Biophysical Reviews (2021) 13:1–6
https://doi.org/10.1007/s12551-021-00788-8

EDITORIAL

Biophysical Reviews—the IUPAB journal tasked with advancing biophysics

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Published online: 10 February 2021

Although accompanied by some uncertainty, 2021 has nevertheless sprung upon us. As we collectively welcome the new year, we concomitantly open a new volume (Volume 13) of Biophysical Reviews. At this time, it is appropriate to recall that the "Biophysical Reviews" journal was founded by the International Union for Pure and Applied Biophysics (IUPAB) in 2009 as a means for assisting with its philanthropic goals of promoting biophysics related research and education through international collaboration. Along with IUPAC (International Union for Pure and Applied Chemistry), IUPAB is one of the more than forty foundational unions that make up the International Science Council (ISC)—the largest non-governmental advocacy body for the promotion and funding of scientific research and the implementation of science-based decision making in public policy. For those not familiar with both the ISC and IUPAB, more can be read about them at the following websites:

- ISC: https://council.science/about-us/
- IUPAB: http://iupab.org/

Through its starting IUPAB mandate, Biophysical Reviews is tasked with the following:

(i) Publication, by experts in the field, of topical review articles in the general fields of biophysics, structural biology, and molecular biology

(ii) Promotion of biophysics as a discipline by assisting with biophysical education, research, and international collaboration

Issue 1 fulfils these IUPAB-constituted duties by containing within it eight quality reviews, an outline of IUPAB's activities for 2021, the biography of a member of the Biophysical Reviews' Editorial Board, and the announcement of the results of an international competition for young biophysicists (organized and sponsored by the journal). As with every other, the first duty of this Editorial is to provide a summary of the published contents. Following this description, this Editorial then goes on to describe the nature of the 2021 Michèle Auger Award for Young Scientists' Independent Research - before announcing the winner.

Description of issue contents

Directly after this Editorial (Hall 2021) is the latest instalment of the Biophysical Reviews' 'Meet the Editors Series' (Vassalli 2021). In beginning, this biographical endeavor the journal placed its focus on the five Executive Editors (Olson 2020; Nagayama 2020; Itri 2020; Ho 2020; Jagannathan 2020). After this initial foray, we then started with members of the Editorial Board (Benedetto 2020). This Issue's contribution by Dr. Massimo Vassalli, from the University of Glasgow, is scientifically intriguing. Describing his research progression over a career spanning fields as diverse as theoretical physics and the mechanobiology of cells; it is clear that Dr. Vassalli has both an interesting personal and research story to tell. After reading this piece, one appreciates that the journal is lucky to have him as a member of its Editorial Board (Vassalli 2021). The next article in the front matter section is a Commentary by Prof. Juan-Carmelo Gomez-Fernandez (Gomez-Fernandez 2021). As the Secretary General of IUPAB, Prof. Gomez-Fernandez is one of the key executive members of the organization. In this commentary, he first

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breaks down how the COVID-19 pandemic has disrupted the activities of IUPAB in 2020, before next describing the planned IUPAB activities for 2021 and beyond (along with their contingencies in case of further disruption).

The first review article (Daria et al. 2021) is concerned with the latest developments in the biophysical design and construction of neural networks. For the reader casually perusing this summary, I point out the atypical aspect of this Review being that these neural networks are not the computational structures associated with machine learning that we so often hear about, but rather the product of actual culturing and machine interfacing of neurons based on opto-genetic/opto-electronic transduction principles. After providing an overview of the biophysics of neurons in isolation and in collection (neuronal circuits), the Review by Daria et al. (2021)discusses the current technical temporal and spatial limitations associated with both, analyzing, and manipulating information transfer in experiments involving individual neurons and neuronal arrays. With much scientific and popular interest in the machine brain interface, this review article provides a digestible introduction to the field along with an excellent presentation of the state-of-the-art and existing open questions.

