Annual Review of Entomology, 2021. Angela E. Douglas, John Trumble and Myron P. Zalucki (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139. Palo Alto, California 94303-0139, USA. Vol. 66. xiv + 504 pages. Price: US$ 118.

The present volume of the *Annual Review of Entomology* has reached our hands at a time when the whole world, especially India is still bearing the consequences of COVID-19 pandemic. In spite of the ongoing pandemic, entomologists continue their essential tasks of research and publications. Just like the previous volumes, this volume also contains reviews that cater to the needs of various groups of people engaged in different fields of entomology. The incredible diversity of topics covered in this volume is fascinating.

One autobiographical sketch and twenty four reviews related to ecology or pest management, molecular mechanisms of insect interactions, neuroscience and behaviour, effects of climate change on insects, new advances in insect control, managing important medicinal and veterinary pests, systematics and evolution of arthropods, historical and sociological perspective of entomological research, and new ways of using insect in undergraduate laboratory exercises are presented systematically in this volume with clarity and depth.

The autobiographical sketch 'Preference provides a plethora of problems (don't panic)' by Michael C. Singer is inspiring. He narrates in his own inimitable style, the hardships he had undergone and skepticism he had faced during his journey. In spite of these setbacks, he was able to achieve high level of success in his pursuit of insect–plant interactions, particularly related to oviposition preference of Melitaeine butterflies in which he was able to show insect preference for specific host. He suggests that insect preference comes with complex dimensionality which frustrates our attempts to derive unequivocal conclusions. I am sure many young researchers will benefit much from this sharing.

The effect of climate change is being felt all over the world and it not only affects humans, but also has its effects on insects. The article 'Survive a warming climate: Insect responses to extreme high temperatures' highlights the biological and ecological effects of extreme high temperatures (EHTs) on insects at individual, population and community levels. EHTs often affect insects at molecular and psychological levels. EHTs are filtered by microhabitats and buffered by insects through behavioural thermoregulation, phenotypic plasticity like acclimation, ontogenetic variation, adaptive evolution and resilience. The authors suggest that the available data at present are not sufficient to comprehensively understand this phenomenon and therefore they recommend the use of innovative and ecologically relevant experimental designs and microclimate models in future studies to understand this better.

A related article 'Growing up in a changing world: Environmental regulation of development in insects' highlights how the insects adjust their development and physiology to ensure that they can produce the functional structures necessary for survival and reproduction. Embryonic and pupal developments appear to be geared towards robust development processes, using morphogen gradients and other mechanisms to buffer errors in developmental timing. In contrast, the larval stages achieve plasticity of growth and robustness of patterning by tuning how traits respond to developmental hormones and balancing these responses with morphogen-mediated growth and patterning. The authors suggest to quantitatively explore the variations in growth and patterning across a range of traits and species to get more valuable insights.

An informative article for those involved in forest entomology is 'Tree diversity and forest resistance to insect pests: Patterns, mechanisms, and prospects'. It is commonly known that increasing tree species' richness at forest stands, improves tree resistance to insect pest damage. This review provides a quantitative assessment (meta-analysis) of tree diversity effects on insect herbivory. Based on more than 600 study cases, the authors point out that insect herbivory is lower in mixed forest stands than in pure stands. Tree species' diversity mainly reduced the damage of specialist insect herbivores in mixed stands with phylogenetically distant tree species. Reduced host tree abundance and enhanced composition of natural enemies contribute to this beneficial effect. Hence, increasing forest diversity is a promising management tool to reduce pest damage.

The article 'Advancing undergraduate laboratory education using non-model insect species' is thought provoking. In the recent past, laboratory courses have made a fundamental shift to enquiry-based modules and authentic research experiences. The authors assert that insects are ideal for inquiry-based undergraduate laboratory courses because research on insects is not limited by regulatory, economic, and logistical constraints to the same degree as research on vertebrates. Inquiry can range from guided inquiry, open-ended inquiry and course-based research. Today, there is a fundamental shift away from confirmatory and cookbook exercises, toward authentic. inquiry-based modules. *Drosophila melanogaster* has been the go model insect system for a long time to study the Mendelian genetics. *Tribolium castaneum* has been used as a model to study classical genetics, population genetics, host–parasite co-evolution, physiology and comparative development. The authors suggest many other non-model insect species, such as *Callosobruchus maculates*, *Nicrophrous tomentosus* and *Tenebrio molitor* (beetles), *Acyrthosiphon pisum* (aphid), *Nasonia vitripennis* and *Melittobia digitata* (wasps), *Manduca sexta*, *Pieris rapae* (lepidopterans) and *Acheta domesticus* (brown cricket) to conduct original and scientifically significant research. This broader use of insects will have an added benefit of fostering increased interest and research in entomology.

The article 'A century of synergy in termite symbiosis research: linking the past with new genomic insights' summarizes how research has moved from simple insights, such as role of symbionts in lignocellulose digestion, energy gas utilization, etc. to symbiont identities, functions and interdependence using genomic tools. Genome sequencing including transcriptome and meta transcriptome have revealed new supporting information on long-standing themes such as microbial species and gene composition. The authors recommend the use of traditional and modern techniques as tools in future studies.

The article 'Chemical ecology, biochemistry and molecular biology of insect hydrocarbons' deals with insect cuticular hydrocarbons, which perform a variety of functions in chemical communication as signals mediating the life histories of insect and in restricting water loss through the cuticle and preventing desiccation. Powerful new tools of molecular biology including RNAi knockdown of specific genes, have provided new insights into the biosynthesis of hydrocarbons. New roles and novel functions for insect hydrocarbons are expected in future.

