

Annual Review of Genetics 2001. Allan Campbell *et al.* (eds). Annual Reviews, 4139 El Camino Way, P. O. Box 10139, Palo Alto, CA 94303-0139, USA. vol. 35. 859 pp.

This volume of *Annual Review of Genetics* is full of reviews on fascinating and wide-ranging topics. Given below is a summary of its contents, though not necessarily in the same order as they appear in the book.

In the first chapter on 'Hypovirus and chestnut blight: Exploring viruses to understand and modulate fungal pathogenesis', the authors Dawe and Nuss describe the recent advances made in the genetics of the hypovirus that infects the chestnut blight fungus *Cryphonectria parasitica*. This hypovirus, so known because it attenuates the host response, is a cytoplasmic element consisting of double-stranded (ds) RNA and is transmissible by hyphae fusion. The authors review the roles of the viral-encoded proteins in modifying host properties (like virulence) by interfering with the expression of target host proteins, like the G-protein. The use of these hypoviruses in the containment of chestnut blight in chestnut orchards of Europe and North America has been discussed.

Crosses between divergent lineages often give hybrids which are inferior in viability or fertility. Such hybrids may not be fit for the environment in which they live (exogenous selection) or may have genotypes which decrease their fitness, irrespective of the environment (endogenous selection). Burke and Arnold review the genetic basis for endogenous selection in their review 'Genetics and the fitness of hybrids'. Based on the available data, the authors suggest that negative epistatic interactions between genes derived from the two parents lead to reduced hybrid fitness, while favourable epistatic interactions between 'alien' genes could give rise to hybrid fitness and speciation.

In the chapter on 'Recombinational DNA repair of damaged replication forks in *Escherichia coli*: Questions', the author Michael illustrates, with the help of lucid diagrams, several pathways of recombinational repair when the replication forks encounter DNA lesions during DNA replication of *E. coli*. The author states that the type of DNA lesion at the stalled site would determine the type of the recombinational repair process invol-

ved and that an understanding of the structure of DNA present at this site is crucial for understanding repair mechanisms. In 'Homologous recombination near and far from DNA breaks: Alternative roles and contrasting views', Gerald Smith discusses the mechanisms by which homologous genetic recombination occurs in a cell during the process of repair of ds breaks. Recombination can occur near or far from the ds break. Using yeast meiotic recombination as an example, the author briefly discusses the recombination repair model when recombination occurs very close to the ds break, at 'hot spots' of gene conversion. The author has reviewed the recombination process in *E. coli* to illustrate recombination far from the DNA break. Here also, DNA ds breaks induce recombination at hot spots of recombination (Chi sites) but, unlike yeast meiosis, these hot spots can be separated from the ds break by more than 30 kb. The author discusses mechanisms underlying RecBCD enzyme system, required for this class of recombination, in *E. coli*. He also discusses models of recombination occurring far from DNA breaks in both bacteriophage and yeast. 'Mechanisms of retroviral recombination' by Negroni and Buc is a review of the mechanisms by which genetic recombination occurs in the genomes of retroviruses. Each viral particle has two genetically distinct single-stranded genomic RNAs as its genetic material. Experimental evidence has shown that recombination occurs during reverse transcription when nascent DNA, while being synthesized from one viral RNA molecule as a template, is transferred to the other RNA molecule (strand transfer). This chapter deals with main molecular mechanisms responsible for this mode of recombination.

This volume contains biographies of two noted scientists. The life of Galton, the father of the eugenics movement and founder of the field of biometrics, has been described by Gillham in 'Sir Francis Galton and the birth of eugenics'. Galton believed that 'talent and character' were genetic factors which were inheritable and that controlled breeding could improve the human race. He coined the word 'eugenics' for his 'science'. The review is an extremely interesting account of Galton's life, work and prejudices. Smocovitis has described the life and work of Ledyard Stebbins in the review 'G. Ledyard Stebbins and the evolutionary synthesis'.

Stebbins had a strong love for plants which found expression in his professional life later. His book *Variation and Evolution in Plants* got him instant recognition and a new field of plant evolutionary biology was conceived. The review covers his associations with other renowned scientists of his time and their influence on his work.

