

mainly of the soft condensed matter variety, is conducted. He was a charismatic speaker, and could convey the background and the essential physical arguments leading to new knowledge, in simple language. He also discussed about education of the young, and encouraged students to ask questions. After visiting more than 200 high schools, he did not accept any more invitations. He has however summarized the main topics in a delightful book entitled '*Fragile Objects*', with J. Badoz as co-author. He emphasizes the importance of practical learning by experimentation, and deplores the excessive 'mathematization of subjects', in the courses taught to students. He also emphasizes the desir-

ability of a marriage between fundamental and applied research. (He was himself a consultant to a few polymer and petrochemical industries.)

A collection of his papers (which were selected by himself) accompanied by some 'afterthoughts', was also published under the title *Simple Views on Condensed Matter* in 1992. Interestingly, the cover of the book has the sketch of a 'Flying Apsara' by the author.

de Gennes visited India twice. The first was to give a series of lectures in a school, which was followed by an International Conference on Liquid Crystals organized at the Raman Research Institute, Bangalore during 1973. The second

visit was in 1996. Large audiences had the pleasure of listening to his inspiring talks, and to interact with him on both occasions.

In the passing away of de Gennes, the international condensed matter physics community has lost a pioneering theorist, and indeed the most illustrious researcher and teacher of soft condensed matter science.

N. V. MADHUSUDANA

*Raman Research Institute,  
Bangalore 560 080, India  
e-mail: nvmadhu@rri.res.in*

## A. K. Tiwari (1960–2006)

Anil Kumar Tiwari, a space scientist who worked in the field of forestry, passed away on 12 November 2006 at CMI Hospital, Dehradun. Born on 5 January 1960 into a forest officer's family in Nishini, a village in Almora District, Uttarakhand, Tiwari had his early education mostly in Nainital, Uttarakhand and did his B Sc in 1977 from H.N.B. Garhwal University, Uttarakhand. He started his career in the field of forest ecology in 1979 after obtaining his M Sc degree in botany. He worked in a project integrated study of the natural resources and environment of parts of the Kumaun Himalaya through remote sensing under the supervision of the ecologist J. S. Singh in Kumaun University, Nainital. During this time span, Tiwari was responsible for a number of ecological studies using aerial photographs and Landsat MSS images. He was awarded the Ph D in 1985 and he served as Assistant Director at the Wildlife Institute of India (WII), Dehradun for one year. Later he moved to the Department of Space in 1986.

Tiwari visited RESTEC, Tokyo, Japan in 1987 for an advanced course in remote sensing technology. He had carried out a number of studies in various aspects of forest ecology using remote sensing techniques at WII and the Regional Remote Sensing Service Centre. He had about 27 years of experience in the use of remote sensing and GIS techniques for natural resources studies in the Uttarakhand region.

His major research contribution was on regional-level biomass estimation; evaluation of net flux of carbon at regional scale; geo-vegetation analysis in landslide-affected areas; wildlife habitat evaluation; sediment yield and soil erosion; biodiversity studies with reference to climate change; biodiversity studies with reference to bioprospecting; modelling landscape nutrient dynamics; integrated studies



for sustainable development. Tiwari has published his research results in both national and international journals of forestry and environment.

His special interest was on biomass and productivity studies, besides biodiversity studies for the Himalayan region. One of his works on component-wise biomass models for trees using non-harvest techniques, published in the year 1992, is used as reference even today for

biomass studies due to its applicability in the present scenario of environmental degradation. Regional level forest biomass mapping using remote sensing techniques is the first study of its kind in India in which an original technique was developed for forest biomass mapping, based on four major assumptions: (i) major quantitative parameters of vegetation expression are interrelated and one can be used to predict the other; (ii) using allometric biomass estimation equations, mean tree basal cover and density, it is possible to compute stand biomass; (iii) generalized species and interspecies biomass estimation equations can be used for dominant and subordinate species respectively; (iv) reduction of vegetation variable into discrete classes will not materially affect the quality of information. The crown cover of forests estimated through aerial photographs was related with the stand biomass estimated for reference sites to develop cover-biomass models. The study was carried out over ten sub-catchments of the Central Himalaya and was extended with minor modifications to estimate the total forest biomass in the entire Indian Central Himalaya. In order to obtain the biomass estimates at much finer level, the digital image processing technique was combined with the cover biomass models to demonstrate the use of digital image processing for forest biomass mapping. Forest biomass estimated through remote sens-

ing and field data was used as a principle variable to compute net carbon flux.

Geo-vegetational analysis in landslide-affected areas done by Tiwari is the first study in India; it revealed a relationship between litho units and vegetation. The study indicated that the Himalayan forest ecosystem has the capability of natural recovery. Among forests, *Pinus roxburghii* with <40% crown cover and among non-forests landuse, and agriculture predominantly occurred in the active and potential landslides zones. The active and potential landslide zones were concentrated along geologically active planes, namely thrusts and faults and/or in the vicinity of toe-erosion of hill slopes.

Tiwari initiated biodiversity studies for the first time in India using remote sensing techniques in the year 1996 under ISRO's Geosphere-Biosphere programme. The study included quantification of biological diversity at different levels; examining the relationship between biodiversity and various biophysical parameters; to develop a rapid biodiversity assessment model and to formulate and test the hypothesis regarding the impact of climatic change on biodiversity. Bio-

diversity studies with reference to bio-prospecting were carried out for the hills of Uttarakhand and a detailed inventory of medicinal, endemic and economically important plants was made.

Tiwari developed a study design for analysing landscape nutrient dynamics using remote sensing and field-based compartment modes. In this study the ecosystem was sub-divided into various compartments like soil, bole, branch, foliage, litter, etc. The rate of transfer of nutrient between various compartments was derived using a set of differential equations generated based on studies in reference sites. Tiwari carried out energy flow relationship studies between agro- and forest ecosystems in Pauri District, Uttarakhand. The finding indicated that for one energy unit of agronomic production, four energy units are extracted by the rural ecosystems, which indicated that about 4–5 ha of well-stocked forest is required to sustain 1 ha of land.

Considering his expertise in remote sensing and GIS techniques and his pioneering work in Uttarakhand, Tiwari was deputed as the first Director of the Uttaranchal (now Uttarakhand) Space

Applications Centre (USAC) under the Department of Science and Technology in the newly formed State. He took up the responsibility to establish the centre with a broad vision, single-handedly. His deputation to establish the State centre was an advantage to the State, as he had already prepared a geospatial database.

On 11 November 2006, Tiwari was shot by an unidentified person at his residence in Dehradun. His untimely death is not only a great loss to science, but also to humanity. Tiwari was a creative, innovative, kind-hearted and an idealistic person, full of energy and with a positive attitude to life. He was a good boxer, a magician and was keenly interested in cultural activities. Tiwari leaves behind his wife, daughter and son.

NEERAJ KUMAR SHARMA

*Jharkhand Space Applications Centre,  
Department of Information Technology,  
Government of Jharkhand,  
Ground Floor, Engineer's Hostel-II,  
Near Goal Chakkar, Dhurwa,  
Ranchi 834 004, India  
e-mail: sharmank@rediffmail.com*