own design of cryogenic engine. If the Agreement cannot be implemented, we are quite confident of our space scientists and engineers who would be able to develop our own technology.

We have had fruitful cooperation in peaceful application of space technology with several countries including the erstwhile Soviet Union, France and United States and now Russia. We would like to continue such cooperation for mutual benefit where feasible. In any event I want to assure this House that we are committed to achieving self-reliance in high technology particularly in areas like space which have a major bearing on our economic and social development.

Intensive course on inverse problems in Science and Engineering

The Technology Advisory Board (TAB) for Physical and Earth Sciences of CSIR recommended that an intensive course on inverse problems and a panel discussion on CSIR Initiatives in Tomography should be held to acquaint scientists with current developments in inverse problems in general and tomography in particular. The CSIR Centre for Mathematical Modelling and Computer Simulation (C-MMACS) organized this course at NAL, Bangalore during Feb. 15–20, 1993. Participation of over fifty scientists from twenty institutions indicates a growing recognition of the importance of these approaches to a wide variety of problems in Science and Engineering. The course was inaugurated by B. V. Srikantan, Scientist Emeritus, IISc and Chairman, TAB with a welcome by R. Narasimha, introduction by K. S. Yajnik and a keynote address by V. K. Gaur.

The core faculty comprised of V. K. Gaur, C-MMACS; P. Bhimasankaram, ISI; G. V. Anand, IISc; Sri Niwas and P. K. Gupta, University of Roorkee; P. S. Moharir and R. N. Singh, NGRI. The course covered several topics such as generalized inverses, singular value decomposition, resolution and spread of inverse solutions, Backus-Gilbert technique and nonlinear and nongaussian inversion. An important feature of the course was the intensive hands-on exercises programme and introduction to available public domain software for inversion (available at C-MMACS). A diskette containing several public domain packages was also given to participants to enable them to apply the techniques learned by them during the course. The last two days of the programme involved lectures by scientists on applications of the techniques to research problems. S. S. Rai, NGRI outlined applications in seismic tomography; S. A. Ahmed, NGRI described applications in hydrogeology; Phoolan Prasad, IISc talked on inverse scattering; N. K. Indira, C-MMACS spoke on time series modelling; G. V. Anand, IISc on ocean acoustic tomography; B. B. Bhattacharya, ISM, Dhanbad on VES tomography and P. S. Naidu, IISc on diffraction tomography.

The panel discussion on the status and future of tomography was chaired by V. K. Gaur and featured the faculty members of the course and P. S. Naidu. One of the recommendations made at this meeting was the constitution of a think-tank comprising of several active researchers in the field by C-MMACS. It was widely felt that the think-tank would be an effective means of stimulating and advancing creativeness of tomographic techniques in system definition at various scales ranging from the large earth, atmosphere, ocean systems to smaller scale engineering systems. The discussion also identified several possible areas of collaborative research.

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OPINION

Science in India – Some basic questions

The current debate on 'Science in India' in *Current Science* has been of considerable interest to the scientific community of India. Most of the articles have been written by eminent scientist-bureaucrats who, having derived immense benefits from the scientific system of the country, are now critical of the same system. Through these columns, I would like to voice my opinion on the threshold of a scientific career in India.

While various viewpoints have been expressed about science, scientists and 'scientific temper', one crucial point has been missed out by most authors: the human element in the scientist. Why is science considered so different from other professions or jobs? The scientist is as much a human as a doctor, engineer, lawyer or bureaucrat. Why is a scientist expected to be selfless, devoted to the 'welfare of society' and have his salary weighed against his achievements? At the risk of being branded a materialist or worse, a nihilist, I would humbly state that in our country, where bureaucracy is God and there is a permanent rush for jobs, a candidate often applies for jobs in diverse fields which may or may not be

according to his abilities or basic training. Then why are hackles raised when engineers and doctors apply (and qualify) for the Civil Services or when a scientist in spite of his post-graduate and doctorate degrees, when offered a temporary 'associateship' in an ad-hoc research scheme prefers to migrate to greener pastures?

