historical and current living standards. Climate action should be based on the normative concerns (or values) of fairness and justice as well as the principle of 'common but differentiated responsibilities' between countries.

Nordhaus sets out to provide a blueprint for a green planet by proposing a vision that goes by the title of this book (pp. 2–3). For the informed reader following Nordhaus and his work, the idea and its articulation offer little or no surprises. As a conceptual framework and an operational plan, this book rests on the principle of competitive markets but '…balanced with the philosophy required to correct market and nonmarket flaws' (p. 3), through the Goldilocks Rule of 'just enough regulation'. Ideologically, Nordhaus positions this book somewhere to the left-of-centre between the extremes of what he calls 'muck brown' or pure profit seekers on the right and 'deep green' or deep ecologists on the left (pp. 297–301). Nevertheless, Nordhaus stands committed to his unshaken faith in 'free-market environmentalism' as he states at the outset and demonstrates through the book (pp. 310–313).

One may not share the ideological positionality of Nordhaus, but this book is a compelling read, and a highly recommended up-to-date guide to the economics of the environment and climate change.

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Annual Review of Microbiology, 2020. Susan Gottesman and Caroline S. Harwood (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 74. xvi + 858 pages. Price: US$ 118.

'My career ended with the ascent of genomics and its accompanying megadata analysis. This development has been transformative and can be greatly interesting to read about, but not my thing to do. In my era, if an experiment required statistics for its analysis, you needed to find a new experiment – a saying I believe is attributed to some luminary I don't remember. One could imagine an experiment, discuss it with a graduate student, and see the result in a day or two; there might be 10 data points giving an unequivocal answer. For the student, as for me when I began, it was a largely individual endeavor, with logic, methodology, and experimental devices all plainly exposed and applied to some question of basic interest. No longer – prominent papers tend to be multigroup collaborations with tens of authors and distinct areas of expertise, often containing a plague of unmemorable acronyms. Likely no one understands everything. I was very lucky to arrive near the beginnings of molecular biology.'

This quote from the opening article 'A tale of good fortune in the era of DNA' by Jeffrey Roberts in this volume of the *Annual Review of Microbiology* (*ARM*) could readily initiate a good debate. However, rather than getting into the debate, I must say that I enjoyed reading the article by the discoverer of Rho, the transcription termination factor. Some would also know Roberts as an author of the fourth edition of the James Watson's *Molecular Biology of the Gene*. He has provided a motivating description of his life in science. Teachers/mentors have always played a special role in charting the paths of their students/mentees in research, and the article emphasizes how they influenced the Robert's interests to pursue biology during his undergraduate training at the University of Texas in Austin, USA, and then in specializing in molecular biology of the λ phage at Harvard University, USA, during his graduate studies in the research groups of Walter Gilbert and James Watson in 1964. The research that Roberts initiated on λ phage at Harvard University remained with him for his entire scientific career (including a short stint at MRC, LMB, Cambridge) to work on the mechanistic details of transcription initiation and transcription termination/anti-termination at Cornell University, USA, from 1974 onwards.

The editors of this volume of *ARM* have done a splendid job of bringing it out with a total of 39 articles (perhaps the largest so far in any of the volumes of the *ARM*). In the times of SARS-CoV-2, while all of us are confined to our homes or offices with no offline interaction, the importance of socialization and personal discussions has come to the fore. Coincidence as it may be, this volume of *ARM* provides a special collection of articles that focus on the social life of microbes. Understanding their lifestyle is, of course, key to target or promote them. Many bacteria make use of their secretion systems to release toxins or virulence factors. Mechanistic details of these secretion systems are crucial to intervene in the host–pathogen relationships, and one would find descriptions of different secretary systems in different bacteria in this volume of *ARM*. The phenomenon of communication among the individuals is complex, and as the authors of one of the articles put it, 'The tower of Babel narrative is an origin story meant to explain the puzzling diversity of human languages. This review presents our own (evidence-based) narrative meant to explain the puzzling diversity of bacterial communication systems'. Languages that the microbes use comprise diverse small molecules produced and sensed by them (dubbed as quorum sensing) in the wild or in their hosts. The articles discuss the roles of the secondary messenger signals, including cyclic dinucleotides (c-di-AMP and c-di-GMP) in decision making for unicellular growth or biofilm formation, in exopolysaccharide synthesis or in the stimulation of host immune response by interaction with STING (stimulator of interferon genes). To respond to the chemical gradients, bacteria make use of flagellum and appropriately an article is devoted on its assembly and dynamics. The natural world of microbes provides an excellent system of chemical ecology.

