THE ADYAR BANYAN

A sense of dismay at its fall and a ray of hope at its replanting accompanied the recent events in the life of the Adyar Banyan Tree. The vast spread of this tree in the Theosophical Society campus at Madras had been accepted as a permanent feature by many who sheltered under its many-pillared canopy. The strong June winds sheared a part of the canopy and probably also the centuries-old main trunk. The ability of the remaining portions to let down new roots could in time fill the gap and, if the replanting effort succeeds, merge with the resurrected portion.

The banyan *Ficus benghalensis* L. belongs to the family Moraceae. The genus is paleotropical, with over 800 species. George King monographed the Indian representatives in 1888. Corner studied over 300 species in the living state and around 470 in herbarium collections.

Ficus benghalensis is a lowland tree extending to regions of drought and slight frost, where it becomes deciduous. It is recognized by its massive pillar roots and slightly cordate, softly hairy leaves with about 7 veins arising at the base of the lamina.

The round, sessile figs of the banyan turn red when ripe. They have a fascinating symbiotic relationship with insects, especially of the genus *Blastophaga*. The fig (syconium) is a fleshy receptacle, which by involution becomes hollow, leaving only a terminal pore covered by scales. There are numerous, tiny flowers on its inner surface. In the banyan the flowers near the pore (ostiole) are male while those away from the ostiole are female or sterile. The sterile flowers, known as gall-flowers, afford a place for the visiting insect to lay its eggs. In the egg-laying process, the pollen-dusted insect comes into contact with the stigma of a fertile female flower and pollinates it. Having completed its dual role, the insect flies away, dusted with fresh pollen from the male flowers in this receptacle.

The banyan is a symbol of hospitality—both in its many-pillared splendour and in its fruit-bearing. It is also a symbol of life. As Corner put it 'there seems to be no reason why it should die'.

Corner, E. J. H., Moraceae, in Dassanayake, *Revised Handbk. Fl. Ceylon*, 1981, p. 252.

King, G., The species of *Ficus* of the Indo-Malayan and Chinese countries, *Ann. Roy. Bot. Gard. Calcutta*, vol. I, 1888.

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BOOK REVIEWS

Annual Review of Entomology, Vol. 34, 1989, pp. 572, (Published by Annual Reviews Inc., 4139 El Camino Way, Palo Alto, CA 94303–0897, USA), Price: US$38.

Another delightful volume of the *Annual Review of Entomology* has appeared, with 24 reviews on a variety of topics, from the bionomics of specific insects or pest groups to theoretical/evolutionary aspects, and, of course, the usual dose of extraordinary accuracy of technical details.

The ecology of *Heliothis*, a notorious pest of worldwide significance, is analysed by Fitt, who considers several of its biological dimensions and in the process highlights the relevance of wild, non-crop plants that invariably act as reservoirs, particularly during crop off-seasons. Continuing the discussion on this noctuid, King and Coleman illustrate the potential for controlling this insect using biological agents—an impressive list of entomophagous arthropods and microbes. This review contains useful information on the conservation, propagation and release of these natural enemies of *Heliothis*.

Appreciating the role of CO_2 in the complex interactions between insects and plants as well as between insects and mammals in the natural environment, particularly those that enable several

invertebrates to perform 'oriented responses' to CO_2 gradients, Nicolas and Sillans provide an interesting account of the effects of naturally occurring high CO_2 on host-seeking behaviour and CO_2-mediated interaction between plants and pollinators. The CO_2-sensitive structures on the antennae of hymenopterans, on the labial palps of lepidopterans, and on the maxillary palps of dipterans necessarily indicate the evolutionary specializations of these insect groups. Critically examining caste evolution, community organization, foraging polymorphism, search pattern and territoriality, Traniello describes the foraging strategies of ants; his discussion relating to age polyethism and development of foraging behaviour will throw open newer avenues in ant behaviour research. The article on the ecology and behaviour of *Nezara viridula* by Todd discusses several details that would ultimately interest the farmer; his recommendation of the use of trap crops as a control strategy for the management of *N. viridula* appears ecologically sound.

