

Bacteriophages are viruses infecting bacterial cells and developing inside them. They were discovered exactly 100 years ago, when Frederick Twort has published the first paper in which he described factors able to kill bacterial cells. Although he did not call them bacteriophages, subsequent studies indicated that there were specific viruses, propagating in bacteria. During next century, they played crucial role in development of biology and biotechnology. To realize their importance in understanding principles of biological processes, one can mention following discoveries made in the course of studies on bacteriophages: DNA is a genetic material, genetic code is based on nucleotide triplets, and gene expression (i.e. translating the information from DNA to proteins) proceeds through RNA. Bacteriophages were also extremely important for development of genetic engineering and biotechnology. In fact, the first gene cloning procedures were performed in bacteriophage DNA, and currently used biotechnological tools often contain either bacteriophage genes or other fragments of their DNA. It is worth reminding that two breakthrough discoveries in biotechnology, identification of restriction enzymes (allowing DNA cloning) and CRISPRs (making possible genetic manipulations in various eukaryotic cells), are closely connected to mechanisms of interactions between bacteriophages and their hosts. On the other hand, until recently, we were not aware about biodiversity of bacteriophages and their role in natural environment. In fact, in molecular biology and biotechnology, researchers have focused on only a few bacteriophages. This was due to the choice of model organisms, but on the other hand, it did not reflect bacteriophage biodiversity. Today, this diversity appears to be huge as bacteriophages are the most abundant biological entities on Earth – their number is estimated to be 10³¹, i.e. there are 10 times more bacteriophages than bacterial cells. Vast majority of currently conducted studies on bacteriophage diversity is based on computation analyses of their genetic material. Such studies provide very interesting information about genetic diversity of bacteriophages, but at the same time they indicate that there are many genes which functions cannot be predicted as they are not similar to already known genes. In this light, it appears that studies on newly isolated bacteriophages which aim to understand processes of regulation of their development, particularly DNA replication and gene expression, are of special interest. According to the current predictions, it is plausible that research in this field may provide novel milestones in biotechnology. Therefore, in this project, we plan studies on newly isolated (in the course of previously performed, preliminary experiments) and unknown bacteriophages. They should lead to achieving following goals:

- (1) Determination of mechanisms regulating DNA replication of selected bacteriophages.
- (2) Analysis of possibilities of bacteriophage growth modulation under various conditions, as well as mechanisms ensuring the optimal bacteriophage development in cells treated with various factors or agents.
- (3) Identification of mechanisms of gene expression control in selected bacteriophages.

The impact of the proposed project on the development of science and civilization is based on the possibility of discovery of currently unknown regulatory mechanisms. Such new information may lead us to understand the diversity of regulation of biological processes in more detail, and thus, to develop novel applications in biotechnology. This, in turn, may influence the economy and society, as biotechnology is one of the fastest developing innovative field, providing both great economical income and novel applications that improve quality of human life (in various fields, like medicine, food production, new materials etc.).