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To the anniversary of Professor R.P. Naumova (according to the memoirs of the students)

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ABSTRACT

Microbiology at Kazan University has been developing since the middle of the XIX century. At the end of the 60s of the last century, an independent department of microbiology was opened under the leadership of Professor M.I. Belyaeva. One of her first students and colleagues is Rimma Pavlovna Naumova, who made a significant contribution to the development of a number of new directions at the department. This article is based on the memories of students about the scientific and pedagogical activities of R.P. Naumova.

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Introduction

Rimma Pavlovna Naumova (nee Kalmychkova) was born in the village of Abramtsevo, Moscow region on November 19, 1933 (Fig. 1). In the period between 1951 to 1956 She studied at the Department of Plant Physiology at the Faculty of Biology and Soil of Moscow State University, received the qualification "Biologist. High school biology and chemistry teacher"1. From 1956 to 1959, she worked as a collector, laboratory assistant, and engineer at the VSEGINGEO Institute of the Ministry of Geology and Subsoil Protection (Moscow). In 1959 she moved with her husband to Severodonetsk, Luhansk region, and in 1961 she entered the correspondence graduate school of MGU2, later she was transferred to the full-time graduate school of KSU. In October 1964 she completed the theoretical postgraduate course ahead of schedule.3 On October 29, 1964, an order was issued by the rector of KSU M.T. Nuzhin to enroll Rimma Pavlovna as an assistant at the Department of Plant Physiology and Microbiology4. In 1966, by the decision of the Higher Attestation Commission of the USSR, she was awarded the degree of Candidate of Biological Sciences5. The dissertation work was called "Transformation of caprolactam by bacteria"6.

On September 30, 1976, R.P. Naumova was appointed Acting Professor of Microbiology. On January 27, 1977, R.P. Naumova was approved for the position of head of the Department of Microbiology (KSU Order No. 9-L)7. She worked in this position for 6 years, after which she performed the duties of a professor (her doctoral thesis was defended in 1989).

Important information about the life and scientific activity of R.P. Naumova was reflected in a series of publications dedicated to Rimma Pavlovna under the authorship of Natalia Vladimirovna Feoktistova, a researcher at the Laboratory of Biochemistry and Bioengineering of Enzymes of the Department of Microbiology. In the first of her publications [1] Natalia

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Vladimirovna tells the story of the formation of the scientific school of Rimma Pavlovna in the direction of "Microbial metabolism of non-natural chemical compounds". According to her, the backbone of the research team was formed by 1990 – this (at that time) student F. Karimova, research associates of R.E. Khabibullin, A.M. Petrov, S.P. Maslov, N.M. Pivovarova, I.A. Paramygin, G.Y. Yakovleva, S.K. Zaripova, I.M. Giniatullin, N.I. Krylova. In 1995, as already noted above, the Laboratory of Ecological Biotechnology and Biomonitoring was organized. Rimma Pavlovna's deputy in the laboratory was Candidate of Biological Sciences Sania Kashafovna Zaripova [1, p. 181]. The NIL EBB consisted of Isabella Davidovna Chasova, Nadezhda Mikhailovna Pivovarova, Ildar Giniatullin, Grigory Lisin, Tatiana Belousova, Lyudmila Zolotukhina, Andrey Petrov, Sania Zaripova, Alexander Maslov, Svetlana Selivanovskaya, Nelly Krylova, Alexander Vasilyevich Garusov, Irina Skipina, Rustem Khabibullin, Sergey Zaripov, Elena Nikitina. Here is what N.V. Feoktistova wrote about the main results of the work of Rimma Pavlovna's laboratory: "... many of the works of scientists in this laboratory are pioneering. For the first time, the biochemical scheme of switching caprolactam and its homologues to the usual pathways of catabolism of natural molecules was substantiated, for the first time (together with the Institute of Biochemistry and Physiology of Microorganisms of the Russian Academy of Sciences, Pushchino), the plasmid of caprolactam biodegradation was revealed.

Fig 1. Professor R.P. Naumova in her youth.

