it is the two features of *instructability* and *reflection* that human beings have evolved which now set them apart from all other species. Another feature that makes human language strikingly different is the extremely close link between our language behaviour and our emotional and motivational states; we can reach each other's emotional core with our speech, chimpanzees and other closely-related species possibly cannot.

Narasimhan also elaborately describes the various ape language studies which attempted to explore language behaviour in chimpanzees in different ways and specifically focusses on the Kanzi Project. This study differed from all the others in investigating the language comprehension ability of a pygmy chimpanzee, Kanzi, rather than its language production capability. Narasimhan provides a wonderfully thorough critique of the project and again highlights the fact that one must compare and contrast the pragmatics of language behaviour in chimpanzees and in humans rather than the more rigid underlying syntactic structures if any insight is to be gained into the nature of communication in these species.

Another important point that Narasimhan makes concerns the importance of non-verbal communication to a species as the chimpanzee. He wonders about the nature of gestural communication in such species, and very perceptively calls for an exploration of the extent to which the evolution of gestural capabilities may have facilitated acquisition of language behaviour. Where I do not agree with Narasimhan, however, is in his contention that Vanitha, his earlier human subject, was clearly superior to Kanzi with regard to her ready object usage in response to how- and where-questions, and her miming and onomatopoeic abilities. Clearly, in order to unravel his full potential, Kanzi would have to be tested in situations that closely resemble his natural life in the forest – sophisticated object use and miming capabilities may not necessarily be important features in the life of a bonobo.

Finally, Narasimhan raises an extremely interesting point – the necessity of attempting to define the levels of complexity of language behaviour modalities in different species before it is possible to outline an evolutionary phylogeny for them. This leads to the realization that all extant human languages are remarkably similar in their complexity, while the language behaviour of the great apes is profoundly different from human language in its rudimentary structure. While examining the possible reasons why chimpanzees, our closest relatives, have not evolved complex language behaviour, it is suggested that these apes lack many of the non-verbal cognitive capabilities that may be essential substrates for sophisticated language behaviour to evolve; these include symbolic play, true imitation, iconic gesturing, and onomatopoeic vocalizing.

While it is indeed true that many of these cognitive abilities may indeed be lacking in chimpanzees, there is now a growing body of literature that it may not be possible to completely dismiss other capabilities of the great apes with regard to behavioural processes such as observation learning, analogizing, tool-making and tool-use, role-taking, and pretend play[6–10]. Recent analytical investigations into primate vocal communication have also unravelled the semantic structure of different classes of social vocalizations[9,11]. In the light of Narasimhan's comprehensive framework outlining different levels of complexity in language behaviour pragmatics, it may be worthwhile to take a fresh look at language behaviour in the hominid group and reinvestigate the causal connections, if any, between language behaviour and other cognitive abilities that prevail within the group. The time has thus come to ask that familiar question once again – does language help us think? And linguists like Narasimhan are clearly showing us the way.

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Annual Review of Entomology 1998. Vol. 43. May R. Berenbaum, Frank J. Radovsky and Vincent H. Resh, eds. Annual Review Inc., 4139, El Camino, Way, P.O. Box 10139, Palo Alto, California, 94303-0139, USA. 733 pp. Price: Individuals US $25, Institution US $130.

The Annual Reviews being the most influential serial publication in Entomology, have consistently catered to the growing dimensions of a wide range of areas from morphology and biosystematics, through behaviour, genetics and evolution to Integrated Pest Management and biotechnology. In upholding this tradition, this volume under review is no exception, including in it thirty articles, sixteen of which relate to biology, ecology, evolution, genetics and behaviour and the rest to diverse aspects of control – pesticide, biocontrol, biotechnology and IPM.

The need for promoting research in insect toxicology, physiology, biochemistry and ecology to achieve selective pest control cannot be overemphasized. Though the current dominance of synthetic organic insecticides is essentially due to economic reasons, their failure, resistance, resurgence of primary pests, upsurging of secondary pests and overall environmental contamination have contributed to the growing popularity of IPM concept. From the IPM perspective, the concept of sustainable agriculture provides a platform for its launching to higher levels of integration. The basic hierarchical ecological scales – the species/population, communities and ecological scales serve as templates for such integration. Integration of methods of control would apply to subspecies or species complexes, multiple species categories and integration of multiple pest impacts in the context of the total cropping system. The advance of IPM to higher levels of integration will hinge on the depth of understanding of agroecosystem structure and dynamics. The development of selective pesticides and botanicals, application of genetic engineering to the development and release of pest-resistant cultivars of crops and natural enemies of pests, advances in semiochemical formulation and in trap cropping contribute to the success of IPM. Eradication of introduced pests is often recommended and unless we understand the time of detection following introduction, the rate at which the eradication programme is mounted and the degree to which the introduced species is adapted to the new environment, such programmes may not be useful. The gypsy moth in North America and the Mediterranean fly in California are good examples of ongoing eradication programmes. For insect pest eradication, techniques include release of sterile males as in the case of screw worm, spraying with insecticides including bioinsecticides and habitat manipulation. The development of new insecticides with insect hormone action is on the horizon and potential exists for the discovery of more highly target-selective juvenoids.

