

THE MAIN
PROBLEMS
OF SOVIET
GERONTOLOGY

LEADING
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GERONTOLOGY

KIEV — 1972

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*MATERIALS FOR
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CONGRESS
OF GERONTOLOGISTS*

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ON THE HISTORY OF THE HOME GERONTOLOGY DEVELOPMENT

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Gerontology, as a complex scientific problem, has passed a long, contradictory way of development and, according to contemporary investigators, has now reached its concluding stage of accumulating practical material to be used for inferring profound theoretical generalizations. To solve that problem, lying on the borderland of many sciences, conceptions and achievements formed in the course of numerous sciences development are being involved — as general biology, physiology, biochemistry, biophysics and sociology. Advances of those sciences have predetermined the rapid and fruitful development of present gerontology. The gerontologists were urged upon to attract into their ranks the representatives of many other specialties.

Though the settling and elaboration of the problem goes back to the end of forties — beginning of fifties of the present century, the whole history of a true scientific research, as far as the study of aging processes is concerned,

had its start with the first appearance of works, belonging to prominent Russian biologist I. I. Mechnikov.

The settling and formation of fundamental conceptions on aging mechanisms that subsequently determined the trend of researches in that branch of world science were associated with achievements of our scientists I. I. Mechnikov, A. A. Bogomolets, I. P. Pavlov, A. V. Nagorny as well as with the activity of founded by them schools. That is why a correct understanding of the present status of gerontology is impossible, unless the sources and the ways of development of both essence and conceptions of aging mechanisms in home biology and medicine have been thoroughly analyzed.

Up to the present time there have been published numerous works devoted to a critical consideration of aging hypotheses, formed in the course of home and world history of science development. Those are works of A. Comfort (1956, 1964), M. D. Grmek (1958), V. N. Nikitin (1958), as well as surveys of the home and foreign literature, such as "Problem of Aging and Longevity" by A. V. Nagorny, V. N. Nikitin and I. N. Bulankin (1963), "Gerontology" by I. V. Davydovsky (1966) and "Fundamentals of Gerontology" edited by D. F. Chebotarev, N. B. Mankovsky and V. V. Frolkis (1969). The mentioned materials enable us to elucidate the main landmarks of home gerontology history occupying a worthy place in world science and elaborating the modern conceptions in basic questions of gerontology.

The study of aging problems and of ways to longevity has profound roots and traditions in our country. One of the first to deal with the problem of longevity from the viewpoint of objective data was a physician and statesman of XVIII century Russia I. Fisher. His book "On Senility, its Grades and Diseases" (*De senio ejusque gradibus et morbis*) was issued in 1754. Should we interpret the direction of that work in terms of modern conceptions, we would say that the author tried to find out the significance for human longevity of constitutional factors, mental status as well as interrelations with the effect of external medium.

I. Fisher attached a definite importance in regard to longevity to the factors of constitutional order, but had to admit the essence of those factors to remain unknown at the level of his contemporary science development.

He emphasized the psychical quiet (*animi tranquillitas*) to play a leading role as a longevity factor. His assertion that a system of medical and hygienic measures would be able to postpone aging was of a substantial interest.

I. Fister's book was republished in 1760 and translated into German in 1766. Many gerontologists consider it to merit attention as a first scientific elaboration of the problem for his time. I. Fisher's ideas, related to the period of 1754—1766, had much in common with some rules of microbotics by Hufeland (1796).

In our survey we should not fail to mention the book of P. Yengalytchev, first published in 1801 under the title: "On Prolongation of Human Life. How to Reach a Healthy, Merry and Extreme Old Age". The book sustained several re-editions. For prolonging human life and preserving health at old age the author attached a great importance to prophylaxis of diseases by keeping to hygienic and dietetic rules, by undergoing timely a medical treatment. He emphasized the necessity to use the "curing power of nature", to harden the organism through systematic exercises and spending most of the time in the open air, to avoid alcohol.

Without dwelling on details we can mention a series of XIX century scientists whose publications and contributions have played a certain role in the study of aging and longevity.

