Purine Biocrystals: A Neglected Pillar of Life

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Biocrystals are among the most widespread yet least appreciated cellular architectures in nature. Found across all domains of life, these highly ordered structures have long been regarded as biological curiosities, obscuring their fundamental importance to cellular function. Recent advances in microscopy, spectroscopy, and diffraction techniques have led to discoveries of more than 60 biomineral forms. Only recently, we found that purine biocrystals almost completely overlooked until now represent the most widespread type of biocrystals. Their role as intracellular nitrogen reserves has revealed a previously unrecognized strategy for nutrient storage that may influence ecosystem productivity globally. Simultaneously, the exquisite optical properties of purine crystals predispose them to be repurposed as photonic mirrors in microbial vision and possibly as light modulating elements in photosynthesis. Integration of structural, physiological, and evolutionary perspectives is transforming our understanding of these enigmatic inclusions. Rather than passive deposits, biocrystals emerge as dynamic cellular components and a neglected pillar of life that has shaped microbial adaptation across Earth's history.