The second Review deals with the biophysical properties of a particular class of short peptides that exhibit cytotoxic antibacterial properties (Cardoso et al. 2021). Reviewing many demonstrated examples of such peptide-based antibacterial and antifungal activity in nature, the authors speculate how the targeted exploitation of this class of short peptide sequences proffers an avenue for the rational development of new classes of antibiotic and antifungal medicines. Particularly comprehensive in its approach, this article (Cardoso et al. 2021) reviews areas as diverse as models of lipid membrane disruption, the quaternary state dependence of the antimicrobial peptide's bioactivity, and modern bioinformatics-assisted and experimental combinatorial chemistry-based approaches for enhancing peptide cytotoxicity.

The third review article (Prabakaran et al. 2021) deals with the subject of quantitative modeling of protein aggregation. Due to its causative association with debilitating diseases such as type 2 diabetes and Alzheimer's, along with the growing recognition of the role it plays as a fundamental regulator ofmany biochemical pathways, research into protein aggregation has proceeded apace over recent years. With the initial recognition of the peptide origin of amyloid (Eanes and Glenner 1968; Glenner et al. 1971; Glenner and Wong 1984), a great deal of research effort has been made to quantitatively describe the structural nature of the protein aggregate and the physical mechanism of its production and regulation, both in vitro, and in the cell (Rochet and Lansbury 2000; Greenwald and Riek 2010; Balchin et al. 2016; Fitzpatrick and Saibil 2019; Hirota et al. 2019). Indeed, different aspects of these topics have been popular subject areas for review within this journal. This Review by Prabakaran et al. (2021) differs from others in the field in that it takes a particularly practical approach by reviewing and benchmarking published methods for predictingif a particular peptide sequence will form an aggregate. One particularly remarkable result to emanate from this benchmarking effort was the authors' finding that the predictive power of three highly cited (and utilized) methods for estimating amyloid formation propensity from unknown proteins (Chiti et al. 2003; DuBay et al. 2004; Tartaglia et al. 2005) all exhibited correlations in the range [−0.4, 0.4] (i.e., effectively none) when tested against more expansive benchmarked experimental data sets than those on which they were trained and developed (Table 5 (Prabakaran et al. 2021)). Anotherinteresting area covered by this review article involved state-of-the-art approaches for increasing the speed, size, and accuracy (sometimes independently of each other) of molecular dynamics-based simulations.

In a change of direction, the fourth review article of Issue 1 (Poillot et al. 2021) adopts a materials science/solid-state physics perspective to discuss structural deformations of collagen within human cartilage and the capacity of strain-induced deformations of this polymer to induce an electrical potential difference—a phenomenon relating to the piezoelectric effect. In reviewing this area, Poillot et al. (2021) first present the known physicochemical effectors of measured potential difference (and/or current flow) within the fluid/solid environment of cartilage placed under load. Breaking down the contributions associated with fluid flow and charged ion diffusion, the authors review the additional contributing role emanating from structural deformation of the collagen itself. Redistribution of the charged groups within the collagen (when the polymer is stretched) generates different local potential differences both along and perpendicular to the fiber axis with the chance for multiple contributions from many aligned and bundled fibers (with the degree of alignment also changing under load). Results of numerical modelling are presented and reinforced with discussion of experiments based on piezoresponse force microscopy—a modified atomic force microscopy that incorporates an alternating current applied through the cantilever and microscope tip (Poillot et al. 2021).

The fifth review article within this Issue's collection examines what is known about the structural biology of serotonin receptors (Sarkar et al. 2021). As an important member of the G protein–coupled receptor (GPCR) superfamily, serotonin receptors act as the chief transducer of the brain signaling chemical serotonin (also known as 5-hydroxy tryptamine, 5HT). Through collation and comparison of X-ray and cryoelectron microscopy–generated structures of various ligand-complexed and non-ligand-complexed serotonin receptors (both fragments and complete receptors inclusive of supporting lipid), the authors discuss potential avenues of drug development and comment on the likelihood of various current models of GPCR activity. The arguments made on the

basis of structural data are extended through analysis of recent coarse grained molecular dynamics simulations made on serotonin receptors (Sarkar et al. 2021]. As serotonin is one of the chief modifiers of mood, this review article by Sarkar et al. (2021) provides a fascinating molecular insight into the way we think and feel.

