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EDITORIAL NOTES

Andrey Nikolaevich Belozersky: Five Decades in Science. Preface to the Special Issue

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The scientific biography of Andrey Nikolaevich Belozersky (1907-1971), an outstanding Soviet biochemist and molecular biologist, has been detailed in several Russian-language publications [1-3]. However, his life and work remain largely inaccessible to the international scientific community. Therefore, as an introduction to this special issue of *Biochemistry (Moscow)* dedicated to his memory, we provide a concise overview of his scientific career.

Andrey N. Belozersky was born 120 years ago in Tashkent, then a small town. He completed his schooling in Alma-Ata but returned with his family to Tashkent in 1917. His scientific career, which spanned exactly half a century, divides logically into five distinct decades.

DECADE ONE (1920-1930). THE BEGINNING

Andrey N. Belozersky began his scientific work in 1922 upon enrolling in the Physico-Mathematical Faculty of the Central Asian State University. This faculty trained not only physicists and mathematicians but also – in a manner similar to Moscow University at the time – chemists and biologists. He soon embarked on research under the supervision of Andrey V. Blagoveshchensky, a prominent Russian biochemist who had come to Tashkent from Moscow. It was Professor Blagoveshchensky who subsequently introduced Belozersky to the Moscow-based biochemist Alexander R. Kizel.

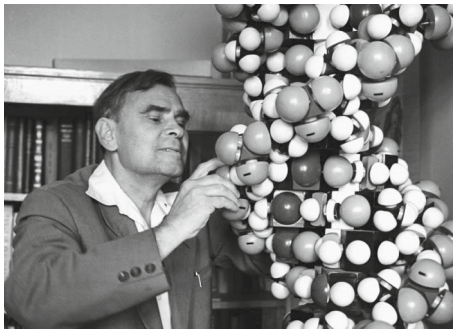

Fig. 1. Andrey Nikolaevich Belozersky

DECADE TWO (1930-1940). FIRST DISCOVERIES

In 1930, Professor Kizel invited the twenty-five-year-old Belozersky to move to Moscow and assist him in establishing the Department of Plant Biochemistry at Lomonosov Moscow State University. Within just three to four years, Belozersky made a discovery that would later secure his place among the pioneers of nucleic acid science: he identified **thymine** in plant nucleic acids, a base previously found only in animal DNA, thereby proving the universal distribution of DNA throughout the living world [4, 5].

This period also included his excellent work in the late 1930s on bacterial DNA and RNA [6, 7], which gained international recognition in the following decade. Concurrently, he conducted extensive research on DNA-binding proteins. Even in these early studies, he demonstrated a firm conviction that nucleic acids exist and function within the cell exclusively as complexes with proteins [8, 9].

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DECADE THREE (1940-1950). INTERNATIONAL RECOGNITION

In 1943, during World War II, Belozersky began studying gramicidin S, one of the first two Soviet antibiotics, discovered the previous year by G. F. Gause and M. G. Brazhnikova. The following year, in collaboration with these distinguished scientists and his student T. S. Paskhina, he published a paper determining the amino acid composition of this cyclic peptide antibiotic [10].

A pivotal scientific event occurred in 1944. American scientist Oswald Avery and his colleagues demonstrated the transfer of a genetically inherited trait between organisms using protein-free DNA [11]. Belozersky was one of the few biologists worldwide who recognized and fully appreciated the profound significance of this finding.

In 1946, Belozersky was invited to deliver a plenary lecture at the first-ever international symposium on nucleic acids, held at Cold Spring Harbor Laboratory in the United States. Although he was unable to attend, he submitted the text of his lecture. This manuscript subsequently formed the opening chapter of the first scientific monograph dedicated entirely to nucleic acids [12].

DECADE FOUR (1950-1960). A MAJOR SCIENTIFIC BREAKTHROUGH. THE BELOZERSKY SCHOOL

In the late 1940s, the Austrian-born American biochemist Erwin Chargaff established key patterns in the nucleotide composition of DNA from different organisms, now known as “Chargaff’s Rules.” The most famous of these is the equivalence of A=T and G=C base pairs [13]. Historians of science universally agree that without this fundamental insight, the discovery of the DNA double helix by Watson and Crick would have been delayed for many years.

A. N. Belozersky immediately recognized the significance of Chargaff’s work and, with remarkable prescience, initiated a large-scale study – seemingly alone in the world at the time – on the nucleotide composition of both DNA and RNA across diverse organisms.

From the vast quantitative data amassed by Belozersky and his collaborators, several fundamental conclusions emerged. First, they demonstrated that comparing the ratios of heterocyclic bases in DNA from different organisms could reliably reveal their evolutionary relationships. These findings laid the groundwork for the new field of genosystematics. Second, by comparing these base ratios in DNA and RNA from a wide variety of sources, A. N. Belozersky and A. S. Spirin made a critical discovery: while base ratios vary widely in DNA, they are conserved within a narrow range in RNA. Spirin and Belozersky concluded that the bulk of cellular RNA does not code for proteins and, through sophisticated correlation analysis, established that only a small fraction is involved in protein coding [14]. Merely a couple of years later, the existence of this class of RNA – messenger RNA (mRNA) – was confirmed.

