

Anna S. Tikhonenko

Electron microscopist extraordinary

Vladimir I. Popenko,¹ Elizabeth M. Kutter² and Hans-W. Ackermann^{3,*}

¹Engelhardt Institute of Molecular Biology; Russian Academy of Sciences; Moscow, Russia; ²Evergreen State College; Olympia, WA USA;

³Department of Microbiology-Infectiology and Immunology; Medical School; Laval University; Quebec, Canada

Aнна Sergeyevna Tikhonenko (1925–2010) is to be remembered for the excellency of her electron microscopical work, particularly with bacteriophages. She published 113 articles and one book, *Ultrastructure of Bacterial Viruses* (Izdatelstvo Nauka, Moscow 1968; Plenum Press, New York, 1972). It included 134 micrographs and a complete overview of the 316 phages then examined by electron microscopy. Most micrographs were of exceptional quality. This book, a rarity in those days of strict separation of Soviet and Western research, was the first bacteriophage atlas in the literature and presented a morphological classification of phages into five categories of family level, similar to a scheme presented in 1965 by D.E. Bradley (J Royal Microsc Soc 84:257–316). Her book remains one of the fundamentals of phage research.

In 1968, Anna S. Tikhonenko (Fig. 1) became head of a laboratory for electron microscopy at the Institute of Molecular Biology of the USSR Academy of Sciences. She continued her work on bacteriophages, but also embarked on studies on chromosomes, chromatin, ribonuclein proteins, and DNA configuration. This included studies of a ciliate (*Bursaria truncatella*), myxomycetes (*Physarum polycephalum*), and the European weatherfish (*Misgurnus fossilis*). She was also interested in bacterial structure, mainly of streptomycetes. However, bacteriophages remained her main interest throughout her career. She used a wide variety of electron microscopic techniques and

developed a special interest in immunoelectron microscopy.

Over 90 of her articles were on bacteriophages, mainly phages of *Bacillus*, enterobacteria, methanotrophs, and on phage immuno-electron microscopy. Most of her scientific work was published between 1959 and 1982. The work of A.S. Tikhonenko is outstanding because of its exceptional quality. Her pictures, which feature capsomers, tail striations and fibers and such delicate things as antibodies, are generally much above the low-contrast, unsharp micrographs now common in the phage literature. It is noteworthy that she always used “manual” JEOL (Japanese Electron Optical Laboratories, Tokyo) electron microscopes and darkroom photography.

Anna S. Tikhonenko led a very challenging and interesting life. She was born in Moscow in 1925. In 1941, the year of the invasion of the Soviet Union by Germany, she was still in school. Her father, an engineer, fell in the war. She and her mother were evacuated to Samarkand in present-day Uzbekistan in Central Asia. Times were hard and the refugees suffered from hunger.

After finishing high school, she returned to Moscow and studied at the Second Moscow Medical Institute, graduating there in 1947 as an MD, and joined in 1948 the Laboratory of Electron Microscopy of the Biology Department of the USSR Academy of Science. The laboratory was headed by Anatolii E. Kriss, founder of the first electron microscopy laboratory in the USSR (1946). A.E. Kriss was interested in microbial ecology and bacteriophage

Keywords: history, biography, TEM, Immuno-EM, classification

Submitted: 12/08/12

Revised: 01/14/13

Accepted: 01/16/13

Citation: Popenko VI, Kutter EM, Ackermann H.-W. Anna S. Tikhonenko: Electron microscopist extraordinary. Bacteriophage 2013; 3:e23646; <http://dx.doi.org/10.4161/bact.23646>

*Correspondence to: Hans-W. Ackermann;
Email: ackermann@mcb.ulaval.ca



Figure 1. A.S. Tikhonenko in 1972. *In* Institute of Molecular Biology, Academy of Sciences of the USSR, Moscow, 1972, p.104. With permission of A.A. Makarov, director of the Engelhardt Institute of Molecular Biology (formerly Institute of Molecular Biology) of the Russian Academy of Sciences, Moscow. Izdadelstvo Nauka, Moscow.

structure. In his opinion, phages consisted of spherical macromolecules arranged in a tight spiral, the head, and a free filament, the tail. Already in 1952, Anna S. Tikhonenko and A.E. Kriss published a

paper entitled *Structure of the bacteriophage corpuscle* (Dokl Akad Nauk SSSR 86:421–3). She also participated in an expedition to the Caspian Sea. In 1956, she became a Candidate of Sciences (PhD) and in 1966,

she presented a doctoral thesis on bacteriophage structure and was awarded the degree of Dr. Biol. Sci. She trained many graduate students and scholars from various republics of the former Soviet Union (e.g., from Georgia, Kazakhstan, Moldova, Ukraine) and set standards by the high quality of her work. These standards are reflected in the general excellence of Russian electron microscopy that prevailed till recent times. A.S. Tikhonenko married the noted virologist, T.I. Tikhonenko, author of about 50 publications on bacteriophage biochemistry. She later divorced him and remarried. She is remembered as very intelligent and charming, but also as meticulous, demanding and outspoken, liking literature, travels, and music. She retired in 2003, but remained a member of the Advisory Board of the Institute of Molecular Biology until her death in 2010 in Moscow.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.