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BOOK REVIEWS

The last extinction by Les Kaufman and Kenneth Mallory. The MIT Press, 28, Carleton Street, Cambridge, Massachusetts, 02142, USA, 1986, pp. 208, $ 16.95. Indian orders to Affiliated East-West Press Pvt. Ltd, 6, Roselyn Gardens Apartments, 20/1A, Barnaby Road, Madras 600 010.

In the present day world of senseless over exploitation, extinction has become a permanent and perennial cause for concern. This book is largely addressed to an American audience, but has worldwide relevance as the effects of environmental destruction is one field where efffects are global. The book is a development from a series of public lectures titled "Extinction: Saving the sinking ark" held in Boston, Massachusetts, USA in 1984. Each of the six chapters considers a theme. In the first chapter Les Kaufman examines the reasons for "why the ark is sinking?". How man, the most adaptable of creatures, through his demands on the living resources eliminates species less endowed with the capacity to adapt to a changing world. The consequences of such mass extinction on the human psyche, the fragmentation of genetic resources into small unviable biological islands, the despoilation of the natural resources of the third world by the western nations through economic assistance — in the process taking most of the riches themselves and the problem and remedies to keep the ark floating are discussed in detail. Human ecology is itself in a flux. We seem to be progressing towards a radical shift in human ecology and behaviour where the individual is suppressed in favour of the mass.

The second chapter by David Jablonski examines the theories for mass extinction. Over the last 600 million years of earth history periodic mass extinction when over 90 per cent of living species are lost has been the fact of life. Several hypotheses such as the Alvarez hypothesis of impact by extraterrestrial object are discussed and mass extinction over the earth's long history are compared. The effect on evolution which is not a steady improvement in life but is crisis sustained; mass extinctions providing the impetus for those that survived to take over the vacated niches. The rate at which extinction is happening today outpacing the evolution of new species assures that man is in the process of causing singlehandedly the worst mass extinction in 65 million years!

The chapter on "The Amazon: Paradise lost?" by Ghillean T. Prance is a case history study. The world's largest tropical rain forest, the Amazon basin with its 1.235 billion acres of land, if separated as a nation, would be the ninth largest nation in the world. The Amazon incidentally drains into the sea, one-fifth of all the fresh water in the world. The heedless destruction of this natural treasure house is described from the point of view of the many facets of the Amazonian ecosystem, perhaps the most species-rich area in the world. The advantages of studying this natural laboratory are illustrated. As an example

one could consider the selective powers of the leaf cutter ants, if a choice of leaves is given, those rejected have been found to contain natural fungicides, which the delicate chemical receptors of the ants can detect — the best way of finding new fungicides is to observe the leaf cutter ant! Development without understanding basic principles underlying the organisation of the ecosystem has been one of the basic causes for failure. Large browsers have not evolved in Amazonia, yet cattle ranching on a large scale has been attempted.

In the chapter on "Vanishing species in our own backyard", James D. Williams and Ronald M. Nowak examine the causes of extinction of species in historic times in the United States and Canada, the direct and indirect causes, habitat disruption and the other facts which have caused the extinction of 105 species and sub-species in USA, Canada and US territories from the time of the appearance of Western Man in the region.

The chapter "Riders of the last ark: The role of captive breeding in conservation strategies" by Thomas J. Foose is of particular interest in the Indian context, caught as we are in a horrifying explosion of human population which is not expected to stabilize within the next 200 years. How many species will survive the human cataclysm depends on how imaginative is the captive breeding programmes to maintain a minimum viable population. The technology available and required are discussed, particularly the genetic factor which is indeed the key factor.

The final chapter, "Life in the next millennium: Who will be left in the Earth's community?" by David Ehrenfeld, shows that the next millennium is so intricately woven into man's lasting effect on the natural world that one has to look back to predict the future. Consider the Aral Sea, a huge fresh water body in Central Asia which had an average depth of 50 ft in 1965, the rivers that fed it have been diverted for agriculture and the lake is shrinking to such an extent that by the year 2000 it is feared that the Aral Sea will be replaced by a salt marsh. The age of exploitation has to give way to an age where "wilderness and wise use have a place in a conserved world".

A thought-provoking book which reviews the state-of-the-art as it exists today.

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The biology of human ageing edited by A. H. Bittles and K. J. Collins. Cambridge University Press, Cambridge, CB2 2RU, UK, 1986, pp. 280, £ 19.50. Indian orders to: Affiliated East-West Press Pvt. Ltd, 6, Roselyn Gardens Apartments, 20/1A, Barnaby Road, Madras 600 010.

