aspects of circular economy. The authors urge us to strive for future energy security, keeping in mind the needs of urban and rural India. The readers will learn about how advancements in materials science and digital technologies can solve the challenges of sustainability, water, energy and net-zero emissions. I strongly recommend their emphasis on sustainability-focused research and education in higher educational institutions.

- Under bioscience and biotechnology, I like the attention given to new and emerging areas like brain research. India has to develop affordable medical products and technologies, and we are already seeing how the top engineering schools in India have begun interdisciplinary programmes in medicine and healthcare.
- Indian institutions should adopt innovative models for augmenting the quality and funding of institutional-level research. They should experiment with the 28 different ideas/models proposed under the categories of Prizes, Challenges, Grants, Knowledge Dissemination, STI Infrastructure Set-up and STI Capability and Policy Development.
- India will immensely benefit from nurturing entrepreneurship ecosystems focused on deep-tech and social innovations.
- The recommendations relating to Academia–Industry–Alumni engagement are well-grounded. While industry collaboration has been an area of interest for some time, the focus on alumni is refreshing.
- Finally, the recommendations pertaining to human enablement – education and skill development – are critical for India. Digital technologies must be embraced to scale our aspirations for higher Gross Enrolment Ratios. We need to bear in mind when it comes to the skilling and reskilling of Indian talent that they service two distinct needs – the needs of an increasingly digitalized world and the social entrepreneurship needs of the hinterlands of India.

The authors' concise summary in section 6 was particularly noteworthy. The appendix provides intriguing and interesting data on the performances of both IITs and IISc, publication trends, *h*-indexes for all IITs, and detailed scientometric information. The authors argue that if 30 recommendations in the book are taken up by S&T institutions in India, then the following dream of 2047 is possible to achieve, namely India is among the top three economies in the world. It is also in the top three nations in global research, and technologies like AI, EV and green hydrogen, and spends 3% of its GDP on R&D. It is in the top 10 in the Global Innovation Index, has achieved Gross Enrolment Ratio of over 50%, and Human Development Index of 0.9.

I strongly recommend this book to every researcher in our country. It motivates every individual involved in S&T to contribute more towards Empowering India.

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As always, the present volume of the *Annual Review of Entomology* contains articles of great merit and interest. It has 23 articles touching upon various fields of entomology, such as insect–plant interactions, chemical ecology, biological insect control, ecology, behaviour, plasticity, molecular mechanisms, pollinator dynamics and resistance development.

Insect–plant interaction is an area of bewildering intricacies, and some related articles highlight the various dimensions of such interactions. Related to this is the field of chemical ecology with its implications in the biological control of insects.

The use of pheromones to attract insects and reduce the population size has been a critical method in integrated pest management programmes. In the article 'Complex and beautiful: unraveling the intricate communication systems among plants and insects', James H. Tumlinson shares his personal experience and sheds light on the existence of chemical communication systems between plants, herbivores and natural enemies. He narrates how he and his research group identified and synthesized many chemical lures used to trap insects. When herbivores attack, the plants produce volatile compounds that help parasitoids associate themselves with herbivore hosts. He recommends collaborating with other experts to develop new hypotheses, approaches and questions.

Stefano Colazza, Ezio Peri and Antonio Cusumano, in their article 'Chemical ecology of floral resources in conservation biological control', enumerate the intentional provision of flowering plants as food resources to enhance populations of natural enemies of insect pests in crop habitats. The role of floral volatiles as semiochemicals and nectar-inhabiting microbes in mediating parasitoid responses to flowering plants is explained lucidly.

Even though there is no consensus on the use of genetically modified crops throughout the world, genetically engineered corn and cotton that produce insecticidal toxins derived from the bacterium *Bacillus thuringiensis* (*Bt*) have been cultivated to manage insect pests in many parts of the world. The article 'Management of insect pests with *Bt* crops in the United States' by Aaron J. Gassmann and Dominic D. Reisig points out the successful suppression of pest population and increased profits for farmers in many cases and the evolution of resistance and damage to crops in some cases. They recommend using novel pyramiding of genes, coupled with adequate use of refuges and integrated pest management systems for sustainable farming.

In the article 'The biology and ecology of parasitoid wasps of predatory arthropods' Minghui Fei, Rieta Gols and Jeffrey A. Harvey state that many parasitoids of predators exhibit intricate physiological interrelationships with their hosts, adaptively manipulating host behaviour, biology and ecology in ways that increase parasitoid survival and fitness. Although most parasitoids exploit insect herbivores as hosts, others parasitize predating insects and arthropods.

Meta Virant-Doberlet, Natasa Stritih-Peljhan, Alenka Zunic-Kosi and Jernej Polajnar, in their article 'Functional diversity of vibrational signalling systems in insects' narrate how insects generate vibrational signals primarily by tremulation, drumming, stridulation and tymbalation. These are part of multimodal communication. Signalling by substrate-borne mechanical waves is the most common form of mechanosensory communication in insects.

Invasive species are a threat to natural habitats. The article 'Biology and management of the spotted lanternfly *Lycorma delicatula* (White) (Hmiptera: Fulgoridae) in the United States' by Julie M. Urban and Heather Leach states how this insect

invaded in 2018 and caused economic and ecological disruption affecting vineyards and ornamental plants. The wide host range and high mobility have contributed to its success as an invader. They state that no single currently available control measure is sufficient to reduce the population of *L. delicatula*.

