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Viewpoint

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"New Physical Chemistry Insight" in Experimental Bio-Physical Chemistry

In 1963, in his lecture series, Feynman noted the remarkable progress in biology in the preceding ten years or so and made the historic comment "*everything which living things do can be understood of in terms of the jigglings and wigglings of atoms*". Of all the disciplines, it is likely that physical chemistry is best positioned to study the biophysical significance of this statement.

Numerous papers have been submitted and many published in *Journal of Physical Chemistry* each year that report new insights into the physical chemistry of biological systems. For each of these submissions, the Editor and reviewers assess the significance of the advance. Incremental advances are less likely to be published than reports with scientifically significant or novel advances. As time passes, even exceptional experiments become routine and it becomes more challenging to make new discoveries. For example, even though human serum albumin is an important drug binding protein, so much has already been published on this system that it can be very difficult to obtain new physical insights. Another example of a topic that has been evolving in biophysics is the use of surfactant assemblies, such as micelles, that are continually being improved upon by more sophisticated hierarchical structures of amphiphilic molecules. Fluorescence based imaging and spectroscopy are central techniques in biophysics but must be accompanied by significant new physical insights. Thus, while all topics in biophysics will be considered for publication in *J. Phys. Chem.* no matter the age of the field or sophistication of the technique, it is certainly true that the context of Feynman's quote is continually changing.

Other types of spectroscopies are key techniques for revealing new and exciting information about biological systems. To be appropriate for *J. Phys. Chem.*, the results, data analysis, and interpretation need to be based on and aim at the direction of physical chemistry. Manuscripts are scrutinized more carefully if they are based on purely empirical spectroscopic observations or spectra with nonunique fits. Standard techniques like circular dichroism (CD) and calorimetry can be important for characterization but usually do not themselves provide enough new insights to warrant publication in *J. Phys. Chem.* When judging papers, we look for quantitative and mechanistic descriptions. Disordered proteins are increasingly implicated in many diseases, and are very much of interest to physical chemists, but to be appropriate for *J. Phys. Chem.*, new physical insights must still be revealed.

Important advances often stem from emerging topics, molecular systems, and techniques. Emerging areas that are ripe to understand with physical chemistry are concepts and approaches in live cells. Cellular machinery, individually and collectively, provide fertile ground for physical chemistry. Single molecule spectroscopy and various microscopies (such as super-resolution and dynamic microscopy) are revealing detailed insights and discoveries within selected regions or organelles in a cell. The assembly of molecules within a cell exhibits new behaviors that are awaiting investigation by physical chemists. Biological systems that exhibit intermittent or semiperiodic oscillations or, more generally, nonlinear dynamics is a field in physics that physical chemists can contribute. New spectroscopies and microscopies, such as multidimensional spectroscopy and multimodal imaging, respectively, could be sources of new discoveries. Big data and machine learning will be more frequently required to handle the results of complex experiments.

We conclude this viewpoint by citing Dr. Marie Curie: "I was taught that the way of progress is neither swift nor easy," and "We have here an entirely separate kind of chemistry...which we might well call the chemistry of the imponderable." We are looking forward to reading and publishing manuscripts with new insights into biophysical chemistry in *J. Phys. Chem.*

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