This is a compilation of the papers presented at a two-day symposium held in April 1984 in Chelsea College, University of London, and organised on behalf of the Society for the Study of Human Biology and the British Society for Research on Ageing. The book encompasses a broad range of topics, from theories of ageing to demography and clinical

aspects of an ageing population. There are several books dealing exclusively with biological or clinical or social aspects of ageing covering both breadth and depth of each area. Therefore, the value of putting together such disparate papers may be little. Inevitably, there is no thread running through the papers.

The first paper by T. B. L. Kirkwood and R. Holliday discusses about a new theory of ageing: "Disposable soma theory" that is based on the premise that investment of resources for maintenance and repair of somatic cells is always less than the amount needed for indefinite survival of these cells, and that resources are made available only until reproduction is carried out. If optimal resources could be channelised for somatic maintenance and repair, the organism would live for ever, but it is not done so in the wild where the organisms die at random and the chances of survival for ever is negligible. The flaw in this thinking is why the domesticated animals living for generations in an environment well protected from the hazards of the wild and well nourished, also have limited life span.

The second paper by S. P. Modak *et al* discusses that the chromatin becomes more compact in the old as seen by its digestion by micrococcal nuclease (MNase). This had already been shown to be so after digestion of chromatin by DNase I (*Biochem. Int.*, 1983, **6**, 357) that cuts the DNA at 10 bp intervals and is more sensitive than MNase which on the other hand cuts the DNA at 200 bp intervals. No reference has been made to this earlier paper. The finding that 5 mC content decreases with increasing age is intriguing. How well the antibody can see this modified base in the whole complex chromatin is not clear. At least it does not appear to be so from the work on nick-translation following digestion by Msp I and Hpa II from which a general increase in methylated CCGG sequences can be inferred (*Biochem. Biophys. Res. Commun.*, 1985, **127**, 604).

M. J. Lamb has used *Drosophila* as a model for ageing and takes advantage of an interesting genetic phenomenon that recombinatorial repair does not take place in the males of this insect. If increasing damages to DNA with age leads to a decreasing in the efficiency of animals, then flies in which some of the chromosomes have always been passed through the males might be expected to have shorter life span. Preliminary experiments show that courtship success of such males is less than the control of comparable age. It appears that the repair of damage of DNA that takes place during recombination in meiotic prophase may have rejuvenatory effect and prolong the life span.

The paper of A. H. Bittles and Y. Sambuy deals with the problem of ageing at a cellular level using fibroblast cells in culture. Though the study of cells *in vitro* does give some useful information, there can be only limited extrapolation of such information to *in vivo* ageing as the cells *in vivo* are constantly exposed to various factors released from different organs and cells, and circulating in the blood. Such a physiological state does not obtain *in vitro*. The shift towards glycolysis in the cells with age that the authors show may only be due to some more basic changes that precede it.

The papers that follow deal with ageing at tissue and organ levels, and naturally do not focus on the basic mechanism of ageing, but they do succeed in projecting specific aspects of human ageing. The topics are "Estimation of biological maturity in the older child" by Preece and Cox, "Biological age assessment in adulthood" by Borkan, "Skeletal age and palaeodemography" by Molleson, "Cell death and loss of structural units of organs" by Bellamy, "Mortality decline and consequent changes in age structure of the population" by Benjamin, "Evaluation of American population projections" by MacDonald, "Age structure of Soviet population in the Caucasus: facts and myths" by Medvedev who questions the validity of the census data and the number of centenarians in the Soviet and "Health of an ageing population" by Grimley Evans who deals with geriatric problems and focusses on age-related derangements such as fracture, stroke, dementia, eye sight and hearing difficulties.

Bailey's paper "Can we tell our age from our biochemistry" is an attempt to monitor the changes in certain components in the serum such as cholesterol and alkaline phosphatase that show linear increase with age and from which it is suggested that one can deduce the approximate age of person. However, such a study requires a very large population to take care of the immense variability of these parameters as shown by Nathan Shock in his longitudinal studies on American males. Also, nutrition influences these factors so much that what is apparently applicable to one country may not be so far another. So is the case for the paper by J. M. Patrick on "Customary physical activity of the elderly".

The paper by B. J. Merry on "Dietary manipulation of ageing—an animal model" (this begins on p. 223, not 233 as shown in Contents) is an extension of the well-known work of McCay. Reproduction, the only well-known parameter to assess ageing as it has more or less well-defined timing, is extended for longer periods if female rats are kept on restricted diet. The last paper "Effects of ageing on homeostasis" by Collins and Exton-Smith deals with thermal homeostasis at physiological level that requires several factors to maintain the body temperature in humans.

