Going into the chapter, it would have been only proper to explicitly write the probability density in terms of the wave function and then connect it with the probability current density. Further down, these concepts are discussed in the context of a double slit experiment and then the new idea of measurement destroying interference and that of a quantum eraser is introduced. The chapter further describes one-dimensional problems and phenomena of tunnelling and bound states in these systems. In discussing the bound states, statements about the coefficients F and G in connection with equations 3.42a, 3.42b and 3.42c being zero are not correct. First the solutions in the classically forbidden regions do not represent a travelling wave since a travelling wave must depend on x and t as a function of $(kx - \omega t)$ or some other form of such combination of x and t. Secondly, these coefficients are set to zero to satisfy the boundary conditions at $x = \pm\infty$ that the wavefunction vanish there. Similarly, while discussing quantum dots, optical properties are explained in terms of excitonic effects. This explanation is not correct. The energy gap between the electron and hole states in a quantum dot increases in inverse proportion to the square of its radius, and that explains the colour of these dots; excitonic effects are neglected in the zeroth level approximation (an interesting reference for these is the material available on the Nobel Prize website). Finally, Lambert's solution for the square well problem using conformal mapping is presented in the last section. It shows the power of using different mathematical techniques to get an exact solution. Interested readers will be attracted to this solution.

On a separate account, inclusion of computational methods for solving the Schrödinger equation in chapter 3 would prove useful to readers. Computational methods have become an integral part of any application of quantum mechanics, and their introduction at the beginning would make the readers of the book more proficient in problem-solving.

Chapter 4 introduces the angular momentum operator as the generator of rotations. However, the discussion is at times confusing. Terms up to second order in the infinitesimal angle are kept in equations 4.11a, 4.11b and 4.11c, probably to show that finite rotations about different axes do not commute. However, one has grown up learning that finite rotations about mutually perpendicular axes do not commute, but infinitesimal rotations do. So, the statement to the contrary after equation 4.12 is a little confusing. Further into the discussion of angular momentum, on page 153, the spin angular momentum is talked about. Like at many other places in the book, too many connections are being made here between different theories and a reader tends to get defocused.

Since this is a graduate-level text, chapter 9 would have been even more useful if a thorough discussion of exchange effects, connection of exchange with Hund's rules and some introduction to correlation effects were also given. Furthermore, instead of just discussing the local density approximation, an introduction to density-functional theory would have proved to be very helpful to the readers for whom the book is intended. Similarly, in chapter 10 some more insights could have been provided by discussing polarization of light and its connection with qubits. Also, a section on quantum cryptography would have been useful.

To summarize, the book is a nice attempt to present quantum mechanics in a different way and by incorporating some new topics of interest. It also gives ample details on many important topics. However, in the author's effort to do so, the book sometimes tends to become too verbose, and in trying to connect too many ideas in one place, in many instances, it makes the reader lose focus on the main topic. I would, therefore, hesitate in using it as the main text-book for an advanced course in quantum mechanics but will definitely recommend it strongly as a reference book for its width of content and inclusion of many important topics.

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Annual Review of Cell and Developmental Biology, 2023. Ruth Lehmann, Jennifer Lippincott-Schwartz and Alexander F. Schier (eds). Annual Reviews, 1875 S. Grant Street, Suite 700, San Mateo, El Camino Way, California 94402, USA. Vol. 39. xi + 437 pages. Price: US$ 511.

The editorial by Ruth Lehmann in this Annual Review would make it interesting for researchers who keep in touch with literature via the internet and are habituated to looking at PDFs rather than in the hard copy of the journal. Lehmann reminisces how early on, researchers began their scientific career by keeping in touch with literature via current contents. Lehmann discusses at length the cost of publication, peer review and open access. The editorial would interest early career researchers who are confounded by open access, preprints, predatory journals, impact factors, *H*-index and increasing use of machine learning.

There are 17 reviews in this volume. They cover a wide spectrum of cell and developmental biology, highlighting the importance of model systems and state-of-the-art techniques. From the reviews, it is evident that structures obtained from cryo-electron microscopy (cryo-EM) and fluorescence microscopy are increasingly used in cell and developmental biology. Quantitative analysis of experimental data and theoretical analysis are being increasingly used. Although the editors have not commissioned the reviews based on specific themes, I have grouped them where there could be some connectivity in terms of techniques or approach.

