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The development of microbiology: A brief historical overview

El desarrollo de la microbiología: Breve reseña histórica

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ABSTRACT

Introduction: At present, when humanity is constantly faced with serious epidemiological problems caused sometimes even by the global spread of various pathogens, consideration of the historical experience of combating dangerous infections, the study of attempts to develop means of protection, prevention and organization of prevention, seems especially relevant. **Methodological approach:** The research covers a significant part of the entire period of the existence of microbiology, from the first scientific papers mentioning microbes to the formation of a modern scientific microbiological school within various universities and institutes. **Interpretation findings:** The study of many years of scientific world experience in microbiology is able to enrich and expand the available modern knowledge.

Key words: history of microbiology, Kazan University, scientific literature, bacteria, microorganisms.

RESUMEN

Introducción: En la actualidad, cuando la humanidad se enfrenta constantemente a graves problemas epidemiológicos causados a veces incluso por la propagación mundial de diversos agentes patógenos, la consideración de la experiencia histórica en la lucha contra las infecciones peligrosas y el estudio de los intentos de desarrollar medios de protección, prevención y organización de la prevención, parecen especialmente pertinentes. **Abordaje metodológico:** La investigación abarca una parte significativa de todo el período de existencia de la microbiología, desde los primeros trabajos científicos en los que se mencionan los microbios hasta la formación de una moderna escuela científica de microbiología en el seno de diversas universidades e institutos. **Hallazgos de interpretación:** El estudio de muchos años de experiencia científica mundial en microbiología es capaz de enriquecer y ampliar los conocimientos modernos disponibles.

Palabras clave: historia de la microbiología, Universidad de Kazán, literatura científica, bacterias, mircoorganismos.

INTRODUCTION

At present, when humanity is constantly faced with serious epidemiological problems caused sometimes even by the global spread of various pathogens, consideration of the historical experience of combating dangerous infections, the study of attempts to develop means of protection, prevention and organization of prevention, seems especially relevant. It is important to note that solving applied problems (fighting a certain infection) often contributed to the development of fundamental ideas about microorganisms. Thus, the study of many years of scientific world experience in microbiology is able to enrich and expand the available modern knowledge.

The main microbiological works of the XIX-XX centuries

One of the first books that outlines the issue of forming ideas about microbes is the publication “The formation of poisons by micro-organisms: A biological study of the germ theory of disease”[1]. The material is presented in the form of 7 lectures, the first of which is just a historical retrospective (from ancient times to L. Pasteur). However, the subsequent parts of the monograph are currently of significant interest to historians of biology and medicine.

In 1903, a monograph was published on the development of bacteriology in the USA[2]. It covers in detail the issues of changing morphology, fermenting ability of microorganisms,

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their virulence and pathogenicity, but the historical aspects are poorly covered.

In 1911, an extensive edition of Microorganisms and Fermentation was published[3]. It consisted of 6 chapters, the first chapter covers in some detail the issues of the development of microscopy and sterilization.

In 1914, the book "Pasteur and after Pasteur" was published, which in 11 chapters describes the life of Louis Pasteur and his followers, presents the history of the study of various diseases (rabies, cholera, plague, diphtheria, typhus, anthrax and others)[4]. Among the early foreign works devoted to the history of microbiology, a brief article published in the journal of the American Medical Association can be distinguished. It discusses the classic works of L. Pasteur, D. Lister, R. Koch. Hall mentions the history of the use of certain media for the differentiation of microorganisms[5]. In 1921, a pamphlet dedicated to A. Leeuwenhoek was published. In it, A. Leeuwenhoek was identified as the first bacteriologist. His detailed biography is presented and his observations are considered.[6]

In 1939, a short report was published in the British Medical Journal, devoted to a review of V. Bullock's monograph "The History of Bacteriology"[7]. It is noted that Bullock's book is "a scientific and literary achievement of the first order". Bullock's monograph itself is a fundamental work, set out on 478 pages. It mentions the names of over 600 researchers. Bullock noted that he was prompted to write the history of bacteriology by the failed release of the second volume of Friedrich Leffl 's edition, which, in turn, in 1887. He published the first part of his planned work "Vorlesungen liber die geschichtliche Entwickelung der Lehre von den Bacterien" ("Lectures on the historical development of the doctrine of bacteria"). The work of V. Bullock presents brief biographical information about each researcher mentioned[7]. The names of Russian bacteriologists are also mentioned: I.I. Mechnikov, F.A. Brauel, G.N. Gabrichevsky, N.F. Gamalei, L.A. Tarasevich, S.N. Vinogradsky, V.K. Vysokovich; which indicates their worldwide recognition already in the first third of the XX century.