Multicellular organisms display coordinated activities of individual cells due to close cell-to-cell contacts. What selective advantages do they have over their unicellular ancestors? In this imaginative review, 'Building a multicellular organism', the author Dale Kaiser defines these forces by comparing the properties of several multicellular organisms, which appeared early in the history of life, with those of their putative unicellular ancestors. The review suggests that evolution towards multicellular forms could be driven due to nutritional advantages, advantages in dispersion and in protection from predators.

'The inheritance of genes in mitochondria and chloroplasts: Laws, mechanisms and models' by William Birky Jr. reviews the advances made in understanding cytoplasmic inheritance. DNA contained in mitochondria and chloroplasts shows vegetative segregation, often uniparental inheritance and generally low levels of recombination. In this interesting review, the author has outlined the observed patterns of inheritance of chloroplasts and mitochondria in different systems and presented models to explain this pattern. 'Chromatin insulators and boundaries: Effects on transcription and nuclear organization' by Gerasimora and Corces, reviews chromatin insulators, DNA sequences which insulate genes from the silencing effects of adjacent chromatin structure. The authors discuss the possible modes of action of several such sequences isolated from different systems like *Drosophila* and yeast. Proteins which bind to these sequences are also reviewed.

'The action of molecular chaperones in the early secretory pathway' by Fewell and colleagues, describes the roles of molecular chaperones associated with endoplasmic reticulum (ER), the site of folding of nearly all secretory and membrane-associated proteins. Genetic and biochemical studies undertaken in the yeast *S. cerevisiae* are focused upon. Proteins are translocated into the ER either contralaterally (requiring the

Signal Recognition Particle, SRP and the SRP receptor SR) or post-translationally. Mutant analysis has shown that post-translational translocation of unfolded proteins and cotranslational translocation of proteins (in the absence of SRP or SR) are both assisted by cytoplasmic molecular chaperones. The mechanisms by which this may occur are reviewed. Removal of unfolded or misfolded proteins also requires molecular chaperones and these processes are discussed.

Using mouse models, the authors Hakem and Mak review the progress made in dissecting the roles of a number of tumour-suppressor genes (TSGs) like *Rb*, *P53*, *ATM*, *CHK2*, *ATR*, *BRCA1*, *BRCA2*, *APC* (and more) in the chapter on 'Animal models of tumour-suppressor genes'. The authors describe the development of abnormalities and cancers in mice homozygous or heterozygous for a TSG mutation. The spectrum of phenotypes obtained from mice is compared with that obtained from humans harbouring mutations in the same genes.

Phenotypic variation in a trait of an individual, such as fitness for growth, is often quantitative, with several genetic loci contributing to the variation. The task of identifying loci governing quantitative traits (QTL, for quantitative trait loci) can be intimidating. In the review 'The genetic architecture of quantitative traits' the author Mackay, discusses various methods which could be used for the identification of QTL and finally the specific genes.

The chapter on 'New perspectives on nuclear transport' by Komeili and Shea reviews the nucleocytoplasmic transport mechanisms inside a eukaryotic cell. While ions and small molecules diffuse through the nuclear pore complex (NPC), the transport of large molecules is an active process. This process uses a family of transport receptors that recognize targeting sequences on their cargoes and interact with nuclear pore proteins while passing through NPC. Several types of transport receptors involved in import and export of proteins in and out of the nucleus have been discussed. Genetic and biochemical studies have shown direct interactions of nucleoporins with the transport receptors, suggesting that these interactions form the basis for translocation through the NPC. The authors discuss RanGTP-dependent and independent modes of nuclear transport. Diverse mechanisms of tRNA, snRNA and mRNA transport have also been described.

Translational regulation of maternal RNA and its localization are extensively used for pattern formation in embryos. mRNA may be localized within a specific region of the cytoplasm and becomes available for translation only at an appropriate time in that region. This fascinating subject is reviewed by Johnstone and Lasko in the chapter on 'Translational regulation and RNA localization in *Drosophila* oocytes and embryos'. The authors review mechanisms by which an mRNA molecule can be translationally repressed and subsequently activated. mRNA localization involves the transport of the transcripts as ribonucleoproteins along microtubule cytoskeleton. A number of proteins have been reviewed, including molecular motors, which facilitate this movement. In 'Conservation and divergence in molecular mechanisms of axis formation', the authors Lall and Patel describe the mechanisms by which dorsoventral and the anterior axes are laid down in *Drosophila* embryos and suggest that axis formation in insects is a rapidly evolving process. 'Epithelial cell polarity and cell junctions in *Drosophila*' by Tepass and Tanentzapf reviews the formation of the epithelial sheet by cellularization and the roles of various cellular junction proteins which specify the epithelial surface domains in the early and mid phases of its development.

