# Physics research as a hobby

I am amused to read the proposal put forward by P. Chaddah (*Curr. Sci.*, 2001, **81**, 868–869) to encourage physics research as an avocation or a hobby. He pleads that bright young persons may opt to do physics research in their spare time for its creative pleasure. I think he has the case of C. V. Raman at the back of his mind and he intends to create more Ramans by his utopian proposal.

In the same issue, T. V. Ramakrishnan (*Curr. Sci.*, 2001, **81**, 977–982) has summed up the Indian physics scenario with the remark that there is a catastrophic decline in the number of students opting for physics at the undergraduate and the postgraduate levels, thus creating a vacuum in the research laboratories. It is most unfortunate that when India has created world-class facilities and infrastructure for physics research by setting up Inter-University Centres, viz. Nuclear Science Centre at Delhi, IUCCA at Pune and IUC-DAEF at Indore, the trend has changed suddenly in favour of information technology, management and engineering disciplines.

I do not reject Chaddah's idealism for promotion of avocational research *in toto*. My apprehensions are based on personal experience of thirty-eight years in experimental physics. However, it may be possible in theoretical physics to do something worthwhile making use of the internet, computers and library services, while experimental research is a full-time job and cannot be pursued as a part-time hobby.

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# Rhizobia of the β-subclass of proteobacteria: A tale of losing the race

Rhizobia are the traditional soil bacteria capable of forming root or stem nodules on various leguminous plants, where they undertake symbiotic fixation of atmospheric nitrogen. Currently, they are divided into six genera with approximately 30 species, including *Allorhizobium*, *Azorhizobium*, *Bradyrhizobium*, *Mesorhizobium*, *Rhizobium* and *Sinorhizobium*. Phylogenetically, all these bacteria belong to the α-subclass of proteobacteria[1]. Till recently, none of the bacteria belonging to the β-subclass of proteobacteria were known to form root or stem nodules on legumes. Moulin *et al.*[2] reported the ability of *Burkholderia* species, a member of the β-subclass of proteobacteria, to nodulate the African legumes *Aspalathus* and *Machaerium*. Later, Chen *et al.*[3] described *Ralstonia taiwanensis* as the first member of the β-subclass of proteobacteria capable of nodulating two species of *Mimosa*, i.e. *M. pudica* and *M. diplotricha*. Careful reading of the two papers indicates that authors of these two papers were in touch with each other and yet, each group claims to be the first to report the α-subclass of proteobacteria as being involved in nodulation in legumes.

During the UNESCO/AICOPTAX sponsored practical training course on 'Molecular techniques in diversity, phylogeny and taxonomy of plant-associated bacteria' organized by us at the School of Biotechnology, Banaras Hindu University between 5 and 18 November 2000, one of the groups of trainees was assigned the task of characterizing the root nodule bacteria of *M. pudica*. The group consisted of Subhash Verma, Abha Mishra (BHU, Varanasi), Parag Vaishampayan (MACS, Pune) and Deepak Sharma (UDSC, New Delhi). The bacterial community present in the *Mimosa* nodules was found to be of only one type as characterized by PCR fingerprinting technique. Some of these isolates were further subjected to identification on the basis of their carbon source utilization ability, using the BIOLOG system which identified all of them as *Ralstonia eutropha*. The finding that some species of *Ralstonia*, rather than *Rhizobium*, could be present in the legume nodule was surprising and unexpected. Since we did not have an easy access to DNA sequencing facility at that time to identify these bacteria on the basis of their 16S rDNA sequence (one of the definitive methods for identifying bacteria), we could not follow up this interesting finding further. Keeping in line with the existing dogma[1] that no bacteria other than the members of Rhizobiaceae can nodulate legumes, we dismissed the intriguing observation possibly resulting from contamination.