The deep microbial destruction of nitroaromatic compounds, including 2,4,6-trinitrotoluene (TNT), which is very resistant to biodegradation, has been demonstrated for the first time, and an original method of bacterial anaerobic-aerobic transformation of TNT has been developed, on the basis of which an industrial biotechnology for the purification of real wastewater from this compound and toxic product of its decomposition has been created. A previously unknown and rarely encountered pathway of microbial transformation of TNT has been discovered (together with IBFM RAS). New data on the bacterial preparatory exchange of arylpolycarboxylic acids (widely used in the production of polymers such as lavsan) have been obtained and a biotechnology for the neutralization of concentrated wastewater from the production of these acids has been developed for the first time. For the first time, the microbiological characteristics of solid waste of petrochemical production – oil sludge, characterized by high toxicity and stored for decades in industrial storage tanks, are given, a mode of activation of intra-sludge microflora is proposed for the purpose of further bioremediation of these environmentally hazardous wastes. NEIL EBB is the only laboratory in Russia studying phytoremediation of oil sludge. In 1999-2005, the technology of phytoremediation of oil sludge was created, which is undergoing field tests at the Nizhnekamskneftekhim production association. Of undoubted practical interest are the works on bioremediation of soils contaminated with oil with concomitant technogenic salinization. Such soils are typical for the oil-producing regions of the Republic of Tatarstan. In laboratory conditions, the high efficiency of the community of osmotolerant microorganisms that destroy oil hydrocarbons in both oxygen and oxygen-free conditions has been shown. Fundamental studies of microbial destruction of the above and a number of other organic compounds that pose a serious danger to the environment have been carried out. The metabolic pathways of the breakdown of these chemicals by microorganisms and their involvement in the natural biogeochemical cycles of carbon, nitrogen, and sulfur have been studied and described. The enzymes involved in the catabolism of xenobiotics were studied, the features of plasmid regulation of a number of such enzymes were revealed. The original concept of preparatory exchange and cometabolism of non-natural chemical compounds is formulated. At the same time, physiological and biochemical studies were directly connected with the creation of environmental biotechnologies. Microorganisms – destructors of chemicals and petroleum hydrocarbons – are used in the development of biotechnologies for wastewater

treatment and gas emissions of chemical and petrochemical industries, neutralization and disposal of oil sludge and other solid waste, purification of oil-contaminated soils. These technologies are in demand and implemented at such partner enterprises as JSC Kazanorgsintez, JSC Nizhnekamskneftekhim, JSC KamAZ. 12 copyright certificates and 5 patents of the Russian Federation indicate the priority of the works of scientists representing the scientific school of R.P. Naumova. In 1988 Rimma Pavlovna was awarded silver and bronze medals of the VDNH of the USSR for practical developments in the neutralization of industrial waste" [1, pp. 181-182].

Rimma Pavlovna played a very significant role as a supervisor in the dissertations defended under her tutelage [1, pp. 183-184]: Zakharova N.G. "Transamination of non-natural ω-amino acids in microorganisms". 1997 Scientific director – Candidate of Biological Sciences, Associate Professor R.P. Naumova, Honored Scientist of the RSFSR and TASSR, Doctor of Biological Sciences, Professor M.I. Belyaeva.

Amerkhanova N.N. "Transformation of α-trinitrotoluene by microorganisms". 1979 Scientific director – Candidate of Biological Sciences, Associate Professor R.P. Naumova, Honored Scientist of the RSFSR and TASSR, Doctor of Biological Sciences, Professor M.I. Belyaeva.

Selivanovskaya S.Yu. "Microbial metabolism of aromatic nitro- and amino compounds in connection with the biotechnology of wastewater treatment". 1987. Scientific hands – Candidate of Biological Sciences, Associate Professor R.P. Naumova.

Fattakhova A.N. "Microbial metabolism of 1-(chloromethyl)silatrana". 1988 Scientific director – Candidate of Biological Sciences, Associate Professor R.P. Naumova, consultant – Candidate of Chemical Sciences E.N. Officers.

Zaripova S.K. "Metabolism of aryl dicarboxylic acids of *Rhodococcus rubroperctinctus*". 1989 Scientific director – Candidate of Biological Sciences, associate Professor R.P. Naumova.

Smirnova N.N. "Microbial destruction of water-soluble lubricants and methods of its prevention". 1993 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova.

Skipina I.M. "Microbial metabolism of nonionic surfactants: acyl- and alkyl derivatives of polyethylene glycol". 1993 Scientific director – Candidate of Chemical Sciences, Associate Professor E.N. Officers, Doctor of Biological Sciences, Professor R.P. Naumova.

Petrov A.M. "Microbiological foundations of biotechnology of wastewater treatment of petrochemical production". 1995 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova.

Yakusheva O.I. "Biotechnology of wastewater treatment and gas emissions of the petrochemical complex". 1998 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova.

Zaripov S.A. "Initial stages of microbial metabolism of 2,4,6-trinitrotoluene". 2002 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova. Nikitina E.V. "Toxic and microbiological aspects of bioremediation of oil sludge – waste of petrochemical production". 2003 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova.

Khabibullin R.E. "Research and development of intensive biotechnology of anaerobic processing of chicken manure". 1995 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova, Doctor of Technical Sciences, Professor V.N. Sharifullin.

Shurkhno R.A. "Fermentation of high-protein plant mass with the introduction of lactic acid bacteria". 2004 Scientific director – Doctor of Biological Sciences, Professor R.P. Naumova.