It has been known for some time that bacterial cells respond to their population density by sensing diffusible signal molecules synthesized and excreted by them. This process is termed as 'quorum sensing'. The signaling molecules interact with their receptors which, in turn, interact with the transcriptional machinery of the cell and lead to changes in gene expression. 'Regulation of gene expression by cell-to-cell communication: Acyl-homoserine lactone quorum sensing' by Fuqua and colleagues reviews our current understanding of quorum sensing by bacteria which synthesize and respond to the signal molecule, acyl-homoserine lactone.

Two reviews of special interest to evolutionary biologists are 'Models and data on plant-enemy coevolution' by Bergelson and colleagues, and 'Does non-neutral evolution shape observed patterns of DNA variation in animal mitochondrial genomes?' by Gerber and colleagues. In the first review, the authors briefly describe and assess mathematical models involving coevolution in victim-

exploiter relationships such as predator-prey, host-parasite, host-pathogen and plant-herbivore interactions. These models are tested for data available on plants and their pathogens. The second review is on the evolution of mitochondrial DNA which has been used extensively for evolutionary studies in mammals. The authors present a case that, contrary to popular belief, nucleotide changes in the mtDNA are not always neutral, but could be selective as well.

The chapter on 'Biology of mammalian L1 retrotransposons' by Ostertag and Kazazian Jr. reviews the mechanisms by which this autonomous non-LTR retrotransposon moves itself in the human genome and has shaped it through millions of years. Consequences of L1 retrotransposition into the genome, both beneficial and detrimental, have been discussed. The authors conclude by citing several applications of L1 retrotransposons, such as their use as phylogenetic markers, for random mutagenesis and as gene delivery vectors.

In 'Identification of epilepsy genes in human and mouse', Meisler *et al.* describe the progress made in the identification of monogenic loci which are clearly linked with human and mouse epilepsies. All of these code for components of the neuronal signaling pathways. The effects of mutations in these genes in causing various clinical syndromes are discussed in detail. In many forms of epilepsies, multiple genes may be involved. The authors conclude by suggesting that a knowledge of the mutation responsible for epilepsy could lead to better pharmacogenetic therapies for individuals. In the review 'Molecular genetics of hearing loss', Petit *et al.* describe the progress made in the last ten years on the identification of genes whose mutated alleles cause structural defects in the ear. The authors describe a list of human and mouse genes involved in the process of hearing, their chromosomal locations, types of proteins coded by them, their localization in different parts of the ear and the phenotypes caused by mutations in these genes. Schematic representations of a number of these proteins are given, to illustrate structure-function relationships.

In the chapter on 'Genetic analysis of calmodulin and its targets in *Saccharomyces cerevisiae*', Martha Cyert has described genetic analysis of calmodulin (a small Ca²⁺-binding protein) function

in the yeast *S. cerevisiae*. Mutational analysis of the gene coding for calmodulin has led to the identification of several distinct and essential functions of this protein. The cellular functions of Ca²⁺-dependent and Ca²⁺-independent targets of calmodulin are described. It appears that in the budding yeast, the essential functions of calmodulin are performed in its Ca²⁺ free form.

In his elegant review on 'Disseminating the genome: Joining, resolving and separating sister chromatids during mitosis and meiosis', Nasmyth has provided an excellent discussion on the roles of the molecular players involved in the cohesion and subsequent separation of sister chromatids. Isolation of yeast mutants, unable to maintain sister-chromatid cohesion, has led to the identification of several different classes of proteins required for establishing and maintaining cohesion between sister-chromatids. One of these classes contains a four-subunit protein complex, the cohesion complex, that forms the 'glue' between sister-chromatids. Its destruction triggers metaphase to anaphase transition. The review details the identity and functions of mitotic and meiotic cohesions and other proteins required for the establishment, maintenance and destruction of cohesions in yeasts and other systems.

