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D. Murali

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A copy of the article:

Nanotechnology is the discipline of convergence

D. Murali

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December 29, 2009, will mark the golden jubilee of nanotechnology, informs Mr T. Pradeep, Professor, DST unit on Nanoscience, Department of Chemistry and Sophisticated Analytical Instrument Facility, Indian Institute of Technology Madras, Chennai.

The celebrated talk of Richard P. Feynman, 'There's plenty of room at the bottom' delivered 50 years ago (on December 29, 1959, at the annual meeting of the American Physical Society at the California Institute of Technology) envisaged the era of nanotechnology – the technology of nanometre scale objects, Mr Pradeep tells *Business Line*.

It is a Sunday afternoon, and we are sitting in the lawn adorned by the campus inaugural plaque, again dating back to 1959. A banyan serves as the backdrop, the deer freely roam about, assorted birds chirp around, and our conversation continues over the email...

Excerpts from the brief interview.

What were Feynman's predictions?

He talked about the possibility of a new kind of technology, by assembling things atom by atom. Such a technology would make everything – all that technology has done till now – small.

Feynman suggested that the entire Encyclopaedia Britannica could be written on the tip of a needle. He talked about small objects moving around the body through blood vessels which would do surgeries. When things are shrunk at atomic levels, many new possibilities come about,

Prof T. Pradeep

as reflected in the emphasis on the word, 'plenty'.

Where are we now?

We have been assembling atoms the way we need, and creating nanometre scale structures, since 1991. Through a technique discovered in 1981, called the scanning electron microscopy and its modifications, this atom manipulation is routine today.

Despite this capability, molecules by themselves are not made today by arranging atoms. This is because the methods of chemistry to assemble atoms to create molecular structures are much more powerful in creating designed structures, especially in large scale.

Tiny diagnostic and therapeutic objects can get into the body. These are not 'surgeons', however, as of now. Electronic storage is possible in pieces of matter of nanometre length as well as in molecules. Information contained in libraries can be stored in hand-held devices. Simple machines of hundreds of nanometre in length have been made.

Where are we going?

Nanotechnology is the power to manipulate matter at the atomic level. This power is that of the creator as He assembles biological matter atom-by-atom to create structures. This implies that all that matter can do will be achievable with that capability. Our technologies are far away from that right now.

Currently, nanomaterials can be used for increasing performance of already established technologies. For example, a structure can be made tougher by incorporating desired nanostructured matter. In the long term, new capabilities can be obtained with additional efforts. Completely futuristic possibilities such as linking biological objects with machines are being investigated.

However, atom manipulations are going on in Nature everyday. The food we eat is cooked in plants, atom by atom, using carbon dioxide, water and sunlight. Plants fix energy in this fashion and we consume that. Automobiles use that energy.

How about fixing sunlight in a reaction vessel? Look at Nature filtering and storing water in watermelons. This happens through a series of molecular processes. How about adapting that to solve our water crisis?

In Nature, all these happen in a clean and green manner, so that life is sustainable. This shows that biology is nanotechnology in perfection. The best chemistry is also that. Physics ultimately is processes at the nanometre scale.

This shows that nanotechnology is the discipline of convergence. Current problems of the world demand that convergence.