned connections, including, in conditions of free behavior – the nature of internal inhibition, and other vital questions of cortical dynamics – were studied by P. K. Anokhin, É. A. Asratyan, P. S. Kupalov, and many others. Mechanisms of formation of neuroses and experimental treatment of disturbances of higher nervous activity were investigated by I. P. Pavlov's collaborators (A. G. Ivanov-Smolenskii, M. K. Petrova, and others).

The role of the higher levels of the central nervous system in compensation of disturbed functions was demonstrated by E. A. Asratyan in a number of researches. Investigations establishing the conditioned-reflex mechanisms of regulation of the activity of internal organs were widely developed (K. M. Bykov and co-workers). Original work, not conforming to the classical concepts, was carried out by I. S. Beritashvili

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to study complex forms of animal behavior. The study of many major problems in physiology of the nervous system was considerably widened and intensified. Parabiosis and the dominant (A. A. Ukhtomskii, L. A. Vasil'ev, A. N. Magnitskii), the adaptive-trophic function of the sympathetic nervous system (L. A. Orbeli and co-workers), the general principles governing the physiology of the central nervous system (I. S. Beritashvili, N. A. Rozhanskii), importance of the blood-brain barrier for activity of the central nervous system (L. S. Shtern and co-workers), the humoral transmission of excitation (A. F. Samoilov, A. V. Kibyakov)—these by no means complete the list of landmarks of progress in the physiology of the nervous system. Physicochemical investigations were carried out in the field of general physiology (D. N. Nasonov, D. L. Rubinshtein).

Soviet theories of the physiology of the sense organs began to develop during this same period (L. S. Andreev, G. V. Gershuni, S. V. Kravkov, A. V. Lebedinskii, and others). An important place is occupied by the physiology of digestion, extensively studied by I. P. Razenkov and co-workers in collaboration with morphologists (Yu. M. Lazovskii, K. M. Bykov and co-workers, A. N. Bakuradze, G. V. Fol'bort and others). In these investigations not only were the physiological principles of neuro-humoral regulation of the secretory and motor functions of the gastro-intestinal tract established, but clinically important data were obtained on the specific properties of digestion in man. The physiology of nutrition and of general metabolism was actively studied (N. N. Shaternikov and others).

The mechanisms of regulation of the circulation were studied with success by V. V. Parin, who described for the first time reflex connections between the pulmonary and systemic circulations; by A. I. Smirnov, A. A. Zubkov and others, who investigated the regulation of cardiac activity; by M. E. Marshak, who studied regulation of the circulation in various conditions of vital activity; and by G. P. Konradi, who investigated the peripheral tone of the blood vessels, and so on.

The comparative physiological, evolutionary line of investigation developed in the 1930s. Problems concerning the phylogenesis and ontogenesis of higher nervous activity of individual functions and general principles governing phylogenetic development of organisms began to be investigated in various laboratories from original standpoints and in different objects (L. A. Orbeli, P. K. Anokhin, D. A. Biryukov, L. G. Voronin, A. G. Ginetsinskii, Kh. S. Koshtoyants, E. M. Kreps, I. A. Arshavskii, A. A. Volokhov, A. A. Markosyan). An ecological movement appeared in physiology (A. D. Slonim).

During the Second World War, despite difficult conditions, scientific research in physiology continued. It was directed toward the solution of problems of providing aid for the country and for the Armed Forces. Important research was done on the treatment of shock and blood loss, restoration of disturbed functions after injury, the repair and grafting of tissues, nerves, and so on.

In the post-war years physiological research was established at a higher level. Problems in higher nervous activity and cortico-visceral relationships began to be studied in close connection with clinical practice, and experimental data provided a basis for hypotheses of the pathogenesis of many diseases. New advances were made in the study of the interoceptors, their central representation, and their role in the regulation of various physiological functions (V. N. Chernigovskii and co-workers, I. A. Bulygin, and others). Mechanisms of conditioned-reflex activity began to be studied by electrophysiological methods as well as by the classical methods (M. N. Livanov, V. S. Rusinov, A. B. Kogan, and others). The importance of ascending influences on the cerebral cortex, the study of which began in the USSR in the 1930s, occupied the center of attention of Soviet physiologists investigating the physiology of the reticular formation. Microphysiological investigations of the fundamental nervous processes have undergone intensive development in recent years (D. S. Voronin, P. G. Kostyuk, A. I. Roitbak, A. B. Kogan, A. I. Shapovalov, etc.).

