understood on the basis of theory presented. Finally, a detailed summary, conclusions and outlook for future are presented in Section 18. In addition, this section includes reference to studies on superlattices by Raman scattering, ion implantation and ion mixing, radiation damage in presence of weak magnetic fields, implantation damage in hi-T_c superconductors, etc.

The publishers could have paid attention to details in the process of publication of the book. It appears as if the book is printed by offset printing directly from the author's manuscript. In these days of advanced desktop publication, the format and printing could have been better. Sectional headings should have been prominent. The contents page should have referred to page numbers corresponding to different sections. An index of important keywords would have been useful. A preface by the author would have put the technical contents within the framework of historical developments of the subject, which dates back to almost a century, as stated later in the book. Repeated references to SLEF phenomenon in detail at a number of places could have been avoided. These lacunae can be taken care of in future editions.

As Khait has rightly emphasized, atomic diffusion has assumed increased importance especially in miniaturized devices and in nanosized materials. The material stability, quality of nanostructures and kinetics of many a chemical reaction in solids are affected by atomic diffusion.

To sum up, the book is an important review contribution covering theoretical, computational and experimental literature dealing with a subtle but ubiquitous phenomenon in solids. Textbooks in solid state physics should include references to this important phenomenon that affects many a solid state property. The book is recommended to libraries as an important addition to collections on physics of solid state.

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Phytochemical Biopesticides. Opender Koul and G. S. Dhaliwal (eds). Harwood Academic Publishers, 6th Floor, Amsteldijk 166, 1079 LH Amsterdam, The Netherlands. 2001. 223 pp. Price: $ 90.00/£ 59.00.

Practitioners of conventional agriculture consider synthetic pesticides as a cure-all[1]. To them, the fleeting magic those pesticides work is obscure. Especially in the last five decades, the effects of synthetic pesticides have been spilling far beyond their desired limits – mainly because of injudicious use – and has consequently been affecting the health of humans and the environment. Injudicious use of synthetic pesticides has also resulted in several other complications in arthropod-pest management. One example for such a complication is the development of resistance in insects to those chemicals[2]. A journey back to 1963 will remind us the prophetic words of Rachel Carson[3]: '. . . in less than two decades of their use, the synthetic pesticides have been so thoroughly distributed . . . that they occur virtually everywhere . . . are now stored in the bodies of the vast majority of human beings, regardless of age. They occur in the mother's milk and probably in the tissues of the unborn child.' Our awareness of the undesirable effects arising out of indiscriminate use of synthetic insecticides, at least in the last two decades, has, fortunately, enhanced[4]. Consequently, we are now exploring the secondary chemical compounds that occur naturally in plants, which have the potential for application in environment-friendly management of arthropod-pests, either as natural insecticides or as feeding deterrents/repellents or growth inhibitors/regulators. Vascular plants spend more energy in the production of secondary metabolic compounds than what they spend for the production of primary metabolites; yet, they synthesize and store them as 'innocuous' compounds. When arthropods inflict wounds (e.g. during feeding), plants liberate the stored compounds through either enzymatic action or oxidation and concentrate them at the sites of damage, firstly, to counter herbivory and secondly, to optimize their own survival rates[5]. Today, we know of the structure and function of nearly 100,000 secondary plant compounds (nitrogen-containing compounds: alkaloids, cyanogenic glycosides and glucosinolates; terpenoids: monoterpenes, diterpenes, sesquiterpenes, saponins, limonoids, cucurbitacins, cardenolides and carotenoids; phenolics: simple phenols, flavonoids and quinones; polyacetylenes) from a staggering range of plants[6]. Given that we are looking for slow-acting and quickly degradable natural compounds which have low toxicity, we need to know these compounds better, so that we can use them efficiently as an environment-friendly tool in pest management. In such a context, the book under review is most welcome. It comprehensively synthesizes all the latest information, offers logical conclusions and identifies appropriate research directions for the future. Secondly, volumes discussing the potency and mode of action of natural products in the context of arthropod-pest management are relatively few.

Extensive knowledge of the chemical ecology of phytophagous arthropods has enabled us to understand the biochemical processes that mediate interactions between arthropods and their host plants, especially those that regulate insect feeding and reproduction as well as host-plant susceptibility and rejection, including defence reactions. Koul and Dhaliwal identify the following as the key objectives of this volume: (i) to present the advances made on phytochemical biopesticides, including behavioural, chemical, biochemical and molecular aspects and (ii) to address the role of phytochemical biopesticides in integrated pest management (IPM), concurrently discussing the problems and prospects of biopesticides for commercial exploitation. They have attempted to realize these objectives with nine chapters written by M. B. Isman and M. J. Smirle from Canada, T. N. Ananthakrishnan, R. Arora, G. S. Dhaliwal, O. Koul, B. S. Parmar and S. Walia from India and J. H. Kim, C. A. Mullin, B. Oppert and S. J. Yu from USA. We could broadly the divide the contents of the book into two sections: (1) bioactive compounds, the biochemical principles that enable them to perform as efficient 'pesticides' and the molecular physiology of receptors; and (2) application of the knowledge provided in (1) in the context of arthropod management practice.

