absorbing major part of energy and hence adjacent parts of Pakistan and Karachi experienced much less damage. In Ahmedabad also, the worst-affected areas like Maninagar, Vasna, Vejalpur, Vastrapur, Paldi, Ambawadi, Jodhpur, etc. are adjacent to Sabarmati river on meander scars, palaeo-meanders, palaeo-channels and palaeo-lakes/past filled lakes and ponds. Weaker constructions have also played their part, but in the above-mentioned areas few one- and two-storied buildings were also damaged and eventually collapsed.

Further, there is a strong correlation between the geometry of the basin filled with sediments and the amount of amplification of the seismic waves[1,2]. Previously studies had been based on artificial shots and seismic surveys[1,2], while in case of Ahmedabad in Cambay Basin seismic waves generated by natural earthquake have shown similar effect.

It has been stated[2] that the amplification results from either focusing associated with the entire basin or resonances and tapping of the seismic energy within the specific layers in the basin, probably the uppermost lower velocity Quaternary deposits, whose geometry may measure the geometry of the entire basin. This is probably true for Cambay Basin also.

As in case of West Bengal and Seattle Basins[1] and New Delhi[5], the seismic wave amplification phenomenon during the 26 January 2001 earthquake can be attributed to the impact of loose sedimentary formation in Rann of Kachchh and Cambay Basin. And as stated previously[1], nothing unusual has been noticed in the surrounding Olympic mountains regions could ascribed to a major extent to surrounding of Bengal Basin[1] near Beliator on crystalline part close to Burdwan. This could also be true even to the western and southern parts of Kachchh, Saurashtra, Nagarparkar ridge, Aravalli and south Gujarat, lying either directly on or with shallow hard rock regions.

Discussion on soil conditions in Delhi by Iyengar[5] also perfectly matches with the experience at Ahmedabad and in Cambay Basin. It is stated[5] that all other parameters such as magnitude and distance remaining the same, local soil conditions dramatically modify the amplitude and frequency content of ground motions. It is pointed out that wherever there are deep deposits of alluvium, tall buildings at such locations are likely to experience amplification of ground motion as the seismic wave passes through the intervening medium. It is further stated[5] that frequency response function – the ratio of the steady state surface amplitude to the amplitude of the bedrock motion – taken to be sinusoidal as a function of frequency, is important. At Delhi[5] maximum amplification was observed in the frequency band of 1–2 Hz, which would be in the range of the first natural frequency of the soil deposit itself. Multi-storied buildings are likely to have their first natural frequency in the same range and hence are prone to experience relatively higher levels of seismic force in comparison with shorter buildings, in case of thicker alluvial deposits. On the other hand, it was stated tentatively[5] that hard rock sites are expected to carry base motion as it is, with its energy more evenly distributed and with a shift towards the higher frequency range of 5–10 Hz, but non-resonance and mismatch of frequency saves constructed structures from larger damage. It is also noted[5] that soft soil sites filter the higher frequencies and exhibit surface motion with energy predominantly in the frequency range of 0–5 Hz.

As it was pointed[6] out for Bengal Basin[1] and North Delhi[5], crustal faults, sedimentary basin and loose deep soil created seismic hazard in Cambay Basin. This phenomenon should be an eye-opener and requires detailed study of the seismic behaviour of the basin for epi-/hypo-centre, outside the basin as well as within the basin. Based on the study, upward revision of the present-day status of earthquake zone-III of the Cambay Basin region needs attention.

1. Reddy, P. R., *Curr. Sci.*, 2001, **80**, 119.
2. Brocher, T. M. *et al.*, *EOS Trans. Am. Geophys. Union*, 2000, **81**, 545–552.
3. Reddy, P. R., *Curr. Sci.*, 2000, **79**, 1045–1046.
4. Reddy, P. R., *Curr. Sci.*, 2000, **79**, 1144–1145.
5. Iyengar, R. N., *Curr. Sci.*, 2000, **78**, 568–574.
6. Kaila, K. L., Reddy, P. R., Mall, D. M., Venkateswarlu, N., Krishna, V. G. and Prasad, A. S. S. S. R. S., *Geophys. J. Int.*, 1992, **11**, 45–66.

N. Y. BHATT

Geology Department,
M.G. Science Institute,
Navrangpura,
Ahmedabad 380 009, India

G. N. Ramachandran – Reminiscences

I met G. N. Ramachandran at the Indian Institute of Science, Bangalore around 1941 or so when he had just joined the institute. Within a year he had done enough work in optics which would have earned him a doctorate very easily, but was submitted for a mere master's degree. The late K. S. Krishnan was the examiner who was known to delay reports unmindful of the enormous anxiety it caused to the candidates and Raman had to write to him to speed up the report!

Because of my early association I could freely talk to him about various scientific subjects which he could grasp very quickly and go to the root of the matter. I had useful interaction with him after his return from Cambridge. The trio, Ramachandran, S. Ramaseshan and V. Chandrashekar, were working on an important paper on optics published in the *Journal of the Optical Society of America* and later as an article in the *Handbook der Physik*. During that time I had useful discussions with him on magneto-optic resonance. We had discussions at his home every week and I remember reporting the famous Lamb-Rutherford paper.

