In this issue

Cray vs Chipps vs Flowsolver vs Param vs Anupam: Evaluating indigenous parallel computers for weather prediction

Forecasting the weather a couple of days in advance is such an important task that one of the first supercomputers (Cray) procured by India is being used for it at the National Center for Medium Range Weather Forecasting. Such supercomputers, however, are quite expensive; more importantly, they cannot always be obtained by money alone. Export restrictions imposed by the government of the country manufacturing it can create major hurdles for importing high-performance computers based on proprietary high-speed processors.

An alternative approach to building fast computers is based on using parallelism. Instead of using a single, expensive, ultra-fast processor, it is possible to connect a large number of relatively inexpensive processors together, which can simultaneously work on different parts of the computation. Such 'parallel' architecture can, in principle, give a very high level of performance for some types of problems – those where parts of the problem can be tackled simultaneously. Weather prediction, as explained clearly and in detail in the article by B. K. Basu on **page 508** of this issue, is one of such tasks. Similar types of calculations have to be carried out on the sets of meteorological variables like pressure, temperature, etc. at many points on the global latitude–longitude grid, for many atmospheric layers at different heights. How effectively can it be tackled in practice using parallel computers? In November 1992, the National Center for Medium Range Weather Forecasting invited several of the centers working on the development of parallel computers for testing the parallelizability of the NCMRWF weather prediction software. Four of these centers accepted the invitation, and actively participated in the exercise between end of 1993 to early 1996. The article by B. K. Basu is an account of this effort.

The machines developed by the four contesting groups (Chipps of C-Dot, Flowsolver of NAL/IISc, Param of C-DAC/IIT (D) and Anupam of BARC) were thus pitted against the Cray, and also against each other. How did they fare in terms of speed and accuracy? Unfortunately, it is not easy to decide who the winner is (if at all). The contestants differed widely in their choice of the type (transputers vs i860) as well as the number (8, 9, 14 and 128) of processors – and the price (if any) has not been mentioned. The major importance of the article is in the interesting description of the range of options available in parallelizing the computations, the intriguing small but consistent (and unexplained) discrepancies between the results of serial versus parallel computation, and the comprehensive look at the potential of parallel computers in taking over many of the other tasks related to weather forecasting. As to the results mentioned there – well, they are as of 31 March 1996. As the author has rightly pointed out, much has changed during the last two years in terms of the availability of computational facilities at these centers as well as at NCMRWF.

Two years is a very long time in the fast-changing world of computers – processors, memories and communications have all become faster, cheaper, more powerful. The 8.5 nanosecond tick of the Cray mentioned in the article has been surpassed by the 5 nanosecond tick of 200 MHz Pentiums available everywhere! This, together with the easily and freely available, robust and powerful Linux operating system and the excellent (and freely available) software tools resulting from the vigorous, internet-based collaborative efforts of the vibrant international community of free software developers have led to unprecedented performance and price/performance ratios. Sustained speeds in the range of gigaflops have been reported for astrophysical simulations from a cluster of sixteen linux-based Pentium class computers. It would be of considerable interest to see how well such systems can meet the complex challenges described by B. K. Basu.

N. V. Joshi

Human impact on an Antarctic freshwater lake: Ecobiological studies of the Priyadarshini lake

Almost all the studies describing human impacts on natural ecosystems demonstrate a substantial degree of deterioration. A welcome exception is the article by Baban Ingole and Vinod Dhargalkar on **page 529** of this issue, where they report that despite a five-fold increase in human activities in the surrounding region over the last 15 years, environment of the Lake Priyadarshini at the Schirmacher Oasis, East Antarctica is in a healthy condition.

Indian studies on this lake (earlier known as the ZUB Lake) began in 1984–85, when the environment was not exposed to human activities. In February 1985, the Indian summer research station Maitri was set up close to Lake Priyadarshini. This was upgraded to a permanent research station in 1988–1989. As a result, considerable scientific activity has been going on in and around the lake. In fact, the movement of vehicles and humans has increased by almost a factor of five over the years; this should have caused some changes in the ecobiology of the lake. There has been a regular monitoring of the water quality of the lake since 1984–85. Earlier studies have mostly been carried out

during the summer. In their article, the authors have described the results of the first year-round study, conducted between January 1993 and January 1994.

The water quality parameters recorded by the authors included surface and sediment temperatures, salinity, pH, dissolved oxygen concentration, proportion of sand, silt and clay and organic carbon, etc. In addition, biological parameters such as the amount of chlorophyll, primary productivity, faunal density and faunal biomass were also recorded. The year-round study has revealed an interesting bimodal pattern; phytoplankton, etc. attained maximum values in summer as well as in late winter. More importantly, a detailed comparison of critical parameters over the decade has shown that despite many adverse factors (emission of gases and dust from generators, domestic waste, possible oil spills from storage and repair of vehicles), the lake ecosystem has remained reassuringly healthy. The authors, however, have also stressed the need for taking steps to prevent any damage to this unique and fragile ecosystem.

N. V. Joshi

Physiology and overcrowding

Does overcrowding affect the physiology of living organisms? There is little doubt that overcrowding influences behavioural patterns in diverse species, from mice to men, but firm correlates to chemistry at a cellular level are still elusive. In this issue (**page 534**), Ravikumar and Michael report studies on the 'influence of group density and sex ratio on the immune response' of a fish with a formidable name, *Oreochromis mossambicus*. Their experimental design is simple. Increase the population of fish in a tank under controlled conditions and monitor the antibody response to a protein antigen, bovine serum albumin. They also investigate the effects of sex ratio within groups. Their results show that the immune response to the foreign antigen was *enhanced* in all 'overcrowded groups' as compared to a control group, except in the case of the equal sex ratio group. Clearly, while overcrowding may be stressful, the effects are mitigated by a more even sex ratio. Interestingly, their results are at variance with earlier reports cited on page 536 that overcrowding in fishes *diminishes* the immune response. This report is one of many in the literature that points to chemical signalling as an important device to control the physiology of animal populations. While pheromones, small, volatile and apparently innocent organic molecules, have been extensively studied with relation to insects, there is growing realization that many new 'pheromones' remain to be characterized. The recent report that menstrual cycles can be modulated by secreted, volatile chemicals (K. Stern and M. K. McClintock, *Nature*, 1998, **392**, 177) is a dramatic example of the control that chemistry exercises over physiology.

The results of Ravikumar and Michael also reemphasize an old concern – how inter-related are the nervous, endocrine and immune systems? How important are environmental stresses in determining physiological responses? In the future where overcrowding and stress are clearly going to be important and unavoidable components of human existence in many parts of the world, the barriers between behavioural science and biochemistry may indeed have to be dismantled.

P. Balaram