In recent foreign publications and scientific articles, one can often find references to the most famous microbiologists. In 1958, the book "Guide to the History of Bacteriology" was published in New York[8]. The book has a section devoted to Soviet microbiology. There are links to the works of Soviet authors published abroad. These are articles by E.B. Babsky, I.G. Kochergin, V.V. Parin (on the achievements of Soviet medicine during the Great Patriotic War), P. Grabar (review of the microbiological literature of the USSR for 1955), review by B.L. Isachenko on microbiology in the USSR for the period from 1917 to 1942, the work of E.E. Ouspensky on the main principles and achievements of Soviet microbiology from 1917 to 1937.

Quite informative from a historical point of view is the popular science publication by Lev Potkov "The World that we do not See"[9]. The book consists of 12 chapters, describes the history of the development of all areas of microbiology. Special attention is paid to Russian and Soviet microbiologists. For example, the name of F. Brauel is mentioned9. In addition, information is provided on the experimental work and observations of D.S. Samoilovich, L.S. Tsenkovsky, G.N. Minkh, N.F. Gamalei, L.L. Heydenreich, I.I. Mechnikov, O.O. Mochutkovsky, P.F. Borovsky, A.G. Polotebnov and V.A. Manassein, S.N. Vinogradsky, D.I. Ivanovsky P.A. Kostycheva, V.L. Omelyansky, V.S. Butkevich, N.N. Khudyakova, M.S. Voronin, B.L. Isachenko, N.A. Krasilnikov, L.A. Tarasevich, A.M. Bezredki, I.G. Savchenko, the first female bacteriologist P.I. Tsiklinskaya, Z.P. Govorlivy, N.I. Latyshev, D.K. Zabolotny and I.A. Deminsky, H.I. Gelman, A.A. Imshenetsky, V.N. Shaposhnikov, V.O. Towson, A.H. Sarkisov and some others.

The work published abroad under the title "Three Centuries of Microbiology" is an essential work on the history of microbiology[10]. However, among Russian researchers, only I.I. Mechnikov, S.N. Vinogradsky, M.S. Voronin are mentioned.

In 1976, P. Collard's book "The Development of Microbiology" was published11. It examines the development of microscopic technology, artificial nutrient media, sterilization methods, the emergence of antibiotics, the development of ideas about microbial metabolism, microbial genetics, the history of research in the field of antibody formation, virology. Of the domestic researchers, only I.I. Mechnikov is mentioned.[11]

Questions of the history of microbiology have often been considered in collections on the history of biology and medicine. For example, the publication of E. Gardner's "History of Biology" presents the research of A. Leeuwenhoek, J. Lister, R. Koch[12]. In the three-volume edition of H.D. Riordan's Medical Mavericks[13], devoted to the history of medicine, one can find a description of the life and scientific achievements of J. Lister and L. Pasteur.

Modern research on the history of microbiology

Not so long ago, the work "History of Microbiology"[14] was published in Russia, which is a Russian translation of the 1999 edition of the same name. The book contains references to the works of many Russian researchers: V.M. Aristovsky, S.N. Vinogradsky (his name is mentioned in the book 29 times), D.I. Ivanovsky, A.A. Imshenetsky, P.A. Kostycheva, A.V. Krainsky, N.A. Krasilnikov, I.I. Mechnikova, E.N. Mishustina, G.A. Nadson, V.L. Omelyansky, B.V. Perfilie , A.S. Faminitsyn, N.G. Kholodny, L.S. Tsenkovsky.

A very significa t work devoted to the history of Russian microbiology is the dissertation work of N.N. Kolotilova[15]. In her dissertation work "The formation of an ecological trend in domestic microbiology in the works of S.N. Vinogradsky, his contemporaries and followers (late XIX - mid XX centuries)", N.N. Kolotilova identified the main stages in the scientific activity of S.N. Vinogradsky, characterized the natural science approach of his research. She was shown that ecological microbiology was actively developing within the

walls of Moscow University (E.E. Uspensky, S.I. Kuznetsov, V.O. Towson, D.M. Novogrudsky). N.N. Kolotilova showed that the Pasteur Institute in Paris not only allowed many Russian scientists to realize their creative potential, but also enriched itself with the ideas of Russian researchers, and S.N. Vinogradsky and his laboratory in Brie-Comte-Robert became a world center in the field of microbial ecology. It showed that an important role in continuing the traditions of S.N. Vinogradsky was played by his follower G.A. Zavarzin, who paid significant attention to the role of microbial communities in the development of the biosphere. Thus, the development of ecological and geological microbiology is widely covered in numerous works by N.N. Kolotilova (Figure 1), who is currently a leading specialist in the history of this section of microbiology in Russia.[16-41]

Figure 1. Natalia Nikolaevna Kolotilova. Department of Microbiology, Moscow State University.