Bed bugs are a menace all over the world, and they have a capacity to develop resistance to many insecticides. In the article 'Historical and contemporary control options against bed bugs, *Cimex* spp.' Stephen L. Doggett and Chow-Yang Lee suggest that the global resurgence of bed bugs is due to the development of insecticide resistance, along with global travel and poor pest management. They give ideas for prevention, detection, monitoring, non-chemical and chemical control methodologies, and potential future control options. Novel control approaches such as RNA interference, toxicant baits and systemic toxicants show future potential.

Wee Tek Tay, Robert L. Meagher Jr, Cecilia Czepak and Astrid T. Groot state in the article '*Spdoptera frugiperda*: ecology, evolution, and management options of an invasive species' that *S. frugiperda* has become a major invasive pest around the globe. They highlight its ecology, reproductive biology, host plant use, the status of insecticide resistance alleles, and biocontrol methods in nature and invasive regions. Genomic analyses show it is much more diverse, and natural forces differ geographically. They suggest a region-specific approach to control this global pest. They recommend biocontrol as an effective method.

The article 'Dehydration dynamics in terrestrial arthropods: from water sensing to trophic interactions' by Joshua B. Benoit, Kevin E. McCluney, Mathew J. DeGennaro and Julian A. T. Dow narrates how terrestrial arthropods survive within a variably dry world and how they shape ecological interactions. Efficient regulation of internal water content is accomplished by excretory and osmoregulatory systems that balance water intake and loss. As the climate changes, evolutionary and ecological processes are critical to species survival during drought.

In the article 'Forest Insect Biosecurity: Processes, patterns, prediction pitfalls' Helen F. Nahrung, Andrew M. Liebhold, Eckehard G. Brockerhoff and Davide Rassati highlight the biosecurity measures used to mitigate the arrival, establishment, spread and impacts of non-native forest insects and possible impediments to implementation. They suggest biosecurity should be a shared responsibility across countries, governments, stakeholders and individuals.

David W. Roubik's article 'Stingless Bee (Apidae: Apinae: Meliponini) ecology' explains how stingless bees have diversified ecologically. They excel in nesting, site selection and mutualism with plants, arthropods, and microbes; they display opportunism, including co-opting plant defense.

Remote sensing is a handy tool with varied applications. In the article 'Early monitoring of forest wood-boring pests with remote sensing' Youqing Luo, Huaguo Huang and Alain Roques explain how remote sensing helps in the early detection of wood-boring pests. The applications of various remote sensing sensors, platforms and detection methods for monitoring are presented. Deep learning and machine learning algorithms are beneficial for early detection.

The article 'Iron homeostasis in insects' by Maureen J. Gorman narrates how insects have homeostatic processes that control the redox state, quantity and location of iron in the body. Insects and mammals have different mechanisms of iron homeostasis. Owen D. Seeman and David Evans Walter in their article 'Phoresy and Mites: More than just a free ride', examine how mites often attach to large animals in a temporary symbiosis called phoresy to exploit patchy resources.

In their article 'Postcopulatory behaviour of Tephritid flies', Diana Perez-Staples and Solana Abraham highlight how mating produces profound changes in the oviposition behaviour of female flies, such as increase in ovipositing, reduction in sexual receptivity, increase in feeding and even excretion. Many of these changes are caused by copulation, sperm and accessory gland products that males transfer to females during mating. Understanding male mating's effects on female behaviour will contribute to developing more effective environmentally friendly control methods.

Zhaoyang Hu, Feifei Zhu and Keping Chen, in the article 'The mechanisms of silkworm resistance to the baculovirus and antiviral breeding', summarize the work done so far in developing baculovirus-resistant silkworms. They suggest hybrid breeding, RNA interference, and genetic modification can help develop resistant silkworms.

The article 'Molecular mechanisms of winter survival' by Nicholas M. Teets, Katie E. Marshall and Julie A. Reynolds states that cold acclimation and diapause cause wholesale transcriptional reorganization, increasing cold resistance and promoting cryoprotectant production and energy storage. Signalling events contribute during and after a cold stressor to prevent and repair cold injury.

Po-Yuan Shih, Akiko Sugio and Jean-Christophe Simon, in the article 'Molecular mechanisms underlying host plant specificity in aphids', narrate how technological advances have revealed plant–aphid interaction at the molecular level. They advocate using molecular tools in future studies to obtain a comprehensive view.

In the article 'Adaptive plasticity of insect eggs in response to environmental challenges,' Monika Hilker, Hassan Salem, and Nina E. Fatouros highlight the phenotypic plasticity of insect eggs and their compatibility to adjust to their environment. The insect egg actively responds to and interacts with its environment.

Overall, this volume enthuses the readers with a collection of varied topics reviewed by internationally reputed scientists. Many articles are embellished with colourful plates, clear figures and valuable tables. All the articles present possible future areas of research. The editors deserve our appreciation for selecting stalwarts in their fields to write these reviews and for bringing out the volume elegantly. This volume should find a place in every library so entomologists and other nature lovers can benefit abundantly.

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