The introductory chapter 'Biopesticides based on phytochemicals' by Isman offers brief insights to information on the

active principles from Annonaceae, Ginkgoaceae, Meliaceae, Piperaceae and on a few essential oils (e.g. eugenol and citronellal) that hold a strong potential in crop protection. In the chapter 'Phytochemcials and insect cell culture bioassays', Koul explores the importance of insect cell lines raised on synthetic nutrient media not only in the production of recombinant proteins and biopesticides through the application of baculovirus vector system, but also for cellular bioassays with established insect cell lines. This chapter effectively brings out various procedures for establishing insect cell lines and some of the standard bioassays. Yu, in the next chapter 'Role of microsomal monooxygenases in phytochemical/insect interactions', explains the key role played by microsomal monooxigenases (also known as mixed-function oxidases or MFOs and poly-substrate monooxygenases or PSMOs) in the detoxification pathway of a lipophilic xenobiotic that enters an arthropod. Information on the metabolism by microsomal monooxigenases, induction and inhibition of microsomal monooxigenases by phytochemicals forms the essential steps for achieving clarity of the basic principles to develop novel and better designs of arthropod-management strategies. Following this chapter, Mullin and Kim discuss methods of exploring the chemosensory physiology of arthropods towards the development of biopesticides in their chapter 'Phytochemical action at amino acid chemosensory reception: An approach to biopesticides'. They articulate reasons to justify how amino acids act as feeding cues for the chewing insects in particular. The entire chapter is delightful, as it explains every minute biochemical action that occurs between the insect and the host plant. Understanding of such mediating action has long-range implications in insect management through transgenic approaches, that would chemically-disable the sensory neurons from sending sensory codes evoking insect ingestion. Ananthakrishnan in the next chapter 'Phytochemicals as insect-behaviour modifiers' articulates how the naturally-existing secondary plant metabolites modify insect behaviour and how this capability of phytochemicals can be profitably extended into pest management.

The chapter 'Transgenic plants expressing enzyme inhibitors and the prospects for biopesticide development' by Oppert discusses the role of enzyme inhibitors (e.g. inhibitors for serine proteinase, cysteine proteinase, α-amylase) produced by plants to counter the herbivorous insects as well as the possibility of manipulating the genes encoding those enzyme inhibitors for pest control. The two sub-sections 'Enzyme inhibitors and *Bacillus thuringiensis* proteins' and 'Insect adaptation to inhibitor-expressing transgenic plants' provide novel insights. Oppert's concluding statement, '. . . success of enzyme-inhibitor transgenic technology relies on the better understanding of insect digestive physiology', is a slap on the face. In our frenzied and material-driven searches for instantaneous 'results', are we deliberately ignoring the importance of basic studies? In the following chapter, 'Role of phytochemicals in integrated pest management', Dhaliwal and Arora review the composition and action of some of the commonly-used compounds such as pyrethrum, nicotine, rotenone and insect-behaviour modifying chemicals such as azadirachtin in agricultural and horticultural plants, forest trees, stored products and humans and livestock. A brief section on some of the hormonal mimics and antagonists also exists in this chapter. Smirle, in the next chapter 'Potential uses of phytochemical pesticides in deciduous temperate fruit crops', in a tone similar to the preceding chapter, identifies the desired and environment-safe characteristics in biopesticides for use in fruit crop pest management. Because any effort to manage the pests of perennial and deciduous fruit trees will be considerably different from the management of annual row crops, this chapter gains in relevance. The concluding chapter 'Prospects and problems of phytochemical biopesticides' by Parmar and Walia includes details of nearly 270 plant-based insecticidal compounds, in addition to explaining the mechanisms that stabilize them. This chapter discusses the problems that affect commercialization of botanicals and lists the prospects that lie ahead. Much of these ideas is pertinent and needs to be considered seriously by young researchers who will be keen to adopt environment-friendly and multi-disciplinary approaches in arthropod management. This chapter also brings out, of course quite subtly, how modern scientific research is no longer a pure science domain and how other disciplines such as economics, politics and international relations can and do influence scientific research. Commentaries on the implication of extraction, trialling and application of natural products on wide-ranging policy issues and intellectual property rights make this chapter worthwhile.

