In this issue

Physics of sailing craft

A sail is pushed by the wind, propels the boat, and that's where the matter ends for all of us. But this is just the beginning of the story which V. Radhakrishnan relates (**page 503**). The article offers glimpses of a fascinating history, physical principles which are surprising at first sight (which even Newton missed!), and implications which are even more surprising such as the highest speed being achieved by going almost against the wind. Contrary to popular belief, the grace and elegance of the sailing ship was in appearance only, the Chinese junk being technologically a better design.

One learns that Rayleigh himself foresaw the connections between the sails of boats and the wings of aircraft yet unborn. Today, many ideas from aeronautics are being fruitfully transplanted back into the water. The last part of the article deals with the novel and still-evolving designs which have emerged, often from the workshops of gifted amateurs. The author brings to his subject four decades of first hand experience of sailing and three of flying, acquired *en passant* while practising radioastronomy around the world.

Rajaram Nityananda

Bergman cyclization

Ernest Rutherford undoubtedly overstated his case when he said that there are two kinds of science – 'physics and stamp collecting'. Chemists and biologists have proved the virtues of a philatelic approach to science. The careful collection and documentation of facts and observations is indeed a central theme of science. Organic chemistry is a discipline in which, traditionally, the collection of experimental facts has taken precedence over the development of sweeping generalizations and unified theories so beloved amongst physicists. Cataloguing reactions and molecular structures spanning a period of over a century has resulted in a subject that appears largely incomprehensible even to scientists in other areas. The lay public is generally blissfully unaware of even useful developments in a field of immense practical importance. The poor public image of organic chemistry (and indeed chemistry as a whole) is partly due to the many problems of environmental toxicity associated with chemicals, while ignoring their myriad beneficial uses. Another oft unappreciated factor is that the language of organic chemistry is totally foreign to those outside its disciplinary boundaries. While practising chemists find the language of chemical structures precise, with a rational grammar, outsiders are bewildered by a stunning array of hieroglyphics. Chemical language, however, has great aesthetic beauty and indeed well-drawn formulae convey a great deal about molecular shape and electronic characteristics. There are structures which have become so widely known that they are readily recognized even by non-chemists. Benzene is an example while water is another. In the drive towards classification and cataloguing, organic chemists have also discovered myriad reactions, which allow the rational transformation of one structure into another. A curiously appealing feature of the subject is that many reactions are named after their discoverers with some of the better-known reactions having been recognized by Nobel committees in this century. (The roll of honour includes Victor Grignard, Otto Diels, Kurt Alder and more recently, Georg Wittig.) It is not surprising, therefore, that students of organic chemistry are often found huddled before examinations studying 'name reactions'.

One such reaction is the esoteric conversion of an acyclic system containing two acetylenic units linked by an ethylene unit (the *cis* enediynes) to a cyclic benzenoid diradical, which was discovered by Robert Bergman at Caltech in 1972. He would have hardly imagined that the *cis* enediyne skeleton would surface in a natural product calicheamicin produced by a microorganism. Even more improbably, the product of the Bergman cyclization of calicheamicin interacts with DNA, resulting in antitumour activity. The discovery of calicheamicin and the elucidation of its structure at the Lederle Laboratories in the 1980s brought the Bergman cyclization to the limelight, illustrating forcefully the importance of serendipity in scientific discovery.

Pramanik *et al.* (**page 527**) examine the electronic factors that influence the Bergman cyclization. The authors use both AMI and *ab initio* molecular orbital calculations, demonstrating the tremendous inroads that quantum mechanics has made into chemistry. Paul Dirac also surely overstated his case when he said the quantum mechanics explains much of physics and certainly all of chemistry. Nevertheless, within the limits imposed by the many inherent approximations in calculations on large molecular systems, quantum chemistry provides glimpses of electronic structure and reactivity that are invaluable in designing new molecules and experiments.

P. Balaram