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An elegant, instructive, and inexpensive experiment

Many readers will recollect the stir caused nearly ten years ago when Michael Berry of Bristol derived a universal 'geometric' phase angle which the wave function of a quantum system acquires as its state is changed. Perhaps not surprisingly, so general and simple a concept had cast its shadow before — one of the best accounts being Berry's own article 'Anticipations of the geometric phase' (*Physics Today*, December 1990). One of these anticipations was by a twentyone-year-old student (and, for those looking for nepotism, nephew) of C. V. Raman, who was studying the interference of non-orthogonally polarized modes in crystals like amethyst. This optical phase angle, now universally called the Pancharatnam phase after its discoverer, has been demonstrated and exploited in relatively sophisticated experiments.

In this issue, Hariharan and Narayana Rao (**page 483**) describe a novel, simple, robust and inexpensive arrangement which demonstrates the geometric phase. For those used to temperamental white light interferometers with hard to see and easy to lose fringes, this one will come as a revelation (the private communication from one of the authors is that insensitivity to vibration extends even to jumping on the table!). University laboratories can now set up for their students an experiment illustrating a contemporary and significant concept in quantum mechanics—indeed in mathematical physics more generally.

Geography and viral detection

In the four years since the discovery of the hepatitis-C (HCV) virus, it has been established that HCV is the major cause of non-A, non-B hepatitis, most often resulting from blood transfusion. HCV infections have been identified in the West and in Japan using enzyme immunoassay procedures, which depend on an antibody response to specific viral antigens in infected patients. An alternative approach to viral detection employs techniques based on amplification of viral nucleic acid by the polymerase chain reaction (PCR) after treating samples with reverse transcriptase (RT), the RT-PCR method. On page **477**, Das *et al.* describe such a procedure to detect Indian strains of hepatitis-C virus. Most importantly these authors establish that as a consequence of genomic heterogeneity among HCV isolates from different parts of the world, careful choice of primers is necessary for viral detection by the PCR method. Indeed, primers suited for US and Japanese strains fail to detect Indian strains. The sensitivity of the method is impressive, in that ELISA-negative samples from patients exhibiting clinical manifestations of non-A–non-B hepatitis infections were found to test positive from HCV by the PCR technique. It is unclear whether the failure to detect HCV antibodies in these samples is a consequence of a sluggish immune response or due to antigenic variations. This study underscores the importance of recognizing genetic variations in viral isolates from diverse geographic regions.

Cooperative breeding in bee eaters

In a significant proportion of bird species, several adults co-operate in raising the brood. Clearly, some of these adults are only altruistic helpers assisting the breeding pair in raising the young ones. Explaining the evolution of such co-operative breeding in birds has been as attractive and even more challenging as that of explaining the evolution of high levels of sociality in insects. In insects, evolution of sociality and altruism has been possible because of the high level of genetic relatedness among the members of the group (though not without objections and controversies). In birds, arguments based on the genetic relatedness cannot be easily extended because there have been instances where adults with no established relationship to the breeding pair, help them raising broods. Thus searching an adaptive basis of the co-operative breeding process in birds has been a more challenging task; this is especially so because birds are not easy to laborotorise as wasps and bees can be and studying them in the field is a highly demanding exercise. Obviously data to test any conceptual issues are very hard in these systems hindering the process of our understanding of these systems. In this context, the paper by Sridhar and Karanth (**page 489**) on small green bee-eaters is a significant contribution towards our understanding of the co-operative breeding process in birds.

There has been some consensus that the evolution of the co-operative breeding process encompasses three important stages: a) Habitat saturation stage: When the birds saturate the available territories of the habitat, there would be 'no where' for the newly breeding birds to go. It might pay well to them to assist the other established breeding pairs and gain the 'apprenticeship' in raising the young. This experience might help them when they indeed get a chance to breed on their own — an opportunity created by a sort of 'vacancy chain' process following the death of any of the breeding parents. b) Family or kin selection stage: In such saturated habitat conditions that enforce assistance than independent breeding, it might be more profitable for the helpers to help their own parents because by this they reproduce their own genes and they also enjoy the probability of inheriting their parents' territories on their death. Thus as long as the probability of getting the territory by inheritance is more than that by independent searching, the offspring would be selected to help the parents. c) Kin-group selection stage: With the increase in the family size, the defendable territory also grows allowing more than one pair to breed in the same area. Flocks of such pairs might indeed be selected to breed co-operatively (and often communally) as they happen to be highly genetically related.

Ornithologists have been looking out for supporting data at all these stages. In their paper, Sridhar and Karanth demonstrate two important issues in small green bee-eaters: i) The helpers reduce the cost to, and the success rate of raising the young by, the breeding pair, and ii) that frequency of helpers was more in the season following low rainfall than that following high rainfall. This feature that under resource limited conditions (i.e. when the territories are limited) there has been a higher instance of 'helpers' than under resource good conditions, is generally emerging as a common pattern supporting the first of the stages envisaged above.
