Advances in insect behaviour

Foreword

Behavioural studies form an integral part of the biology of insects and one of the major aspects involved in the concept of integrated control of insects is behavioural approach. Neural integration, forming as it does an important parameter, naturally involves the role of chemosensory and other structures which are known to adequately respond to a variety of chemical substances, whether attractants or repellants. It is in this light that diverse approaches are being made to study various components of insect behaviour with reference to phytophagous or haematophagous insects, not to mention of predators or parasites. The growing tendency for an indiscriminate use of several categories of insecticides has so visibly affected the behaviour of many insects, that a proper understanding of behavioural studies becomes imperative. The recognition of the significance of biological rhythms in the behavioural activities of several insects, as well as an understanding of energetics involved in such activities have opened up new avenues of research. Social insects also offer many clues to an understanding of the complexities of the behavioural repertoire, and further studies in this area have gone a long way in enabling us to understand the true significance of the genetics and evolution of social behaviour. Papers presented in this volume relate to behavioural rhythms in insects, bioenergetics and behavioural mechanisms in insects, hormones in insect behaviour, insects and behaviour-modifying chemicals, insect toxicology and behaviour, analysis of behavioural trends in social insects, host-switching mechanisms and searching behaviour and behavioural analysis of feeding and breeding in insects.

Communication signals play a salient role in the social interactions of various animal groups. Despite the prevalence of diverse signals such as visual, acoustic, tactile and olfactory among higher animals, olfactory cues have certain specific advantages over other modes of communication. During the recent past considerable attention has been focussed on chemical signals in animals especially in economically important insects. Sex pheromones, aphrodisiacs, trail markers, aggregating and alerting pheromones have been isolated in different insects and diverse factors regulating sex pheromone behaviour have been discussed.

Hormones may directly control the behaviour of insects, or they may modulate the nervous system in integrating the behavioural repertoire. In neurally-modulated hormonal control of behaviour, hormones may either switch-on new neural patterns of behavioural activity, or by evoking neurophysiological activity, or hormones may increase or decrease the threshold of stimuli modifying the behavioural pattern of the animal. Pheromones are of utmost importance in the hormone-behaviour interaction in insects. Hormones also affect adult behaviour, including male sexual behaviour, receptivity as well as oviposition behaviour. Insect migration and orientation as also related behavioural patterns in insects like locusts, is controlled by hormones.

Different types of behavioural, developmental and physiological rhythms have been identified in many species of insects. Daily cycles of activity in endocrine and nervous systems of insects have attracted attention because of the probable importance of these systems, in the control of overt rhythms of physiology and behaviour. Many developmental events in insects have long been known to occur in a specific part of the day to manifest a population rhythm. Although some information is available regarding endocrine rhythms in varied groups of insects, studies on different physiological and metabolic rhythms in relation to the hormonal activity pattern in insects remain scanty and available information in this regard is presented. Biological clocks in relation to the eclosion rhythms of *Drosophila*, the problem of on-and-off rhythms and their simulations by appropriate high/low or low/high intensity transfers are also discussed.

Food acquisition behaviour in insects includes such energy requiring activity components as location, gathering and processing. In most insects oviposition is preceded by a precise estimation of the presence of minimum food supply for successful completion of developmental stages and emergence. Discussion is presented on the energy-requiring behavioural activities associated with courtship, mating and oviposition in some insects. Like the phytophagous insects, haematophagous species are also known to possess chemoreceptors that can detect host specific factors (odours) and non-specific or group factors. Closely associated with this behavioural aspect is the capacity of the haematophagous arthropod to 'taste' the blood meal, where contact chemoreceptors come into play and these aspects have been discussed in detail. The feeding behaviour and the patterns of host selection in phytophagous insects are conditioned not only by their ecological requirements but also the general behaviour of the insects concerned. Though they are generally polyphagous, they are not indiscriminate feeders and the food plant range is often correlated with their behaviour which is conditioned by their sensory perception.

Social insects often behave in ways that appear to lower their genetic fitness while increasing the fitness of other conspecifics. The most extreme examples of such altruistic behaviour is provided by the sterile workers of social insects, and the evolution by natural selection of social or altruistic behaviour has long been recognised as a problem and an incisive discussion is provided on the evolution of social behaviour. Lamellicorn beetles in particular, the passalids and scarabaeids are also known to exhibit social behaviour, sound production by stridulation in both the larvae and adult passalids being attributed to social behaviour permitting gregariousness. Interesting aspects relating to the whole sequence of bisexual co-operation in the nesting behaviour of scarabaeids are also discussed.

As conventional methods of control developed for agricultural pests are often not suitable for forest pests because of the large area covered by the crops, recent investigations have shown the potentiality of using behavioural studies to greater advantage in the management of forest insect pests. Information provided on the teak defoliator, particularly on moth immigration, a common occurrence in tropical forests, other behavioural characteristics such as crowding of caterpillars on tree trunks and aggregation, appear to be useful in the development of suitable management strategies.

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Behaviour', held at the Entomology Research Institute, Loyola College, Madras from December 14–16, 1984. I wish to express my deep sense of gratitude to the Department of Science and Technology for sponsoring this Workshop. It is hoped that this publication comprising as it does diverse aspects of insect behaviour would stimulate further interest in this upcoming, inter-disciplinary field, of considerable significance in applied entomological studies.

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