

Annual Review of Neuroscience 1997. W. Maxwell Cowen, ed. Annual Reviews Inc., 4139 El Camino Way, Palo Alto, California 94303-0139, USA. Price: Individual \$ 65, Institutions \$ 130, 651 pp.

This volume of the *Annual Review of Neuroscience* has many articles of interest for the developmental neuroscientist. The mechanisms underlying cerebral cortex patterning are discussed by Levitt and others. They suggest that areas or zones are created early in development using general positional information molecules. Further patterning, finally leading to a specific cortical organization in an organism, is overlaid on the initial pattern. A more basic developmental question is addressed by Brivanlou and Melton in their article on the molecular basis of the 'organizer'. The article is clearly written and elucidates both recent findings as well as future questions in the field of primary neural induction. Herrup and Kuemerle present recent molecular evidence which supports the original idea based on anatomy, that the cerebellum is compartmentalized. However, the functional reasons for such compartmentalization remain unknown. Callaerts *et al.* review a relatively newly discovered developmental 'master gene' encoding the Pax6 family found in organisms as diverse as the nematode *C. elegans* to humans. What makes this master gene so interesting is the finding that it seems to control the same developmental process in many diverse organisms. For example, Pax6 homologues in both *Drosophila* and mouse are at the top of the hierarchy of genes that control eye development. This finding casts doubt on the 'convergent evolution' theory of eye development proposed for the arthropod and mammalian visual systems and suggests the existence of a common ancestral visual organ.

Connectivity and plasticity are discussed in a number of articles for different areas of the brain. Wise *et al.* have written about a newly-defined area in the dorsal pre-motor cortex in which inputs are received from the extrastriate visual cortex through just one other area, the post-parietal cortex. Such connectivity between the visual and motor regions has led them to propose that this area functions in visually guided movements. Hypothalamic plasticity is reviewed by Hatton. The structural changes associated with such plasticity are well documented. However, the consequences of these features in terms of function and final output are still to be

understood. The article by Botjer and Arnold looks at the role played by development in creating plastic neural circuits for bird songs in males. Full appreciation of this review however, requires greater familiarization with the field of songbird vocal behaviour. In the review by Chen and Tonegawa, the use of targeted gene disruption in understanding synaptic plasticity, learning and memory at the molecular level is discussed. As pointed out by the authors this technology has suffered from the drawback that the function of neural genes, which are also required during development, cannot be analysed. We await results from the Cre recombinase method that will allow spatio-temporal control of gene disruption.

Among reviews in the field of cognition and behaviour, Deadwyler and Hampson review advances in ensemble recording. Information obtained by this method is revealing new aspects of behaviour and cognition not possible from multiple single recordings. Clearly, though for ensemble recording data to have its full impact it is essential to analyse it in the context of other methods such as neural network simulation. Those interested in the underlying mechanisms of sleep and arousal will find the article by McCormick and Bal both informative and well written. Perception of speech has traditionally been considered a special feature of the human brain. Fitch *et al.* tell us how there is gathering evidence that speech is perceived by the same mechanisms that exist in non-humans for processing of complex acoustic signals. In this context, as the authors point out, it is important to distinguish between speech and language. Advances in the genetics of a serious behavioural disorder Manic Depressive Illness (MDI) are reviewed by MacKinnon and others. They discuss the positive impact of the human genome project on tracing the basis of genetically complex illnesses such as MDI. Ethical issues raised by identifying such genes are also discussed.

Some of the articles review 'molecules of importance' in the nervous system. Liu and Edwards discuss the importance of newly-discovered transporter proteins which are required for the transport of neurotransmitters into synaptic vesicles. The regulation of their activity will provide important insights into synaptic transmission. A catalogue of potassium channels from different phyla, with their structure and function relationships, is provided by Jan and Jan in their article. The