Chemical communications are also responsible for the relationship of plants with the microbes in their habitat, and in the plants influencing and enriching distinct microbiota in their habitat. Fungi emit volatile organic compounds, which we know mostly as obnoxious odours, but some are important as flavouring agents and yet others serve as developmental hormones for fungal species or are even important as pheromones for arthropods. Likewise, chemical

compounds from the surface bound bacteria influence the metamorphosis of the larvae. The diet dependent changes in gut microflora are of huge interest. Could one design live sensors to sense disease biomarkers? Interestingly, inspired by the chemosensory properties of microbes, synthetic biologists have indeed made progress in this direction to design genetic networks to sense and emit visual signals. In response to poor nutrients or other stress signals in the environment, the endospore forming Firmicutes begin the process of sporulation. This is an ancient topic of study, but continues to offer important knowledge to developmental/differential gene regulation and finds important space in this volume of *ARM*. Metagenomics is adding to our better understanding of the microbial world; but there is dire need of better bioinformatics/analytical tools to make full use of the data. The articles also make a case for single-cell genomics and metabolomics data to study the microbial networks. It is a war out there and microbes use multiple strategies to survive and thrive. So while bacteria (archaea too) developed the CRISPR-Cas systems to immunize them against viruses (or foreign genetic elements), the invading entities ('the genetic parasites') developed anti-CRISPRs (Acrs)-mediated immune suppression. The volumes of *ARM* have usually covered the aspects of malaria, which continues to be a huge burden for humankind with over 400,000 deaths in 2018. Interestingly, the articles in this volume discuss the origin of human malarial parasite, development of drug resistance in *Plasmodium*, and the gene drive and microbial manipulations to incapacitate the mosquito vector. Given the human interventions with nature, and the increasing risks of zoonoses, these are important topics to be covered. The topics of archaeal DNA replication, and the evolution of the centromeric regions in fungi are also covered in this volume. Another article discusses the class of bacterial and archaeal nitrogenases which use vanadium (V) and iron (Fe) only as transition metals (V/Fe or Fe/Fe cofactors in place of Mo/Fe cofactor), and these may well be important for the microbes in the molybdenum-limited environments. Other important articles that do not directly fall into the prominent themes of chemical ecology or malarial biology, cover advances made (by cryoEM) in membrane functions of phototrophic bacteria; mechanisms of phase variation as an epigenetic regulatory mechanism of virulence and immune evasion; structure and function of Ro60 ribonucleoprotein and the noncoding Y RNA present in all domains of life; role of functional amyloids in signalling pathways; structure-based understanding of catalysis of methanogenesis; reproductive isolation of *Saccharomyces* species; and the capability of the bacterial world in developing a tremendous diversity despite their smaller genomes.

I enjoyed reading through this volume of *ARM* and got to learn a whole lot of new things. Clearly this volume like the earlier ones in this series, would serve as an excellent resource for preparing lectures or a ready reference for research. All articles are extremely well written to provide a lasting impact of the topic. The editors have all done a tremendous job in bringing out this volume of *ARM*. I congratulate them, and highly recommend this book to the students and researchers alike.

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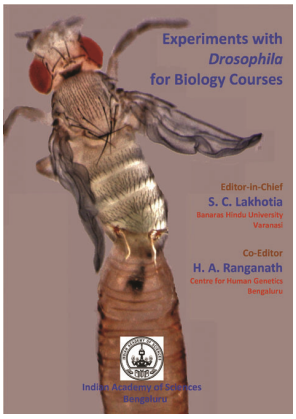

Experiments with *Drosophila* for Biology Courses. S. C. Lakhotia and H. A. Ranganath. Indian Academy of Sciences, Bengaluru 560 080. 2021. x + 618 pages; e-Book.

The 'Cinderella of genetics', *Drosophila*, is one of the most popular model organisms in the field of research. Researchers have a long association with this multicellular organism employing it to study diverse aspects of biology for over a century. The book under review is an open-access book whose editors are well known in the field of *Drosophila* research. S. C. Lakhotia (Banaras Hindu University, Varanasi) has more than five decades of experience in *Drosophila* research. He has made notable contributions in the fields of chromosome biology, non-coding RNAs and stress response. He is the recipient of numerous prestigious accolades including the Shanti Swarup Bhatnagar award, one of the highest Indian science awards in India. H. A. Ranganath (University of Mysore, Mysuru) has been working on the *Drosophila* model for more than five decades and has carried out pioneering studies on the genetics of speciation and evolution. He also has several awards to his name and is the Founder Vice-President of the Indian Society of Evolutionary Biologists. It is noteworthy to mention that the academic lineage of the pioneering Indian *Drosophila* researchers, including Lakhotia and Ranganath goes back to Thomas Hunt Morgan.

Hands-on-training with model organisms gives a better appreciation of science and bridges the gap between the virtual world of reading and the life in motion. This book takes note of the lack of experimental studies with model organisms at the undergraduate and postgraduate levels in science. The editors and fly researchers across India have compiled this volume to cater to the needs of researchers, teachers as well as students. They do so by offering experiments with fruit flies to provide a practical understanding of diverse life processes. In the words of the editors, it is an effort to 'bring life to life science courses'.

Experiments with fruit flies are advantageous in terms of time and economic requirements. This book is a compendium of extensive fly-based laboratory protocols. Many experiments require minimal basic set-up and are devoid of any ethical constraints. The protocols have been prepared in the laboratory manual format providing a background, stepwise description of the procedures followed by analytical questions to refine the understanding of the subject matter. These laboratory exercises cover diverse aspects of biology and are written by the relevant experts. The experimental procedures should inculcate a good understanding of developmental biology, genetics, molecular biology, immunology, behavioural biology, neurobiology and a host of other topics covered in the protocols. With a generous fly community and the simple set-up, majority of the experimental procedures should not be a difficult task to carry out in most institutions.

The *Drosophila* genome bears a striking similarity with the human genome with