The biomechanics of movements, created in the 1920s by N. A. Bernshtein, and the idea of their control which he developed in the 1940s, were important achievements in the application of mathematical methods to physiology, a trend which achieved popularity after cybernetics became a recognized science. I. P. Pavlov's concepts of mechanisms of self-regulation in every system, originally derived from I. M. Sechenov, were the prototype of the ideas of cybernetics in physiology; P. K. Anokhin's conception of reciprocal afferent impulses as an essential part of any action providing a control over its performance was confirmed by modern neurocybernetics.

The field of study in the physiology of the circulation was considerably broadened. Traditional approaches to the problem of regulation of the general and regional circulation (G. P. Konradi. M. E. Marshak, G. I. Mchedlishvili, M. G. Udel'nov, V. M. Khayutin) began to be supplemented by experimental

and clinical studies of hemodynamics. New techniques made the physiological analysis of many problems of the circulation possible, as a result of investigation of healthy and sick persons (E. B. Babskii, V. V. Parin, L. L. Shik and others). The physiology of respiration was developed by M. E. Marshak, M. V. Sergievskii, L. L. Shik and others. Considerable attention was paid to the study of respiration during physical work and in sport, the study of hypoxia and hypothermia, and investigation of the mechanisms of origin of respiratory failure.

Pathological physiology, as an independent discipline, was created in the USSR with the support of I. P. Pavlov. Important roles were played in its development by A. A. Bogomolets' and S. I. Chechulin.

The school of A. A. Bogomolets' occupies an outstanding place in the history of Soviet theoretical medicine. The range of its scientific research was unusually wide. It included the study of constitution, of the role of active mesenchyme in physiological processes, the problem of reactivity of the organism (N. N. Gorev, N. N. Sirotinin), experimental oncology (R. E. Kavetskii and I. I. Neiman), and endocrinology (L. R. Perel' man). It was A. A. Bogomolets' who, long before the work of Selye, demonstrated for the first time the role of the adrenals in reactions of the body to an external stimulus. The work of N. A. Fedorov, O. S. Glozman, Ya. G. Uzhanskii, and D. I. Gol'dberg was of great importance to the elucidation of problems in experimental hematology and blood transfusion.

An important role in the development of Soviet pathology and pathophysiology was played by A. D. Speranskii's school. Speranskii developed the Soviet concept of "nervism" and developed a "neurotrophic" theory in pathology. He demonstrated the important role of the nervous system in the development of pathological processes of widely different origin, and in specific and nonspecific resistance. He segregated research into the mechanisms of disease, recovery, and treatment into special subdivisions of general pathophysiology, and, like Pavlov, he recognized the fundamental importance of experimental therapy as a method of investigation of pathological processes. A. D. Speranskii established standard forms of development of pathological processes and demonstrated for the first time the important role of the hypothalamus in their genesis. Speranskii's ideas developed fruitfully and productively in the researches of his many pupils and followers (A. Ya. Alymov, M. L. Borovskii, V. S. Galkin, S. I. Lebedinskaya, I. A. Pigalev, A. A. Solov'ev, A. M. Chernukh, A. Yu. Bronovitskii, O. Ya. Ostryi, D. F. Pletsityi, S. I. Frankshtein, G. N. Kryzhanovskii, and others).

Soviet pathologists, in their work, paid great attention to the analysis of general pathophysiological problems—the theory of disease, etiology, and pathogenesis (A. A. Bogomolets', P. D. Gorizontov, I. V. Davydovskii, I. R. Petrov, A. D. Speranskii, G. P. Sakharov, S. S. Khalatov); special theoretical and experimental investigations were devoted to the study of mechanisms of recovery (A. D. Speranskii, S. M. Pavlenko, A. M. Chernukh, and others), and also to processes of compensation of disturbed functions after various pathological processes. The development of clinical physiology, especially in recent years (N. I. Grashchenkov, V. V. Parin, etc.), with many points of contact with pathological physiology, has considerably facilitated analysis of problems in pathogenesis and recovery in various pathological states. Work on the reproduction of pathological processes and of human diseases as experimental models has been of great importance for the development of research into experimental therapy (N. V. Lazarev, P. I. Remezov, G. N. Pershin, D. S. Sarkisov).

