Annual Review of Physical Chemistry, 2019. Mark A. Johnson and Todd J. Martínez (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA, Vol. 70, viii + 377 pages. Price: US$ 116.

With the proliferation of research journals and papers, we can no longer keep up with the literature. So, we turn to reviews and monographs for help. Even that is becoming hopelessly difficult to manage. Best is to look up some of the reviews of the reviews. For a physical chemist, help comes in the form of the latest volume of *Annual Review of Physical Chemistry* (*ARPC*). Similar Annual Reviews exist for other branches of chemistry and other disciplines of science. We leave it to the reader to find out about them.

For me, it is always a pleasure to look up the *ARPC*, year after year. I come to know what is trending (to use the language of the internet era). Sure enough, the recent (2019) volume reflects current research at the forefront of physical chemistry. The keywords are: starting from the fundamentals of atomic and molecular processes, multireference theories, conical intersections, photochemistry, ultrafast dynamics, atmospheric chemistry, organic semiconductors, atomic thin materials, plasmonic nanostructures, superfluids, DNA, proteins, electron transfer, drug binding, microscopy, cell biology, etc. The very first article (after the prefatory article) says it all: 'Conical intersections at the nanoscale: molecular ideas for materials'. That sums up pretty much what is practiced in physical chemistry today. It is no longer adequate to study adiabatic processes. Looking at dynamical processes within the Born–Oppenheimer (BO) approximation reminds one of looking under a lamp post for the key that was lost elsewhere, because there is light under the lamp post. I remember my early days as a PhD student. We used to perform Hartree–Fock and limited configuration interaction (CI) calculations for the ground electronic state of a triatomic system. Because of the variational principle, we knew that we could get the best results for the ground electronic state. If we could generate the potential energy surface (within the BO approximation), we would carry out quasi-classical trajectory calculations. Whenever possible, we would do quantum calculations (be it time-dependent or time-independent) for collinear geometries. Non-adiabatic processes were dealt with conceptually. Even photochemistry invoked transitions between adiabatic potential energy curves/surfaces, allowing for nonadiabatic interactions qualitatively. Things have changed over the years. To include nonadiabatic couplings in a dynamical study is the way to go about fully understanding molecular processes. Studying molecular processes in gas phase is no longer fashionable. To study dynamics at the molecular level in condensed matter is. Atomic thin (wafer thin is outdated) materials, nanomaterials, conductors, semiconductors and superconductors in two dimensions are the in-things. Microscopy today means much more than what we used to learn when we were students. With various imaging capabilities, one needs to specify what kind of microscopy we are doing: single molecule spectroscopy, multi-photon imaging, live imaging, etc. Studying exotic molecular processes is definitely challenging and intellectually rewarding. And if you can do it for biological systems, why not? More value for the money. Interrogating individual molecules in a biological cell in real time would perhaps be the ultimate step in our understanding of Nature at the most elementary level. The latest volume of *ARPC* provides a bit of everything that is mentioned above.

Whenever I open a volume of *ARPC*, the first thing I look for is the prefatory chapter. It gives me an idea of how great scientists started their life like anyone of us and built their careers based on their ideas, that of their mentors, etc. The volume under review carries the prefatory chapter by E. R. Davidson. I remember listening to him in a quantum chemistry conference, way back in 1977. I was mesmerized. I did not fully understand what he was describing, but I was impressed with the way he explained things. Those of us, who have dealt with configuration interaction calculations have definitely dealt with Davidson's correction. Unlike some successful scientists who know their game plan, what is unusual about Davidson is that he confesses to choosing problems as they appeared. That is reassuring for lesser mortals, who do not have great ideas to start with, but are willing to look at almost any problem in science with a childlike curiosity and apply all the tools in their armour. I like the title he has chosen for his chapter: 'The right answer for the right reason'. That is a sobering thought in an era, where one is in a hurry to publish and publish as much as one can.

The problem of electronic correlation studied by Davidson continues to remain a challenge. Two electrons repel (and therefore, avoid) each other and yet they form a pair (with opposite spins) in a chemical bond. Understandably, their motions are correlated. To study them and to account for their correlations accurately, one has to go beyond independent electron models; one has to go beyond the Hartree–Fock method. Multireference theories are a must. Li and Evangelista discuss the driven similarity renormalization group (DSRG) approach to solving the problem. If you thought two electrons posed enough challenge, consider a four-electron problem in the form of a triplet pair. It offers all the challenges that you can think of: from quantum entanglement to cryptography. For details, the reader may like to read the chapter by Musser and Clark on organic semiconductors.

One of the early lessons that I learned as a graduate student was that potential energy curves for states of the same symmetry of a chemical system do not cross each other (in one dimension); they avoid each other. When they come close to each other in two or more dimensions, conical intersections arise and they play an important role in transitions between electronic states, facilitating energy transfer and they can favour some unexpected reaction products too. They seem to be responsible for the efficacy of some of the sunscreen lotions! When conical intersections occur in nanomaterials, they are of technological importance. Levine *et al*. discuss the challenges and opportunities offered by conical intersections for nanoscience.