Papaj and Prokopy highlight the evolution of 'learning' in phytophagous insects. Since the host plant is a major component of the insect's habitat, they suggest that insect behaviour can be monitored and quantified effectively by the experimental manipulation of the plant. By assessing the impact of learning, they affirm that the dynamics and coevolution of plant–herbivore systems can be established. The lock-and-key hypothesis, proposed nearly a century and a half ago, purporting to explain species-specific genetalic morphology in terms of mechanical reproductive isolation, has fared poorly in several attempts to test it, but it remains unfalsified in a definitive sense. Shapiro and Porter argue that it is unfalsifiable globally either in its unrigorous pre-darwinian form or in its darwinized form. They predict that as it is falsified for more and more specific cases, its potential domain becomes more and more restricted.

Since its coining and use from 1967, the term guild in insect ecology has gone through many newer interpretations and conceptual extensions. Through an extensive synthetic analysis, Hawkins and MacMahon clarify the status and usage of this term. The review on the structure and the function of deutocerebrum in insects by Homberg *et al.* should provide extremely interesting reading material, particularly to behavioural biologists, since it is the deutocerebrum that processes antennal sensory information initially.

Crawley's analysis of the effects of plant population dynamics *vis-à-vis* insect herbivory will set new research trends in the study of insect–plant interaction. The history of *Vedalia* beetle importation into California by Caltagirone and Doutt is interesting, especially against the backdrop of the early human perception of biocontrol in the late nineteenth century. The *Vedalia* success story should encourage strengthening the concept of biological pest control. Carpenter bees, essentially of the genus *Xylocopa*, are excellent natural pollinators of several horticultural plants. Discussing the bionomics of these bees, Gerling *et al.* offer a comprehensive overview of their seasonal activities, life cycles, nest types, nesting activities, floral associations, natural enemies, mutualism, mating behaviour, chemical communication, exocrinology, and origins and forms of sociality.

Maeda's review on the expression of foreign genes in insects using baculovirus vectors, and Meeusen and Warren's article on insect control on genetically engineered crops provide great insight into the biotechnological approach in modern entomological research. Soderlund and Bloomquist explain the neurotoxic actions of pyrethroids. They suggest that the voltage-sensitive sodium channel is the principal molecular target site for all pyrethroids, although to some extent, a voltage-sensitive calcium channel could also be involved. Entomological remote sensing using radar and special optical techniques has made major contributions to the study of insect flight, and in this context, Riley attempts to provide a detailed analysis of the processes involved, such as photography and videography from the air, multispectral scanning, radar and acoustic sounding. In the article 'Leafhopper and planthopper transmission of plant viruses', Nault and Ammar highlight the current trends in vector research involving new technologies, particularly the more sensitive serological methods and molecular probes.

The reviews on the ecology of the anthomyiid, *Delia*, in relation to vegetable crops, with adequate support information on its biological control, by Finch, the biology, host relations, and epidemiology of the scabics causer *Sarcoptes scabiei* by Arlian, the entomology of the oilseed *Brassica* by Lamb, the economics of pesticide resistance in arthropods by Knight and Norton, the bionomics of the Nabidae by Lattin, the chemical ecology and behavioural aspects of mosquito oviposition by Bentley and Day, and the enhanced biodegradation of insecticides in farm soil by Felsot provide extremely useful information.

To me, personally, reading this volume has been a good learning experience. The Editorial Committee has dedicated this volume to the Entomological Society of America which is celebrating its centennial this year. The ESA has indeed received a very rich tribute worthy of its name and traditions.

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Annual Review of Microbiology, Vol. 42, 1988, pp. 794, (Published by Annual Reviews Inc., 4139 El Camino Way, PO Box 10139, Palo Alto, California 94303, USA), Price: USA, $34; elsewhere, $38.