In the subsequent period all the main subdivisions of pathological physiology have been intensively developed. An important contribution to the theory of allergy was made by the work of A. D. Ado, G. P. Sakharov, N. N. Serotinin, and A. N. Gordienko. The pathophysiology of inflammation has been studied by A. A. Bogomolets', D. E. Al'pern, V. V. Voronin, I. A. Oivin, A. M. Chernukh, and others; the pathology of metabolism and endocrine regulation by N. N. Anichkov, S. G. Genes, L. M. Gol'ber, S. M. Leites, I. M. Neiman, G. P. Sakharov, S. S. Khalatov, A. M. Charnyi, N. T. Shutova, and others; the problem of nerve nutrition and nerve degeneration has been investigated not only by A. D. Speranskii, but also by A. V. Lebedinskii, N. N. Zaiko, S. M. Pavlenko, A. V. Tonkikh, and others, the pathology of infections was studied by A. D. Ado, A. M. Chernukh, Kh. Kh. Planel'es, G. N. Kryzhanovskii, V. V. Mikhailov, and others, and the pathophysiology of fever received a detailed examination from P. N. Veselkin.

In recent years a new branch of pathological physiology—reanimatology, or the science of resuscitation—has developed rapidly. Preparatory studies were made by F. A. Andreev, P. N. Bakhmet'ev, and A. A. Kulyabko, and an important contribution was made by S. S. Bryukhonenko, who must be credited with priority for creation of the artificial circulation technique which is now extensively used in clinical

practice. Reanimatology has developed very greatly in recent years as a result of the work of V. A. Negovskii and co-workers, I. R. Petrov and co-workers, V. D. Yankovskii, and others.

Research into problems concerned with shock, blood loss, collapse, burns and anoxia are of great importance for medical practice. These problems have been investigated by the pathophysiologists I. R. Petrov, N. N. Serotinin, N. A. Fedorov, and many others, and also by physiologists, morphologists, and clinicians.

The pathology of the coronary circulation, of hypertension and atherosclerosis has been widely studied. The role of disturbances of lipid metabolism in these diseases has been clarified by the work of N. N. Anichkov and S. S. Khalatov, N. T. Shutova, and others. V. V. Parin and co-workers, A. I. Smirnov, S. V. Andreev, F. Z. Meerson, M. E. Raiskina, B. M. Fedorov and others have made extensive investigagations of the pathophysiology of the heart (hyperfunction, myocardial infarction, myocarditis, arrhythmias, etc.).

The effects of exposure of the body to various physical factors (electric current, ionizing radiation, electromagnetic fields, ultra-high frequency currents, ultrasound, and so on) have recently acquired special importance. They have been studied by P. D. Gorizontov, N. M. Liventsev, I. R. Petrov, I. A. Piontkovskii, N. L. Gurvich, G. L. Frenkel', and others.

The mechanisms of development of edema have been studied by Ya. A. Lazaris, R. Yu. Loog, B. I. Mazhbich, V. I. Oivin, B. M. Sagalovich, and others.

In connection with the demands of cardiovascular surgery and reanimatology, increasing attention has been paid to the investigation of hypothermia (I. R. Petrov, V. A. Negovskii, P. M. Starkov, V. A. Bukov, E. V. Gubler, and others).

Soviet biochemists have achieved considerable success. The leading Soviet biochemists A. N. Bakh, A. N. Belozerskii, A. E. Braunshtein, G. E. Vladimirov, V. S. Gulevich, B. I. Zbarskii, S. R. Mardashev, A. I. Oparin, V. N. Orekhovich, A. V. Palladin, S. S. Salazkin, S. E. Severin, V. A. Engel'gardt, N. A. Yudaev, and others have carried out important investigations, many of the results of which have been described in the pages of "Bulletin of Experimental Biology and Medicine."

In 1937 the first report (by A. E. Braunshtein and M. G. Kritsman) of a new mechanism of amino acid formation by intermolecular transfer of an amino group was published in our journal. This article had a tremendous influence on the development of research in the field of amino acid metabolism. This mechanism of amino-acid biosynthesis by transamination was found to be universal in the animal world. Since that time every year many articles on transamination have appeared in the world literature.

Discovery of the enzymic activity of myosin led to the appearance of a new trend of research in the mechanochemistry of muscle (V. A. Engel'gardt and M. N. Lyubimova).