The sixth entry, from Sackmann and Tanaka, reviews the fundamental role of the lipid membrane in generating eukaryotic cell polarization and cell migration based on a crawling mechanism (Sackmann and Tanaka 2021). The review begins with an introduction of the two general modes of eukaryotic cell crawling based on either amoeboid movement (pseudopodial projection due to differential weakness in the membrane) or mesenchymal migration (actively driven by bundled actin fiber projection originating from within the cytosol). Focusing on the mesenchymal mode, thesubsequent exposition reviews lipid phase separation driven by the phosphoinositide 3-kinase (PI3K) enzyme–catalyzed conversion of phosphatidylinositol (4,5)-bisphosphate (PIP2) to phosphatidylinositol (3,4,5)-trisphosphate (PIP3). Introducing supporting evidence gained largely from reflection interference contrast microscopy (RICM) measurements, the authors discuss how this key lipid chemical transition results in membrane phase separation, followed by selective peripheral and integral protein localization that ultimately stimulates actin fiber polymerization and differential external protein attachment through stimulation of integrin activity. Introducing the downstream biochemical players in the cellular attachment and release oscillatory cycle, the authors do a very admirable job of making the complex subject of the cell's pulling and pushing events comprehensible, with the underlying physical chemistry not lost in an acronymsalad of pathway components (Sackmann and Tanaka 2021).

The seventh contribution is a short review vignette that discusses the biochemical pathways directing tissue remodeling in varicose vein formation within the leg (Saberianpour et al. 2021). Dealing with the topic of mechanobiology, this review article describes the mechano-transduction principles (based on changes in the activity of integrins, ion channels, and G protein receptors) that translate changes in shear velocity and lateral pressure, occurring within the vein lumen, to cellular growth patterns in the surrounding vasculature.Describing how downstream communication is carried out by changes in the expression of hypoxia inducible factors (HIF) and matrix metallopeptidases (MMP), this Review article discusses how the surrounding extracellular matrix can be modified to produce the varicose phenotype (Saberianpour et al. 2021).

The final Review of Issue 1 is concerned with the topic of biocompatible ionic liquids (Le Donne and Bodo 2021). For those unfamiliar with the topic, the term ionic liquid is typically reserved for a special class of molten salts that are liquid below 100 °C. With the potential to be constructed from a plethora of different highly chemically substituted cations and anions (all relatively loosely held together by ionic bonds), the development of ionic liquids over the last 100 years has presented a novel solvent-based alternative for the rational design of chemical catalysts, with a design philosophy inherently different tosolid-state or enzymatic methodologies. In their article, Le Donne and Bodo (2021) review the development of a particular class of ionic liquids in which the cation chemistry is based on the cholinium ion ((2-hydroxyethyl)trimethylammonium), a chemical component naturally found within the human body. Treating issues relating to the synthesis, biocompatibility, and physical simulation of liquid structure, this article provides a fascinating insight into a potentially non-toxic range of ionic liquids with ‘tunable’ chemical properties.

Winner of the Michèle Auger Award for Young Scientists’ Independent Research (2021)

In late 2018, the journal lost a much admired editorial board member, Prof. Michèle Auger, to illness (IUPAB 2019). To commemorate Michèle’s association with the journal, Biophysical Reviews started a competition with the twin aims of honoring her memory and promoting some of the values that were important to her (described in Hall 2019). Conducted on a yearly basis, the award winner receives the following.