On the whole, the organisers have tried to present a variety of papers covering a broad spectrum of the field of ageing. For a general audience, the presentations may be somewhat useful. However, the first three papers appear out of place for an audience of clinicians, and for the biologists looking for basic knowledge on ageing, the book offers very little. Hence the utility of the book is little. The Editors should be congratulated for an error-free production.

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Energy transducing ATPases — Structure and kinetics by Yuji Tonomura. Cambridge University Press, 1986, pp. 296, £ 40. Indian orders to: Affiliated East-West Press Pvt. Ltd, 6, Roselyn Gardens Apartments, 20/1A, Barnaby Road, Madras 600 010.

It is nearly 50 years since ATP is recognized to play the central role in energy transduction in living cells. It is formed by a dehydration process between ADP and Pi with the energy supplied through basically an oxidative reaction. The reverse process of release and/or transfer of the terminal phosphate of ATP will provide energy for innumerable energy dependent reactions in cells. Simply stated these are represented thus: ATP → ADP + Pi. To understand the mechanisms underlying the processes represented by this simple equation has, however, proved to be one of the fascinating and elusive studies.

The book written by Tonomura is a cogent summary of the present knowledge on the subject. His research contributions have covered the breadth of this field and his discovery of enzyme-phosphate-ADP complex as an intermediate in the ATPase reaction catalyzed by myosin had influenced the thinking on the mechanism of the reaction. It is interesting to note that Tonomura was invited to write a book for the Cambridge University Press and he asked his young colleagues to write a chapter each in Japanese. He spent long time editing these to make them "readable and accessible" and brief. Before completing the task, Tonomura died of heart attack in 1982. It is a tribute to this man as a scientist and teacher that his students and Prof. Ebashi of the National Institute of Physiological Sciences, Okazaki completed the book and published it in 1986 with his sole authorship.

The book consists of 296 papers and is divided into nine chapters each with emphasis on one aspect. The crisp prologue at the beginning and epilogues at the end together provide excellent summary of the state-of-the-art. Three chapters are devoted to myosin and actomyosin ATPase, reflecting his own personal interests. One chapter each on dynein ATPase, F, — ATPase, sarcoplasmic ATPase and Na^+, K^+–ATPase covered the rest of the subject. Each chapter contains some figures, especially electron micrographs, illustrations and tables of data. It would have been very useful if comparative properties and features of these ATPases are codified into a table in the epilogue. Each chapter is provided with relevant references, in alphabetical order of authors, along with the titles of the articles. In an overall good quality printing the reviewer found a minor error on page 167. The Table under figure 6.12 (b), which is reduced to a size that makes it difficult to read, the explanations for steps 7 and 8 in the figure are reversed.

The reader of the book will get a perspective of the developments on ATP hydrolyzing systems and the basis of structure and function relationship of these energy-transducing systems. These are essentially three types: Contractile ATPase, Transport ATPase and H^+–ATPases. Two types of contractile systems are now identified for motility in organisms and cells — the myosin-action and dynein-tubulin systems. The coupling between energy and mechanical work occurs through a linear process of sliding filaments. The proteins, myosin (480 KD) and dynein (1300 KD), form complexes of the

type E-P-ADP as 'a key reaction intermediate during the reaction cycle', composed of: 1. Formation of cross-bridges between myosin heads and actin filaments; 2. Sliding of actin filaments by a rotational movement of the cross-bridge coupled to ATP hydrolysis, and 3. Dissociation of the components. In dynein, sliding of the microtubule doublet past each other generates mechanical work. In all the cases calcium directly activates ATPase and regulates mechanical actions of muscle or celia/flagella. This subject has been covered extensively in five chapters.

Transport across membranes is invariably coupled to an ion-linked ATPase giving the energy. Two well-known systems – Na^+, K^+–ATPase of plasma membrane and Ca^{2+}, Mg^{2+}–ATPase sarcoplasmic reticulum – are discussed in two chapters with parallelisms brought out. These transport ATPases are similar in having a single polypeptide (100 KD) and require lipids for activity. The associated activity of hydrolysis of ATP is obtained through an E-P intermediate as an aspartyl phosphate. The changes in conformation between two forms alter the cation-binding affinities. The cation pumps act in the reverse and synthesize ATP.

The proton pump is the most primitive in evolution and is the most important in bioenergetics. Its identification has revolutionized the thinking in the energy-transduction process. The F_1–ATPase (about 320 KD) of bacterial and mitochondrial membranes bear relationship to contractile ATPase in the formation of E-P-ADP intermediate. When an F_1–ATPase is associated with F_0 and is part of a complex in the lipid membrane it gains the capacity tor proton transport and for the synthesis of ATP. A number of microorganisms have now been found to have such ATPases (about 100 KD), inhibited by Dio9, NaF and vanadate, and forming an intermediate of the type EP, having a phosphorylated aspartate.