In his review on 'Informed consent and other ethical issues in human population genetics' Henry Greely has pointed out some controversial ethical problems that have been encountered by researchers working on human population genetics. There has been a flurry of activity in this field, with a number of organizations launching projects on collecting genetic data on populations and extended families. The author discusses the main ethical problem – whether the researchers should obtain the informed consent of an individual within a group or of the group as a whole. These and other related issues, such as confidentiality of data, return of information to the population, commercial fallouts and right to use the research data, etc., have been addressed in this review.

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An Introduction to the Mammalian Fauna of the Siwalik System: Biodiversity of the Siwalik Fauna. K. N. Prasad. Prasad Publications, 8, Venkataraman Street, Srinivasa Avenue, RA Puram, Chennai 600 028. 2001. 295 pp. Price: Rs 300.

The pioneering work on the Siwalik stratigraphy and palaeontology was done by British and American workers in the nineteenth and early part of the twentieth centuries. Post-independence geological work in the Siwaliks of India and Pakistan can be grouped in two broad categories. The first category deals with the palaeontological aspects and the second belongs to magnetostratigraphic work, which is mostly clubbed with vertebrate palaeontology. The author K. N. Prasad, has tried to compile all the available information on the Siwalik Group in this book. In the first two chapters various aspects of the Siwalik Group and its relation to the Karewas of Kashmir, Nepal Siwaliks and Quaternary deposits of Peninsular India are discussed. The next 12 chapters deal with various mammalian groups, viz. Primates, Rodentia, Carnivora, Suoidea, Hippopotamoidea, Traguloidea, Giraffoidea, Bovoidea, Equoidea, Rhinoceroidea, Proboscidea and Edentata. The last chapter is devoted to origin, evolution and migration of mammals of India. In the first two chapters, the author has discussed the stratigraphic details, but not the current stratigraphic nomenclature for the Siwalik succession. He has referred the succession to 'System' (cover page), 'Sub-group' (p. 15), 'Group' (pages 15 and 17), 'Super Group' (pages 1, 5, 6 and 10) or 'Super-Group' (p. 10). This is confusing for the general readers. Presently, the Siwalik succession carries the status of 'Group' not only in India and Pakistan, but also in Nepal. American workers combined the vertebrate palaeontological data with magnetostratigraphic data from the Siwaliks of Potwar Plateau and proposed four biostratigraphic interval-zones for the Middle and Upper Siwalik subgroups. Prasad did not mention these. He has given excellent compilation on vertebrate fossils but did not discuss in detail the various combined faunal studies associated with magnetostratigraphy. In India, similar studies were carried out in Jammu, Haritalyengar (Himachal Pradesh) and

Chandigarh regions, but these are not highlighted properly by Prasad. However, he has provided some useful data pertaining to the first and last appearances of selected Siwalik taxa.

Prasad is among the foremost Indian scientists who worked on Siwalik fossils, particularly those belonging to primates. He has systematically provided the latest information regarding the various Siwalik mammalian groups. He has even provided useful information on certain Siwalik genera. Faunal lists of various Siwalik horizons compiled by Prasad will be of great use to future workers. His book will be useful to postgraduate students, as he has provided the basic data on the Siwalik stratigraphy and fauna.

Prasad's book is profusely illustrated. However, most of the diagrams are very clumsy and not up to the mark. Scale or magnification for many figures of fossils is not provided and it is difficult to judge the actual size of bone and teeth elements. All the line diagrams are not original and some are taken from different publications; sources of all illustrations should have been stated. A few diagrams are not properly oriented. These are printed upside down or side ways. General editing of the chapters is not uniform. There are numerous editorial and formatting inconsistencies. In some places genera are printed in italics, but in others they are upright or even given in bold. Prasad has given the classification of Siwalik succession and equated the various Siwalik horizons with marine stages (p. 6). He should have given land mammal ages. A comprehensive list of references is provided at the end, but these are not arranged alphabetically.

Despite the above-mentioned lacunae, the work is informative. There has been a great need for such work on Siwalik faunas as no comprehensive update was available. Prasad's book fills the lacuna partially. The chapters on fossils, which form the major part of the book, are well written and supplemented with illustrations. The author is able to update the Siwalik data to a large extent. I trust the publication will be popular both with the researchers and postgraduate students working on the Siwalik stratigraphy and palaeontology.

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