Overall, *Phytochemical Biopesticides* has come out as an impressive product of Indo-North American cooperation and offers a wealth of information by characterizing explicitly the role and scope of botanicals in arthropod pest management. We felt that the two key objectives with which Koul and Dhaliwal started the project have been more-than-adequately realized. They have mustered the best brains in the field to achieve the best outcomes. We could easily perceive an ecological thread running firmly throughout the book and that is a major strength. Although the book deals with the topic in a global context, six of the chapter authors are from India. This is another strength, because many Indian examples are available and this, we are sure, will help – and even provoke – scientists from other developing nations to act vigorously in this research direction.

We want to compliment Koul and Dhaliwal for organizing the chapters in a way that each blends with the other well in contents and continuity. Isman in his introductory chapter and Parmar and Walia in their concluding chapter set the book's perspectives admirably. Every chapter includes at least one clear and critical message, a conclusion that effectively captures the futuristic context of biopesticides research and an impressive list of recent literature (1980–2000). We are confident that these strengths, further to the brilliant commentaries and summaries provided as chapters, will encourage and enable any beginner interested in the field of application of natural products in arthropod management to start with relative ease. However, we wondered if repetition of the structural formulae and capabilities of diverse phytochemicals could have been avoided in chapters 7, 8 and to some extent in 9, because Isman had already referred to them in the first chapter. A detailed subject index adds to the utility of the book. Throughout the book, the language used is simple and reader-friendly. Nonetheless, we are unable to hold ourselves back from making

the following observation: the word *et cetera* (etc.) appears at several places and that was distracting. It would be good if words like 'very', 'etc.' could be eliminated in professional writing, since such words mean nothing. Production quality is excellent and the logical reaction to such an observation in any reader will be, 'How much does the book cost?'. We do not know, but we do wish that the price of the book will be within the purchasing capacity of scientists and students from developing nations.

We are convinced that our critique weighs greatly in favour of strengths. Master's and doctoral students and professionals researching aspects of chemical ecology, insect–plant interactions, phytochemistry, insect physiology including behaviour, insect toxicology and agricultural managers employing IPM strategies will find this book extremely useful.

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PERSONAL NEWS

Fred Hoyle: Scientist of multifaceted talents

Sir Fred Hoyle, the most original and versatile astrophysicist of our times passed away on 20 August 2001. He is survived by his wife Lady Barbara Hoyle, son Geoffrey and daughter Elizabeth. I had the privilege of being his student and later a coworker. The following impressions do only partial justice to a multifaceted personality.

I recall an event in 1964–1965. A play was staged in the newly built Mermaid Theatre in London, on the south bank of the river Thames. London is well-known for plays, both established ones as well as new experimental plays. In Shakespeare's times, there had been a theatre of the same name on the south bank of the river. The new Mermaid Theatre had been rebuilt on the same site. That evening, the theatre was full to capacity, but not for a Shakespearean play.

And, there was another difference. The average age of the majority of the audience was 8–14 years. Because, the play was based on science fiction and was written specially for children. To suit them, these shows had been arranged during the Easter vacation. The unusual thing was that it was not written by a professional playwright from the literary world, but by a scientist, famous for his research in astronomy. The name of the play was 'Rockets in Ursa Major', and the author was Fred Hoyle.

In the early part of the twentieth century, the distinguished scientist James Jeans from Cambridge contributed

significantly towards making astronomy popular amongst common people. The lecture halls used to be 'packed' during his lectures and his books were internationally read and acclaimed. Hoyle, also from Cambridge, was a worthy successor of Jeans.

Fred Hoyle was born on 24 June 1915, in a little village called Bingley in Yorkshire. (Fred is not a shortened version of Frederick; in Yorkshire it is a complete name by itself.) Fred's father used to trade in cloth materials and his mother was an expert in music, especially in playing the piano. Fred developed interest in the piano as well as in mathematics, when he was small. His power of analytical reasoning was demonstrated at the age of three, when he had worked out the way to read the clock and tell the time, all by himself.

At a young age, Fred developed interest in astronomy. The Hoyles, father and son, would walk eight miles to the house of a friend who had a telescope, and would return early in the morning after a night of sky-watching. Astronomy encouraged his inquisitive and highly original mind. He also was something of a rebel and would not accept the conventional wisdom, unless his mind was satisfied as to its correctness.

In his first primary school, a teacher once taught in the class that a certain type of flower has five petals. The next day, Fred produced a flower of the same kind with six petals and asked the teacher to justify her statement. The teacher,