This book provides a ready reference to the current knowledge on ATPases, the core of chemical energy-transducing systems in living cells. Although the definition at molecular level is now available, it is still not clear how the energy transfer occurs through these protein systems. Tonomura's book is a useful work to be possessed, read and used by scientists working in the field of bioenergetics.

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The role of calcium in drug action edited by M. A. Denborough. Pergamon Press, Oxford, UK, 1987, pp. 183, $ 75.

This volume is 124th in the series on International Encyclopedia of Pharmacology and Therapeutics and is supplement No. 24 to the review journal, Pharmacology and Therapeutics. The theme has been excellently summarized by the editor in the first sentence in the preface reproduced here. "The free cytosolic Ca^{2+} ion concentration controls many cellular functions, and an abnormality in the concentration of intracellular Ca^{2+} can lead to profound metabolic effects". It is now well established that alterations

in cellular concentrations of calcium can lead to disorders of heart, muscle, bone and blood cells as well as hypertension and calcium and these are likely to be caused by disturbances in hormones and adrenergic receptors. Thus these aspects are covered in seven chapters of this book, each written by active workers in the field.

Among the calcium-regulated membrane function of erythrocytes are cell shape, lipid composition and cation permeability. Activation of K^+ channel is one of the effects of rise in intracellular calcium variety of stimuli-activate platelets by increasing free cytosolic calcium and activating protein kinase C, both acting synergistically to evoke the effect. A number of drugs that include calcium channel blockers, calcium antagonists, local anaesthetics, antihypertensive drugs have been found to affect the actions of calcium in platelet activation.

The major therapeutic agents in the treatment of bronchial asthma are corticosteroids, methylxanthines, disodium cromoglycatecate, beta-adrenergic drugs and anti-cholinergic agents which prevent bronchoconstriction by relaxing airways smooth muscle. Treatment of asthma is considered to depend on direct or indirect interaction with Ca^{2+} since both mediator release and smooth muscle contraction involve Ca^{2+} possibly through firstly, activation of phospholipase A_2 to release arachidonic acid, and secondly, of 5-lipoxygenase to produce leukotrienes.

Calcium ions are implicated in the contraction of vascular smooth muscle and several aspects of calcium handling by blood vessels and its alterations by drugs and in hypertension are covered. Calcium channel blockers such as verapmil, nifedipine and diltiazem are found to be powerful cardioactive agents and act by changing free cytoplasmic calcium concentration. Another chapter summarized the role of calcium in the mechanism of action of alpha-adrenergic agonists in rat liver. The pools of calcium mobilized originate from mitochondria in addition to endoplasmic reticulum and plasma membranes and the cytosolic calcium increased as a consequence. It is interesting to note that the link between the signal and calcium release is still unknown.

The role of circulating hormones on the skeletal calcium release has been discussed and a view is presented that cells of osteoclast lineage are the prime targets.

Although updated in 1987, the references beyond 1985 are scarce. Those working in the field of calcium will find this book useful.

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Oxygen radicals in chemistry and biology edited by W. Bors, M. Saran and D. Tait. Walter de Gruyter, Berlin, 1984, pp. 1029, DM 250.

This volume presents the proceedings of an international conference on the title held in Neuherberg, FRG, during July 1983 with over 200 participants. The importance of oxygen radicals in biology came to be recognized with the discovery of superoxide

dismutase by McCord and Fridovich just over 15 years ago. Since then oxygen radicals such as hydroxyl, peroxyl and alkoxyl have been shown to have biological effects, even of greater significance and damage than superoxide. This area of research had become most active and most pervasive in a variety of biological phenomena and is covered periodically by these meetings with the present one being the third in the series. This book was produced by photo-offset process for early publication and appeared in 1984. This review in this Journal is made available as late as 1987 because of the supply of the book by the publisher only now. Notwithstanding this the reviewer found the information given in the articles useful and not out-of-date. Indeed this book will be a good way to be introduced to the field with almost all the areas of research being covered and given in brief articles of 4–16 pages each and 141 of them. Each article is a mini-paper with some crucial data given as tables or figures, succinctly discussed and provided with a list of references at the end. Thus this will be a valuable resource book of information on oxygen radicals till 1983. One vanishing feature of such publications of conference proceedings that found a place in this book is the 'discussion' which reveals the thinking and experimental details, otherwise unavailable in the formal presentations.