Two reviews discuss patterning. Toll is well known to those working in immunology for its role in host defense against pathogens. However, its role in development was discovered much earlier. 'Neofunctionalization of Toll signaling in insects: from immunity to dorsoventral patterning' by Roth details the crucial role played by Toll signalling in dorsoventral axis formation patterning in *Drosophila* and other insects. Roth mentions that Toll signalling strongly supports the analysis of the emergence of an evolutionary novelty. Milinkovitch *et al*. in 'The unreasonable effectiveness of reaction diffusion (RD) in vertebrate skin color patterning', describe a theoretical approach involving the reaction–diffusion framework developed by Alan Turing to skin colour patterning. The introductory section describes Turing's contributions to computer science and the objectives of the review that should help readers not familiar with the methodology to appreciate the approach. They discuss the theoretical framework, taking zebra and lizards as examples. The conclusion section links the experimental observations with the RD mathematical framework.

Two reviews broadly relate to evolutionary aspects wherein genetic programming occurs due to environmental factors. The review by Perera *et al.* discusses how various organ systems in animals evolve

depending on adaptation to new environments. The evolution of sensory system and tooth development in surface fish and eyeless cave fish *Astyanax mexicanus* are described, along with circulatory system and metabolic evolution. Sengupta *et al*. in 'The logic of transgenerational inheritance: timescales of adaptation', discuss aspects of multigenerational inheritance. Transgenerational inheritance is epigenetic inheritance (TEI) and can serve as a long-term memory of altered environments. They stress how insights on TEI could help in blocking maladaptive responses to benefit humans.

Norden, in the chapter 'A fish eye view: retinal morphogenesis from optic cup to neuronal lamination' describes the neurodevelopment of the eye with a focus on zebrafish and medaka. The review describes retinal development from its early stages. The use of *in vitro* cup models using mouse and human retinal organoids is highlighted. The authors outline future lines of investigations to address challenges in retinal morphogenesis.

Three reviews discuss tissue biology. Adler *et al*. propose a complex system theory approach in 'Tissue biology: in search of a new paradigm'. Though not mathematical, the review describes various aspects of tissue organization, cell types, cell categorization based on cell relations and modular organization of tissues. Drawing from extensive experimental data, they discuss possible rules of cell communication and argue that these rules will help understand and treat diseases. Kicheva and Briscoe argue in 'Control of tissue development by morphogens' that a combination of experimental and theoretical results is essential to understanding morphogen-controlled aspects of development, such as cell fate and tissue growth. Although there are no mathematical equations, morphogen gradient scaling and its relationship to pattern scaling and dynamics of morphogen-regulated gene regulatory networks are clearly represented as graphs. They argue for the need for sophisticated computational models and combining theory with experiments for understanding tissue development by morphogen gradients. Wu *et al*. review the understanding of matrix and adhesion molecules in tissue morphogenesis, emphasizing physical interactions that drive morphogenesis. The figures in sections on cell–cell adhesion and cell–matrix adhesion graphically illustrate the networks and different protein–protein interactions. The requirement for more biophysical tools for systemic measurements is emphasized.

Ang *et al*. review 'Mechanisms of regeneration and fibrosis in the endometrium'. Diverse endometrial disruption events in humans, nonhuman primates and rodents, as well as associated mechanisms of regeneration and nonregenerative healing of the uterus, are covered. Endometrial disruption and topics on uterine fibrosis have direct relevance to reproduction health. The authors suggest that the study of uterine biology can provide information on wound healing, regeneration and inflammation.

Two reviews discuss RNA in cell and developmental biology. Burgess and Storkebaum discusse the importance of tRNA gene regulation in neurodevelopment. The table of tRNA gene abundance and codon usage is a good refresher, as is the information about tRNA genes in the introduction. The authors discuss how defects in tRNA splicing processing and modification lead to disease. The review emphasis various aspects of tRNA biochemistry and disease and highlights the central role played by tRNAs in human health and disease. It would be useful to new researchers working on neuronal diseases. Eichenberger *et al*. discuss mRNA 'life' and cell biology. They discuss insights obtained from imaging of single mRNA in fixed and live cells. The authors provide a useful outline of the methodologies used in figure 1 of the review. They discuss recent developments in imaging single mRNAs in fixed and live cells and the coupling of steps in gene expression. The review would be useful to researchers using microscopic techniques in cell and developmental biology.

