In this issue

Triple helix

The *triple helix* appears to be a name from the pages of a biochemistry textbook, evoking an image of three intertwined strands of a biological structure – G. N. Ramachandran's collagen model. If the name conveys a sense of intimacy between the chains, its use in an entirely different context may not be too surprising. This issue carries a report (**page 690**) of a meeting held in Amsterdam, which considers a three-way interaction between academia, government and industry, a system christened as a Triple Helix.

The collapse of communism has spawned a new industry – the development of think tanks, which analyse and reanalyse novel development strategies, even as much of the world struggles to cope with new and unfamiliar international situations. These are turbulent times for science and technology policy makers, who have to grapple with the problems of diminishing governmental support and the need for generating innovative science, which translates into applicable technologies.

In India, academia is a heterogeneous collection of universities and research institutions, of widely varying quality with woeful infrastructure for carrying out competitive research. Government, of course, is omnipresent with state funding being the sole way of supporting the science and technology enterprise. The vast network of government laboratories now labours under the pressure of having to show a large influx of funds from external sources (although sometimes even another arm of the government suffices). Industry is yet to recognize the need for a long-range commitment to scientific research. Industrial R&D laboratories are yet to attract the visionary management that will build bridges to academia in the future. Indeed, the three strands of the triple helix show little signs of a cohesive and stabilizing interaction in India as yet.

The need for linkages between academia, industry and government is clear, the world over, but the modes of interaction are still to be defined. The news from Amsterdam is comforting. There may be as many variants of the triple helix as there are nations. Diversity is obviously not restricted to biology but spills over into human affairs.

P. Balaram

Fractal analysis of sea level changes

Just as the year-to-year variations in rainfall ('the vagaries of the monsoon') are taken for granted, so is the constancy of the mean sea level. Even a glance at the datasets depicted by Indira, Singh and Yajnik on **page 719** of this issue, however, is enough to appreciate the remarkable complexity and inter-annual and between-stations variability of the mean sea level. Studies carried out in other parts of the world, involving time spans ranging from two hundred to two hundred million years, tell similar stories. The patterns of temporal variation are too irregular for trends or cycles to be easily discerned by conventional means; techniques of fractal analysis (such as determination of fractal dimension), however, seem to offer some insights.

What exactly is meant by a fractal dimension of a time-series? (Going by the sheer number of publications dealing with fractal dimensions of this and that, one is reminded of Szent Gyorgi's description of what a drug is – a substance which, when injected into a rabbit, produces a paper.) For an easier understanding, one can focus on the differences in the levels between consecutive years, instead of the sea level *per se*. A time series of these differences (steps) is now reminiscent of a random walk in one dimension. In standard random walks, the consecutive steps are uncorrelated and neither the size nor the direction of one step depends on the previous ones. This is not true, however, for the mean sea level (and many other natural phenomena such as rainfall, water level in reservoirs, river discharges, temperatures and pressures). In these phenomena, the changes from one time-step to the next tend to be positively correlated – colloquially, one good (or bad) turn deserves another. These systems thus show persistence, i.e. long (and non-periodic) trends of increase or decrease. The fractal dimension quantifies the extent of this persistence. Indira, Singh and Yajnik have demonstrated that, notwithstanding the striking differences in the patterns of mean sea level changes, very similar values of fractal dimension are obtained for Bombay, Cochin, Madras, Vizag and Sagar.

More important than correlations between successive steps is the property of scaling. Imagine a graph of mean sea level in meters (y axis) versus time in years (x axis). If instead of one year, we choose a decade as a unit of time, the magnitude of changes seen on the y axis would certainly be higher (though not by a factor of 10); large departures which occurred roughly once in 10 units would now be shown to occur in only one unit. For fractal curves, the original looks can be restored by adopting a different scale for the y axis. It turns out that if the scale of the y axis is adjusted so that one unit is now 10^H, the graph 'looks' exactly like the original. More importantly, this relationship holds for larger timespans as well, changing the unit of x axis by a factor of 1000, and that of the y axis by 1000^H leaves the look of the graph unchanged. When such is the case, the time series can be called self-similar, and H gives an indication of its fractal dimension. For the standard random walk, H is known to be 1/2, whereas the authors find it to be around 0.75 for mean sea levels at all the stations, again indicating persistence. More interestingly, this value is close to that obtained for global precipitation records, oxygen isotope ratios (a proxy for temperature) in the Pacific cores, and for the late Pleistocene sea levels. Though skeptics (perhaps not unjustly) remain unconvinced, the authors also highlight the usefulness of this exercise for modelling this 'complex nonlinear atmosphere–ocean–cryosphere–lithosphere system'.

N. V. Joshi

Glacial behaviour

The growth rings in trees not only throw light on the age of the plants, but also tell a good deal about the condition of climate in which they grow. A Bhattacharyya and R. R. Yadav (**page 739**) show that a species of pine (*Pinus wallichiana*) growing in Kinnaur and Kashmir indicates lower temperatures and attendant glacial advances in the western Himalaya in the periods 1970–1976, 1981–1984 and 1989.

K. S. Valdiya