The articles are grouped under the following sub-heads:

1. Physico-chemical and chemical properties of oxygen radicals
2. Generation and reactions of inorganic and organic radicals
3. Activated oxygen species in fatty acid and lipid peroxidation
4. Oxygen activation by metal complexes and metallo-enzymes
5. Photooxidation and singlet oxygen
6. Oxygen radicals in radiation biology
7. Oxygen toxicity and detoxifying systems
8. Superoxide dismutases
9. Physiological aspects of oxygen radicals
10. Medical aspects of oxygen radicals.

A glance through five pages (983–987) of panel discussion gives highlights of the meeting and a sort of summary. Some samples are given here. 'Crypto-hydroxyl' radicals have been postulated to reconcile with the inhibitor behaviour not consistent with 'free hydroxyl' radicals. Whether this is a concept or a reality in the form of metal-peroxy radicals (*e.g.*perferryl) remains to be seen. While metal catalyzed reduction of H_2O_2 to generate hydroxyl radicals is well-known (Fenton reaction), it now seems possible that an organic compound with an extra electron can also give this reaction. The complexity of the process of lipid peroxidation is once again reiterated. Lipid peroxides themselves seem to activate prostaglandin synthesis which adds physiological significance for this reaction. Transition metals participating in the generation of radicals is no surprise but the same metals are needed to detoxify them. The Fe-superoxide dismutase is discovered in higher organism and Cu-Zn enzymes are now found in bacteria, thus eliminating the presently understood demarcation. It is interesting to note that the 'birthdays' were exactly in 1900 for both radicals and the culprit in photodynamic actions in diseases. In radiation biology, the popular assumption of damage to DNA is now expanded to include membrane damage through lipid peroxidation. It is interesting to note the

involvement of radicals summarized thus: "At first, O_2 was assumed to be very toxic, then one realized that may be peroxide was responsible for toxicity. Then came the fashion that SOD helps everything. Later one decided that really OH, formed from O and hydrogen peroxide, was the important entity and Haber-Weiss reaction became popular. Then one made a small modification — that it goes through catalysis by metal ions... and OH became fashionable again". Defence of cells against oxygen toxicity occurs in many ways of radical quenching. The finding of protection of membranes from peroxidation by a 20 KD protein, also having glutathione peroxidase activity, is an interesting beginning for search of other protein factors. The view that 'superoxide is not all bad' has gained support. Also a phospholipase A inhibited autooxidation because it does the repair reaction of the damaged phospholipid. The therapeutic value of SOD has gained support. The section on panel discussion is most thought-provoking and offers useful tips. Two such items are: it is impossible to assure pure water with iron below 10^{-7} M and that commercial EDTA has to be recrystallized several times before the metal impurities are decreased. This book will benefit any laboratory working with radicals and the time lapse diminishes its utility only a little.

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Third European bioenergetics conference: ICSU short report volume 3, edited by G. Schafer. Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, UK, 1985, pp. 745, £ 50.

This book of 745 pages contains proceedings of the third European Bioenergetics Conference held in Hannover, F. R. G. during September 2–7, 1984 and printed by offset printing in 1985 by ICSU press. But this reached this Journal for review rather late and therefore of limited value both from the view point of the contents and this review. The articles are presented as 56 symposia and colloquia lectures and about 300 posters. Scientists from all over the world, including some from India, participated in the conference. Such a broad field and large participation makes it difficult for this book to focus on any aspect. In fact, most areas of research now active in bioenergetics are covered. This can be easily perceived when one scans the long 50-page contents section. The subjects categorized by the organizers are as follows:

1. Microbial energy conversion and conservation
2. Structure and control of bacterial redox systems and ion-pumps
3. Structural aspects, conformation and topography of bioenergetic systems
4. Structural organization of oligomeric complexes in energy transducing membranes
5. Relation of structure and function in bioenergetic systems
6. Genetic and evolutionary aspects of bioenergetic systems
7. Biogenesis of bioenergetic systems
8. Catalytic site mechanisms in energy transduction
9. Mechanism and regulation of ATP-synthase

10. Mechanism of electron transport
11. Mechanism and components of electron transport
12. Generation and utilization of proton motive force
13. H^+-ATPases: Structure, function and regulation
14. ATP-driven cation pumps
15. Anion transport systems
16. Bioenergetics of interated cellular systems
17. Bioenergetic aspects of metabolic regulation
18. Biosynthesis and molecular genetics of energy transducing membrane components
19. Light driven bioenergetic systems
20. Selected special topics

The information provided in this book serves the purpose of giving a glimpse of the current frontiers in bioenergetics from each laboratory. This book does not offer a cogent view of any area and is obviously not intended to as it is a collection of abstracts. It is for this reason its use will be shortlived being already three years behind publication. It is of marginal value even in a library.