Nevertheless, in view of the observation being unexpected and novel, we kept wondering if it could be true. After a few weeks when we thought of reinvestigating the bacteria from the *Mimosa* nodules, it was realized that the proper time for getting *M. pudica* plants with nodules was September–November. Therefore, we had to wait till September 2001 to isolate bacteria from the surface-sterilized nodules of *M. pudica* plants. The isolates were handled with utmost microbiological care and subjected again to BIOLOG way of identification. This, once again confirmed these bacteria to be *R. eutropha*. The 16S rDNA from these isolates was PCR-amplified and the RFLP of amplicons showed that all of them were genetically identical. The 16S rDNA amplicon was then sequenced and compared with the sequences in the databases. To our surprise we found 99% sequence identity with a very recently described *Ralstonia taiwanensis*, showing that bacteria isolated by us from *M. pudica* nodules was indeed closely related to *R. taiwanensis*. With respect to the 16S rDNA sequence, the next most similar species to our isolates was *R. eutropha*. When we started searching the description of this species, we failed to find any publication describing this species in the BLAST information database. While searching for publica-

tions by the authors who submitted the 16S rDNA sequence of *R. taiwanensis* in the BLAST database, we learnt about the article by Chen *et al.*[3] describing isolation and identification of *R. taiwanensis* from the root nodules of *Mimosa* species.

We realized that we had lagged behind in the race by not pursuing an intriguing observation immediately. We had made the novel observation in November 2000, while the two reports[2,3] claiming to be the first on the ability of the β-subclass of proteobacteria to nodulate legumes were published in June and September 2001, respectively.

Despite the large diversity of legumes (up to 18,000 species) and a great number of them being able to form nodules, rhizobia of ~ 11,200 nodulating species are completely uncharacterized. Therefore, current taxonomy and phylogeny of rhizobia are based on isolates from the nodules of only 10% of the 750 legume genera. As India is considered a zone of mega biodiversity, studies on symbionts of the yet unexplored legumes may unravel the presence of new types of bacterial groups in their nodules. Nature has more surprises in store than we expect.

1. Young, J. P. W. and Haukka, K. E., *New Phytol.*, 1996, **133**, 87–94.
2. Moulin *et al.*, *Nature*, 2001, **411**, 948–950.
3. Chen, W. M. *et al.*, *Int. J. Syst. Evol. Bacteriol.*, 2001, **51**, 1729–1735.

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# Youngest Toba Tuff

This is with reference to the correspondence '~ 74 ka Youngest Toba Tuff' by A. R. Nambiar (*Curr. Sci.*, 2001, **81**, 334–335) regarding our paper 'An occurrence of ~ 74 ka Youngest Toba Tephra from the Western Continental Margin of India' (*Curr. Sci.*, 2001, **80**, 1322–1326). Our paper deals exclusively with Youngest Toba Tuff (YTT) of ~ 74 ka, whereas the symposium abstract by Nambiar *et al.* (PFS32, GIO – 1996, p. 93), makes mention of the overall Indonesian Arc Volcanic Tuff. It is well-known that the eruption of Toba occurred during ~ 74 ka, ~ 540 ka and ~ 840 ka, which are known as Youngest Toba Tuff (YTT), Middle Toba Tuff (MTT) and Oldest Toba Tuff (OTT) respectively, and are together known as the Indonesian Arc Volcanic Tuff. Each Toba event is characterized by distinct chemical and isotopic characteristics. Nambiar *et al.* (1996) find that the tephra layers discovered in the Arabian Sea suggest the Indonesian Arc as the source. Since their report does not specifically mention the YTT, we did not take their report as the first one on YTT. Moreover they do not provide unambiguous evidence to show that the ash layer is from the Youngest Toba eruption of ~ 74 ka. We have cited all the relevant published information on YTT in our paper. Lastly, papers in refereed journals largely receive citation. Additionally, the discovery of Indonesian Arc Volcanic material in the Indian Ocean was made by Ninkovich *et al.* (*Nature*, 1978, **276**, 574–577), and any subsequent publications only report the new occurrences.

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# Polite and impolite

A. K. N. Reddy draws unnecessary distinctions between 'impolite' and 'polite dissent' (*Curr. Sci.*, 2001, **81**, 735–736).

We Indians are unable to discriminate between professional and personal criticism. Hence our unease in being impolite. Professional criticism should be as harsh as possible. Otherwise the 'natural selection', 'competition' and 'diversity' alluded to by Reddy, will simply not emerge.

The politeness we witness could, in part, arise from fear. However, given the lawless and shameless climate generally prevalent today, I suspect a simpler reason for the politeness in Indian science – just plain and simple lack of confidence in one's own professional abilities.

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