If we consider an earlier period, then undoubtedly we should mention the historical works of the outstanding Russian microbiologist B.L. Isachenko. As N.N. Kolotilov wrote in her article dedicated to the 150th anniversary of Boris Lavrentievich, “his patriotic articles on the history of microbiology should be especially noted...”.[39]

Indeed, since the early 1940s, review papers on the history of microbiology began to be published under the authorship of B.L. Isachenko. However, he had previously covered the activities of individual microbiologists. So, in 1927, a material dedicated to the memory of S.M. was published. Visloukh, author of the textbook “The Doctrine of microorganisms” (1916)[42]. For example, in 1928, a material was published dedicated to the death of V.L. Omelyansky, a famous Russian chemist, who by chance came to the laboratory of S.N. Vinogradsky.[43]

In this note, B.L. Isachenko points to the role of V.L. Omelyansky in the study of the processes of microbial decomposition of fibe , the study of the drying process in Azotobacter and spontaneous fermentation of dough with the participation of gas-forming bacteria. Isachenko reviewed not only the scientific works of Vasily Leonidovich, but also characterized his human qualities; noted his kindness to everyone and desire to help people. One can also mention the works of Boris Lavrentievich on the life and work of O. Fernbach and M. Shen.[44] In this memorable note, B.L. Isachenko emphasizes their contribution to the study of alcoholic fermentation processes (both were heads of the Fermentation Department at the Pasteur Institute in Paris). Boris Lavrentievich noted that the works of Fr. Fernbach’s research was mainly concerned with the study of fermentation enzymes (sucrose, amylase) and conditions affecting sugar inversion (light, phosphates). In addition, O. Fernbach investigated the peculiarities of fermentation carried out by *Amylobacter* and the associated formation of acetone and butyl alcohol; he also conducted a series of studies on the work of amyloocoagulase, which converts starch into maltose, glucose, acetic acid and other compounds in *Tyrothrix* tenuis cells. In relation to M. Shen, B.L. Isachenko wrote that he was focused on the chemistry of alcoholic fermentation and its intermediates (mannitol and others). According to Boris Lavrentievich, both microbiologists had an important influence on the development of food microbiology in the USSR. In 1939, a commemorative material was published on the 55th anniversary of N.F. Gamalei’s scientific activity (Isachenko, 1940)[45]. Perhaps the most significant contribution of B.L. Isachenko in the field of the history of microbiology is his article “Microbiology in the USSR for 25 years”.[46]

Later, materials dedicated to the memory of L. Pasteur[47] and I.I. Mechnikov[48] were published. In 1945, the work “From the history of the development of microbiology in the USSR (to the 220th anniversary of the USSR Academy of Sciences) was published[49]. In this article, Boris Lavrentievich calls Martin Matveevich Terekhovsky (1740-1790), who studied the processes of reproduction and respiration of microbes at the Medical and Surgical Academy (p. 66), the first domestic microbiologist. B.L. Isachenko in this article notes the merits of L.S. Tsenkovsky, S.N. Vinogradsky, V.L. Omelyansky, T.L. Ginzburg-Karagicheva, A.A. Maliyants, L.D. Sturm, V.O. Towson, L.I. Rubenchik, N.G. Kholodny, N.A. Krasilnikova, V.N. Shaposhnikova, N.N. Khudyakova, M.P. Korsakova, E.N. Mishustin, S.P. Kostycheva, V.S. Butkevich, A.A. Imshenetsky, A.M. Peshkov, G.A. Nadson. After the death of B.L. Isachenko (in 1948), A.A. Imshenetsky published “Selected Works”[50], which contain his articles on the scientific work of Boris Lavrentyevich; E.N. Mishustin and S.I. Kuznetsov also wrote about B.L. Isachenko. An article by G.A. Zavarzin was published about A.A. Imshenetsky himself in 2005.[51]