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Semiochemistry, flavours and pheromones (Proceedings of the American Chemical Society Symposium, Washington D.C., U.S.A., August 1983) edited by Terry E. Acree and David M. Soderlund. Walter de Gruyter, Berlin, 1985, pp. x+289, DM 160.

It was not very long ago that animals were considered deaf, dumb and virtually blind. Karl von Frisch, the discoverer of the honey bee dance language shook us out of this megalomania when, not willing to believe that flowers were exquisitely coloured merely for the aesthetic pleasure of human beings, showed that honey bees not only had colour vision but that they could also sense colours such as ultraviolet to which we humans are blind. Frisch along with Niko Tinbergen and Konrad Lorenz went on to develop the science of animal behaviour called *Ethology*. A major triumph of modern ethology has been to show that much of animal behaviour can be broken down into *fixed action patterns* that are predictably evoked by extraordinarily simple *releaser* stimuli. Egg retrieving behaviour in geese which is normally triggered by a real egg lying outside but near the nest will also be released by beer cans, light bulbs, smooth stones or any object ever so vaguely resembling an egg. Herring gull chicks which normally begin to beg at the approach of their mother can be induced to show the same response by appropriately vibrating a pencil as long as it has a bright red spot at its tip like the mother's beak. Male sticklebacks which develop a bright red belly during the reproductive period not only attack their red-bellied neighbours but anything that is red, not sparing even the reflection of passing red postal trucks! The simplicity of the releasers is a matter of great satisfaction because we now know that even single nerve cells are capable of responding

to these stimuli. The neurophysiological basis of a great deal of behaviour is thus stripped of mystery[1].

As a young student, the now famous sociobiologist, Edward O. Wilson listened to Konrad Lorenz lecture about releasers and wondered that "If birds and fish were guided to such a remarkable extent by auditary and visual releasers, ants and other social insects must be guided to an even greater degree by chemical releasers"[2]. It is a matter of history that among other things Wilson went on to demonstrate chemical releasers of many complex behaviours in ants such as trail following behaviour, alarm behaviour and even the behaviour of detecting and disposing off corpses so that even live ants could be converted into 'corpses' when applied with the chemical in question and would be "carried to the refuse live and kicking". Such chemicals that are produced by one individual but elicit a response in another of the same species have been called *pheromones* ever since Peter Karlson and Adolf Butenandt[3] first used the term. When they elicit a response in an individual of another species they are called *allomones* or *kairomones* depending on whether they benefit the producer or the receiver. *Semiochemical* is a more recent but composite term that includes chemicals used in communication both within and between species[4]. As explained by the editors of this book in their introduction, "*Semiochemistry* is the isolation, chemical characterization, synthesis, and bioassay of such chemicals".

Being the proceedings of an American Chemical Society symposium entitled "The isolation and characterization of biologically active natural products" held in Washington D.C. in August 1983 and augmented by additional invited chapters, this book, in the words of the editors, "like semiochemicals themselves, ... is intended to stimulate". The intention of the editors I think will be largely fulfilled. The contents, depth of treatment, general interest and quality of the 16 chapters which comprise this book are however highly variable. The book does well to begin with a chapter "Viewing behaviour-modifying chemicals in the context of behaviour: Lessons from the onion fly" by J. R. Miller and M. O. Harris of Michigan State University. This chapter is a paragon of virtues. For the manner in which their study was planned and executed, for the style of their writing and above all for the communicative power of their graphs I unhesitatingly vote this chapter as the best research report I have read in some years. It deserves to be made compulsory reading for all graduate students as it has been in my lab. Miller and Harris begin their chapter by describing their frustration in being unable to establish good laboratory cultures of the onion fly *Delia antiqua*, a serious pest of onion fields, in spite of meticulously following all details of published procedures. Their highly emulation-worthy method of meeting this challenge and even more so their attitude to science is best summed up in their own charming words.

"In desperation we visited the laboratory of Dr. Freeman McEwen (University of Guelph, Ontario), which was rearing massive numbers of *D. antiqua* for release of sterile males. We were taken step by step through their rearing procedures and found most of our methods were very similar, except for one seemingly minor exception. In obtaining eggs, the Guelph researchers followed a practice that had never been reported in the literature. In addition to moist sand and chopped onion, their oviposition dishes were

routinely provisioned with a spring of onion foliage about 6 cm tall and standing upright in the sand over the chemical stimulus. When queried on the rationale of the 'stems' the technician who spent considerable time overseeing egg collections insisted that they improved egg production. However, no quantitative data were available on the effect of the onion stems, and furthermore, we received the impression that the degree of belief in effectiveness onion stems was inversely correlated with extent of formal education in entomology. Upon returning to our laboratory, one of us (MOH, graduate student) was enthusiastic about incorporating onion stems into our rearing procedures, suggesting that the additional visual/physical stimuli might have a major impact on behaviour. The other (JRM, major professor) was very skeptical, finding it hard to believe that important determinants of oviposition would have gone unnoticed in the previous classic studies on host colonization by *D. antiqua*. More fundamentally, the skeptic was a proponent of notions prevalent among those schooled in insect chemical ecology that: 1) insect behaviour results from a series of simple reactions, and 2) that chemicals are without question the primary regulators of insect behaviour, particularly in host-plant colonization by insects. Fortunately, the 'less informed' junior author did not share these assumptions." (References to literature given as serial numbers in brackets at various points in this paragraph have been omitted).