I. P. Kamensky (1812), professor of anatomy, physiology and medico-judicial science at Kazan University in studying longevity attached great importance to the fact that pleasant emotions prolong life, while unpleasant ones, were responsible for shortening it. Professor of anatomy and physiology at Kharkov University L. O. Vanotti (1818) emphasized the qualitative peculiarities of an organism at different stages of its age development. The leading role in reaching a man's longevity he attached to public health. I. O. Kalenichenko (1839) — a zoologist and physiologist of the same university denoted continuous changes occurring in age associated development of a living being. An interesting thought belongs to him: "both life and death are always within us; we live continuously dying and we die continuously reviving".

S. D. Kostyurin (1866) published in St. Petersburg his work on senile changes of cerebral hemispheres at old age.

In 1887 S. A. Belyakov's dissertation "On Patho-Anatomical Changes of the Central Nervous System in Dotage" appeared. A. I. Kazanly (1889) effectuated a study on senile changes in joints.

A particular place in the home and world history of aging study belongs to the outstanding Russian clinician S. P. Botkin, who planned a mass examination of aged people undertaken in St. Petersburg in 1889. In April 1889 under his guidance a program for that examination was elaborated. The examination had to be performed by a special group of physicians. Contingents to be examined consisted of inhabitants of St. Petersburg almshouses. S. P. Botkin denoted key questions of the program, having emphasized the necessity not to limit the work with examination of diseased and decrepit subjects, but to examine all almshouse dwellers bearing in mind "the scientific interest of a mass examination of a great number of people in the state of extreme old age", as one of his collaborators — doctor A. A. Kadyan (1890) — had written.

S. P. Botkin's ideas on human aging genesis, on peculiarities of age-induced changes, on development and course of diseases in old people were reflected in A. A. Kadyan's work (1890) in which it had been presented a summary of examinations performed under personal guidance of S. P. Botkin. Those examination materials were also generalized in several dissertations.

The examination embraced a great number of people: 2626 subjects (408 men and 2218 women) aged from 11 to 110 years with a predominance of persons of 66—75 years. The number of elderly and old people amounted to 2240. Women were established to have prevailed over the number of men and to have a greater longevity. At the age of 80 and over the percentage of women among all old people was 8, while the per cent of men reached only 4. However, at the age of 50 the ratio was quite inverse: 31% of elderly people were men and 11% — women. That found explanation in a higher mortality among men aged 50—80 — the greatest mortality among men was noted at 75—80 years of age, while in women the critical age came much later. The author considered the women to possess better adaptation of the organism to vital conditions. That conception obtained now a statistical confirmation.

The question concerning the factors influencing human



S. P. Botkin.

longevity was of no lesser importance. To answer the question it was taken into account the family status of examined subjects, number of their children, heredity circumstances, use of alcohol, syphilis. It was established that married subjects reached the age over 70 more often than the single ones. Women who had children, in particular those of many births, showed a higher longevity.

Senility was emphasized to have been determined not by the years of age, but by phenomena inherent to a definite age. In other words, it was dealt with the problem of both chronological and biological ages. The main principle propounded by S. P. Botkin was his proposition to differ the physiological senility from the pathological one.

Urged by S. P. Botkin's ideas A. A. Kadyan proposed a series of indices characterizing both physiological and pathological, premature senility. He considered the terms of senile changes development and their tempo to be different in various organs and systems. "If an aging process begins earlier than the usual term — it is a premature senility. But if the aging proceeds irregularly, if one organ is affected by senile changes earlier and stronger than the others — so that the aging process in that organ becomes a pathological factor influencing the whole organism — then it is a pathological senility"...

Having divided all the examined elderly and old subjects into two groups, A. A. Kadyan found the group of persons with a physiological senility to surpass in number the other one with a pathological senility.

Interesting data was obtained on arteriosclerosis diagnosed by the usual for that period methods of clinical investigation. At the age of under 60 sclerosis was diagnosed in 76% of men and only in 38% of women. To the 81st year of age the number of men with sclerosis symptoms reached 100%, while in women aged 90 it was discovered only in 88%.