A perusal of a few issues of *(Re) Employment News* is ample evidence of the anomalous situation existing today. While in the 'generalist category', an ordinary graduate can apply for competitive exams and be appointed in the scale of Rs 2200–4000, a scientist can thank his lucky stars if he ever gets the same scale in spite of his higher qualifications and experience. Advertisements of various scientific agencies are sometimes amusing with demands for highly qualified and experienced scientists for paltry Class II posts. Is it any wonder that these posts continue to remain vacant?

In most scientific agencies, the scientists once appointed instead of devoting their energies to research find themselves pitted against their peers, all engaged in the race for the next promotion. Unlike other government jobs, higher scientific posts are often filled by open advertisements. Naturally the average 'human' scientist finds himself in a permanent rat race to further his career and prospects. Can his research be 'socially relevant' in such circumstances? Or conversely, has one ever seen the post of Secretaries or Civil Surgeon or Chief Justice being advertised? When other government employees can be promoted to higher posts on the basis of their ACR dossiers and seniority, why not the scientists? And why is the scientist assessed by his ACR dossiers at all when his publications are there to see?

Another fallacy in the attitude towards scientists is that the term 'scientist' immediately conjures up the vision of an Einstein or Newton or Bose. Is every architect a Le Corbursier, every nurse a Florence Nightingale or every army officer a Patton? Why are our scientists expected to be as brilliant as Einstein, noble as Gautama Buddha and serve society as Mother Teresa? Why is every bit of research expected to generate a 'technology', other current jargon being 'cost benefit ratio', 'appropriate technology', 'market feasibility', 'social relevance', 'sustainable development', etc. The plethora of jargon and demands can be confusing to the average scientist. On one hand, he is expected to publish his work in reputed international journals which entails hi-tech facilities which are sadly lacking; on the other hand he is expected to constantly generate 'appropriate technologies' in the least expensive manner to serve society. This rules out fundamental research and also his chances for career betterment, the system itself being ambiguous.

The above discussion again brings out the inherent contradictions in our scientific system and focuses on the moot point: Whither Indian Science? Should we really do research? Barring a few 'elite' laboratories, a cursory look at the conditions of our scientists and their labs brings out an emphatic 'NO'. Why do our scientists produce shoddy research here but do brilliant work abroad? How is a scientist supposed to serve his career interests as well as society's especially when other non-scientific staff are taking it easy? Why does the government and society expect so much from scientists while assigning them an inferior position in society? What is a scientist supposed to do when he is made to do push-ups by petty clerks? Why is the term 'publicly funded' research a proverbial Damocles' Sword over the heads of our scientists when every other bit of governmental activity is also publicly funded and no one seems to bother?

These questions are not to serve as an excuse for the low productivity of our scientists, but to highlight their confusion regarding their role in society. These and other similar questions often plague the minds of our scientists. And finding no answers, they are compelled to write articles, like this one, hoping that somewhere, someone is listening.

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Foraging decisions by plants—Making a case for plant ethology

K. N. Ganeshaiah and R. Uma Shaanker

The deer stand still with the grass in their mouth falling down;
The peacocks have abandoned dancing; and shedding their grey leaves, the creepers appear to be shedding tears!

(In *Abhijnansakuntala* by Kalidasa; Act IV;
Priyamvada explaining the sorrow of nature while Sakuntala was leaving to her husband's house)

It is said that, Charles Darwin was prompted to refute Carl von Linneaus' claim that plants are incapable of exhibiting movements like animals do[1]. Demonstrating that every tendril and tip of the radicle have their own power of independent movement, he stated that plants 'acquire and display (*this*) power only when it is of some advantage to them'[2]. Unfortunately, Darwin's wisdom does not seem to have been inherited by biologists in general; even today, for most biologists, plants are incapable of behaviours such as movement, communication, aggression and sensitive responses exhibited by animals.

But in a recent report, Colleen Kelly[3] of the Oxford University, demonstrated the dramatic ways in which plants also exhibit choice over food patches as actively as animals do. Her experiment illustrates that plants exhibit behaviours