From here Miller and Harris go on to conduct an immaculate series of experiments to show that 1) the onion stem indeed has a profound impact on oviposition, 2) a vertical glass tube with yellow paper is almost as effective as the real onion stem, 3) chemical stimuli from the chopped onion and the visual stimulus of the vertical yellow real or surrogate stem act synergistically, 4) yellow colour of the surrogate stem is far more effective than other colours, 5) heaviest egg deposition occurs when the surrogate stem is in the shape of a narrow cylinder, 6) with an optimum diameter of 4–6 mm, 7) an optimum height of 10 or more cm, 8) and an optimum angle of 90° to the soil surface and so on until they go on to fly watching and discover the optimal stimuli for each step in the fly's ovipostition behaviour and finally cap it all by presenting a neurophysiological model for stimulus summation across different sensory modalities. The result is not only a package of efficient methods for culturing the onion fly but a *tour-de-force* in insect behaviour providing the much needed emphasis on well designed experiments and an open mindedness about a multiplicity of releasers acting simultaneously or synergistically. I have referred to the effectiveness of their data presentation before. As can be seen from a sample reproduced (fig. 1), their graphs can be almost completely understood without reference to the text. How much faster would scientific progress be, and how much easier and error-free would reading of scientific papers be if their approach and style became more popular!

Most of the remaining chapters are more technical reports of less interest to anyone other than those working in fields such as chiral semiochemistry, microanalytical methods for structure determination of pheromones, etc. Conspicuous exceptions to this are a study of the pheromone of a true bug by J. R. Aldrich and a masterly review, with much useful advice, of behavioural analysis of pheromones by T. C. Baker. In summary, I feel that this collection of papers would be useful to anyone working in the area of

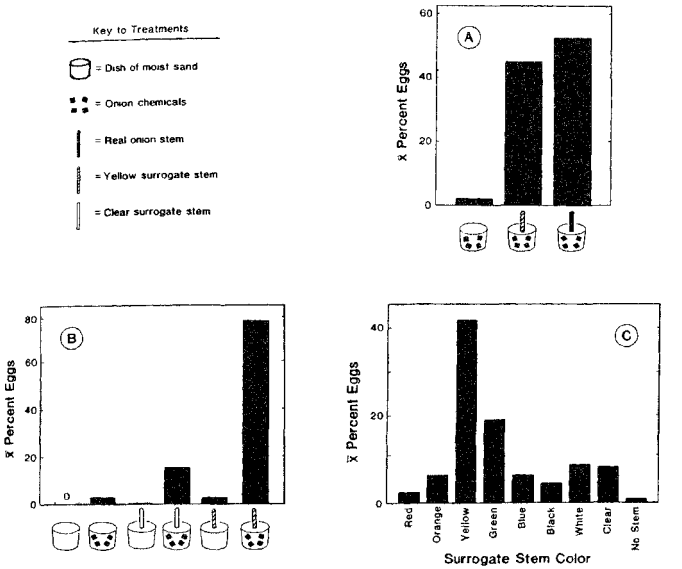

FIG. 1. Patterns of onion fly egg deposition in "choice tests" with dishes containing various combinations of chemical and visual/physical stimuli. For statistical assignments, see original research papers cited in text. (Reproduced with permission.)

natural product chemistry and recommend that the chapter by Miller and Harris be read by anyone interested in animal behaviour or even merely interested in some tips on effective communication in science.

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Trace element analytical chemistry in medicine and biology edited by P. Bratter and P. Schramel. Walter de Gruyter and Co., P.O. Box 110240, D–1000, Berlin, 11, 1987, pp. 629, DM 295.

This book contains the proceedings of the 4th International Workshop on the subject held in Neuherberg, FRG, during April 1986. This workshop focussed attention on nutritional aspects of trace elements and their role in clinical states.

About a hundred participants took part in the meeting and 56 articles in a total of 629 pages are given in the book produced soon after the meeting by photo-offset process.

