This book is a useful reference for teachers of isotope geology as well as practising geoscientists who use geochronological data for their research. Unfortunately, it lacks the desirable attributes for a textbook. There are no worked-out examples, no problem sets and fewer illustrations. Considering that the author's main target is students, the book would have greatly benefited from information on methods of determination of decay constants, concept and derivation of mean life, derivation of decay equation from statistical principle, error propagation in isotope dilution analysis and mass spectrometric data reduction techniques, most of which are rarely covered in books on the subject. I sincerely hope that subsequent editions of the book would be more comprehensive. Notwithstanding my above comments, I would strongly recommend the book to all my colleagues who teach isotope geochemistry and all the geoscience departments. I commend the author for writing such a brilliant book on isotope dating.

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Annual Review of Entomology, 2017. May R. Berenbaum, Ring T. Cardé and Gene E. Robinson (eds). Annual Reviews, 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94303-0139, USA. Vol. 62. xii + 482 pp. Price: US$ 107.

Insects nurture and protect us, sicken us, kill us. They bring us joy and sorrow. They drive us from fear to hate, then to tolerance. At times they bring us up short to a realisation of the way the world really is, and what we have to do to improve it. Their importance to human welfare transcends the grand battles we fight against them to manage them for our own ends. Most of us hate them, but some of us love them. Indeed at times they even inspire us.

– McKelvey

Insects have been central to many advances in science. The inspiration from insects has prompted the *Annual Review of Entomology* (*ARE*) to review significant developments in the field of entomology, including biochemistry and physiology, morphology and development, behaviour and neuroscience, ecology, agricultural entomology and pest management, biological control, forest entomology, acarines and other arthropods, medical and veterinary entomology, pathology, vectors of plant disease, genetics and genomics, and systematics, evolution and biogeography from 1956. It is indeed refreshing to see that *ARE* has been at the forefront of publishing excellent reviews dealing with many different facets of entomology for the last 62 years, when we have tried to place the many disciplines of science into compartments, even though the boundaries between different disciplines are difficult to delineate clearly. Insects have been, for nearly 400 million years, the most dominant animal group and the most successful in the evolutionary history of the earth. It is appropriate that the study of insects spans many disciplines and entomological research has taken great strides in these different areas.

This volume of *ARE* begins with a wonderful introduction by Subba Reddy Palli (an editorial committee member), where he traces the process the editorial committee uses to select contents for each and how the planning for each volume starts three years before the publication date. Only 50% of the proposals received from potential contributors is turned into articles in this volume. Covering a range of topics in most of the subdisciplines of entomology, this volume includes 24 excellent and comprehensive reviews. Through this array of reviews covering a perfect balance of both basic and applied aspects, this volume seeks to make it delectable reading for a large number of readers. Some of the subdisciplines covered include biochemistry and physiology, morphology and development, behaviour and neuroscience, ecology, agricultural entomology, biological control, forest entomology, medical and veterinary entomology, insect pathology, genetics and genomics, systematics, evolution and biogeography, history of entomology, autobiography and spider silk. I would like to discuss a few of the compelling and thought-provoking reviews and present a tingling taste of the flavours in this volume.

Choosing 'Yellow brick road' as a title for his autobiographical sketch, Charles H. Calisher, the arbovirologist (one who studies viruses that are transmitted between vertebrates by hematophagous arthropods), nicely brings out how the road to happiness or good things as in the *Wizard of Oz* is simply being in the right place at the right time. In his wonderfully clear and conversational tone, the author brings out his satisfying career spanning almost 27 years at the Centres for Disease Control and Prevention (CDC), USA. Some of the quotes of significance from this piece are – 'Perhaps a bit of my personal history will provide more perspective as to how I got from hither to yon', 'People were not hired to fill professional positions', 'Italicization of a virus name is simply incorrect and those who use such typeface when writing about a virus err', '... and to have the opportunity to present my often very subjective opinions, not simply my objective findings'. Calisher recounts how on his retirement at the age of 75 and having had enough of meetings, grant applications, editing students' dissertations, serving on committees, and dealing with parking regulations, he simply shifted to an easier schedule, writing reviews, reviewing manuscripts, staying in contact with long-time friends and colleagues, and generally not keeping to a well-defined schedule. I would highly recommend this delightful article for the sheer joy of reading it.