bcl2 gene family which codes for various apoptotic/anti-apoptotic proteins is described by Merry and Korsmeyer. However, the article fails to convey any idea about the functional role of these proteins in the nervous system. There is a similar problem with the article on RNA processing by Nakielny *et al.* The article is well written and informative but no attempt has been made to link the importance of RNA processing with neuronal function. The complexity of G-protein coupled receptor signalling is addressed by Gudermann *et al.* They have attempted to answer the question of how multiple receptors elicit differential responses in the same cell given the limited number of heterotrimeric G-protein subunits and even fewer effectors which are known to exist. This is a rapidly evolving field and is further complicated by the discovery of cross-talk between G-protein coupled receptors and other signalling pathways. Special molecular features of the neuromuscular junction are addressed by Fischbach and Rosen in their review on the protein called ARIA. This polypeptide is probably a ligand for a receptor tyrosine kinase and has been implicated in development of the neuromuscular junction. A model predicting how ARIA expression in growing nerve terminals leads to clustering of specific receptors on the post-synaptic muscle terminal is put forward. Finally, there are two articles on sensory transduction. The first of these deals with the molecules of mechanosensation. The molecular basis of mechanosensory transduction is still poorly understood but it is clear from this review that the field is set to grow in the next few years. In comparison, olfactory transduction and the coding of olfactory information in the brain is much better understood. The review by Hildebrand and Shepherd has carried out a much-needed analysis of olfaction in both invertebrates and vertebrates. They have compiled information from all fields of olfaction including molecular genetic, electrophysiological and biochemical approaches and attempted to look at these in the context of olfactory discrimination. The suggestion from their analysis is that there maybe common mechanisms of odor discrimination among phyla.

GAITI HASAN

*National Centre for Biological Sciences,
Tata Institute of Fundamental Research,
Indian Institute of Science Campus,
Bangalore 560 012, India*

Annual Review of Entomology 1997. Thomas E. Mittler, Frank J. Radovsky and Vincent H. Resh (eds). Annual Reviews Inc., 4139 El Camino Way, Palo Alto, California 94303-0139, USA. Price: Individual \$ 65, Institutions \$ 130. 600 pp.

Reviewing a collection of reviews is a tall order and a worthless exercise. Much of the material is dated and not addressed to a wider audience. It is not always that it is 'readable' material and in general is unlikely to follow a uniformity of style or even contents. Much of it, if it is in our area of interest, we would be familiar with and if it is not, it is unlikely that we will find it easy to browse. One is bound to find some good, some indifferent and some bad articles in such a collection. *The Annual Reviews* have always been an exception to this and that has earned its various issues a rightful place in the library shelves around the world. The *Annual Review of Entomology 1997* reads more like a text-book and covers a range of studies on insects but with a preponderance of reviews dealing with insect behaviour in a general sense. It was difficult for one like me to read but I have to say I became much wiser and better informed going through this volume.

John Kennedy made study of insect behaviour more quantitative and precise than ever before. The biographical essay by John Brady is not just the history of one person's scientific career, but the story of the coming of age of the integrative approach to animal behaviour. I have always found these biographical sketches eminently readable and they produce nostalgia for a kind of science that was not sullied by the current-day style of grant hopping mindlessness. It seems the older generation had a problem to solve and worked with dedication towards the best solutions despite adversities. The several reviews that follow are invariably analytical and full of new information, a pleasant departure from reviews that tend to become catalogues. Insects have dominated the living world for so long and continuously they have possibly every good example of adaptation to environments. The adaptations in scale insects are truly amazing and one wonders whether insect pest managers will be able to cope with such versatile adversaries. From altering the host structures to suit their needs to unusual life cycles and chromosomal adaptations, the variety of scale insect strate-

gies that have evolved will need as many diverse methods of control since these form the major group of agricultural pests. Gullan and Kosztarab have attempted quite successfully to highlight the variety of scale insect adaptations. In an era where biology has practitioners who cannot possibly pronounce most of the Latin names, leave alone identify the various taxa the review on the biology of galling thrips (Crespi *et al.*) is an example of material that informs while not demanding too much of a background. I for one learnt that among insects it is not just the canonical bees, wasps and ants but even thrips that have social behaviour. The chapter by Feener and Browns on dipterans as parasitoids provides us some glances of the life of possible future candidates for insect pest control. Several thousand dipteran insects parasitize other insects and they have evolved their virtuoso strategies. I found the behavioural changes in host induced by parasites like the bumblebee, which stays back away from its nest when parasitoids infest it or buries itself in soil when near death remarkable. By changing song patterns of their host crickets, parasitoids seem to affect even interaction among host individuals to their advantage. The physiology and chemistry of such behavioural alterations could be rewarding areas of study. The need for a thorough understanding of the behaviour and ecology of insects and their parasitoids to develop pest management strategies cannot be overstated. Antonio Panizzi's review of stink bugs (Pentatomids) ought to have been read by plant biotechnologists before they attempted large-scale disbursal of BT transgenic plants. The insect strategies described here would have altered them to the pitfalls of field trials that were discovered at the cost of credibility.

