In this issue

Preparation of novel quantum states

Nearly sixty years ago, Einstein, Podolsky and Rosen drew attention to the strange behaviour of certain quantum states which show nonlocal correlations between the results of measurements made on different particles at large spatial separation. Ever since, these 'EPR' effects have fascinated theoretical and more recently some experimental physicists. Thirty years ago, John Bell sharpened the feeling that this behaviour cannot be classically understood as a theorem, which in turn has been sharpened in subsequent work. The article by F. Laloe (**page 1024**) presents a novel optical approach to preparing such states, which might ultimately lead to experimental texts of some of the most paradoxical features of quantum mechanics.

R. N.

Overturning a belief: Non-occurrence of style length dimorphism in figs

One of the most popular examples of plant–insect cooperation is provided by the fig and fig–wasp system. The figs provide flowers for the wasps to lay eggs, and the wasps pollinate the fig flowers. On closer scrutiny, however, it is seen that this apparently harmonious relationship (like many others) is actually a fine balance between the two parties, each one trying to derive maximum advantage for itself. As driven by natural selection, the fig would make the styles longer and longer so that it is more and more difficult for the wasp to usurp the flower by laying an egg in it (and thus preventing seed formation), however, the length should not be so long as to prevent any eggs being laid – the wasps are needed for pollination. On their part, the wasps would make their ovipositor (the organ for depositing eggs) longer and longer so as to usurp as many flowers as possible, but not so long that it becomes too heavy a burden; nor should they usurp *all* the flowers – new trees need to come up. How does natural selection quantitatively achieve the balance of power?

A beautifully simple solution, proposed over three decades ago and accepted ever since, suggested that the fig produces two types of flowers, short and long. The wasps can usurp all the short ones, and seeds will be formed in all the long ones. The ovipositor length corresponding to the short style length is at a local maximum in fitness, since a small increase in length does not increase the number of flowers that can be unsurped. A coevolutionary equilibrium is reached wherein the fig tree has an upper hand – by controlling the fraction of short-styled flowers, it exclusively controls the proportion of flowers available for wasps. If aesthetic criteria alone were adequate for accepting an explanation, the bimodality-based argument would have continued to reign supreme.

An exciting aspect of science is that, once in a while, an advance is made which overturns established beliefs, regardless of how elegant they are. A rare instance of a beautiful and well-accepted explanation turning out to be vulnerable to a detailed investigation is reported in the article by Kathuria *et al* (**page 1047**). They have meticulously measured the lengths of over 1200 flowers from seven tropical monoecious fig species and seen only a unimodal distribution in each of the species; in fact, the usual normal distribution seems to fit the data quite well in every case. While some recent studies from Africa and from neotropics have presented some preliminary evidence against the bimodal dogma, this article is the first one to do so in a much more quantitative and comprehensive manner. Another interesting feature reported in this article is that for some species the mean ovipositor length is greater than the mean style length – the wasps thus have the potential to usurp all the flowers. The authors have put forward a tentative but plausible explanation of this being an example of natural selection operating on the *variability* of a character (in contrast to the *magnitude* of a character). Other instances of hostile coevolutionary dynamics (e.g. between prey and predator) may be profitably examined from this new and interesting angle.

N. V. J.

A closer look at 'directed' mutations

The role of chance in evolution was firmly entrenched ever since the classic experiments of Luria and Delbruck (the fluctuation test), and the randomness of mutations was taken for granted. Then in 1988, the startling results from Cairns and coworkers indicated that mutations could not only be nonrandom but also directional. In other words, the probability of a 'favourable' mutation taking place was higher. More explicitly, a (wild-type) bacterium which is unable to grow on, say, galactose has a certain probability of undergoing a mutation which then enables it to use galactose. However, if a wild-type is faced with a situation where galactose is the only available food, the probability of a mutation taking place, which will enable it to use galactose, is higher than the earlier case (where there was really no need for such a mutation)!

This phenomenon on the face of it looks absolutely outrageous when seen from a conventional point of view – how can a bacterium 'know' what is good for it? Cairns' results generated a heated controversy, and several objections were raised against the interpretation as well as experimental protocol. Subsequent experiments by Barry Hall confirmed the results *a fortiriori*, but the consensus is yet to be reached about the basis of this phenomenon.

An underlying and unquestioned assumption here was that the directional mutations would always be more beneficial to the organism, almost by the very definition. In the article on **page 1039** of this issue, Watve *et al* examine this aspect in detail, based on a simulation of bacterial evolution in a chemostat. Interestingly, they find that under a restricted set of conditions, directional mutations showed 'little selective advantage', thereby emphasizing the necessity of taking an even more careful look at this debate.

N. V. J.