Of my work on nuclear magnetic resonance, particularly radiation damping and NMR of flowing liquids, he was the only one who could fully understand its importance. I remember my discussions with him on the possibility of maintaining self-sustained oscillations through flowing liquids which would perhaps have resulted in an NMR laser; that was not to be because of very poor experimental facilities. During that period Ramachandran was trying to focus X-rays through reflections in poly-crystalline materials like copper. I suggested and made a simple focusing arrangement using a thin sheet of mica and some vacuum. Ramachandran published this in *Physical Review* and he has acknowledged my suggestion which resulted in the work of late Y. T. Thathachari.

I have always marvelled at his paper on collagen and how with hardly a few spots on the X-rays photographs he could arrive at the structure. Had he tackled other bio-molecules, particularly DNA, it would have been a boost for science in India and worthy of Ramachandran's innate genius. However on his return to IISc from Chennai, he founded a very active school on molecular biology which has contributed a lot to that branch of science in India.

I met Ramachandran early last year as an inmate of the voluntary health scheme resort at Chennai. In spite of his physical disability due to an incurable syndrome, he was mentally fully active and I had the occasion to talk to him about some of the work I had been carrying out on time and gravitation and related matters. He was very quick to understand the key points and was immensely happy. I remember him smiling and wishing me all the best.

G. SURYAN

Sunrise Emerging Technologies (R&D),
B-279 (a), 7th Cross,
Peenya Industrial Estate,
Bangalore 560 058, India

Every morning, after breakfast, G. N. Ramachandran and I used to walk to the Physics Department at the Indian Institute of Science, Bangalore. Then he told me that after joining the Electrical Engineering Department at IISc, he used to meet C. V. Raman every evening and talk with him for an hour or two. He also used to request Raman to take him into the Physics Department. I asked Ramachandran, 'Did Raman ask you questions in physics?' Ramachandran said: 'No. He used to tell me that he was writing up his Baroda lectures on optics. (This appeared later as a book entitled *Lectures in Physical Optics*, published by the Indian Academy of Sciences.) He discussed with me, item by item, the various aspects of optics that had interested him (Raman). I never knew that optics could be so exciting. I used to ask him hundreds of questions, to which he invariably gave clear answers. These meetings in the evening were long discussion sessions and after one such long session, late in the evening at about 7 p.m. Raman said, "I think I will try to get you transferred to my Department." My joy knew no bounds. I feel that it was during these conversations and discussions that I really understood the physical basis of Fourier theory and Fourier transform' (This proved to be of great use to Ramachandran for his researches in X-ray crystallography.) Raman sent a copy of the book *Lectures on Physical Optics* to S. Chandrasekhar, to which Chandrasekhar replied: 'I was delighted to receive the other day a copy of your *Lectures on Physical Optics* with your inscription. I had earlier seen this book with Pancharatnam when he visited us last summer. I was most impressed with this book at that time, and I am very happy now to possess a copy. By accident it happens that I am lecturing on advanced optics and I intend to make use of your book in these lectures . . .'

S. RAMASESHAN

Raman Research Institute,
Bangalore 560 080, India

As in Sb clusters

In the article on low energy cluster beam deposition technique by Ravi Prasad *et al.* (*Curr. Sci.*, 2001, **80**, 280–284), although the authors state on p. 282 that 'no other foreign impurities even at ppm level could be detected', the PIXE data (figure 2 *b*) clearly show the presence of arsenic. Two lines are seen as for Sb and from their amplitudes the amount could be a few per cent at least. This is not surprising because the authors state that 'chemically pure Sb was taken'. As belongs to the same group as Sb and is a common impurity in Sb. This is not a trivial observation because the photoluminescence (PL) attributed to Sb cluster is more likely to originate from As, which is a semiconductor with a bandgap of 1.2 eV approx. This would give a PL peak near 1000 nm. The authors state that Sb oxide is present due to the ambient and so, As oxides should also be expected. Combinations of these compounds, all semiconductors unlike Sb which is a semi-metal, if present, could account for the PL near 514 nm.

D. N. BOSE

Advanced Technology Centre,
Indian Institute of Technology,
Kharagpur 721 302, India

Response:

As to the arsenic impurity in the PIXE spectrum, we have used the As doped Si as a substrate for Sb cluster deposition. However, when the PIXE spectra were recorded, the duration of exposure of the bare As–Si to the proton beam was only for 15 min as the thickness of the As–Si wafer is 125 micron. The As peak could not develop for shorter time exposures. After depositing the Sb cluster of 100 Å thickness on the same wafer, we exposed the wafer to the proton beam for 2 h to get good statistics. The PIXE experiments detect the atomic concentration of the sample. As the Sb cluster film is thin enough one may expose the target to the proton beam for long time exposures. In both the cases the proton energies were kept same. Hence, the As detected from the Sb cluster film is solely from the substrate only.

As far as the PL data are concerned the glancing angle XRD of the Sb cluster film detected only Sb and Sb-oxide (Sb_2O_3). Sb_2O_3 is a semiconductor and