(i) A year’s paid subscription to the journal (courtesy of Springer-Nature)
(ii) An invitation from the journal to publish a single author review article on an aspect of their research work, with this Review containing a printed foreword on the life and research of Prof. Michèle Auger
(iii) A personal plaque to keep in perpetuity along with their name and year of award printed on a memorial plaque kept by the principal officer of the journal

Each year, a call for nominations for ‘The Michèle Auger Award for Young Scientists’ Independent Research’ is put out in the editorial of issue 3, with an entry deadline set for October 31 (Hall 2020a). The requirement for nomination is that the young scientist be currently involved in biophysical research and be under 40 by the deadline of application. In 2020, the inaugural ‘Michèle Auger Award for Young Scientists’ Independent Research’ was conducted and this competition was won by Dr. Alexandra Zidovska, Assistant Professor at New York University (Hall 2020b; Zidovska 2020). For the 2021 award, the journal received 15 nominations. Judging was carried out by a panel of sixteen judges. All judges were at the senior professor/head of school/head of institute level with twelve male and four female judges[1].

[1] I was not a member of the judging panel.

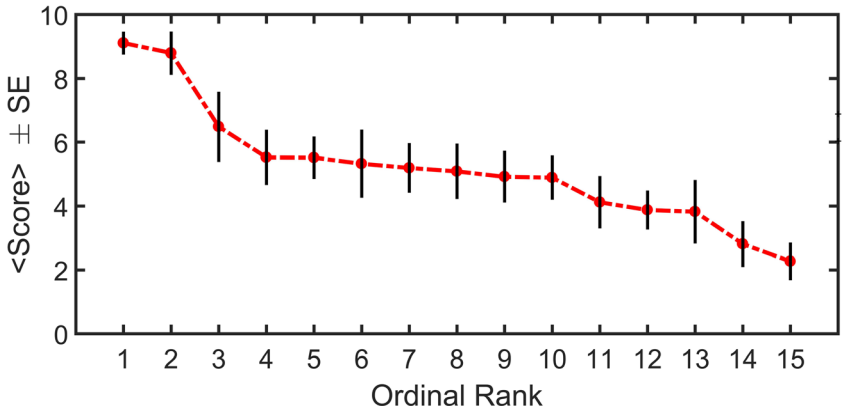

Fig. 1 Ordinal ranking of the 15 candidates for the 'Michèle Auger Award for Young Scientists' Independent Research'. Scores are presented as averages with error bars denoting plus or minus one standard error. Each contestant was assessed by a minimum of nine judges

Each nominee was assessed according to three categories, (i) originality, (ii) independence, and (iii) scientific excellence. Scores were given from 1 (low) to 10 (high) and the winner was determined on the basis of a simple average of all scores (Fig. 1). The journal owes a great debt to members of the judging panel for their time spent in assessing the nominees' papers and c.v. I would also like to express the journals' thanks to the many scientists who nominated a junior colleague for this year's award. The many sincere nomination letters also served to perpetuate the legacy of Prof. Auger.

As with the previous year, this year's scoring was very close. The winner of this year's prize was Associate Professor Jorge Alegre-Cebollada. Jorge is a group leader at the National Institute of Cardiovascular Research (CNIC) in Madrid, Spain. More can be read about his research at his laboratory home page (https://www.cnic.es/en/investigacion/molecular-mechanics-cardiovascular-system).

Jorge will soon receive a plaque and complementary journal subscription and is scheduled to publish his awarded review article (carrying a foreword on the life and research of Prof. Michèle Auger) as the lead article of volume 13 issue 4 (published mid-August 2021). On behalf of the journal, I would like to congratulate Assoc. Prof. Alegre-Cebollada. We look forward to learning more about him and his research later this year.