In general, Georgy Alexandrovich Zavarzin has published many works on the history of microbiology. His last work was presented after his death and it is dedicated to the memory of his contemporary Igor Nikolaevich Krylov[52]. It notes the contribution of I.N. Krylov to the study of fossil microorganisms. Much attention was paid by G.A. Zavarzin to S.N. Vinogradsky[53,54]. A separate work was devoted to the history of the S.N. Vinogradsky Institute of Microbiology55. In this article, G.A. Zavarzin examines the origin and development of microbiology in Russia in a historical context, highlighting a number of periods - the “golden age” (1880-1914): “the discovery of representatives of the main groups of bacteria based on pure cultures. Priority works of Russian researchers in the field of chemosynthesis, nitrogen fixation, methanogenesis”; 1920-1970: “Unity in biochemistry” - “proof of universal reactions and metabolic pathways in selected representatives of physiological groups. The discovery of

antibiotics and the search for producers of physiologically active substances"; 1970 - present: "the detection of many organisms with similar functions instead of a few typical representatives, the application of genetic criteria to identify microbial diversity" (p. 600)[56]. The research conducted at the S.N. Vinogradsky Institute of Microbiology is described in detail. The names of G.A. Nadson, B.L. Isachenko, N.A. Krasilnikov, A.E. Kriss, V.I. Kudryavtsev, A.A. Imshenetsky, G.I. Burgvitz, V.L. Ryzhkov, S.V. Goryunova, E.N. Mishustin, V.M., are mentioned. Gorlenko, G.A. Dubinina, G.I. Karavaiko, N.N. Lyalikova, A.I. Korenyako, L.V. Kalakutsky, D.G. Zvyagintseva, G.K. Scriabina, V.F. Galchenko, D.I. Nikitina, Yu.I. Sorokina, T.P. Turova, T.N. Zhilina, I.S. Zvyagintseva, E.A. Bonch-Osmolovskaya, S.N. Dedysh, D.I. Nikitina, L.M. Gerasimenko, S.I. Kuznetsova, E.P. Rozanova, T.N. Nazina. G.A. Zavarzin, also has a separate work dedicated to the 125th anniversary of the birth of B.L. Isachenko.[57]

Several publications on the history of Russian and European microbiology belong to a student of S.N. Vinogradsky, V.L. Omelyansky (1867-1928). These are essays on I.I. Mechnikov[58], Louis Pasteur, the Italian microbiologist Constantino Gorini, D.K. Zabolotny[59]. To learn about V.L. Omelyansky himself is possible from the article by I.P. Golikov.[60]

An important work on the history of the formation of the microbiological department at the Institute of Experimental Medicine in St. Petersburg was performed by T.V. Andryushkevich and presented in the form of a dissertation study "The formation of microbiological schools of the Institute of Experimental Medicine and their impact on the development of scientific research in Russia" (2004)[61]. Tatyana Vladimirovna writes: "...the development of Russian microbiology is primarily associated with the natural sciences and medical faculties of universities (Moscow, Dorpat, Kazan, Kharkov, St. Petersburg, Warsaw, Kiev, Novorossiysk, Tomsk, Saratov). However, the St. Petersburg Society of Naturalists, the Society of Russian Doctors (St. Petersburg and Moscow), and the medical societies of Kiev, Kharkov, Odessa, Kazan, Tomsk also played a significan role". T.V. Andryushkevich noted that in the famous monograph L.Ya. Skorokhodov[62] (1948), for some unknown reason, there was no analysis of the activities of the microbiological department of the Institute of Experimental Medicine. Tatiana Vladimirovna's dissertation work eliminated this gap. It highlights in detail the initial stages of bacteriological research, the opening of the St. Petersburg Pasteur Station (June 13, 1886), which was headed by K.Ya. Gelman, whose only employee at first was V.A. Krayushkin1. T.A. Andryushkevich. It was shown that together with K.Ya. Gelman, A.Yu. Bertush also worked later (died trying to create a vaccine against sapa) and E. Shperk (ibid., p. 9).

T.A. Andryushkevich notes that the subsequent opening of the Imperial Institute of Experimental Medicine, which took place on December 8, 1890, made it possible to significantly expand the range of research conducted. K.Ya. Gelman headed the department of epizootology, in 1896 he was replaced by A.A. Vladimirov. Since 1891, the IEM has had a department of general microbiology, headed by S.N. Vinogradsky.

Thus, T.V. Andryushkevich traced the activity of the IEM over a long period, from the opening to the middle of the twentieth century. She was shown that two scientific schools had been formed: K.J. Gelman, A.A. Vladimirova, O.O. Gartokh, V.I. Loffe, A.A. Smorodintsev, and the school of S.N. Vinogradsky, V.L. Omelyansky, D.K. Zabolotny; each of which had an important influence on the development of microbiology in various cities of Russia (Saratov, Stavropol, Rostov-on-Don, Irkutsk, Volgograd, Alma-Ata).

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