Belozersky’s interest in RNA during this period was profound and extended to the problem of the origin of life. In 1957, he presciently wrote: “There is no doubt that nucleic acids have played a significant role in the development of the organic world. However, it is unlikely that RNA and DNA arose simultaneously in the early stages of life’s development. It seems to us that the emergence of ribonucleotides and then RNA was primary. DNA arose significantly later, parallel to the increasing complexity of functions and greater differentiation of protoplasm.” [15]. Thus, A. N. Belozersky can rightly be considered a forerunner of the now-established “RNA World” hypothesis. The groundbreaking achievements of this decade secured his reputation as one of the founding fathers of molecular biology.

DECADE FIVE (1960-1970). THE BELOZERSKY INSTITUTE

In early 1963, the Rector of Lomonosov Moscow State University, Ivan G. Petrovsky, invited A. N. Belozersky to discuss fostering the “new biology” at the university. This interdisciplinary field, flourishing at the intersection of biology, physics, and chemistry, was rapidly advancing in leading scientific nations. Together, they decided to establish a novel academic unit, naming it the Interfaculty Laboratory of Bioorganic Chemistry. Rector Petrovsky proposed that Belozersky lead this new division, an offer he promptly accepted.

Belozersky’s core organizational principle for the Laboratory was to unite young university researchers who had already demonstrated significant scientific promise. With an average age of about thirty, each was granted the autonomy to establish their own research team. Unsurprisingly, within just five or six years – and still during Belozersky’s lifetime – the scientific community came to regard the Laboratory as a *de facto* research institute, operating at the level of the premier academic institutions in molecular biology.

Upon being formally granted institute status, it was renamed the A. N. Belozersky Institute of Physico-Chemical Biology. This legacy continued when V. P. Skulachev, who led the Institute for the subsequent half-century, founded the new Faculty of Bioengineering and Bioinformatics. This faculty has become

one of the most sought-after at Lomonosov Moscow State University and remains organically linked to the Institute.

REFERENCES

1. Spirin, S. A. (2006) Andrey Nikolayevich Belozersky: On the 100th Anniversary of His Birth. Scientific and Pedagogical Activity, Memoirs, and Materials [in Russian], Nauka Publishers, Moscow.
2. Razin, S. V. (2024) From Plant Biochemistry to Molecular Biology: 95 Years of the Department – A Memoir Project (in 2 Volumes) [in Russian], Vol. 1, Buky-Vedi, Moscow.
3. Razin, S. V. (2024) From Plant Biochemistry to Molecular Biology: 95 Years of the Department – A Memoir Project (in 2 Volumes) [in Russian], Vol. 2, Buky-Vedi, Moscow.
4. Kiesel, A., and Belozersky, A. (1934) About the nucleic acid nucleoproteins of pea germ [in German], *Hoppe Seilers Z. Physiol. Chem.*, **226**, 160-166, https://doi.org/10.1515/bchm2.1934.229.4-6.160.
5. Belozersky, A. N. (1935) The nuclein complex of the french bean seedlings [in Russian], *Proceedings of Moscow State University*, **4**, 209-215.
6. Belozersky, A. N. (1940) On the quantitative content of proteins and nucleic acids in the bacterial cell [in Russian], *Microbiologiya*, **9**, 107-113.
7. Belozersky, A. N. (1941) On the composition of the protoplasm in *Spirillum volutans* cells as a function of culture age [in Russian], *Microbiologiya*, **10**, 185-199.
8. Belozersky, A. N., and Chernomordikova, L. A. (1940) On the nucleoproteids and nucleic acids of wheat germs [in Russian], *Biokhimia*, **5**, 133-139.
9. Belozersky, A. N. (1940) On the nucleoproteids of plant origin [in Russian], *Proceedings of Moscow State University*, **36**, 5-11.
10. Gause, G. F., Brazhnikova, M. G., Belozersky, A. N., and Paskhina, T. S. (1944) Biological and chemical characterization of crystalline gramicidin S [in Russian], *Bull. Exp. Biol. Med.*, **13**, 3-6.
11. Avery, O. T., Macleod, C. M., and McCarty, M. (1944) Studies on the chemical nature of the substance inducing transformation of pneumococcal types: induction of transformation by a desoxyribonucleic acid fraction isolated from pneumococcus type III, *J. Exp. Med.*, **79**, 137-158, https://doi.org/10.1084/jem.79.2.137.
12. Belozersky, A. N. (1947) On the nucleoproteins and polynucleotides of certain bacteria, *Cold Spring Harb. Symp. Quant. Biol.*, **12**, 1-6, https://doi.org/10.1101/SQB.1947.012.01.003.
13. Chargaff, E., Lipshitz, R., and Green, C. (1952) Composition of the desoxypentose nucleic acids of four genera of sea-urchin, *J. Biol. Chem.*, **195**, 155-160, https://doi.org/10.1016/S0021-9258(19)50884-5.
14. Belozersky, A. N., and Spirin, A. S. (1958) A correlation between the compositions of the deoxyribonucleic and ribonucleic acids, *Nature*, **182**, 111-112, https://doi.org/10.1038/182111a0.
15. Belozersky, A. N. (1957) On the species specificity of nucleic acids in bacteria [in Russian], in *The Origin of Life on Earth*, Reports on the International Symposium, August 1957 (Oparin, A. I., ed.) Publishing House of the USSR Academy of Sciences, Moscow, p. 198-205.

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