Toth and Aharonovich discuss single photon sources in atomically thin materials that are of immediate use in quantum technologies and nanophotonics. If you can generate photons from materials, you can use the same photons to investigate materials. Diroll *et al*. discuss optical and physical probing of thermal processes in semiconductors and plasmonic nanocrystals. Recent developments in the area of chiral plasmonic nanostructures are reviewed by Urban *et*

al. A bottom up approach to building such structures (3D printing?) promises to be of value in sensing and other fields. Superfluid helium nanodroplets provide an exotic and exciting topic for investigation and also a unique medium to study weakly bound complexes. Imaging quantum vortices in superfluid helium droplets give us detailed access to the wave function describing the quantum fluids, as shown by Gessner and Vilesov in their review of the subject.

Photochemistry of molecules like ozone and others in the earth's atmosphere is of immediate interest for our survival and that of other species on earth and above (and below too). Much of the action seems to take place at the interface between air and water and in aerosols. Zhong *et al*. provide an insight into various photochemical processes occurring at the interface. Manfredi *et al*. discuss the photochemistry of organic retinal prostheses that are of value in improving the vision of the less abled or the ones who end up with vision impairment in an accident.

Microscopes, as soon as they were invented, opened a gateway into the biological world that was not obvious to the naked eye. From static images to live cell imaging, microscopy has come a long way. Morris and Payne review the recent developments, particularly in the area of fluorescence imaging. Zhu *et al*. describe in detail the principle behind transient absorption microscopy that provides insight into carrier and exciton transport. Interferometric scattering microscopy (iSCAT) is the new tool that has begun to unravel the mysteries of biomolecular dynamics and interactions as discussed in the review by Young and Kukura.

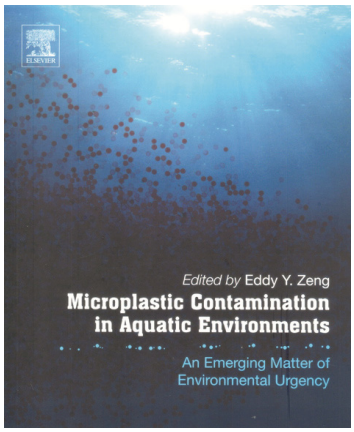
The central dogma of molecular biology is that DNA carries information that is transferred to RNA, which in turn produces proteins. The question of the difference between DNA and proteins, when it comes to electron transfer is addressed by Beratan.

Reading all of the above exciting topics may make the reader wonder if thermodynamics and kinetics is still of any value to (physical) chemists. The answer in the affirmative is given by Bernetti *et al*. in their review of drug binding and residence time.

Overall, *ARPC* 2019 was worth a read for me (and I hope it would be for anyone interested in physical chemistry) in my endeavour to keep abreast of the recent developments in physical chemistry.

N. SATHYAMURTHY

Indian Institute of Science Education and Research Mohali,
SAS Nagar,
Manauli 140 306, India
e-mail: nsathyamurthy@gmail.com



Microplastic Contamination in Aquatic Environments: An Emerging Matter of Environmental Urgency. Eddy Y. Zeng (eds). Elsevier 50 Hampshire Street, 5th Floor, Cambridge MA 02139, United States. 424 pages. Price: US$ 125.00.

Marine microplastic pollution has drawn global attention and the need for appropriate remedial measures is being increasingly sought. The book edited by Eddy Y. Zeng brings out several aspects of the challenges that are important in this context. The book has thirteen chapters authored by several authors.

The book begins with a review article by Woon Joon Shim *et al.* on the abundance, distribution and composition of marine microplastics. It provides an account of the distribution of microplastics in seawater, sediment and composition by size, shape and polymer type. The distribution and fate of microplastics in aquatic environment are regulated complex physical and chemical processes. This article brings out the current knowledge of the spatial and temporal distribution of microplastics, and emphasizes the importance of systematic monitoring. It emerges out that mere cataloguing of the abundance and the diversity based on physical features, though a good beginning, will have limited application or management utility. In this context, a wholistic source to sink evaluation approach will be needed. Such an integrated approach needs careful planning and trans-disciplinary execution.

Limitations of microplastic quantification in the ocean and freshwater systems are addressed by Shiye Zhao *et al*. and Rachid Dris *et al*. Their analyses provide an overview of the methodologies adopted and how they vary. Limitations of the methods adopted and their variability point towards comparison across the regions a difficult task. They also bring out that consistency of analytical techniques should be the first priority in this area of research. This facet of microplastic pollution research is critical, if one intends to build a robust and reliable database. The monitoring efforts should establish standard protocols, test their reproducibility prior to embarking on large domain observations and transboundary inferences.

Freshwater systems are a major source of plastic introduced into the environment. In spite of the proximity and observational ease, information from freshwater systems is limited when compared to marine ecosystems. Dafne Eerkes-Medrano and Richard Thompson point out through their analyses that an integrated approach which deal with methodology applied, conditions influencing the quantity of microplastics in the freshwater environment are important and need attention. Efforts related to quantification of microplastic contamination in the rivers have benefits on the understanding of their fate in estuaries, coasts and the oceans. This once again reiterates that the evaluation of the pollutant quantity, source, physical and chemical characteristics at its origin has to be integrated for an effective assessment.

Land-based sources are the major contributors of plastic debris in the marine environment (stated as 75–90%) and the remaining generated from ocean-based sources (shipping, fishing, recreation and offshore industries). Wai Chin Li dealing with the occurrence rate and effects of microplastics in the marine environment raises the importance of awareness amongst stakeholders and education of plastic waste management, especially amongst the operators of fishing vessels. Surveillance of intentional or negligent dumping of plastics in the oceans also