THE HINDU BusinessLine

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# The future is nano

**From water purification to poverty alleviation, the small can play a big role in our lives. Wake up to nanotechnology and its potential.**

Look within to find answers for all problems, saints say. Perhaps, almost similar is the hope of scientists: that working at tiny things in nano-scale can help us achieve many things inconceivable in the past.

"One can start arranging molecules to achieve the functions of a complex machine. A future with controlled molecular assemblies of this kind, the molecular nanotechnology, will revolutionise everything - from food to thought will change with this newly acquired power," writes T. Pradeep in Nano: The Essentials, from Tata McGraw-Hill (www.tatamcgrawhill.com).

Nanoscience and nanotechnology refer to the control and manipulation of matter at nanometer dimensions; the market for these is expected to grow to $350 billion by 2015. For starters, nanometer is `10 to the power minus 9' metre, or a billionth of a metre.

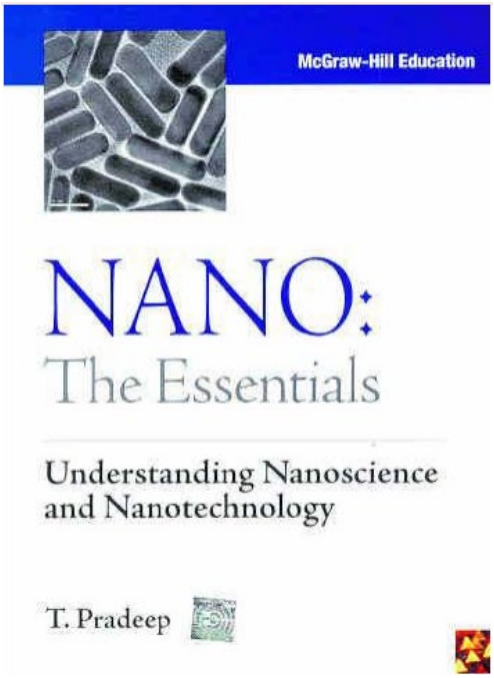
In day-to-day life, the smallest distance one can see without instruments is 0.1 mm, or `10 to the power minus 4' metre, which is the thickness of a cotton fibre. To a nanometre, though, this fibre is like a 100-metre wide highway, explains Pradeep.

He then delves into a discussion of how `nano' observations are made. The lab tour begins with SEM (scanning electron microscopy) and ends with X-ray diffraction.

Brace up for a lot of technical reading. Such as: "When an X-ray photon falls on an intrinsic semiconductor (having no charge carriers), due to photoabsorption, charge carriers (electrons and holes) are created. These are swept by an applied bias forming a charge pulse. This charge pulse is then converted into a voltage signal. Intrinsic condition is hard to achieve and detector crystals are made to behave like intrinsic silicon. This is made by applying Li on p-type Si, thereby forming a p-n junction.

"Part three of the book is on diversity in nanosystems, with chapters on Fullerenes (`molecular forms of carbon, which are distinctly different from the extended carbon forms known for millennia'), carbon nanotubes (`among the most extensively researched materials today'), SAMs or self-assembled monolayers (`important nanostructural systems which are two-dimensional nano assemblies'), and so on.

In part 4, Pradeep explains `evolving interfaces' such as nanobiology, nanosensors, nanomedicines, molecular nanomachines, and nanotribology. "An overlap of nanotechnology, biotechnology, and bio-informatics has resulted in the advent of a new technology called nanobiotechnology," one learns.

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"During the past decade, this technology has reached a level, which enabled it to develop probes for understanding the intracellular and intercellular biological process, novel targeted labels for biological systems, and efficient nanoparticle-based immunoassays for the detection of biomarkers at extremely low concentrations."

An essential read is the final chapter on `societal implications'. Nanoscale techniques can offer useful tools to fight against poverty, assures the author. "Developing countries have recognised nanotech as a catalyst for economic, human, social, technological and environmental development and launched national nanotechnology initiatives. Worldwide, more than one-third of all the nations are promoting R&D, including education and training of nanoscientists and nanotechnologists."