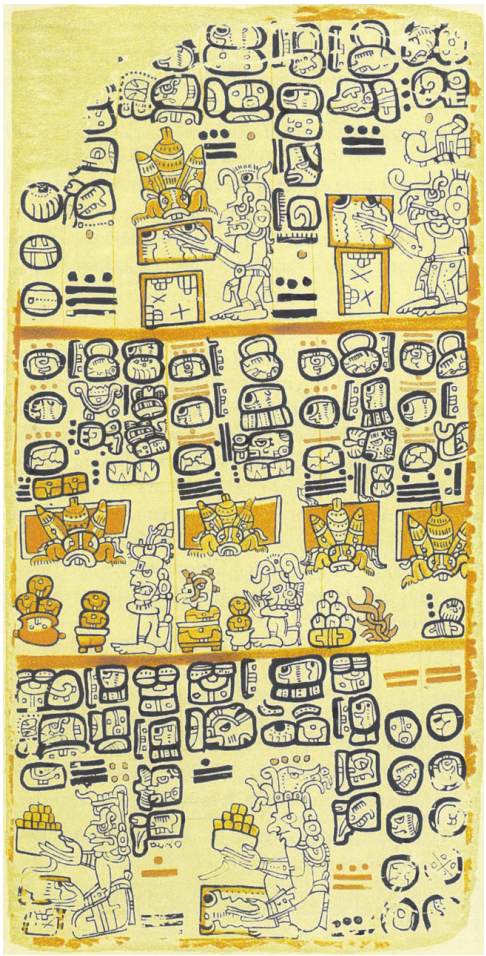
Next let me highlight the brilliant article 'Beekeeping from antiquity through the Middle Ages' by Gene Kritsky, which artfully takes you through the history of beekeeping practice starting from the 7000 to 8000 yr-old rock paintings in Spain, depicting rope ladder-suspended honey hunters harvesting honey from wild bee colonies to the tryst with apiculture of the Egyptians, Romans, Asians and Mayans, illustrating how beekeeping developed in isolation in many parts of the world. The absolutely fascinating history of our relationship with honey bees is well illustrated through the evolution of different hive structures in Egypt, Rome, Greece and Europe as a whole. Evidence of the knowledge of beekeeping with the cavity-nesting honey bee, *Apis cerana*, especially in China, dates back to 3500–4000 years, with later beekeepers being aware of the different castes, understanding swarming, how to unite and separate colonies, etc.

Bee-keeping seems to have developed independently in India around 327 BCE through migrating people. The robust beekeeping tradition enjoyed by the Mayans even before the Spanish arrived in early 16th century is evidenced by their use of honey as a trade commodity with the Aztecs. The Mayans are also credited with having knowledge about the bees harvesting nectar from flowers to make honey, as revealed by the ritual dances held to encourage the Gods to provide flowers for the bees and aid in their work to produce honey. Unlike beekeeping that revolved around *Apis* in Europe, the Middle East and Asia, Mayan beekeeping used the stingless bee, *Melipona beechii* to develop meliponiculture between 300 and 250 BCE. The *Madrid Codex* created around 1400 is an important record of Mayan beekeeping and includes images of log hives, harvesting of honey and deities associated with beekeeping.

