

In this issue

Chemistry, caste and honeybees

Does chemistry determine behaviour? Undoubtedly so, but rarely do chemists and behavioural biologists find a common meeting ground. In a speculative paper in this issue, Gadagkar (page 975) asks a provocative question, 'What is the essence of royalty' that determines the queen in a honey bee colony? The answer appears to be provided by a recent paper by Plettner *et al.* (*Science*, 1996, 271, 1851-1853), which examined the mandibular gland secretions of queen bees and workers. Interestingly, the secretions which contain hydroxylated, unsaturated fatty acids differed only in the position of the carbon atom that is hydroxylated. The differences arise because of a 'caste-specific bifurcated pheromone biosynthetic pathway' for the production of these compounds. The major pheromone produced by queen bees is 9-keto-(E)2-decenoic acid (9-ODA), a compound with a name far more formidable than its chemical structure. This substance differs from the major component of the worker pheromones, which lack the carbonyl group at position 9; tempting Gadagkar to state emphatically that the 'essence of royalty is just one keto group'.

Caste-specific biochemistry in social insects like honey bees provides a chemical rationalization of the differentiation between the queen and workers in a colony. The remarkable phenomenon of colonies that contain 'thousands of sterile workers, a few hundred drones and a single fertile female, the queen' has fascinated sociobiologists for a long time. Several questions remain to be addressed,

the most obvious being – who came first, the queen or the worker? In considering this problem Gadagkar returns to the reactions of pheromone biosynthesis and argues that pathways in workers appear to be more 'ancestral' while that in queens which result in 9-ODA appear to be more 'derived'. His thesis is based on the argument that the production of the keto acid (9-ODA) is 'energetically unwise', thereby suggesting a more important motivation than mere production of energy by oxidative metabolism. There are many fascinating issues to be considered, not the least of which is the evolution of sociality. Queen bees can indeed 'be thought of as an invention of sociality'.

Gadagkar uses this essay on the essence of royalty to emphasize that the failure to make distinctions 'between proximate physiological explanations and ultimate evolutionary explanations' leads to 'unnecessary confusion as to what constitutes a valid answer to the question of why an animal does what it does'. The biochemical analysis of 'caste-specific' pheromones in honeybees by Plettner *et al.* is a marvellous example of the interplay between 'proximate and ultimate factors'. Gadagkar concludes with an Utopian vision where evolutionary biologists become biochemists and vice versa. It would appear that there is still life in lipid biochemistry.

Revolutionizing life science education

Most scientists and educationists appear to agree that all is not well

with the state of university science education in India. Academies have pondered over the issue and there have probably been many eminently forgettable reports commissioned by successive generations of planners and governments. The National Science University proposal which aroused an extended debate in this journal, highlighted the widespread concern that science education in universities needs a dramatic reorientation. In an article on page 960, Modak details a proposal for an integrated 5-year M Sc course in life sciences. The growing importance of the biological sciences and the high hopes that have been raised by the ongoing biotechnology revolution, emphasize the importance of focussing on this area. Modak's proposal for integration of various subdisciplines will find an echo in other areas of science. Few will quarrel with the synthetic approach espoused by Modak and none will argue with the need for favouring inventiveness in students. However, a sobering thought is that we have rarely been short of good solutions on paper to important problems. The real difficulty lies in implementing any new programme, cutting through thickets of resistance to change. In a strongly worded postscript, Modak argues that his suggested experiment in education should be supported 'because it is revolutionary and original. It is a direct attempt to replant the cured soil of higher education in science with an epigenetically modified and better-yielding variety.' Deeds must follow words.

P. Balaram