This volume has 29 articles beginning with an autobiographical sketch by R. G. E. Murray (University of Western Ontario, London, Ontario, Canada). There are 11 reviews on medical microbiology, 10 on microbial physiology and biochemistry, and 7 on microbial genetics and recombinant DNA technology. Most of the 29 reviews are from North American research institutions; 7 are exclusively from the UK, France or West Germany. The reviews are not only of current interest but are also exhaustive in their coverage.

Medical microbiology

D. A. J. Tyrell (Harvard Hospital, Salisbury, UK) describes clinical trials and mechanism of action of some new anti-viral compounds against the common cold virus. R. W. Emmons (California State Department of Health Services, Berkeley) reviews the ecology of the virus that causes Colorado tick fever. Shigellosis or bacillary dysentery caused by *Shigella* spp. is a result of poor sanitation in developing countries. The genetic determinants of *Shigella* pathogenicity have been outlined by A. T. Maurelli (Uniformed Services University of Health Sciences, Bethesda, USA) and P. J. Sansonetti (Institut Pasteur, Paris). Pathogenic bacteria and parasites successfully evade destruction mediated by the opsonic, chemotactic and lytic components of the complement system. K. A. Joiner (NIAID, National Institutes of Health, Bethesda), provides an overview of the subject and discusses strategies involved in the defence mechanism, citing the specific examples of *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Salmonella* spp. and other infections. *Aeromonas* and *Plesiomonas* have been recognized as pathogens of amphibians, reptiles, fish, snails, cows and humans. Sporadic gastrointestinal infections, osteomyelitis, septic arthritis, endocarditis, peritonitis, and eye and urinary infections have been attributed to *Aeromonas* spp. N. Khardori and V. Fainstein (University of Texas, Houston) describe the bacteriology and epidemiology of these unusual infections. Human skin affords a substrate congenial to the growth of bacteria and fungi which, in spite of the defense mechanisms, gain access to the body and cause infections. The ecological factors governing the colonization of these micro-organisms on skin have been elucidated by R. R. Roth and W. D. James (Walter Reed Army Medical Centre. Washington, DC). Aspergillosis, zygomycosis, candidiasis and trichosporonosis are some hospital-acquired fungal infections described in detail by T. J. Walsh and P. A. Pizzo (National Cancer Institute, Bethesda). The classification, isolation and properties of the simian immunodeficiency viruses have been described by R. C. Desrosiers (Harvard Medical School, Southborough, Massachusetts, USA). An understanding of the simian viruses may provide insight into the origin of viruses that cause AIDS in humans. *Actinobacillus*, *Bacteroides*, *Capnocytophaga*, *Fusobacterium*, *Rothia*, *Streptococcus* and *Veillonella* are genera of oral bacteria, which coaggregate and form the primary constituent of dental plaque. The ecological aspects of these bacteria have been studied and presented by P. E. Kolenbrander (National Institute of Dental Research, Bethesda). The prospects for vaccine development against filariasis caused by *Wuchereria*, *Brugia* and *Onchocerca* form the subject matter of an article by M. Philipp, T. B. Davis, N. Storey and C. K. S. Carlow (New England Biolabs Inc., Beverly, Massachusetts, USA). The Institut Pasteur in Paris is well known for research on medical problems. In a review of the contributions of this Institute M. Girard of the Institute relates the research into and development of viral vaccines for rabies, yellow fever, poliomyelitis, influenza and hepatitis B.

