amounts of circulating Ig (replacement therapy) and several inflammatory diseases. The mechanisms involved in its use as an anti-inflammatory agent are discussed and involves competing with auto-antibodies to bind IgG receptors on cells. Antibodies to citrullinated proteins as a diagnostic tool in rheumatoid arthritis, the roles of programmed death (PD-1) and its ligands and mast cells are also reviewed.

Finally, the autobiographical piece by K. Frank Austen entitled, 'Doing what I like' looks back at the twists and turns of his distinguished research career. He recounts his contributions in the field of inflammation, namely cysteinyl leukotrienes, mast cells and complement components. Two notable findings are highlighted – his group identified slow reacting substance of anaphylaxis (SRS-A) from lung, which is distinct from histamines, and mediates bronchial constriction during asthma (an inflammatory condition). Subsequent studies demonstrated that SRS-A is composed of three cysteinyl leukotrienes: intracellular leukotriene C4 and its extracellular metabolites, LTD4 and LTE4. His collaborations with E. J. Corey led to proper characterization of the biological functions of these defined molecules. In addition, his laboratory characterized the role of the leukocyte immunoglobulin (Ig)-like receptor (gp49B1) containing an immunoreceptor tyrosine-based inhibition motif (ITIM) in reducing mast cell function. Overall, he tried to understand how immunological reactions contribute to biochemical changes that lead to different functional outcomes. He suggests that 'experience with focus provides insights and inclination for measured risks that is productive for research in a setting with talented trainees and wise colleagues' – an useful thought for the turbulent times that we live in!

Overall, this volume offers fascinating information on different aspects of the immune response and is a must read for naive, differentiating and mature immunologists!

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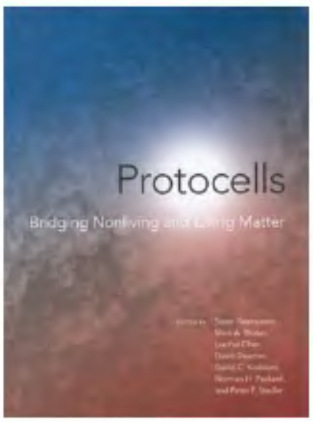


Protocells: Bridging Nonliving and Living Matter. Rasmussen *et al.* (eds). MIT Press, 55, Hayward Street, Cambridge, MA 02142. 2009. 684 pp. Price: $ 75.

What is life? Several historically important texts begin with this question and somehow end up towards the same question following a spiritualistic approach. Scientifically, the challenge lies in actually defining (measurable) parameters through which a system called 'life' can be constructed. The book edited by Rasmussen *et al.* attempts exactly to do that in the form of a cohesive text that attempts to integrate the evolution of parameterization of a system known as 'life'. While doing so, it uniquely (and boldly) introduces a variety of experimental and theoretical approaches that have been developed in different forms to mimic 'operational functionalities' that define 'life'. From my point of view, the book essentially exemplifies the inter- and multi-disciplinary nature of modern biology. An important feature of the book is that it makes the reader appreciate the requirement of the so-called reductionist approach in experimental (both wet and dry) biology. It does so elegantly without compromising on the need to be constantly reminded of the complexity resulting in nature through biological evolution. Before delving into brief specifics about the contents of the book, I would like to emphasize that this is certainly a book that should become a part of every library that caters to undergraduate students, postgraduate students and 'independent' researchers at all levels (from entry level scientists/faculty to seniormost level) and not necessarily specializing in only biological research.