Pradeep expects that the most widespread impact of nanotechnology in the developing world would happen in the area of water purification. Carbon nanotube-based filters can be effective for the purpose, he says. "Nanoparticles have been shown to degrade pesticides and pollutants... A filter that can separate petroleum hydrocarbons from crude oil has been demonstrated."

Big help to those who would like to track the small things.

**VILLAGES `OUT OF REACH'**

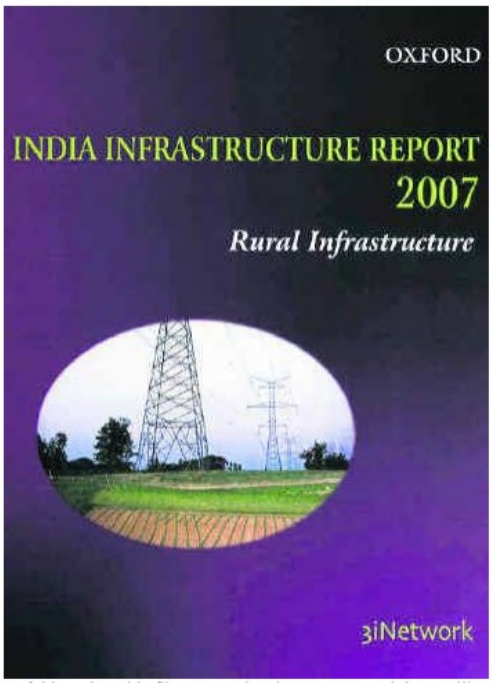
What are the barriers to telecom penetration in rural India? The first hurdle is network coverage, says India Infrastructure Report 2007 in a chapter on `rural telecom'.

With mobile tariffs having fallen considerably, there is a huge demand for mobile telephones in rural areas, but unless mastheads cover rural areas, this demand will remain unmet, says the publication of 3iNetwork, from Oxford (www.oup.com).

"It is probable that the present ARPU (average revenue per user) of Rs 322 per month (approximately $7) in the telecom sector will go down further if the operators enter rural areas. Research tells us that Indian cellular

operators can remain profitable even at an ARPU of $4 per month," notes the report, citing Morgan Stanley's findings.

The second barrier is of backbone infrastructure. "Currently around 6.7 lakh route km of optical fibre is laid across India." Of the 35,000 exchanges in the country, 30,000 exchanges (including 27,000 exchanges in rural areas) have OFC (optical fibre cable) connectivity. Also, we have satellite systems offering high bandwidth connectivity all over India through VSAT.




**"In spite of the existence of this nationwide fibre network, adequate connectivity to villages is not available to an entrepreneur other than the facility owners."**

"In spite of the existence of this nationwide fibre network, adequate connectivity to villages is not available to an entrepreneur other than the facility owners (which is BSNL)," observes the report. "The cost of installing backbone infrastructure in semi-urban and rural areas for a new entrepreneur can be substantial, and it is in the interests of economic efficiency that the existing infrastructure be fully utilised."

Infrastructure sharing can be voluntary or mandated. But, at times, the rentals for sharing can be usurious, as it was found in Andhra Pradesh. So much so, `the laid fibre remains dark and operators are forced to lay alternative fibre or try alternative modes of delivery'.

The report, therefore, notes indignantly: "A network laid at the expense of the taxpayers' money in the name of rural connectivity remains unutilised."

The constraints are thus more on the supply side, even as purchasing power is not a barrier in rural areas, says 3iNetwork. "While in percentage terms, the middle to high-income households in rural areas are nearly one-third of those in urban areas, in absolute terms these numbers are almost the same. Further, in the lower middle-income group, while the percentage of rural households is just a shade higher than urban households, in absolute terms, these constitute nearly two-and-a-half times the number in urban areas."

According to a World Bank study, `poor communities often spend on communications as much as urban communities, in terms of percentage of available income,' given the choice. However, 3iNetwork is of the view

that any subsidisation of individual telephones may not be an appropriate policy, `in view of the huge rural demand and inevitable problems in implementing micro-managed subsidisation policies'.

Recommended read for those gunning for fortune at the bottom of the pyramid.

**Tailpiece**

At a village tea-shop:

"Do you think they will offer us free mobile phones during the next election?"

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A copy of the newspaper article is here:

eWorld

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BOOKS2BYTE

D. MURALI

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