

Tribute to Professor Igor S. Kulaev

A. Kornberg

Department of Biochemistry, Stanford University School of Medicine, Stanford, California 94305-5307, USA

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Inorganic polyphosphate (polyP), a chain of many hundreds of phosphate residues linked by high-energy bonds, was likely a catalyst and precursor of nucleic acids and proteins early in prebiotic evolution. Of greatest interest is the ubiquity of polyP found in every cell in nature—in bacteria, fungi, plants, and animals. For lack of knowing any essential physiological functions for polyP, the polymer was designated a “molecular fossil”. Ignored in all textbooks of biology, chemistry, and biochemistry, the polymer was largely forgotten except for a very few who kept the torch for polyP aflame.

Most prominent among those was Professor Igor S. Kulaev who explored the widespread occurrence of polyP, methodologies for its determination, biosynthetic pathways and a variety of other features of the polymer. His monograph, *The Biochemistry of Inorganic Polyphosphates*, published 20 years ago [1] was then, and remains still, the most comprehensive compendium and guide to the field and was most helpful to me when I decided to reenter the polyP field after an absence of nearly forty years.

Our recent studies of the enzymes of polyP synthesis and utilization complement those of Kulaev. As described in a recent review [2] and papers [3, 4], we find that polyP plays an important regulatory role in bacteri-

al responses to stresses and stringencies, in developmental changes required for survival in stationary phase and in the source of virulence factors employed by some major pathogens [4]. For example, knockout mutants of *Pseudomonas aeruginosa* that lack polyphosphate kinase (the enzyme that synthesizes polyP from ATP) lack motility, quorum sensing, and biofilm formation and as a result are avirulent in mouse models.

It is a tribute to Prof. I. S. Kulaev that his pioneering efforts during a dark age of polyP science helped keep the field alive for future studies that will surely make the forgotten molecule unforgettable.

REFERENCES

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