The analysis of material obtained by S. P. Botkin's collaborators during examination of elderly and old people brought many facts, which were new for that period, dealing with the state of various organs and systems of an aging human organism. Thus, a definite parallelism was found to exist between the grade of certain senility indices particularly sclerosis and the appearance of arrhythmia, cataract, decrease in the urine specific weight etc.

An assumption expressed earlier by S. P. Botkin concerning a greater motility and a displacement of the human heart at old age was confirmed by M. M. Volkov (1889) who had been urged by S. P. Botkin to examine 758 old people at hospitals and almshouses of St. Petersburg. V. V. Kudriavetsky investigated the dyspnea in old people.

A. A. Kadyan communicated to have encountered rarely in examined subjects symptoms of gastro-intestinal catarrhs, nephrolithiasis, chole lithiasis and gout. He associated these facts with the character of nourishment and therefore recommended to limit the diet at extreme old age (1891).

After a scheme proposed by S. P. Botkin the state of the

nervous system in elderly and old people from almshouses was also determined. Data of these investigations were given in A. A. Kadyan's accounts and thoroughly analyzed later in A. N. Alelekov's dissertation (1892) carried out at a clinic of prof. Merzheevsky. Men were found to suffer from mental and nervous diseases twice as often in comparison with women. It is of interest to note, that A. N. Alelekov having composed for his dissertation a survey of literature on the problem of aging came to the conclusion that the majority of works dealt with diseases of old age, while both anatomical and physiological sides of the problem had not been studied; "they are, however, of no lesser interest and significance. Anybody would scarcely deny it".

A wide clinical study that had been undertaken and started by S. P. Botkin had not been achieved under his guidance, he could not take part in the analysis of obtained material. However, even what had been done was an important contribution to the development of both clinical gerontology and geriatrics.

In the first place, the conception of aging underwent a delimitation: a difference was established between a physiological aging and a premature pathological aging. Thereby it was acknowledged the possibility of a natural physiological aging, of an existence of a natural aging, not aggravated by chronic diseases which often affect a human being at the concluding period of his life. The ideas of direct dependence of definite senility forms on environment were quite new for that epoch and very significant for correct understanding the genesis of aging. The way of viewing aging as a natural physiological process having no obligatory connection with any diseases enabled to envisage more optimistically the perspectives of a struggle for longevity, a struggle against a premature extinction of a human organism.

S. P. Botkin's thesis on pathological and physiological aging obtained its further development in the works of his pupils and followers; it firmly entered into the scientific literature. Performed by his team investigation originated a scientific clinico-physiological approach to a study of peculiarities of various systems and organs functioning in aged persons as well as of conditions and factors underlying the human longevity.

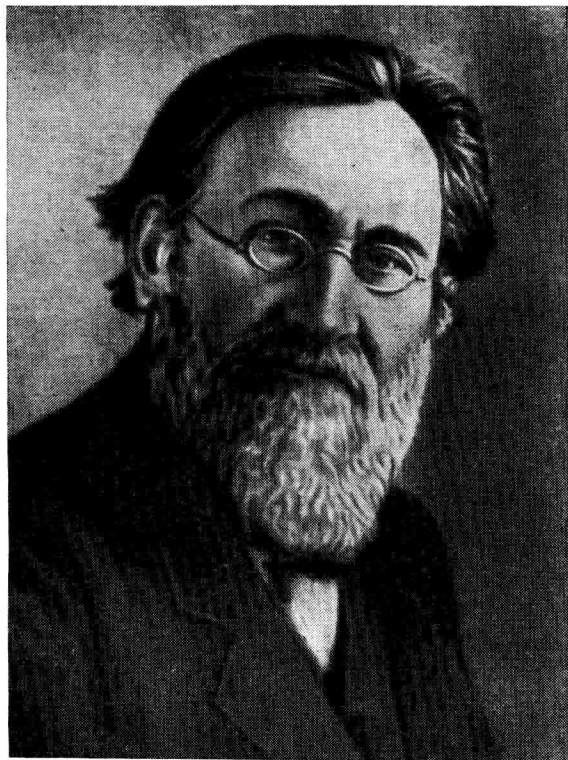
The influence of S. P. Botkin's ideas may be traced in a series of works carried out at that period. Those are dissertations and monographs by I. Zakharov (1891), P. K. Ugryumov (1892), V. Ya. Menshov (1893), M. I. Pavlov (1894), A. I. Solovyev (1894), B. Kh. Orbant (1896), M. V. Bogdanov-Berezovsky (1897), V. N. Bulatov (1897), N. A. Shurygin (1897), G. A. Yastrebov (1901), N. D. Dobrovolsky (1902) et al.