The major developments are covered by invited speakers under the titles: bioavailability, dietary requirements and recommendations, interactions, toxic action, role in metabolic processes, infant nutrition, parenteral nutrition, diagnosis and therapy of cancer and psychiatric disorders.

It is difficult to give even a broad perspective of such a meeting and a subject of diverse coverage. I will attempt to give some comments on a limited sample, somewhat selective based on my interests. There seems to be greater dependence on animal experiments now to monitor requirements of trace elements for assessing the 'human nutriture'. It is interesting to note that the 'effect of dietary fiber on bioavailability of essential trace elements' is controversial. Body iron status is regulated by adaptation of uptake in upper small intestine. Therefore adequate intake is necessary. Fortification of iron in fruit juices, even in countries like Germany, is being contemplated. Chromium, now recognized as an essential trace element in human nutrition, is shown to enter the food through stainless steel vessels. But it is not clear how this metal is obtained in those who do not use these vessels. A routine analysis of 19 trace elements in different types of diets in Switzerland was reported in which it is interesting to note that in vegetarian diet cobalt was low and molybdenum was high. A comprehensive article is provided on toxic actions of trace elements and the interesting points to note are: molybdenum intoxication can induce secondary copper deficiency and copper toxicity is hereditary (!), iron exposure can occur through erroneous intake, hereditary hemochromatosis, or overload from blood transfusion; manganese toxicity occurs only when ingested *via* lungs but not through food.

Iron overload is a clinical condition and removal of excess iron is accomplished by desferroxamine but this chelator had no effect on intestinal uptake. Several articles described possible sensitive markers specific for metal ions, such as enzyme activities. A number of articles described methodologies of trace element analysis in biological

materials, metallothioneins are now detected and appear to be induced in human tissues. Aluminium toxicity had been identified with renal failure and removal of this metal from water, food and drug formulations is indicated. Selenium had attracted a large attention especially in view of its relationship to glutathione metabolism and oxidative stress.

The book leaves one with the impression that the whole field of trace element biology is just scratched on the surface. The work must now expand from merely analytical and survey levels to focus on molecular basis of the nutritional needs and toxic effects.

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General photobiology by Donat-Peter Hader and Manfred Tevini. Pergamon Press, Oxford, 1987, pp. 323, $ 21.95.

Photobiology is an interdisciplinary science drawing its sustenance from biology, medicine, agriculture, veterinary science, physics and chemistry. The past two to three decades have brought in impressive progress which is only represented in the various reviews scattered in a variety of journals. The first book with the explicit title photobiology was written in German in 1930 (L. Pincussen, "Photobiologie" Thieme, Leipzig, 1930). The book under review is an excellent summary of our knowledge of the rather vast subject. The authors have done well in giving the book a practical slant, describing at greater length the methodology rather than abstruse theory.

The choice of topics is judicious. Thus part I 'Photophysics' and Part il 'Photochemistry' provide valuable information to the biologist in understandable language. The authors deserve to be congratulated on the lucidity and style of their text. This in itself is a commendable achievement for the non-English-speaking authors. The chapters 'Absorption and wavelength selection' is especially good with all the information on wavelength, selective filters, polarization filters and monochromators. It is common knowledge that a good measure of data on the biological responses evoked by monochromatic light turn out to be of dubious merit since the wrong kinds of interference filters had been used or that the 'half-band width' was not suitable. The chapter on the measurement of radiation also gives valuable and practical tips. Part III contains valuable information on the biological aspects for the physicist and the chemist. The chapter 'Molecular basis of vision' does appear to be out of place. It does *not* seem to do justice either to the morphology and anatomy of photoreceptors/eyes in animals, on the one hand, or to the electrophysiological aspects of vision on the other hand. The book would not have been poorer even with the exclusion of this section. But this is a minor aberration.

What impresses the reader is the fact that whatever is stated or described is done on the basis of landmark papers and authoritative reviews. Each chapter has its own 'Bibliography' consisting of two sections: 1) Textbooks and reviews and 2) Further reading. This is an old German tradition. Bibliographic coverage of literature is very exhaustive and up-to-date. The authors acknowledge the constructive criticism and

productive discussions with their colleagues who are themselves authorities on several topics discussed in the book. *General photobiology* is the best textbook to appear on the subject in recent years and this reviewer knows of no other single book that contains so much authentic information on so many subjects in this vast field. Hader (the Umlaut on a is missing in the cover page) and Tevini must be congratulated on a masterful synthesis of a wealth of available information and for keeping their narration uncluttered and the number of pages to a manageable 323. I recommend the book to photo-biologists of all extractions: zoological, botanical, physical and chemical and to the student and researcher alike. The publishers deserve unqualified praise for excellent standards of production, get-up, proof-reading and, last but not the least, the surprisingly low price.

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