Another publication by N.V. Feoktistova (Feoktistova, 2009) was dedicated to the 75th anniversary of Rimma Pavlovna (celebrated on November 19, 2008). It briefly presents the results of R.P. Naumova's work, but, what is especially valuable, the teachers of Rimma Pavlovna during her student days at Moscow State University (1951-1956) are mentioned: these are the luminaries of Russian biochemistry and microbiology A.N. Belozersky, A.I. Oparin, V.N. Shaposhnikov, N.D. Jerusalem, M.N.. Meisel, S.I. Kuznetsov, E.N. Kondratieva [2, 2009, p. 274]. In this material, N.V. Feoktistova also presents the memory of I.B. Leshchinskaya (Head of the Department of Microbiology at KSU from 1982 to 2003): "I worked with Rimma Pavlovna from the first days of her appearance at Kazan University. I can say with absolute confidence that she has no equal in the style and content of work with students and postgraduates. Even not very successful students, falling into her hands, turn into science fans before her eyes. In Rimma Pavlovna, the Moscow biological school was perfectly felt – a deep knowledge of microbiology and biochemistry, the ability to present students with the most complex material on the physiology and biochemistry of bacteria, great pedagogical talent and much more. I considered and still consider Rimma Pavlovna one of our most talented professors. What courage and conviction it was necessary to have in order to decide to find a new scientific direction next to such a scientific authority as Margarita Ilyinichna Belyaeva, which has been successfully developing all these years and has significantly enriched

not only microbiological science, but also the educational process itself at our department" [2, p. 277].

On the occasion of the death of R.P. Naumova, a commemorative note was published on behalf of the staff of the Department of Microbiology [3]. It said the following: "The feeling of irreparable loss does not leave. A world-renowned scientist, a talented teacher, a bright, extraordinary person has passed away.

It seemed that Rimma Pavlovna's energy and enthusiasm were inexhaustible. It is impossible to imagine that she has lost a sincere, restless interest in her work. Science and scientific research were the main area of Rimma Pavlovna's aspirations. She was burdened by administrative work, the meetings of the Academic Council distracted her from the case, it was a pity to have time for an interview… But as far as the scientific sphere was concerned, there were no insurmountable obstacles for R.P. Naumova. She worked without knowing weekends and holidays: at the same time, she developed several scientific directions within the framework of a common theme, agreed with partners on new applied projects, worked out the strategy of scientific research with each of her students and colleagues, ensured that each experiment was conducted at the highest level, attracting the best domestic and foreign specialists.

Undoubtedly, R.P. Naumova would have achieved success in any field, but microbiology became her vocation. Rimma Pavlovna devoted her entire more than half a century of rich and fruitful scientific and pedagogical activity to the study of microbial destruction of xenobiotics" [3, pp. 254-255]. At the end of her memorable material, N.V. Feoktistova noted: "Until the last day of her life, Rimma Pavlovna Naumova remained a Scientist and Teacher. She remained an example of dedication, optimism, courage in overcoming difficult life situations" [3, p. 256].

Conclusions

Finally, it should be said that the scientific works of R.P. Naumova are widely represented in international citation databases. For example, her 59 articles are indexed in Scopus (linked to the author's identifier No. 7006041118), Rimma Pavlovna's Hirsch index is 9, and her articles have been cited 448 times (in 360 documents). The last work of R.P. Naumova (Grigoryeva, T.V., Laikov, A.V., Rizvanov, A.A., Ilinskaya, O.N., Naumova, R.P.

Composition of the oil-slime microbial community as determined by analysis of the 16S rRNA gene (2013) // Microbiology (Russian Federation), 82 (5), pp. 637-641) was published already in the year of her death, but after that Rimma Pavlovna's scientific publications were cited dozens more times. The list of journals in which her scientific works were presented is impressive: "Microbiology" (RF) – most of Rimma Pavlovna's articles were published in this journal), "Russian Journal of Plant Physiology", "Genome Announcements", "Chemosphere", "Biochemistry (Moscow)", "Applied and Environmental Microbiology", "Petrochemistry", "Applied Biochemistry and Microbiology", "Petroleum Chemistry", "FEMS Microbiology Letters", "Eurasian Soil Science", "Reports of the Academy of Sciences", "Journal of Chemical Technology and Biotechnology" – the article in this journal has been cited 87 times, "World Journal of Microbiology and Biotechnology", "Chemistry and Technology of Water", "Reviews of Environmental Contamination and Toxicology", "Soviet Journal of Water and Chemical Technology", "Proceedings of the USSR Academy of Sciences. Biological series", "Scientific reports of the higher school. Biological sciences", "Soviet chemical industry". All this undoubtedly testifies to the highest level of scientific research by R.P. Naumova.

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Further Readings

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