The chapter by Foster and Harris on behavioural manipulation methods is good reading for new ideas on containing insect damage. May be covering the ditches and turning of or turning on lights at appropriate times would be far simpler and cheaper methods to control mosquito-borne disease than more expensive tools. It is important that host, pest and parasite behaviours are analysed in detail for such purposes. How much these ideas are of value have been demonstrated by the relative resistance of Brahma cows to insect-borne diseases and hence the popularity of these breeds in Southern America.

The discussion of visual acuity in insects by land is an example of the class

of articles in *Annual Reviews* that has made this series popular. A substantial fraction of the review is devoted to a discussion of the theoretical background. This makes reading the review a lot easier. This and the chapter on evolution of arthropod silks by Catherine Craig will be highly valued for years to come.

I for one think insects are great things to read about for every one and should become part of curricula but with more easy to remember common names. When we gather that insects do not just produce silk but also polyesters, that without them we will not have chocolate or vanilla and there is much economic gain by managing insects than destroying them indiscriminately, I believe it is important that the study of insects and animal behaviour become a vital and necessary part of curricula for all school children. I hence found the chapter by Robert Mathews and others agreeable.

These days no book is written on insects without something to be said about *Drosophila*, the insect that has made study of insects highly respectable. The genetics of mating behaviour is wonderfully written and highlights recent inroads made in our understanding of the genetics of deviant sexual behaviour. A starting point for exploring molecular mechanisms of sexual behaviour will certainly come from *Drosophila* because of our ability to genetically manipulate and disrupt specific steps in a highly stereotyped set of behaviours that is mating.

Other chapters I found interesting were the one on host plant influences on sex pheromones by Landolt and Philips and the most amazing biology of *Wolbachia* by Werren. Insect immunity deserves to be a topic for major discussion. The review by Gillespie *et al.* will be of value for those who are on the trail of new antibiotics. The biology of immunity in insects itself has close parallels in mammals but the variety of antibacterials is bound to be astounding given the number of insect species that share this planet with us.

The editors Mittler, Radovsky and Resh deserve high praise for the choice of the reviews. This volume is for more than just entomologists and good value for money.

K. S. KRISHNAN

*Molecular Biology Unit,
Tata Institute of Fundamental Research,
Homi Bhabha Road,
Mumbai 400 005, India*

The Self-Avoiding Walk. Neal Madras and Gordon Slade. Series on Probability and Its Applications. Birkhauser, Boston. 1996. 426pp. Price: DM 68.

Intersection of Random Walks. Gregory F. Lawler. Series on Probability and Its Applications. Birkhauser, Boston. 1996. 225pp. Price: DM 68.

Long-chain polymer molecules in a good solution occur in a swollen state, the large length-scale structure of which is best described as a random walk. However, the fact that two different polymer molecules cannot be very close to each other, implies that this chain must not have any self-intersections. This excluded volume effect implies that the average radius of gyration of such molecules is more than expected otherwise. About 50 years ago, Flory gave an approximate argument that takes account of the effect of excluded volume unreasonably well. By the early 1970s, the precise relation of this problem to other statistical mechanical models of phase-transitions was fully realized. Today, one has fairly good understanding of the critical behaviour (exponent values from series expansions, numerical simulations, and conformal field theory, behaviour in large dimensions, etc.). Both these books are on this general problem, and have a fair degree of overlap.

The book by Madras and Slade contains an expository account of the current status of the more 'rigorous' results of self-avoiding walks, as well as some discussion of the more 'heuristic' or numerical approaches. Of course, some more specialized topics (though focus of current research) are not discussed. For example, the collapse transition, polymers where chemical units along the chain are not identical, polymers in random environment, exact results for polymers on fractals, and application of conformal field theory to polymer networks.