Investigations have been carried out to study the nature and role of high-energy compounds in physiological functions, and the metabolism of proteins and amino acids, lipids, carbohydrates, and mineral substances. Interesting work has been carried out on the biochemistry of the nervous system (A. V. Palladin, G. Kh. Bunatyan, P. G. Kometiani), disturbances of various types of metabolism in pathological states (V. S. Il'in, S. Ya. Kaplanskii, M. F. Merezhinskii, S. E. Severin), and hormonal regulation (A. M. Utevskii, N. A. Yudaev). Several important investigations have been carried out in the preparative chemistry of proteins and other biologically important substances (S. R. Mardashev, V. N. Orekhovich), the biochemistry of nutrition (A. A. Pokrovskii) and analytical biochemistry as applied to clinical laboratory investigations (V. S. Asatiani). Particular attention has been paid to the biochemistry of malignant neoplasms and metabolic disturbances in malignant tumors (I. B. Zbarskii, V. S. Shapot). Interesting work has been carried out to study the biochemical role of imidazol compounds (S. E. Severin) and also work on mucopolysaccharides (S. M. Bychkov), nucleic acids (S. S. Debov), and the biochemistry of muscles (I. I. Ivanov and D. L. Ferdman). Soviet research has laid the foundations of bioenergetics (V. A. Engel'gardt, V. A. Belitser).

Soviet pharmacology has developed in many directions. The examination of problems concerned with the effect of pharmacological agents on higher nervous activity, the study of the mechanisms of action of narcotics, sedatives, and analgesics, and the investigation of cholingergic and adrenergic mechanisms in the action of pharmacological agents were of particular importance to experimental biology and medicine. Research into the pharmacology of cardiac glucosides, hormones and vitamins, and substances of plant origin developed successfully. The study of the toxic properties of snake venom was the subject of a number of investigations.

Great attention has been paid to the development of chemotherapy, which has become an extremely important and independent subdivision of pharmacology, and to the search for new chemotherapeutic substances, including those active against parasites. Problems in general pharmacology and toxicology have been successfully solved, and special attention has been paid to the study of the relationship between structure and effect of pharmacological agents.

In this journal alone during the last 30 years more than 600 papers on pharmacology have been published. Important contributions to the development of pharmacology in the Soviet Union have been made by V. V. Savich, S. V. Anichkov, V. V. Zakusov, V. M. Karasik, M. D. Mashkovskii, M. N. Nikolaev, M. L. Belen'kii, G. N. Pershin, and others.

Since the time of I. I. Mechnikov, immunology has been a traditional field of activity in Russian biology and medicine. The work of such outstanding Soviet scientists as V. A. Barykin, A. A. Bogomolets', N. F. Gamaleya, D. K. Zabolotnyi, P. F. Zdrodovskii, L. A. Zil'ber, S. I. Zlatogorov, and I. I. Krichevskii in this field is well known. In the years of Soviet rule, and particularly recently, the number of groups studying problems in immunology and microbiology has increased and new scientific research institutes have been created. The number of articles published, both in the specialized journals and in the appropriate section of the Bulletin of Experimental Biology and Medicine, has increased considerably. Without discussing work in the more specialized subdivisions, we may mention merely the main trends of research.

Problems in general immunology have been tackled by the study of immunologic reactivity, of the biosynthesis of antibodies (at the cellular and subcellular levels), and the mechanism of their action. The physical chemistry of immune globulins has been studied in detail, and much has been learned of the submolecular structure of antibodies.

Progress in general immunology has been assisted by the creation and rapid development of immunochemistry and immunomorphology, and also by the intensive development of immunologic methods. Progress in fundamental investigations has paved the way for the study of homotransplantation of organs and tissues, of autoimmune diseases, of allergic processes, and to the study of radiation sickness and has provided new opportunities for cancer research. Problems in special immunology have progressed mainly in connection with improvements in methods of vaccination, immunodiagnosis, serotherapy and seroprophylaxis. In recent years research in noninfectious immunology has been conducted on an ever increasing scale in the Soviet Union (P. N. Kosyakov, G. I. Abelev, O. E. Vyazov).

Research into experimental oncology, reflected in articles published in our journal, has advanced in several directions. Great attention has been paid to the study of chemical carcinogens, and especially to determination of the possibility of their appearance. In this field the work of L. M. Shabad, one of the pioneers and founders of this branch of experimental oncology, is widely known. Many investigations have been carried out to detect carcinogenic substances in nature and to discover chemical substances possessing carcinogenic properties.