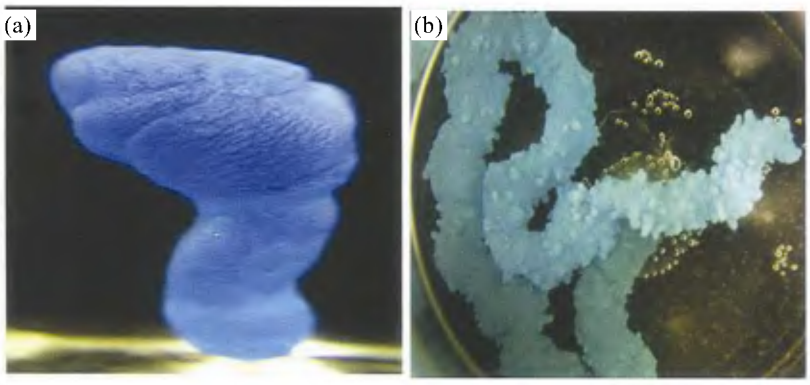
The book is divided into four major parts. The first part lays the foundation of scientific thought that went into description and acceptance of 'protocells' as a term that would experimentally define a living form within the definition of life. This definition of life essentially comprises of three components (referred to as 'operational functionalities'): (a) extraction and use of energy from the environment, (b) chemical realization of informational control that can be replicated or passed on and (c) a closed system or a 'container' that can keep the first two together and segregated from the surroundings. Through the various chapters in the first part, especially the one written by Deamer (chapter 2), the book provides a good summary of different experimental attempts, with due attention to the historical thought process that went into the design of those experiments, at creation, measurement and objective assessment of the 'operational functionalities'. The best aspect of this part of the book for me as a reader was its fresh presentation unlike so many aspects of modern biology in which hypothesis-driven work often tries to force the reader into a certain direction of thought. The authors in this section are careful in presenting a body of experimental work that is open to interpretation, with clear mention of the limitations of the systems. The only major drawback was lack of sufficient information on the failed experiments or experiments with negative results. As an example, elegant experiments with DMPC vesicles encapsulating RNA polymerase or 'self-reproduction' of caprylate micelles do seem fascinating; however, the specific choices leading to these experimental systems were surely driven by several attempts with different combinations of amphipathic and enzymatic molecules. A brief outlook towards why one system works in a certain way compared to another would have definitely added a more thought provoking value. Nevertheless the quality of writing and description of the results do allow the reader to build an independent perspective rather than get entangled into the limitations of the experimental systems or interpretations of the results as mentioned by the authors.

The second and third parts of the book are quite interrelated, with the aims of 'Integration' and 'Components' and are not exactly independent of each other. Both these parts oscillate frequently between the chemistry of wet experimen-

tal systems and theoretical frameworks utilized for dry/simulation based experimental systems aimed at achieving the 'operational functionalities' from part one. These parts will probably be a little cumbersome for some readers since the book does not build the experimental or the theoretical foundations behind the approaches or the results provided. It would have been very useful had the authors introduced the readers to some common approaches mentioned (e.g. preparation of liposomes in wet experiments or Monte-Carlo simulations or utilization of log normal distributions instead of normal distributions), with further directions/references towards several good basic textbooks that exist (e.g. *Molecular Driving Forces* by Dill and Bromberg, Garland Science). Since this is the first text of its kind aimed at introducing the concept of 'protocells', the above limitation may tend to take a reader away from the apprehension of investment of time that may be required to build the foundations for understanding the approaches utilized, without realizing the relatively straightforward nature of the approaches. This limitation is also coupled with the mild drawback in the first section regarding specific reasoning behind the choice of several experimental systems (e.g. POPC based liposomes in chapter 7). The above limitations aside, chapters 5 and 6 are elegantly written and directly address some parameters that go into design, development and utility of experimental systems in order to test the operational functionalities defining a living system. Chapters 8–12 are more specific in their investigations towards searching of measurable or quantifiable parameters behind a 'logic' that can be applied within the framework of Darwinian evolution. It was my feeling that these chapters may be more important for readers interested in exploring simulation based approaches falling under the umbrella of synthetic biology. However, the major drawback in this section was the lack of information on the exact procedures required to replicate the simulation results, including computational resources (both hardware and software) that can be utilized. Further, there is a slight oversight on the part of the authors/editors in terms of reproduction of figures that would have been much more informative in colour rather than those presented in black and white. Chapters 13–15 (third part) present an overview of the experimental thought process for generating the parameter of self-replication in laboratory. The text is relatively easy to follow, however, once again, one could face some difficulty in trying to design or reproduce the work for exploratory purposes. The most informative, thought provoking and useful chapters in the third part are by Gabaldon *et al.* (chapter 16), Smith *et al.* (chapter 20) and Woodruff (chapter 21). These chapters lucidly introduce the reader to thinking about distribution of energetics in living systems, with a point of view not limited to specifics parts of a living system, but by treating the system as a whole.