'Learning in insect pollinators and herbivores' by Jones and Agrawal brings out the strong selection pressures exerted in the relationship between plants and insects during both foraging and oviposition. The process of insect pollination is itself believed to be the basis for the 135 million years evolutionary history of flowering plants. The plants may be under selection so that their flowers are easily recognized and remembered by their insect pollinators, while the leaves of the same species may be under selection from insect herbivores to be difficult to learn – is an enigmatic hypothesis that needs to be tested. One group of plants, the orchids, have developed floral colour, form and fragrance that allow these flowers to interject themselves into the life cycle of their pollinators to accomplish their fertilization. Unfortunately, most of the research on associative learning on pollinators has been conducted with bees, and other pollinators like wasps, butterflies, moths, beetles and flies have been little studied. While in herbivores the antagonistic relationship with plants might favour evolution of specialization, the mutualistic relationship of pollinators with plants may favour evolution of generalization. The authors emphasize the need for empirical research linking insect learning (of both pollinators and herbivores) to plant reproductive success.

The review of tephritid integrative taxonomy by Schutze *et al*. strongly argues the case for integrative taxonomy as opposed to evidence from a single discipline and, more importantly, of individual taxonomic authorities proclaiming opinion as 'fact' to challenge extensive evidence generated via scientific hypothesis-testing methods by several discipline specialists. The multidisciplinary approach where more than one species delimitation tool is used for operational delimitation of species is gaining ground, as revealed by the increase in the number of papers using this approach (from 12 papers in 2010 to 44 in 2015), and the fact that more than one line of evidence has been used in 65% of the nearly 500 species delimitation studies conducted between 2006 and 2013. Schutze *et al*. (*Syst. Entomol.*, 2017, doi: 10.1111/syen.12250) in another recent paper have come up with strong arguments against this trend of claims of taxonomic authority and acceptance of taxonomic acts not subjected to peer review, and have put up a strong case for discouraging this. Taking the case of the Oriental fruit fly, *Bactrocera dorsalis* (Hendel) the reviewers suggest an integrative approach using morphological, morphometric, molecular, cytogenetic, behavioural and chemoecological evidence generated by independent researchers from different parts of the world to delineate species limits for a pest of major global economic and food security importance. This is all the more important as there is no mechanism to enforce independent review of taxonomic revisions, and the International Commission on Zoological Nomenclature is not empowered to assess taxonomic judgments (ICZN, 1999, Introduction). Though the exchange of words in some of these papers from both sides has left a bitter taste, I think controversies are critical in science as they motivate others to do even more ingenious experiments to arrive at accurate results.

'African horse sickness virus' by Carpenter *et al*. is another excellent review of the history, transmission studies and



A page from the *Madrid Codex* showing the stingless bees with their hives (17); in the public domain.

status of research of this lethal, infectious, noncontagious disease of equids (up to 80–90% fatality during outbreaks), that is transmitted by biting midges of the genus *Culicoides*. The review also brings out the knowledge gaps and charts a course for future studies on the virus. The importance of entomological studies to improve our understanding of the disease epidemiology and control is aptly brought out, especially in terms of more data to detect, predict and control the disease. Tracing the history of the virus, the authors seem to have identifiable records of the same as early as the 14th century. The primary vector, *Culicoides imicola* Kieffer, is the most important species in the field transmission of the virus and is present across most of Africa, the Middle East, southern Europe and South Asia. The development of cross-protective vaccines that can provide rapid protection and be differentiated from natural infections during outbreaks seems to be the major priority for research, though the time elapsing from incursion to vaccination is significant in determining the impact of outbreaks.

Though it is enticing to write about several more reviews featured in this volume, I would restrict myself to making a mention of a few others which caught my attention – microRNAs and the evolution of insect metamorphosis by Belles; impact of insect herbivores on plant populations by Myers and Sarfraz; the ambrosia symbiosis: from evolutionary ecology to practical management by Huler and Stelinski; ecoinformatics for agricultural entomology by Rosenheim and Gratton, and the article on Spider silk by Blamires *et al*. All of the above reviews have reflected on the recent trends in research areas that harbour great potential for multidisciplinary approaches to look at different aspects of insects and entomology in general. The volume of *ARE* has been an enlightening and informative experience for me. It would be a welcome addition to many libraries that would help students of entomology and in the bookshelves of discerning entomologists.

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