In three reviews, the dynamics of proteins take centre stage. The reviews discuss transcription factors, actin and tubulin in cell and developmental biology. Wagh *et al*. discuss transcription factor (TF) dynamics using live-cell imaging techniques. The authors discuss the methodologies in detail such as aspects of mobility signatures, time duration of binding to chromatin, regulation of their spatio-temporal dynamics and how changes in their dynamics affect transcription. Although the review deals largely with TF dynamics and its effect on transcription, the authors, in the end, indicate how TF dynamics can give information about various processes in cell biology. In the review by Blake and Gallop, Actin takes center stage. The authors describe the different protein-protein interactions involved in packing actin filaments in filopodia (Figure 1). The biochemistry of other molecules involved is described. The section on biochemical reconstitution experiments on the organization of filopodia indicates how molecular dissection can provide important insights into cell biology. Microtubules have been extensively investigated in cell biology and biochemistry. McKenna *et al*. discuss how the genetic and chemical diversity of Tubulin is a 'tubulin code'. The background and development of tubulin code hypothesis is presented with an excellent illustration (Figure 1). The authors discuss genetic and chemical diversity in tubulins with a detailed illustration of tubulin code regulation. Clearly, tubulins will continue to be an exciting area of research in cell biology.

Membrane proteins are in the foreground in the reviews by Emmerstorfer-Augustin and Thorner, Hui and Hanna *et al*. Emmerstorfer-Augustin and Thorner discuss various aspects of the biochemistry of TORC2 (TOR: target for rapamycin), a plasma membrane protein that plays an important role in maintaining the plasma membrane integrity from studies on *Saccharomyces cerevisiae*. How TOR was identified, and details of TORC1 and TORC2 complexes form a useful background. The cryo-EM structure of yeast TORC2, its assembly and components along with function and regulation, are described in detail. *Cis* interactions, a less studied regulatory mechanism, is described by Hui. *Cis* interaction refers to two interacting proteins anchored on the same membrane. The Introduction describes *cis* interactions in detail, which is different from the extensively studied trans interactions. A case for studying *cis* interactions and its physiological relevance is made out. *Cis* interactions in the immune system are described with excellent figures that clearly bring out the essence of *cis* interactions. The section on approaches to studying *cis* interactions indicates the extensive use of biophysical techniques and should spur researchers looking for new research problems. Hanna *et al*. discuss the biochemistry and cell biology of the newly discovered lipid transfer proteins (LTPs) defined by a repeating beta-groove (RBG) rod-like structure with a hydrophobic channel running along their entire length. These LTPs facilitate bulk lipid transfer by a bridge-like mechanism between adjacent bilayers without penetrating the bilayers. Cryo-EM has greatly aided in delineating the structures of LTPs with RBG. Their sub-cellular localization is clearly described in a Figure. The review dwells on the role

of this class of proteins in physiology and disease.

The *Annual Review of Cell and Developmental Biology* will be open access henceforth. This would be beneficial to students and early career researchers.

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Annual Review of Physical Chemistry is an edifying collection of articles highlighting the scientific advances in physical chemistry ranging from spectroscopy to computation. The authors of each article have clearly described the respective topics to provide the readers with a holistic view of modern research in physical chemistry. Each chapter encompasses a detailed elucidation of various concepts, theories and experiments associated with chemical systems, including excited-state modelling, many-body electron scattering and super-resolution fluorescence imaging.

The book starts with a tribute to Phillip L. Geissler, the distinguished theoretical chemist who made important contributions to the field of statistical mechanics of biological polymers, heterogeneous materials, and chemical dynamics in aqueous environments. The chapter 'Remembering the work of Phillip Geissler: a coda to his scientific trajectory' discusses the seminal work of Geissler in developing models and analytical and computational methods to understand the dynamics of water and biopolymers like DNA and proteins, nanoscale self-assembly, structural and compositional transformations of nanocrystals, and formation of nanomaterials. The remaining chapters of the book mainly fall into categories such as photochemistry, nanomaterials and theoretical chemistry.

