that metrics which ignore the semantic content of citations are a blunt instrument and that biblometrics must encourage practices that are beneficial for the scientific process. As the chairman of this subgroup has said, 'metrics affect the behaviour of researchers, such as their choice of journals, as they seek to maximize their performance as measured by the metrics used. Metrics can contribute to the maintenance of high journal prices, and promote intense competition rather than openness and sharing, and fail to recognize research contributions such as the production of datasets, software, code, blogs, wikis and forums. Governments might argue that they also do not recognize the impact of research on society at large'.

The author lends legitimacy to the *h*-index by considering it as one of the 28 indicators (pp. 52–53; 105–106), of course with some caveats. He should have discussed the views of others, especially those who are critical of the *h*-index. According to Waltman and van Eck, it 'cannot be considered an appropriate indicator of a scientist's overall scientific impact'. Yves Gingras considers the *h*-index to be poorly constructed, 'inadequate and invalid' and it 'may even distort evaluation and hiring processes'. In his view, 'it is actually quite noxious when used as an aid to decision making because it can generate perverse effects'.

On the whole, the publication can be used as a textbook for an advanced course in science metrics.

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The *Annual Review of Entomology* is one of the eagerly awaited volumes by entomologists and insect enthusiasts all over the world because of the range of articles it covers, the in-depth analysis of the topics it selects and the lucid presentation it makes. The 2019 volume containing totally 21 articles written by experts in their fields of specialization offers food for thought and opens up new avenues for research.

Among these 21 articles, seven relate to the management of insect pests, two touch upon anthropogenic factors affecting insects, seven cover the molecular dimensions of some insects, two deal with hymenopterans, two relate to arachnids and one is an autobiographical note. Many of the topics selected are relevant in today's context as we are struggling to control insect pests with less chemical inputs. The articles such as management of locusts and grasshoppers, cereal aphids, subterranean termites and blueberry pests give insight into many effective preventive management strategies that can be used to enhance our efforts. As the modern genetic techniques are offering new tools to delve deep and unravel many complicated insect systems, the articles such as epigenetics in insects, molecular evolution of chemoreceptor gene families and molecular mechanism of wing polymorphism throw light on the genetic control systems.

The first article 'An unlikely beginning: a fortunate life' by E. A. Bernays is an autobiographical sketch of the author's involvement throughout her life in the physiology, behaviour and ecology of feeding in herbivorous insects. Her observations on the behaviour of generalist and specialist grasshoppers in choosing their food are original and thought- provoking. Her life is an inspiration for many young researchers.

The article 'Locust and grasshopper management' presents the historical perspective, current reality, their economic impact, the strategies we need to manage them, monitoring, forecasting, control methods and the socio-economic context in relation to their management. In the context of the recent outbreak of locusts in some parts of Gujarat, this article has great relevance. The authors recommend more efficient monitoring and control techniques by increased use of biological products, satellite imaging and GIS.

The article 'Ecology of collective behavior in ants' summarizes the dynamics between the environment and collective behaviours. The author affirms that ecological conditions shape the evolution of collective behaviour. The article 'Invasion success and management strategies for social *Vespula* wasps' describes how three species of *Vespula* became invasive in Australia, Hawaii, New Zealand, and North and South America and how they affected all trophic levels, more particularly, severely affecting pollination and the apicultural industry. The authors suggest the use of gene drive as a potential method of control.

The article 'Invasive cereal aphids of north America: ecology and pest management' takes into consideration three cereal aphids and their role in disrupting cereal production. The authors encourage the use of aphid-resistant cultivars and area-wide management systems. The article 'Blueberry IPM: past successes and future challenges' discusses the importance of blueberry trade globally and the great potential available for biological, behavioural, cultural, and physical methods to blueberry IPM.

The article 'Development of baits for population management of subterranean termites' elaborates on the history of bait development and the success of chitin synthesis inhibitor baits in colony elimination. In the context of termite infestation in many parts of the country, this article gives several relevant tips to manage them. The article 'Biology and control of the Klapra beetle *Trogoderma granarium*, a major quarantine threat to global food security' discusses the advances made so far and directions to consider for future research. The authors recommend research on molecular diagnostics. The articles 'Vectors of babesiosis, and movement and demography of at-risk butterflies: building blocks for conservation' are informative and stimulating.

In the article 'Epigenetics in insects: genome regulation and the generation of phenotypic diversity', the authors provide an introduction to the field of molecular epigenetics in insects, and the techniques for profiling and perturbing individual facets of the epigenome. They recommend the study of intergenerational epigenetic inheritance to know more about genomic imprinting in insects.

The article 'Bee viruses: ecology, pathogenicity and impacts' highlights the diversity of viruses that infest bees, the complexity of their transmission routes and the strategies evolved to combat virus infection. The article 'Molecular

evolution of the major arthropod chemoreceptor gene families' summarizes the available knowledge on odorant, gustatory and ionotropic receptors, and the conservation of certain amino acids and gene families.

The article 'Life and death at the voltage-sensitive sodium channel: evolution in response to insecticide use' discusses the development of resistance in insects through multiple mutations in the voltage-sensitive sodium channel of the insect's nervous system. The potential pathways by which multiple mutations arose are also presented. In the article 'Nonreproductive effects of insect parasitoids on their hosts', the authors discuss about the death, altered behaviour, altered reproduction and altered development of hosts due to parasitoid attack. The article 'Movement ecology of pest *Helicoverpa*: implications for ongoing spread' highlights the invasiveness and adaptability of the moth. We all know how notorious this pest is and what damage it causes to hundreds of economically important crops. The authors advocate the use of experimental and theoretical approaches to arrest the spread of this pest.

The article 'Molecular mechanisms of wing polymorphism in insects' highlights the physiological adaptations driven by molecular mechanisms to suit ecological success. In the article entitled 'Fat body biology in the last decade', the authors highlight the central role of fat bodies in the insect's life, and the fascinating new developments this knowledge can offer in studying metabolic disorder and immune diseases.

In the article entitled 'Systematics, phyologeny, evolution of braconid wasps: 30 years of progress', the authors summarize the current status of the phyologenetics of the Braconidae in a historical perspective, and the use of genetic markers and mitochondrial genomes in systematics and classification. Today many insect taxonomists are using molecular identification techniques and this article offers good suggestions.

In the article 'Water beetles as models in ecology and evolution', the authors propose that water beetles can be used as excellent models for addressing a variety of questions in ecology and evolution. The last article deals with the 'Phytogeography of ticks (Acari: Ixodida) with special emphasis on their origin, divergence and spread'.

On the whole this volume of the *Annual Review of Entomology* offers the readers an array of fascinating and illustrative articles that throw light on the life, development, spread, genetic mechanisms and control measures related to various insects. Many of the articles have several figures and tables along with good illustrations. Future directions are also indicated in many of the articles to help other researchers move forward in newer areas of research. The editors have done a commendable job in selecting many relevant topics of current interest. I am confident that this volume will be an asset to all the libraries and other avid entomologists.

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