The article 'The interplay between viruses and RNA pathways in insects' is an

enlightening one. Small interfering RNA (siRNA) pathway of the RNA interference response is the primary antiviral defense mechanism against insect viruses. This siRNA pathway confers long-term immune memory against the same pathogen which may be inherited. The authors suggest that insect virus molecular interactions may provide knowledge for the control of agricultural pests and vectors of diseases, as well as the protection of beneficial insects.

The article 'Mechanism of resistance to insecticidal proteins from *Bacillus thuringiensis* (BT)' highlights the development of resistance in insects to BT. To date, high levels of resistance to BT sprays have been limited to one species in the field, another in greenhouses and eight species in transgenic plants. Insects may develop high level of resistance through altered trans-regulators of Cry binding proteins.

The article 'How dung beetles steer straight' is quite fascinating. The authors surmise that the dung beetle compass is not pre-programmed. It continuously adapts to the visual cues; in the morning and in the afternoon, it orients with the sun; at midday, it reacts to the wind; and at night or in a forest, it favours the celestial polarization pattern. The same neurons switch their responses to various cues. The authors suggest that insect's navigation system can help in designing a robust compass system.

In the article 'Semiochemicals for thrips and their use in pest management', the authors state that over 100 species of thrips or plant pests in agriculture, horticulture and forestry are causing damage through feeding and transmission of plant viruses and the semiochemicals offer significant opportunities for their management. A rich diversity of chemicals has been identified in the defensive secretions of wide range of thrips. More studies are needed to assess the behavioural responses of thrips to semiochemicals.

The article 'Transposable elements (TEs) and the evolution of insects' shows that in addition to being involved in insect adaptations and ageing, TEs are at the cornerstone of insect antiviral immunity. Phylogenetic relatedness generally correlates with similarity in TE content. The authors state that TE appears to be involved in a variety of adaptive events in many insect species.

The articles touching on 'gene drive to control wild populations of insects', and 'the interplay between viruses and RNAi pathways in insects' offer interesting and thought provoking reading.

On the whole the editors have done a commendable job of selecting many relevant and informative articles and presenting them in a concise manner. The authors also deserve our appreciation for compressing the vast available literature into limited pages with suitable figures, tables, summaries and future possibilities. This volume is certainly a good addition to the literature related to entomology.

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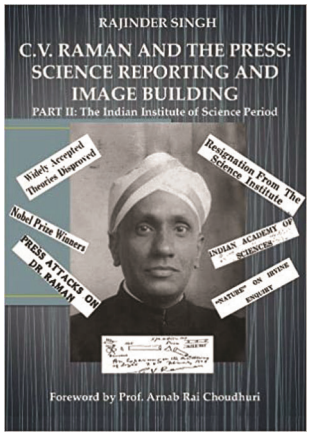

C.V. Raman and the Press: Science Reporting and Image Building – Part II. The Indian Institute of Science Period. Rajinder Singh. Shaker Verlag, Düren. 2020. xviii + 173 pages. Price: € 21.90.

Rajinder Singh, author of this volume, is a renowned science historian of India. His journey into the history of science of India starts with C. V. Raman. This is his fifth volume in the Raman series. In the preface, the author recounts: 'In the past, I have written the following books on Sir C.V. Raman, the founder of Raman Spectroscopy: (i) "C.V. Raman and the Press: Science Reporting and Image Building – Part 1: Kolkata Period" (2019). (ii) "C.V. Raman's Laboratory and Discovery of the Raman effect" (2018). (iii) "Nobel Laureate C.V. Raman's Science, Philosophy and Religion" (2005), and (iv) "Nobel Laureate C.V. Raman's Work on Light Scattering – Historical Contributions to a Scientific Biography" (2004).' The volume under review deals with Raman's stay in Indian Institute of Science (IISc) where he tried to create an independent 'Bangalore School of Physics'.

In the foreword to this volume, Arnab Ray Choudhury pays tribute to the author as follows: 'Rajinder Singh, who is known for his important studies on the history of Indian physics in the early decades of the twentieth century, has embarked on a study of the relationship between Raman and the press in three volumes. I am not aware of similar studies of other scientists by historians of science in other countries. There is no doubt that this book contains invaluable materials for the scholar interested in Indian science of that period.'

In the introduction, the author writes that 'C.V. Raman spent 25 years in Kolkata at the Indian Association for the Cultivation of Science (IACS) and the University of Calcutta. In 1932, he was appointed as the first Indian director of the Indian Institute of Science. Raman's interaction with media was explored until 1932 which forms the basis of my first volume, "C.V. Raman and the Press: Science Reporting and Image Building – Part 1: Kolkata Period". This volume covers Part II: The Indian Institute of Science Period from 1933 to 1948.'

In chapter 1, the author reports about Raman joining as first Indian Director of IISc on 1 April 1933 and starting the Department of Physics from a scratch in July 1933. Raman, even as a Director was not having full financial powers and was feeling handicapped due to bureaucratic hurdles. Within two years, he was able to attract the best available researchers of India to join his group. Raman reported to *Bombay Chronicle* (23 June 1935) under the heading 'Nobel Prize Winners of the Future', with a photo of S. Bhagavantam under the banner line, about planned research activities of IISc and the physics department: 'New activities started in Applied Physics, especially the study of Geo-Physical methods of prospecting for minerals. The School of Physical Metallurgy and investigation in Fuel Technology on the fundamental side. It is hoped to initiate research work on Cosmic Rays and to make a beginning with the investigation of Nuclear Physics.'

Raman was in favour of pure science as reported in *The Illustrated Weekly* (June 21, 1936): 'Science, alas, is a very particular