Biological control is an important component of IPM and multiple interactions being the rule, the host plants of pests may affect natural enemies. Plant volatiles may be important in guiding natural enemies to their host/prey habitats, with some being able to distinguish volatiles produced by plants of different growth stages. The release of whole plant synomones increase the size of the odour, plume, augmenting chances of finding of the host by natural enemies. Manipulation of parasitoids in the field by applying herbivore-derived kairomones is a means to stimulate the search behaviour of the natural enemies. Selecting plant cultivars that stimulate or enhance foraging efficiency of natural enemies is important, as this information is vital for predicting how to combine natural enemies and plant resistance for long term results. A related aspect pertains to the parasitoid *Encarsia formosa* used worldwide for the biocontrol of white flies on vegetables and ornamentals. Within crop cultivars they may vary in their effects on the interactions between the parasitoid and predatory populations. Similarly, the establishment of refuges during a productive season may provide for increased pest suppression by predatory coccinellids which are abundant in such refuges at various times of the year. The basis for refuge development naturally relates to the use of host cues to locate the habitat and encourage reproduction.

Interestingly enough, predatory and parasitic insects are attacked by their own suite of predators, parasitoids and pathogens. Unfortunately natural enemy ecology has often emerged from laboratory studies, where natural enemies are isolated from all elements of the biotic community. The view that interactions of biocontrol agents with their own natural enemies can disrupt the effective control of herbivore populations, has underlined the need for a study of higher order predation. Investigations on parasites and pathogens associated with mites are essential for mite-affected crops and the diseases they cause. In this connection, mention may be made of the mantispids which prey on the eggs of virtually all groups of hunting spiders.

Biological control of weeds, with a long history and a good success rate is equally important. While classical biocontrol is the mainstay, mycoherbicides also play an important role. The necessity for detailed host specificity studies of all biocontrol agents before field release, as well as evaluation of biocontrol programmes, particularly their impact on non-target organisms cannot be overemphasized. The control of salvinia and water hyacinth, which has preserved the lifestyle of the entire communities, as well as restored the biodiversity of damaged aquatic ecosystems is a good example.

Chemical communication is emerging as an important component in pest management. Scarab beetles are important agricultural pests and synthetic pheromone traps captured beetles for a longer period of time in a day. Because the beetle population annually increased to more destructive levels, spreading to new areas, identification of botanical attractants is useful to survey their spread. Molecular biology of signal transduction in the recognition of chemical signals relates to odorant binding patterns, odorant receptors and degrading enzymes in sensillar lymph. Antennae-specific pheromone degrading enzymes in scarab beetles have evolved to participate in the deactivation of the pheromone and other odorants.

Genetic engineering to speed the action of baculoviruses has stimulated renewed interest in baculoviruses for controlling lepidopteran pests. The use of recombinant baculoviruses for insect control is a new and rapidly-changing field. Impact evaluation is very vital, especially in host range information. Sublethal infections that give rise to a reduction in host reproductive fitness also need study. The fate of recombinant baculoviruses in the environment and sites of potential impact are needed to enable designing of post-release monitoring programmes. To design more effective recombinant baculovirus insecticides with minimal environmental impact, knowledge of baculovirus genetics, molecular biology and ecology are important. Besides, the potential impact of transgenic cultivars on insect population dynamics and evolution underlines the need for a solid understanding of both the target insect ecology and the cultivar performance under varied field conditions. This is an essential aspect to predict effects of transgene cultivars on pest and natural enemy dynamics. Lack of information necessary to use transgenic insecticidal cultivars in ways that would avoid rapid genetic adaptation of insects has been of much concern, an aspect which might result in losing the utility of the transgenic crops.

Studies on the interactions between behavioural physiology in adaptation to toxins tend to show increased attraction to insect behaviour in evaluating crops protective toxins. Research in this area could improve our understanding of evolutionary relationships between insects and plants and tend to improve sustainability of crop protection. In particular, studies that link spatial distribution of toxins with genetic variation in behavioural responsiveness and physiological tolerance in phytophagous insects are important. Another related area in insect–plant interaction relates to stress-induced changes in host plants on insects and the importance of the combined efforts of drought conditions, nutrient deficiency and air pollution cannot be overemphasized, including variation in plant genotype.