Spectroscopy is a powerful tool in photochemistry that helps unravel the static and dynamic behaviour of molecules. In the chapter titled 'Gas-phase computational spectroscopy: the challenge of the molecular bricks of life', the authors discuss the challenges in the theoretical modelling of molecular bricks of life, e.g. DNA bases or amino acids and prospects of *a priori* predicting the spectral signatures of medium-size molecules in the gas phase with particular emphasis on rotational and vibrational spectroscopies. The chapter 'Ultrafast X-ray probes of elementary molecular events' discusses the importance of analysing the fast processes that occur during photochemical reactions and how they affect the functionality of molecules. The authors specifically focus on non-adiabatic dynamics, which occur at conical intersections and involve rapid transitions between electronic states in molecules. The chapter 'Spectroscopic studies of clusters of atmospheric relevance' reviews the spectroscopic investigations of atmospheric aerosols, focusing on secondary particles to understand the intermolecular interactions governing the mechanism of particle formation and growth. Vibrational spectroscopy and electron spectroscopy have played pivotal roles in revealing acid-base interactions in small clusters consisting of vapours that accelerate new particle formation, elucidating the structures of growing clusters, and exploring the complex process of cluster hydration. In the chapter titled 'Studies of local DNA backbone conformation and conformational disorder using site-specific exciton-coupled dimer probe spectroscopy', reviews the application of recently developed spectroscopic methods and analyses that combine linear absorbance and circular dichroism spectroscopy with nonlinear 2D fluorescence spectroscopy. The prime focus of the review is on the utility of these spectroscopic techniques to investigate the local conformations and conformational disorder of the sugar-phosphate backbones of ssDNA–dsDNA fork constructs that have been internally labelled with exciton-coupled carbocyanine dimer probes. The chapter '*In situ* measurement of evolving excited-state dynamics during deposition and processing of organic films by single-shot transient absorption' highlights the importance of understanding the photophysics of organic thin films in semiconductor devices and how their deposition and processing methods affect their electronic structure and excited-state dynamics. In the chapter 'Photodarkening, photobrightening, and the role of color centers in emerging applications of lanthanide-based upconverting nanomaterials', fundamental aspects and emerging functionalities enabled by colour centres within Ln-doped nanocrystals are being focussed. The distinctive characteristics of colour centres within Ln-doped nanocrystals offer diverse applications in afterglow-based bioimaging, X-ray detection, inorganic nanocrystal photoswitching and fully rewritable optical patterning and memory. The chapter 'Photochemical up conversion (PUC)' provides an extensive overview of PUC research, covering spin physics, photophysics, design considerations and enhancement approaches. It also focuses on the emerging field of sensitizing PUC using bulk semiconductors and its impact on hybrid opto-excitonic devices. The chapter 'Ultrafast dynamics of photosynthetic light harvesting: strategies for acclimation across organisms' outlines the fundamental aspects of light-harvesting systems, energy transfer principles, and relevant time-resolved spectroscopic tools focusing on the acclimation mechanisms of three classes of photosynthetic organisms (purple bacteria, cyanobacteria and green plants) to variations in light, temperature and nutrients. Furthermore, concepts belonging to the sub-domains of applied photochemistry and bioimaging are also described chapter-wise. The chapter 'Photoacid dynamics in the green fluorescent protein', explores proton tunnelling in the electronic ground state and the excited-state proton-transfer reaction taking place in the picosecond timescale in green fluorescent protein. The chapter '3D super-resolution fluorescence imaging of microgels' details how modern super-resolution fluorescence microscopy techniques enable visualization of single microgels and give new insights into the shape, morphology, internal compartmentalization, cross-linker density, polarity and deformation of microgels, and in general soft polymer materials.

Nanomaterials can take on unique optical, magnetic, electrical and other properties. These emergent properties have the potential for great impacts in electronics, medicine and other fields. The chapter 'Magneto-optical properties of noble metal nanostructures' discusses the connection between the magneto-optical signatures of colloidal noble metal nanostructures and their various applications, such as photonic integrated circuits and applied spectroscopy. It highlights how electron doping and single-atom substitution affect the magneto-optical response and transient spin polarization of nanoclusters. The chapter titled 'Adsorption at nanoconfined solid–water interfaces'