In this issue

The ever-ready pollen

Nature's oddities are often well beyond the best imagination of human mind. Some of these have indeed been the inspirations for a few of the most artistic and aesthetic creations by man. Often these oddities also pose clear challenges to his inquiring mind. Indeed as Stephen Jay Gould remarks, these oddities of Nature are the scientists' bread and butter. One such bizarre feature of the plant reproduction is reported in this issue by Sharma and Koul (**page 598**): the precocious germination of pollen grains in a species of *Trifolium*.

Normally pollen grain are released as well-protected units such that they could beat the odds of weather during their long journey, often hitch-hiking on the body of insects or birds or mammals from the anthers of a flower to the stigma of another flower of probably another plant. Obviously they are induced to germinate only by the uniquely suitable conditions prevailing on the target stigma. The conditions are so unique to each species that plant breeders have to frequently struggle to construct suitable growth media for germinating the pollen grains of different species.

However, occasionally in certain species the pollen grains are precociously germinated even before they are released from the anthers. Sharma and Koul report that in *Trifolium dubium* the pollen grains germinate well within the anther in all the anthers of all the flowers of all the spikes of all the plants they studied. They also found that in some situations the pollen tubes enter the stigma from the undehisced anthers. They interpret it as a strategy to facilitate obligate self-pollination. This, however, is not consistent with their statement that the 'species practices high pollen competition'; one cannot visualize a severe level of pollen competition in a species that is obligate self-pollinated. There could be alternate explanation also: precocious germination of the pollen grains has also been interpreted as a strategy for gaining a head start in the severe competition among the pollen grains for the limited ovules in the ovary – a form of male–female competition in plants. This possibility is especially likely in *Trifolium dubium*, as there are only two ovules of which one at the base eventually aborts. Thus pollen grains would indeed be selected to be competitive to gain access to the ovule at the stigmatic end. But if this be true, Sharma and Koul might have to reevaluate the level of selfing in this species.

K. N. Ganeshaiah

Flow process modelling

Whether we like it or not, we have to face up to the fact that the whole world has now come under the spell of the American ethos. One of the more disturbing aspects of this ethos is the notion that one has to choose between selling and being sold, with no other alternative being available. In this harsh climate of hard sell, so many tall claims are made that we become very wary of any claim at all. Take the case of computational fluid dynamics (CFD). It has been very common among some of its practitioners (the school of *hard* CFD?), to claim that with sufficient computing power available CFD has made or will make expensive wind tunnels and experimentation obsolete; that given enough computing power, any fluid dynamic problem can be solved. To more rational and knowledgeable people, these claims have sounded like sheer madness. But it would be very foolish to let the hysteria put one off from correctly estimating the true potential of CFD. What is its real potential?

The reason that fluid dynamics is so hard is because nonlinearity is at its core, and as we all know, there are no general ways of dealing with nonlinear problems. As a consequence, even after more than a century of effort, we still have no real handle on the central issue, of immense practical importance, of turbulence, which Feynman considered the last unsolved problem of classical physics. Since theory could do little, one was forced to rely on experimental testing to solve the kind of fluid dynamical problems that needed to be solved off campus. What is not often noticed or recognized, is that such experiments and testing were often ingenious and clever, often drawing, with the help of theory, useful conclusions of a general nature from a small number of tests; but there was no glamour. In this frustrating situation, enter that panacea of modern times, the computer. Suddenly, it appeared that people who knew little mathematics or physics or fluid dynamics could suddenly 'solve' difficult fluid dynamic problems and even present the results in the most attractive colours. It appeared that turbulence was licked or was about to be so. *By Golly, it could even be done on a PC!* Or so the claims went. But what was the truth? Yes, it is true that many problems can now be solved, especially for complex geometries and flows, that could not have been dreamed of a decade ago. More important, there are flows of great industrial importance that can now be modelled at least approximately, but usefully, by CFD using inputs from experiments and theory. But the problem of turbulence has not been licked. The shameful truth is that we still cannot compute, from first principles, how much power we would need to pump a given volumetric flow of liquid through a pipe if the flow rate is high enough!

Yet great successes have been achieved and are being achieved. There is a large body of hard facts to show that in the aerospace industry, CFD is now playing a crucial role in design and development. I would go so far as to say that some of the planes flying today, would not have been the commercial successes that they have become if it were not for the economies that intelligent use of CFD brought about. Less well known is the role that CFD can play in non-aerospace industries. It is for this reason, especially in the Indian context, that Ranade's article (**page 602**) is timely and appropriate. At a time when Indian industry is being exhorted to be competitive in order to survive, when it is often suggested that Indian companies are backward in not supporting inhouse R&D, that no attempts are being made to improve existing technologies, let alone develop new ones. Ranade's examples and suggestions show us an alternate, positive path. By the intelligent use of modelling, of grafting on to existing codes incremental new details and ideas, it is possible to make suggestions and predictions that could have a significant impact on technology and hence on the economy. Ranade points out, and I believe correctly, that important inputs will have to come from basic research if this programme is to succeed; further that this effort, in order to be really successful would have to be a collaborative effort of scientists working in the universities, the national labs and in industry. There is a lot more than hype here. Let us hope that the vision projected here comes to pass and that CFD comes to play the useful and key role that it is really cut out for.

P. N. Shankar

Designing molecular locks

Emil Fischer's 'lock and key' concept of molecular recognition is a century old. Spurred by the exquisite specificity of biological receptors (invariably macromolecules), chemists have in the last few years turned their attention to the design of molecular hosts which can recognize specific guests. The game is conceptually simple; design molecules which are most often hollow or concave and attempt to find guests which can then fit snugly into cavities stabilized by a variety of non-covalent interactions. Specificity is then achieved by tuning cavity size and the nature of the binding interactions. While crown ethers, cryptands, cyclodextrins and cyclophane based systems were intensely investigated in the period between the mid 1960s and the late 1980s, attention has turned to diverse molecular scaffolds in recent times. A particularly versatile unit is the bile acid skeleton in which polar, functionalisable hydroxyl groups lie on one face of an amphiphilic molecule. Maitra (**page 617**) provides an elegant account of the use of bile acids in generating novel, artificial receptors and as auxiliaries in asymmetric organic synthesis. Laboratory design is still far from achieving the specificity and versatility of biological receptors. 'Molecular locks' are frequently the products of sophisticated design strategies. The interactions which bind the lock and key together are hard to control, except in the case of hydrogen bonds. The organic chemist is, however, not really bound by the limitations of biochemistry. The expectation is that imaginative design approaches will lead to novel molecules which will have diverse applications including use as molecular devices and sensors.

P. Balaram