The importance of viruses in the etiology of tumors has been the subject of many investigations. This line of research has been developed with good results by L. A. Zil'ber and co-workers. A number of new viruses playing a role in the genesis of malignant neoplasms in animals have been discovered. The previously held view of the strict species specificity of the oncogenic viruses has been disproved, and the similarity of the effect following administration of the same virus to animals of different species has been demonstrated (L. A. Zil'ber, G. Ya. Svet-Moldavskii, and others). Many important investigations have been carried out to study the pathogenesis and nature of leukemias, and the possibility of their experimental reproduction (V. M. Bergol'ts, B. A. Lapin, N. P. Mazurenko).

Important work on the biochemistry of tumors has been undertaken in the laboratory directed by B. I. Zbarskii, and on the culture of malignant cells and tissues in A. D. Timofeevskii's laboratory. Special investigations have shown the importance of the nervous system in the growth processes of tumors (M. K. Petrova, R. E. Kavetskii, S. I. Lebedinskaya, etc.). Much work has been devoted to the detection of autoimmune reactions during growth of malignant tumors by the identification of a specific cancer antigen in tumors (L. A. Zil'ber and co-workers, G. I. Abelev, V. V. Gorodilova, I. N. Maiskii and co-workers). The results of these investigations were published in this journal.

Detection of a specific cancer antigen facilitated the development of research into antitumor immunity. The results of these investigations resulted in the differentiation of transplantation immunity from specific cancer immunity and demonstrated the role of immunologic reactions in the pathogenesis of malignant disease and, in particular, in the processes of metastasization.

The chemotherapy of tumors has developed considerably during recent years. Many new chemotherapeutic antitumor preparations have been suggested, and the mechanisms of action of different antitumor preparations have been studied (L. F. Larionov, M. M. Maevskii, etc.).

In the 1920s, and especially in the 1930s, intensive development of certain branches of experimental biology began—experimental endocrinology, embryology, the study of postembryonic development and regeneration, and so on. An outstanding role in the development of experimental endocrinology was played by M. M. Zavadovskii. Most scientists who have worked and who are still working in the field of endocrinology are pupils of his (L. Ya. Blyakher, P. A. Vunder, Ya. M. Kabak, V. F. Larionov, E. V. Pavlova, A. L. Paducheva, I. A. Eskin, etc.). The 1920s and 1930s also saw fruitful developments in the study of the problem of the relationship between hormones and the development of various signs. At the end of the 1930s, M. M. Zavadovskii enunciated the principle of "plus-minus interaction," anticipating the concept of the feedback regulation of relationships between the endocrine glands and organs. Later a method of increasing fertility by administration of pituitary hormone to animals was developed, and has become widely used in practical livestock farming.

After the Second World War, Soviet scientists continued to make progress with the study of interaction between the endocrine glands, the analysis of mechanisms of hormone action, and the study of neurohumoral relationships (B. V. Aleshin, A. A. Voitkevich, N. I. Lazarev, N. A. Yudaev, etc.). Considerable attention was paid to the study of mechanisms of cell division. Following his investigations of cell division, A. G. Gurvich in 1922 described mitogenetic rays which stimulate cell division. Recently, investigations have been concentrated around the problem of inhibition of cell division by various factors (S. Ya. Zalkind, I. A. Utkin, G. S. Strelin, etc.), the effect of hormones and the nervous system on cell division, and the diurnal rhythm of cell division and associated processes of nucleic acid synthesis (I. A. Alov, V. N. Dobrokhotov, L. N. Zhinkin, S. Ya. Zalkind, etc.). F. M. Lazarenko has carried out important work on tissue culture in vivo.

After its foundation in the 1920s, experimental embryology has made considerable progress. The number of published papers on development of the eye and limbs has been particularly great. The foundations of experimental comparative morphology were laid by D. P. Filatov. His pupils (T. A. Detlaf, G. V. Lopashov, V. V. Popov, etc.), continuing the fruitful study of problems of embryonic development, have considerably widened the range of objects investigated (mammals, fishes). Many of their investigations have been published in the pages of our journal.