To assess the S. P. Botkin's role in the development of studying the aging process it should be taken into consideration that he was the first to elaborate the program of studying longevity. The ideas of S. P. Botkin and the works of his pupils substantially contributed to the settling of clinical gerontology and geriatrics the creation of which belongs to I. Nascher (1909). Many of the problems propounded by S. P. Botkin did not lose their actuality even at present time. A series of his conceptions determine most significant directions at the development of gerontology and geriatrics.

However, a real progenitor of gerontologic problem, creator of modern biology of aging both in Russia and in the whole world was I. I. Mechnikov. He approached to the study of aging from the positions of his world-wide known studies in biology and comparative pathology. His creative work defined to a significant extent a biological direction in a search for aging mechanisms.

The origin of I. I. Mechnikov's ideas on human longevity and aging biology, later developed into a cycle of experimental works and such fundamental publications as "Studies of Human Nature" (1904), "Studies of Optimism" (1907), "Forty Years of a Rational World Outlook" (1913), relates to the 80th—90th years of the past century when the author had been working at the Novorossiysk University (Odessa). The first evidence of experimental work in that direction started by him we find at the end of nineties. Those were his articles in the February issue of the "Russian Archives for Pathology, Clinical Medicine and Bacteriology" (1899) and in October issue of "Annales de l'Institut Pasteur" (1899) as well as a letter to Academician D. N. Anuchin, editor of "Russkiye Vedomosti" that had been published in January, 1900 (A. L. Schwarzmam, 1954).

Resting on elaborated by him conceptions on the significant part played by phagocytosis in the atrophic processes,



I. I. Mechnikov.

I. I. Mechnikov expanded his theory on the senile atrophy, trying to find ways for an active interference with the struggle of macrophages against the noble tissue elements, either enforcing the one or weakening the other of adversaries: ...“on one hand, a re-inforcement of the most valuable organism elements and, on the other,— a weakening of the aggressive attacks of phagocytes”.

At first, having applied the results of his studies on the “specific effect of sera against various cellular elements”, I. I. Mechnikov hoped to prevent the atrophy of noble elements by dint of an “antiphagocyte serum” which he believed to be effective enough. On his opinion, it was one

of the ways to sustain the noble tissue elements in their struggle against the phagocytes.

The idea of using cytotoxic sera was expressed by I. I. Mechnikov already in the first of his articles (1899). Narrowly looking at peculiarities of intertissular relations in aging, I. I. Mechnikov already in that paper had planned to attempt an experimental clearance to evaluate the effect of different biological preparations upon the senile atrophy in old animals. His aim was to find means for stimulating protective capacity of noble cells in their struggle with phagocytes. Those means, in his opinion, could be found in embryonal tissues.

In his continuous endeavour to find a practical application of elaborated theory there was displayed the efficacy and activity of I. I. Mechnikov's scientific world-outlook. A main thesis in those searches was, after I. I. Mechnikov, the similarity of means suitable for treating atrophic and hypertrophic diseases with those used against infectious illnesses. Those means, in his opinion, were specific immune sera.

In the same paper I. I. Mechnikov deals with causes of the senile phagocytosis. He thinks the latter to result from a disharmonious weakening of single elements of vitality in a living organism: at the old age the noble cellular elements get weakened to a greater degree than those of connective tissue.

Similarity between tissular changes both in senility and in disease brings him to a conclusion that: ...the analogy of a senile degeneration with atrophic diseases of our major organs enables us to assume also a similarity of factors causing those both phenomena... Certain infectious diseases give rise to a premature aging... We are authorized on account of more than one analogy to assume the senility to be caused by poisoning of our organism, a slow chronic poisoning. Insufficiently destroyed and excreted poisons weaken the tissues, their activity becomes troubled and slowed down... Of all cellular elements the phagocytes have a major ability to resist the action of poisons abounding in our organism. Sometimes those toxic substances even stimulate the phagocytes...