Finally, part four of the book summarizes more of a philosophy behind the scientific evolution of the concept of 'protocells'. It does so in quite a fascinating manner that is bound to invoke some curiosity in a general reader to at least 'play around' with one or more of the ideas and approaches presented. We overlook the limitation of having B&W figures at several places in this part that would be much more informative in the colour. Chapters 22–27 are fun to read and interesting to explore. The treatment of a whole system as an interacting dynamic entity was indeed the most interesting feature of this part. It is also rich enough in specifics and references that can direct the reader towards reproducing, at least on a semi-quantitative level, the results presented. In my view, it also builds enough foundations for a reader to design independent experiments based on parameterization of rather difficult philosophical concepts. Finally, the last chapter by Bedau and Parke invokes a discussion on social and ethical issues concerning protocells. After going through the text in the previous chapters, especially the one relating to the elegant development of the chemoton, I could not help thinking how in today's world of 'political correctness' we have to include a disclaimer regarding the possible misuses of (possible) advances in science. By no means do I think that it is not important to have discussions on ethical and social implications of scientific advancement. However, for a field in its infancy, geared not only towards understanding the origin of life, but also towards creating a system that can at least mimic some beautiful designs out of sheer randomness, I think it is too premature to worry about social and ethical issues. It just takes the fun out of the science and more often than not, creates an unnecessary hype of what may never be.

The book symbolizes the approach and the thought that must go into any kind of research in modern biology. There does seem to be some redundancy regarding the historical literature cited and discussed in many chapters, however, that may be unavoidable in an area that has been 'named' within the last 5 years only. I found the material to be refreshing in terms of not being limited to a specific component in a living system, rather appreciating the value of a living system as a whole. Of course, it is indeed a pleasure to consider the fact that in a time when many researchers are seemingly married to a single protein in a single pathway that affects a particular strain of a particular species in a particular life form, this book introduces us to the joy of appreciating the value of a more generalized outlook towards a



Influence of an additional compound on cell information. In (a) the cell developed in a Cu^{2+}–silicate system, whereas in (b) the structure developed in a Cu^{2+}–silicate–glycine system. The additional structures seen on this cell's surface results because glycine is both a complexing agent and a surfactant able to form its own cells.

living system. It brings to the forefront, as many call it, the 'big picture' which is often forgotten in the detailed nitty-gritty of everyday experimental systems. Finally, this book also shows indirectly that modern research is not necessarily married to capital-intensive, off the shelf sophisticated instrumentation. Rather, it is the beauty of experimental design within the constraints of what is measurable, that is more important in scientific exploration especially in modern biology.

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Annual Review of Neuroscience, 2008. Steven E. Hyman, Thomas M. Jessel, Carla J. Shatz and Charles F. Stevens (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, USA. Vol. 31. 612 pp. Price not mentioned.