Large-scale numerical simulations of self-avoiding walks have been very useful for understanding their properties. As far as studies of critical exponents are concerned, polymer systems can be much more efficiently simulated than other, say spin-systems. In 1955, Rosenbluth and Rosenbluth were able to generate chains of length 64 steps, using the computers available then. The longest chains simulated nowadays have a length of order 80,000 steps. More than just a brute-force gain in computer speed, this has been achieved by successively better algorithms. In a very enjoyable chapter which reads like an adventure story, the authors have described the historical development, and analysed the efficiency of different simula-

tion algorithms. One notes that many early algorithms were extremely inefficient, or suffered from not sampling all configurations with equal weight. The CPU time grew as $\exp(N^x)$, where $x \leq 1$. Current best (the pivot) algorithm has a performance which seems to need time increasing only as N . One can only hope that recent difficulties in simulations of the protein-folding problem will also be eventually overcome by better algorithms.

The book is a very well written comprehensive account of the status of our current knowledge of the self-avoiding walk model. It is very readable: statements of results in simple language precede a detailed mathematical treatment, so that if a physicist and chemist reading the book finds the mathematics too heavy, one may skip the proofs and still get the overall picture. At many places, the authors have highlighted the open problems. For example, it is a sobering thought to realize that the best rigorous upper bound on the number of self-avoiding walks of N -steps, C_n , in two dimensions known is still the Hammersley and Welsh 1962 bound $C_n \leq \mu^N \exp(\alpha N^{1/2})$, whilst the expected behaviour is $C_n \approx \mu^N N^x$ with $x=11/32$, where μ is the growth constant for the walk.

Other topics covered in the book are the lace expansion, polymers in dimensions $d \geq 5$, relation to the Edwards' model of weakly self-avoiding walks, kinetic growing walks, and loop-erased walks.

I think that this book provides a good introduction to the subject, and also is a good place to find what is known about the subject. It should be a mandatory reading for all graduate students, and researchers involved in the theoretical studies of polymers.

The book by Lawler, as noted in his preface, deals more precisely with 'problems dealing with non-intersection of paths of random walks'. One of the questions which turns out to be important in the theory of random walks is whether there is a nonzero probability that a random walker will never return to the starting point again. It was shown by Polya that in one and two dimensions, this probability is exactly zero. But if the walker is bound to return to the origin at least once, he is bound to return again, and again. This, in turn, implies that in one and two dimensions, a random walker 'eventually' visits all sites infinitely often. In higher dimensions, there is a finite probability that a walker will not visit any particular pre-chosen site at any later time, however long we wait. Thus the behaviour of random walker in d dimensions is quite different for $d \leq 2$ and $d > 2$.

Polya's theorem concerns the probability of intersection of the path of a random

walker with a fixed point in space (say the origin). One can extend the treatment to the case when the walker is instructed to stop as soon as it hits any one of a pre-specified set of points. What is the distribution of probabilities of different stopping points? Such probability measures, when the initial point of walker is very far from the region where stopping points are, are called harmonic measures. These often are important in physics, e.g. in the study of diffusion-limited aggregates, which models the aggregation of soot particles in air. To characterize the average properties of these diffusion-limited aggregates (such as the fractal dimension), one needs to understand the properties of the distribution of growth probabilities on randomly generated sets, which are given by harmonic measures. The problem of estimating the harmonic measure of sets of points is addressed in this book, and some bounds on the measure derived. These, for example, give a lower bound on the fractal dimension of the diffusion-limited aggregates.

If the set of stopping points of walker is itself an infinite set, say generated as the sites visited by another walker, this becomes related to the question as to how often the paths of these two walkers intersect. In this case the basic result is that in more than 4 dimensions there is a finite probability that paths of two walkers starting at the same point will never intersect again, however long we wait. In less than 4 dimensions, the probability that no intersection of paths occurs within L steps decreases as a power of L . Lawler discusses bound on this no-intersection probability. Another related subject discussed is the study of self-intersection of random walks. In a chapter devoted to self-avoiding walks, it is shown that the Edwards model is not in the same universality class as the self-avoiding walks in two dimensions. One chapter in the book is devoted to loop-erased walks. Much of what is known about loop-erased walks is due to Lawler, and this is the most readable account of this subject that I am aware of.

This monograph contains a clear account of these topics, and there is an emphasis on rigorous results. The book has an extensive bibliography. It is likely to interest a smaller set of people than the book by Madras and Slade, but it will be useful to graduate students and researchers who study random walks from a mathematician's viewpoint, and need to go beyond the standard textbooks, such as those by Feller and Spitzer.

D. DHAR

*Theoretical Physics Group,
Tata Institute of Fundamental Research,
Homi Bhabha Road,
Mumbai 400 005, India*