Physiology and biochemistry of micro-organisms

Bacillus subtilis is the most studied organism among the bacilli; the genetic systems involved in carbohydrate metabolism in *Bacillus* have been

reviewed by A. F. Klier and G. Rapoport (Institut Pasteur, Paris). Bacteria offer simple biological systems for studying protein phosphorylation. The review by A. J. Cozzone (Université de Lyon, Villeurbanne, France) summarizes the biological role of bacteria in phosphorylation. Bioluminescent bacteria are classified into the genera *Vibrio*, *Photobacterium*, *Alteromonas* and *Xenorhabdus*. These bacteria emit blue-green light produced by a reaction catalysed by the enzyme luciferase. The bioluminescence operons of a number of marine bacteria have been cloned and the genes identified. An in-depth review of this aspect has been provided by E. A. Meighen (McGill University, Montreal, Canada). Species of the bacterial genera *Alcaligenes*, *Achromobacter*, *Pseudomonas* and *Rhodobacter* grow anaerobically and reduce ionic nitrogenous oxides to gaseous products. The review by L. I. Hochstein (Ames Research Centre, Moffett Field, California, USA) and G. A. Tomlinson (Santa Clara University, Santa Clara, California, USA) deals with the enzymes concerned with denitrification. The write-up by W. Reineke (Bergische University, Wuppertal, FRG) and H. -J. Knackmuss (Stuttgart University, Stuttgart, FRG) deals with the pathways for degradation of polychlorinated biphenyls (PCBs) and chlorinated benzenes, which reach the environment as pollutants. Progress in the area of anaerobic degradation of aromatic acids, phenols and hydrocarbons has been reviewed by W. C. Evans (University College of North Wales, Gwynedd, UK) and G. Fuchs (Ulm University, Ulm, FRG). During the first 20–40 min of the germination of spores of *Bacillus* spp., up to 40% of the total dormant spore protein gets degraded to free amino acids. The review by P. Setlow (University of Connecticut Health Centre, Farmington, USA) concentrates on this aspect and outlines some unanswered questions and future directions for research. The special sieving properties of the outer membrane of Gram-negative bacteria are due to the presence of a few major proteins known as porins. The structure and function of porins are the mainstay of an article by R. Benz (Wurzburg University, Wurzburg, FRG). Several protozoa lack mitochondria, and the peculiar metabolic properties of these organisms have been reviewed by M. Muller (Rockefeller University, New York). The precise factors that determine the site of virus assembly at cellular membranes are not well understood, and the review by E. B. Stephens (University of Florida, Gainesville, USA) and R. W. Compans (University of Alabama, Birmingham, USA) deals with the several unanswered questions about the mechanisms.

Microbial genetics and recombinant DNA technology

Baculoviruses—over 400 of them—have been isolated from invertebrates, and of these only 20 have been studied at the molecular level. A review by L. K. Miller (University of Georgia, Athens, USA) deals with recombinant virus production and protein synthesis using recombinant viruses. Kinetoplast DNA is the mitochondrial DNA of parasitic protozoa. The replication mechanism of this DNA in trypanosomes has been discussed by K. A. Ryan and associates (Johns Hopkins University School of Medicine, Baltimore). The current understanding of the genetics and biochemistry of *Streptomyces fradiae* and tylosin synthesis has been summarized by R. H. Baltz and E. T. Seno (Eli Lilly and Co., Indianapolis, USA). A detailed picture of the evolution of RNA viruses has been provided by J. H. Strauss and E. G. Strauss (California Institute of Technology, Pasadena). Resistance to arsenic and antimony is governed by plasmids, which also code for resistance to other heavy metals. Such plasmid-mediated resistance to heavy metals in bacteria has been reviewed by S. Silver and T. K. Misra (University of Illinois College of Medicine, Chicago). Certain basic information about the control of genetic transfer between *Agrobacterium tumefaciens* and the host plant serves as the basis of a review by A. N. Binns (Pennsylvania University, Philadelphia) and M. F. Thomashow (Michigan State University, East Lansing, USA). The genetic factors that enable a micro-organism to become a symbiont or a parasite in plants seems to be the basic theme of a discussion provided by N. T. Keen (University of California, Riverside) and B. Staskawicz (University of California, Berkeley). They cite the example of *Rhizobium* (a symbiont) and *Agrobacterium* (a parasite), which belong to the same family but interact in very different ways with plants.

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