The Annual Review of Neuroscience has over the years come to be a much-anticipated yearly enterprise because it has traditionally provided the neuroscience community with a combination of timely reviews with an emphasis on those areas of research with a sufficiently built up knowledge base and hence controversies that require some degree of untangling and simplification, necessary for the field to move forward. In this respect, these books not only serve as a repository of critical and authoritative reviews, but provide readers with a 'scientific weathercock' so to speak. Consequently, these books become necessary reading for researchers wanting to be well informed about the latest developments at least in their respective fields. For the student of neuroscience, the exhaustive list of references can serve as a useful starting point to begin their research. The basis of excellence for the *Annual Reviews* is simple; build a collection of reviews by getting the most distinguished and active researchers in their fields to participate. This job is facilitated by the presence of a distinguished editorial board. This year's editorial board led by Prof. Steve Hyman of Harvard and supported by Profs. Thomas Jessel of Columbia University, Carla Shatz of Stanford University and Charles Stevens of the Salk Institute continues the tradition of excellence set by their predecessors. In putting this review together I have taken the liberty to reorganize the presentation of chapters, emphasizing functional links where possible. I hope this approach might be of greater value to a reader of this meta-review interested in getting a gist of the breadth of issues being examined in the 2008 edition, rather than just evaluating the reviews in their order of presentation in the volume, or segregating the reviews into areas such as molecular, cellular, systems, behavioral/cognitive and computational neuroscience as is typically done in many neuroscience journals these days.

Neural development, plasticity and the acquisition of higher cognitive functions. It is now well established that neural circuits are specified by the spatiotemporal gradients of certain molecules. One such class of molecules referred to as Wnt (pronounced as *wint*) are known to be critical regulators of neural development. The review by Salinas *et al.* (Wnt signalling in neural circuit assembly; pp. 339–358) discusses the role of distinct signalling cascades of Wnt and reports how these may support the diverse roles hypothesized for Wnt in influencing distinct aspects of neural circuit development such as migration, polarity and axon path finding. A particular interesting case of neural circuit development is provided by the well known decussation of fibres constituting the optic tract. The article by Petros *et al.* (Retinal axon growth at the optic chiasm: To cross or not to cross; pp. 295–316) reviews the molecular mechanisms underlying the axonal pathfinding in this circuit. In addition to molecular cues, a number of studies since the work of Hubel and Wiesel have shown the critical role that electrical activity plays in the development of neural circuits as well. Understanding the roles that signalling molecules and activity play in the development of topographic maps and receptive field properties in the visual system is the focus of the article by Huberman *et al.* (Mechanisms underlying development of visual maps and receptive fields; pp. 295–316). The article by Flavell and colleagues (Signaling mechanisms linking neuronal activity to gene expression and plasticity of the nervous system; pp. 563–590) attempts to address how patterns of electrical activity are translated into patterns of gene expression that help build and modify neural circuits. Work in this important area may finally provide answers to our understanding of how the brain develops under the influence of both nature and nurture. While not entirely obvious, it is now clear that electrical activity continues to play an important role in dynamically reshaping neural circuits right through adulthood. The article by Caporale and Dan (Spike timing dependent plasticity: A Hebbian learning rule; pp. 25–46) describes mechanisms by which this might occur. A critical site where plasticity manifests itself is the dendritic spine. In the hippocampus these changes in spine morphology form the structural basis of our current understanding of learning and memory and provide the central theme of the review by Bourne and Harris (Balancing structure and function at hippocampal dendritic spines; pp. 25–46). The article by Briggman and Kristan (Multifunctional pattern-generating circuits; pp. 271–294), drawing examples invertebrate physiology, describe the architecture of circuits that are endowed with multifunctional dynamics endowing them with the ability to take part in distinct behaviours. These sort of circuits, the authors argue, may provide the basis for understanding how circuits are dynamically reconfigured by subtle changes in the external and internal states of an organism. Ultimately, the need for such flexible circuits arises because our brain needs to support complex cognitive functions such as language. The article by Kuhl and Rivera-Gaxiola (Neural substrates of language acquisition; pp. 511–534) reviews the much expanding literature on the development of language in infants drawing on non-invasive techniques such as evoked response potentials and functional magnetic resonance imaging. While flexibility may be a hallmark of learning, one paradoxical consequence of over-learning may be the generation of habits that are stereotypical behaviours that may override higher-order deliberative behaviours. The article by Graybiel (Habits, rituals and the evaluative brain; pp. 359–388) discusses the neural representations underlying such behaviours and suggests that the basal ganglia may play a critical role in their expression and modulation.

Information processing in neural circuits. As is usually the case, a number of articles in the 2008 edition have been devoted to reviews that are pegged