Soviet scientists have formulated new concepts of regeneration of organs and of histogenetic processes during regeneration of invertebrates and lower animals (N. V. Nasonov and co-workers, P. G. Svetlov, L. Ya. Blyakher and his pupils, M. A. Vorontsova, B. P. Tokin). Much attention has been paid to the restoration of lost regenerative power (L. V. Polezhaev, É. E. Umanskii, etc.). Ideas that regeneration of organs in mammals and man is impossible have been revised, and investigations have been conducted to study methods of regeneration and the effect of various conditions influencing them (M. A. Vorontsova, L. D. Liozner, V. P. Mikhailov, B. P. Tokin, S. I. Shchelkunov, etc.), the connection between asexual reproduction and regeneration, and also histogenetic processes taking place during regeneration. Some of the more important of these investigations have been published in our journal.

Transplantation problems have constantly attracted the attention of investigators. The number of papers in this field has increased considerably in recent years. Many investigations, a large proportion of which have been published in our journal, have been devoted to the problem of overcoming tissue incompatibility during homotransplantation. Methods have been worked out for increasing the time of survival of the graft, and the factors causing rejection of homografts have been studied (M. I. Efimov, E. A. Zotikov, A. G. Lapchinskii, A. Ya. Fridenshtein, etc.).

An extensive series of investigations has been carried out in the field of experimental embryology. Mechanisms of neuronal development, stage-specific factors, the action of various toxic substances on development of the embryo, and the sensitivity of the embryo to these agents at various stages of embryogenesis have been investigated (P. G. Svetlov, O. E. Vyazov, A. P. Dyban, etc.), and the importance of the protective media and membranes of the fetus in these processes has been examined (B. P. Tokin).

Numerous investigations have been carried out to study the effect of various external environmental factors on the development of animals (P. G. Svetlov, B. A. Kudryashov, V. F. Larionov, P. V. Makarov, etc.), and especially the effect of radiation.

The time when our journal was founded (1936) coincided with the rapid development of genetics in general and of medical genetics in particular, in the Soviet Union. At that time the center for theoretical genetics in the USSR was the Institute of Experimental Biology of the Ministry of Health of the USSR, founded and directed by N. K. Kol'tsov. Medical genetics, founded in the USSR by S. N. Davidenkov and S. G. Levit, was most widely developed at the Medico-Genetic Institute and the Gor'kii All-Union Institute of Experimental Medicine (VIEM). The results of these investigations by geneticists have been published in our journal from its very first numbers. Since 1936 and until February, 1967 inclusive, 102 papers on various aspects of experimental genetics have been published in the journal.

In the prewar and immediate postwar years many articles were published in the journal on such important problems in genetics as interaction between heredity and environment, mutagenesis and gene structure, the cytogenetics of Dosophila and of man, and so on. Among authors whose papers have appeared in the journal are N. P. Dubinin, P. I. Zhivago, M. M. Zavadovskii, D. Kostov, S. G. Levit, M. E. Lobashev, I. A. Rapoport, V. V. Sakharov, B. N. Sidorov, and many other geneticists. Their scientific publications were an important contribution to Soviet genetics,which had then secured an important place in world genetics. An exceptionally interesting paper published in the journal was that by N. P. Dubinin (1936) on mutations in Drosophila and the effect of position of the genes. Dubinin's work at that time essentially marked the beginning of research which has subsequently led to the discovery of the fine structure of genes. In 1936-39 the highly important investigations of M. E. Lobashev, I. A. Rapoport, and V. V. Sakharov on chemical mutagenesis were published in the journal. These papers, along with other, earlier investigations by these workers, laid the foundations of genetic research which contributed to the discovery of the molecular mechanism of mutations. In the years preceding the Second World War, papers by P. I. Zhivago and by other workers at the All-Union Institute of Experimental Medicine, Khar'kov University, and the Institute of Experimental Biology, Ministry of Health of the USSR, on the cytogenetics of man, monkeys and Drosophila, were published in the journal. These studies were of great technical importance at that time. Indeed, it can be said that the results of their investigations of twins in order to determine the role of environment in the manifestation of certain inherited characteristics has not lost its importance even today. These investigations were published in our journal in 1936 by workers from the Medico-Genetic Institute.

After the Second World War,papers on experimental genetics once again reappeared in the pages of the Bulletin of Experimental Biology and Medicine. They included articles by N. N. Petrov and R. P. Martynova, who examined the role of heredity in the origin of malignant tumors, and also articles by N. N. Medvedev, I. A. Rapoport, and other investigators on other problems in genetics. Subsequently, however, the number of investigations in experimental genetics has fallen considerably.

