

Editorial*

T N C Vidya, Associate Editor

How does one find out what another is thinking? How does one find out what another knows if they do not speak the same language? How about if they belong to a different species? Humans have long attributed various qualities to non-human animals, ranging from the mundane to the mythical and magical although the latter can be forgiven sometimes, for the realms of the real and seemingly magical do intersect, thanks to the diversity of life. I grew up hearing my father's favourite quip *Observation is Discovery*. Systematic observation of animal behaviour has allowed biologists to obtain some glimpses of animals' minds. As the renowned primatologist Frans de Waal has argued, shared language may not necessarily provide insight into another's abilities and may, in fact, be an impediment, whereas observation and ingenious experiments can be very insightful. However, setting up such experiments is not an easy task and one of de Waal's book titles asks *Are We Smart Enough to Know How Smart Animals Are?*

One of the biologists who was smart enough to design clever studies to understand some of the abilities of other animals was Dorothy Cheney, featured on the back cover of this issue. She would have turned 70 this month. Dorothy Cheney, not only carried out rigorous experiments but also stressed the importance of asking ecologically relevant questions and making inferences in the context of an evolutionary perspective. Cheney's husband and collaborator, eminent primatologist and behavioural scientist, Robert Seyfarth, provides some examples of their fascinating research in a General Article. An Article-in-a-Box provides a short biography of Cheney. I am grateful to Robert Seyfarth for immediately agreeing to put together the General Article, providing



Email: tnevidya@jncasr.ac.in

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photos and other information, and choosing a Classics—‘Monkey Responses to Three Different Alarm Calls: Evidence of Predator Classification and Semantic Communication’—by R M Seyfarth, D L Cheney, and P Marler, in *Science*, 1980). Unfortunately, we did not receive the permission to reprint the Classics in this issue, but I urge you to read the paper if you can access it. Cheney and Seyfarth pioneered the use of experimental methods such as playbacks in field studies of primates, yielding new understanding about how monkeys perceive their world.

Moving from experiments in the field to those in the classroom, H A Ranganath describes experiments that can be carried out by students using *Drosophila* fruitfly mutants to understand some basics of genetics. Contrary to what one might naively expect, it is possible for dominant, lethal mutations to be maintained in a population; read the Classroom article to find out how. We also have another Classroom Article by Dhatrak N R on the IUPAC standards for representing organic molecules.

Different kinds of representations of real and abstract entities are probably limited only by the imagination. For example, you might have heard the “sound” of pi on the internet. If one is musically inclined, it might be easier to remember the notes rather than the numerical value. In this issue, G S S Murthy, in the fascinating article ‘The Knight’s Tour Problem and Rudrata’s Verse’, describes the composition of Sanskrit verses (in 9th century AD India), in which syllables represented numbers. Thus, a meaningful poem could simultaneously provide the solution to a mathematical problem—in this case, The Knight’s Tour Problem. The Knight’s Tour Problem, which is a famous example of the more general Hamiltonian path problem in graph theory, requires a chessboard knight to perform a series of moves such that the knight visits every square, but only once. It is also interesting to see how different subjects are interconnected. In searching the space of phylogenetic trees (trees depicting the historical relationships between different taxa) to find the best tree given the data, one of the methods we use is the branch and bound algorithm. This algorithm was used to solve the travelling salesman prob-



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lem, a famous Hamiltonian cycle problem. Thus biologists like me were introduced to the Hamiltonian problem through phylogenetics rather than mathematics.

Jayant Narlikar provides some important points of view about why there is an arrow of time or irreversibility in the flow of time in his General Article ‘The Nature of Time’. He explains how the arrow of time that shows up in different branches of physics—cosmological, electromagnetic, and thermodynamic—may be connected together. Another General Article by S Dattagupta explains line shape analysis based on the doctoral thesis of theoretical physicist and Nobel Laureate, P W Anderson who was featured in the May issue this year.

We feature three Research News articles in this issue. Amit Roy reports on the recent discovery of a tetraquark at the Large Hadron Collider, and Amanda Karakas describes the recent discovery of lithium production in red clump stars by Kumar and collaborators that is not predicted by theory. B Sury explains the hundred-year-old Rectangular Peg Problem in mathematics and its recent solution by Greene and Lobb.

We hope you enjoy reading this issue.