Supposing the senile atrophy to have resulted from a struggle between different tissular elements that was enhanced in ageing, I. I. Mechnikov did not think arterio-

sclerosis to play the main part in development of senile atrophy. Not having denied the significance of arteriosclerosis in aging process, he was reluctant to single it out from the general series of sclerotic changes in all the organs, considering everything to result from one common cause: ...“In senile vascular changes as well as in regeneration of all organs it comes finally always to a considerable proliferation of the connective tissue”. Mechnikov denied the existence of a physiological sclerosis of organs. All the so-called physiological sclerosis result from intoxication with poisons, mostly of an intestinal origin. He considers the organism to contain in itself the cause of its own destruction.

A further development of I. I. Mechnikov's conception was reflected in his second article that appeared at the end of 1899. Resting on his investigations, he came to the conclusion that of the two ways of interference into phagocytic mechanisms of senile atrophy the phagocytosis inhibition with a specific phagocytic serum did not justify itself. More expedient was the other way: stimulating “...enforced activity of nobler, apt to atrophy elements”.

The investigations of J. Bordet, on I. I. Mechnikov's opinion, brought forth a sufficient experimental foundation “for enforcing the noble elements of our organism” by using small doses of appropriate cytotoxic sera. For further studies in that direction definite experimental ways were planned, which had been described in the above mentioned letter to D. N. Anuchin (1900) and delivered by I. I. Mechnikov for realization to his assistants Kantakuzen and Bezredka. “The first experiments in that direction appeared to be favourable, but the work is far being achieved and it requires a great deal of new experiments”. I. I. Mechnikov failed to obtain positive answers to propounded questions, because of great difficulties in obtaining the sera and determining their dosing.

The problem of autointoxication as a supposed cause of aging found its further development in I. I. Mechnikov's lecture, held in 1901 at Manchester. The lecturer presented an analysis of the human intestinal flora and noted the damage of organism due to its chronic intoxication with products of the colic flora vital activity. Speaking on methods of affecting those harmful processes I. I. Mechnikov urged upon the importance of stimulating the weakened

cells by small doses of sera and proposed another way of immediate influence upon the intestinal flora for changing its composition. One of the versions dealt with ingestion of sour milk products. To be just, we must add that whatever was I. I. Mechnikov's enthusiasm on the idea of changing the colic flora to prevent a premature senility, he never considered that way to have been a radical solution of the problem. He merely contented with expressing his hope that a rational and early applied regime of nourishment, which he recommended, might help the people to preserve both their health and mental energy.

I. I. Mechnikov deserves to be credited for initiating the experimental study of aging. His experiments associated with investigating the effect of numerous toxic substances having formed in certain conditions on an animal organism upon that organism were actually the first attempts to obtain an experimental model of senility. In administering to rabbits and monkeys paracresol — one of the phenols produced in the largest amount by the colic bacteriae — I. I. Mechnikov observed several months later degenerative changes in arteries of kidneys and liver similar to those associated with old age. Indole caused still greater senile — resembling changes.

All that makes only one side of I. I. Mechnikov's conception. Yet there is also another side of it — a philosophic one, dealing with inevitability of death and with a mortal fear.

A comparative-biological study of death incited I. I. Mechnikov not to envisage it as a general law of nature. "A natural death is in a man rather potential than actual. The senility, not being a physiological phenomenon, presents pathological symptoms. No wonder that under those conditions it leads only to a casual death. It is, however, probable for a natural death to occur at an extreme old age". Looking for cases of a natural death in the animal world I. I. Mechnikov found examples from comparative physiology of lower animals and comes to a conclusion that in those animals the death is caused by "intoxication through deficiency in their own tissues metabolism".

Not analysing I. I. Mechnikov's conception on potential immortality of certain organisms which is hitherto discussed in literature, it has to be emphasized that such