In an attempt to overcome this time lag, Soviet geneticists are at present concentrating their efforts on tackling the most urgent problems in general and medical genetics (E. F. Davidenkova, A. A. Prokof'eva-Bel'govskaya, V. D. Timakov, etc.). In an attempt to cooperate in finding a solution to this problem, the Editorial Board has devoted a separate section of the journal to experimental genetics with a view to attracting greater attention of the scientific community to this subject.

Papers published during recent years in the journal have dealt mainly with molecular genetics (genetics of bacteria and viruses), the genetics of somatic cells, simulation of heredity diseases, human cytogenetics, and so on.

Among the experimental morphological investigations described in the pages of this journal some of the more important have dealt with the study of structure of the nervous system. The work of B. I. Lavrent'ev and his pupils established the basic principles of structure of the autonomic nervous system. Many studies have been made of the structure of different parts of the central nervous system, especially the brain (S. A. Sarkisov and others). During recent years, great attention has been paid to a closer examination of the fine structure of the reticular formation of the brain and of synaptic transmission. Techniques of histochemistry and electron microscopy are being increasingly used in these investigations. Considerable space in the journal has been allocated to papers describing the blood supply of different parts of the brain, especially the pericellular capillary network (B. N. Klosovskii and co-workers). The study of the receptor apparatus of the vascular system and internal organs has received the closest attention of investigations for many years (B. A. Dolgo-Saburov, V. V. Kupriyanov, E. K. Plechkova and others). This line of research has developed parallel with the systematic study of the physiology of interoception by V. N. Chernigovskii's school.

Experimental histology has developed principally as a result of the work of A. A. Zavarzin, N. G. Khlopin, A. V. Rumyantsev, B. I. Lavrent'ev, and other Soviet histologists. The application of experimental methods enabled the foundations of evolutionary histology, an original venture by Soviet science, to be laid.

Investigations associated with the denaturation theory of cell injury (the theory of paranecrosis), developed by D. N. Nasonov and V. Ya. Aleksandrov, are widely known. The results of a study of the sorption properties of the cytoplasm after exposure to various injurious agents have been described in numerous papers. It should be emphasized that this is one of the most delicate methods of detecting structural changes in the nucleus and cytoplasm.

Considerable attention has been paid to the systematic study of the structure of connective tissue and collagen, and the dynamics of collagen fiber formation; to the fine structure of the elements of loose connective tissue, and so on (V. N. Orekhovich, A. A. Tustanovskii, A. I. Strukov, etc.).

The study of structural changes in various tissues in acute and chronic radiation sickness has been a frequent subject for research.

A field of study of particular interest has been the morphological investigation of the pathogenesis of human diseases and their complications: atherosclerosis (N. N. Anichkov and co-workers), myocardial infarction (A. I. Strukov and co-workers), defects of the heart valves, hypertension, peptic ulcer, osteomyelitis, infectious and fungal diseases, pneumonias (V. D. Tsinzerling), avitaminoses, pulmonary edema, and so on. Many important investigations have been carried out in connection with pathological problems of such fundamental importance as inflammation, permeability, edema, and so on.

During recent years, investigations in the various fields mentioned above have increasingly made use of the latest methods of structural analysis—histochemistry, electron, luminescence, and ultraviolet microscopy, autoradiography, etc.

An important role in the subsequent analysis of various problems in experimental biology and medicine has been played by the systematic publication in this journal of new methods of investigation, descriptions of experimental models, examples of the application of thematic methods of analysis to biological and medical investigations, descriptions of new apparatus, and so on.

At the present time all sections of experimental biology and medicine in the USSR are developing intensively. This is associated with the great opportunities presented to our scientists by the Communist Party and the Soviet Government, ensuring a higher technical standard of research. New fields of science have appeared, such as cosmic biology and medicine, making their own contribution to the world-famous achievements of Soviet science and engineering in the conquest of space. The importance of experimental medicine in the solution of current clinical problems has grown tremendously, and developments have taken place in the physiology of work and sport. Soviet scientists are engaged in the study of problems of great theoretical and also of practical importance. The ever increasing and productive collaboration between biologists and medical scientists on the one hand, and physicists and mathematicians on the other, is playing an important role. Scientific links between Soviet scientists and their colleagues abroad have been extended.

The 50 years of Soviet Experimental Biology and Medicine have been years of sustained and creative work, years of great progress; they have created the opportunities for still further advances in the near future.