Design of the Michèle Auger Award

As scientists mature, we slowly become inured to the disappointments associated with not winning every grant/award we apply for, or having each paper we submit be accepted. However aside from the disappointment, sometimes (as in the case of grants, fellowships, or paper rejections), there can be real negative consequences associated with these 'failures' especially so for those at a relatively junior stage of their career. For competitions involving the description of the candidate's original and unpublished future research ideas, there is a risk that fellow researchers within our field may be influenced by our future plans. Although the best institutions/associations try their hardest to guard against cases of unwanted idea dissemination, this is nevertheless a risk faced by those engaging in academic competition/grant application and only the most naïve scientists would be dismissive of this phenomena. On top of the dangers associated with such horizontal 'research proposal' transfer are additional problems that relate to what could be best described as stochasticity in judging quality. Too often research proposals written over several months may be sunk by lazy and unprofessional judging[2]. The final unappreciated (and often the most pressing) consequence of one's failure in research competition is the loss of time. For young scientists, often running small laboratories with limited manpower, they are often solely responsible for both writing the grants/fellowship applications, as well as also performing the research and then writing the papers. In such circumstances, injudicious usage of time can have very real negative consequences for those participatingdown the research track.

With deliberate consideration of these special risks for young scientists, the 'Michèle Auger Award for Young Scientists' Independent Research' has been designed with the following four points in mind.

(i) An a posteriori philosophy: By basing the judging on what each nominee has achieved to date, the approach is intentionally made to limit exposure of nascent and unpublished concepts to an anonymous audience.
(ii) Simplest of entry procedures: Candidates can be either self-nominated or be nominated by a colleague. After nomination, they are requested to submit, via email, a one-page c.v. and their five best papers as pdf files.
(iii) Judging quality: The number of independent and anonymous (to each other) judges is typically set at a large number (this year we had 16 with each candidate scored

[2] Although lucky to enjoy research granting success, I have also had research proposals dismissed after receiving two A's and a C (with the C judge's comments looking like they may/may not have read the grant at the breakfast table that morning).

by a minimum of 9 judges). This is done to counteract the too-often encountered situation in academic assessment in which the standard error associated with scores derived from a panel of two or three judges is large enough to encompass the average score of nearly all the entries.

(iv) Positive experience: Even without winning, each entrant benefits from having had their c.v. and best papers read by 16 of some of the world's most eminent biophysical scientists—all active in research assessment and conference organization. Having such a direct method for having your research appreciated by those ata senior level has no down-side for entrants, whether they win or place within the runners-up pool.

This competition will be run again in 2022 with the next call to be announced in the upcoming issue 3.

Conclusions

The coming year will, without doubt, present a range of difficult challenges for all. Under the impresario of the IUPAB organization and the Springer-Nature Publishing House,Biophysical Reviews will continue to assist both authors and the wider biophysics community through the publishing of high-quality review articles and promoting various national societies' biophysics events and activities on an international stage. To learn more about the journal, I invite you to peruse the various explanatory content located at its website maintained by Springer-Nature and also within its social media pages on Twitter and YouTube (web: https://www.springer.com/journal/12551; Twitter: @BiophysicalRev1; YouTube: www.youtube.com/channel/UCzG_5MWmnrB2UBibtxs2DuA).

Prospective authors interested in submitting a review article to Biophysical Reviews are encouraged to first broach the matter with either the chief editor or their local executive or editorial board member. After discussion on the suitability of their article, a timetable for their submission will be arranged in conjunction with the professional officers of the journal.

Acknowledgements I would like to thank both Dr. Meran Lloyd-Owen and Prof. Adam S. Foster for comments made on an earlier draft of this manuscript. DH acknowledges funding associated with the receipt of a Tokunin Assistant Professorship carried out at the WPI-Center for Nano Life Science, Kanazawa University. DH also acknowledges (i) The Nagoya Institute of Technology for an appointment to their 'Visiting International Scientist' program carried out at the Department of Life Science and Applied Chemistry, and (ii) The University of Aalto, for an appointment to their Affiliated Researcher Program carried out within the Department of Applied Physics.

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