An aspect of uniqueness in the reproductive physiology of some insects relates to sperm transfer mechanisms such as direct transfer and dissociated transfer involving spermatophore trampling by rival males. Of particular interest is the fact that secondary sexual characters are typically absent in species with females and males not contacting each other during sperm transfer, like the water mites. This suggests that female choice does not act on male morphology, unlike in direct species contact where the role of female preferences in male mating success and the evolution of male secondary sexual characters contribute to behavioural ecology studies. Females of dissociated species have the ability to chemically differentiate between groups of males on the basis of their spermatophores – though it cannot prove that females can consistently choose spermatophores of a given male.

The developmental timing and mechanisms of caste determination are discussed in relation to wasps and evidence is presented that the concept of caste cannot be applied to most eusocial vespids. The physiological basis of caste determination has been addressed from an ecological viewpoint. In short, reproductive caste differentiation often occurs before adult eclosion, some females emerging as workers and incapable of producing fertilized eggs, another set of females emerging as potential queens, with dominance contests. Of equal interest is the evolution of social behaviour in burying beetles which coordinate reproduction with the location of a necessary resource that is unpredictable in time and space and reproduction must be coordinated with a mate. Their complex social behaviour in an ecological context focusing on the evolution of extensive biparental care in communal breeding is discussed.

Diverse facets of ecology of arthropods are highlighted in relation to global climate change, impact of fire in forest ecosystem and biodiversity in threatened stream ecosystem, with emphasis on biodiversity. Current focus on global climate change research provides an opportunity to study fundamental ecological processes and spatial dynamics in harsh environments like arctic systems which are strongly heterogeneous, requiring a diverse array of adaptive responses in morphology, behaviour and ecophysiology – all responsible for low species diversity of invertebrates. Interaction of fire with insects can delay or redirect forest succession and can have a significant consequence for forest productivity and biodiversity. Fire has been used in agriculture and range systems and can predispose trees to attack by bark beetles or some wood-boring beetles. Among the most threatened ecosystems on earth are the streams and to be able to maintain and restore biodiversity of stream ecosystems, documentation of the patterns in stream insect biodiversity, identifying the major environmental factors controlling these patterns is essential.

Phenotypic plasticity resulting in adaptive phenotypes depends on the environment during ontogeny. Genetic differentiation and phenotypic plasticity are two phenomena linking phenotype to genotype, besides canalization or developmental homeostasis. High level plasticity involves genetic polymorphism and polyphenism and these should be prime targets for research. A synthesis of ecology and genetics is needed to find out the nature and stability of genetic variation. A combination of evolutionary ecology and genetics will be useful, phenotypic plasticity providing a wonderful way of adapting the phenotype. An equally relevant area for future research relates to colour and habitat usage with reference to spider colonization. It is indicated that true polymorphism tends to occur in forest habitats, reflecting the suggested role of bird predation in the maintenance of colour polymorphisms.

Aspects relating the phylogeny and evolution of host–parasitoid interaction in Hymenoptera, mycetocyte symbiosis, biology of nonfrugivorous tephritid fruit flies, ecology and management of hazelnut pests and malarial parasite development in mosquitoes provide equally useful information relating to agricultural and medical fields. Needless to emphasize, the collection of articles in this volume highlights several emerging trends in the field of Entomology and goes a long way in providing very relevant information on diverse aspects which makes the Annual Review an invaluable compendium.

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Geodynamic Domain in the Alpine Himalayan Tethys. Anshu K. Sinha, F. P. Sassi, D. Papanikolaou, editors. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi 110 015. 440 pp. Price not known.

This book is a collection of 20 papers, mostly presented at the special session of the International Geological Correlation Programme (IGCP) Project-276 on Palaeozoic Geodynamic Domains and their Alpidic Evolution in the Tethys, organized during the 29th International Geological Congress held at Kyoto in Japan in August 1992. The Tethys zone stretches from the Atlas mountains in Algeria through Iran, Himalaya, Trans-Himalaya and Southeast Asia. In the Himalayan context, the terrane north of the Main Central Thrust and south of Indus Suture Zone incorporating the Phanerozoic basins is generally considered as Tethys. However, on a wider frame the term Tethys has acquired a more liberal application and dilution as to be of doubtful utility. This has led to terms like Paleo-Tethys, Neo-Tethys and Proto-Tethys. Ultimately it is uncertain whether the Tethys is a phase or an entity.

The perusal of the book brings out that many of the contributions do not conform to the basic theme of Palaeozoic geodynamic domains and their alpidic evolution in the Tethys.

The book unfolds with a review of broad geodynamic aspects of the Himalaya and adjacent areas with an emphasis on terrane concept (Sinha). It is followed by a paper which highlights some events in Ladakh during Cretaceous–Cenozoic time involving oceanic