In this issue

Water

In the contemporary world, water has been in the centre stage of discussion in the context of development, globalization and environment. The concern on water scarcity, at least among the 'wise' amongst us, is on the increase despite the fact that water is a renewable resource maintained by the solar-energy driven hydrologic cycle. Two expressions of concern are worth quoting here.

'Born in a water-rich environment we have never really learnt how important water is to us. ...We have spent it with shameful and unbecoming haste... . Everywhere we have poured filth into it.'

– William Ashworth

'Our entire society rests upon – and is dependent upon – our water, our land, our forests and our mineral resources. How we use these resources influences our health, security, economy and well being.'

– John F. Kennedy

Ashworth's statement that 'we have never really learnt', it may be argued, is not true of ancient India. Again this argument is not relevant to modern India. Wherever we go in India today a very common saying among people is that 'we have water problems or water is a problem'. In reality, however, *'we'* actually cause problems to water. We do not realize that '*water is life on earth; to sustain life in all its totality on earth, water should be carefully managed in its natural habitat. The present problem of water scarcity is mostly a cumulative result of our ignorance on earth system processes that maintain water on land, wrong priorities on water use and poor management of its resources'*. The best management practice depends on the moral and ethical values of contemporary society and requires participation of all its people as people are there wherever water is. Conscious participation in turn, requires an understanding of some of the basic facts of water on earth in general, and those specific to India in particular. The purpose of this special section on water is to disseminate the simple and basic facts of water on earth and on India, essentially to increase the water-literacy through *Current Science* readers. All the papers that are assembled here are designed to be simple, more of scientific facts and less of scientific analysis, so that basic facts of water are better understood, appreciated and effectively used for common good.

The first paper is by Narasimhan (**page 787**) on Water: Science and Society. He discusses briefly the attributes of water and the hydrologic cycle relevant to water on land. Using the present knowledge of the earth system processes in the maintenance of water as well as life on land and in the hope of achieving a 'Civilized Society', he advocates that water management in every society has to be guided by a set of three basic premises, viz. (i) Laws of nature, (ii) Sustenance of life on earth, and (iii) a Civilized society. The first one refers to the immutability of physical laws that control the hydrologic, erosional and nutrient cycles which have been maintaining the water budget. The second refers to the fact that these interconnected earth cycles are the basis of life on earth and can be disturbed beyond natural resilience by human activities. The third premise requires that any civilized society with human values should avoid private ownership of water and disturbing the life sustaining earth cycles. For India, he suggests that efforts should be made to make people water-literate so that they learn to live with Nature's constraints. Rakesh Kumar *et al.* (**page 794**) have reviewed the available water resources in India and have projected the future needs based on estimated increase in human population and their demands. Because total utilizable surface and groundwater resources could fall short of projected demands by 2050, there is a pressing need to judiciously manage the water resources and to augument the utilizable water resources. Datta (**page 812**) discusses the problem of groundwater depletion and degradation with increasing exploitation in different parts of India and the management of this precious resource at different spatial scales. He points out that management of groundwater also involves clearly identifying zones of recharge in any area and protecting them from contaminants from various sources, and evolving appropriate pricing policy for groundwater exploitation. Ramesh and Yadava (**page 818**) using precisely dated, high resolution palaeomonsoon records from natural archives show that reconstructions of monsoon intensity variations in India are prone to erroneous conclusions if they are based on single proxy. To constrain monsoon intensity distribution over India, data from multiple proxies are recommended. Available data on the SW monsoon intensity in the latest part of the Holocene suggest an increasing trend at least in the west coast of India. Gupta and Deshpande (**page 825**) analyse the available ^{18}O data of groundwater from various parts of India and discuss their significance in terms of various atmospheric, surface and subsurface processes. They suggest that more isotopic data supplemented with other conventional meteorological, geographic and hydrogeological data would help in better understanding of the hydrological cycle over India.

Rajiv Sinha (**page 836**) discusses the geomorphic diversity in the Ganga plains and found that the rivers of the eastern gangetic plains are aggradational and those in the western gangetic plains are degradational. He has explained that the stream power and sediments supply, which are influenced by rainfall and tectonic activity, control this diversity. He urges that the aggradational and degradational processes influencing the channel dynamics and flooding have implications to the long-term river management in our country, e.g. river interlinking project. Krishnaswami and Singh (**page 841**) review weathering of rocks in the catchments and the chemistry of Himalayan rivers. They discuss the various inputs to the Himalayan rivers, e.g. rock weathering and anthropogenic and factors influencing the silicate weathering and the effect of silicate weathering on climate due to CO_2 consumption. During the Cenozoic, silicate weathering in Himalayas twisted the global climate to cooling. They suggest developing suitable proxies to identify contribution of even minor lithologies to the river chemistry.

In the last paper, Rajamani (**page 850**) reviews the basic facts of water on earth and the strong inter-connections that exist among river flows, groundwater storage, soil thickness and microbial plant life on land. He suggests that groundwater is needed to store more of it which maintains the rivers. Pointing to the existence of positive feedback mechanisms in the storage of groundwater and formation of thick soil mantle and to the symbiosis among water, soil and life on land, he opines that management of one component such as the lower forms of life on land has the potential of simultaneously maintaining all life-sustaining resources. Many of these ideas also find a mention in the paper by Narasimhan. The commonality of their thinking, as expressed in the first and last papers of this special section on water reinforces the need for a holistic approach to water management. We hope that this set of eight papers provide enough interest and motivation among the readers to start the water science and education in a big way in India.

V. Rajamani

Cousin to the crab

Gupta *et al.* (**page 853**) report the discovery of a young, rapidly rotating neutron star located inside what was long suspected to be the site of a stellar explosion which occurred about a thousand years ago in the inner reaches of our galaxy. Many of these neutron stars reveal themselves by their characteristic regularly spaced pulses of radio emission and have hence been known as pulsars since their discovery some forty years ago. More than a thousand of these objects are now known, so why look for or worry about one more? The reason is that this one belongs to a rarer subclass which have been caught young so to speak – i.e. within a few thousand years of their birth, in contrast to the few million or even billions of years for the others.

The first example of such a young radio pulsar was found in 1969 in the already famous Crab nebula. The energy which we see all the way from radio waves to gamma rays pouring out from the nebula was an outstanding puzzle until this pulsar was revealed to be the underlying dynamo – literally so, since it rotates some thirty times a second and has a magnetic field a million million times what we are used to on earth. Naturally, the hunt was on to find more such objects, and G21.5, the subject of the paper, was a prime target for many searches which were not successful so far. Even now, only about half a dozen are known, and the paper highlights the kind of questions one can hope to answer by studying such young pulsars. The picture below shows G21.5 in X-rays, imaged by the *Chandra* satellite of NASA, with whose courtesy it is reproduced. The picture shows both a shell and a central blob which is regarded as evidence of an underlying pulsar.

To readers from other fields, some additional background might be of interest as well. This work would of course not have been possible without the one and a half decade long effort which went into planning and building the Giant Metrewave Radio Telescope (GMRT) from the mid 1980s to the late 1990s. While the radio astronomy group of TIFR started by Govind Swarup in 1963, took the central role, collaboration from elsewhere was also critical. In the early nineties, the Reactor Control Division of BARC designed the antenna control systems and built about

one third of them. About the same time, the Raman Research Institute with its strong scientific interest in pulsars built a piece of special-purpose digital hardware called the GAC (GMRT array combiner) which in effect produces a single 200 m diameter dish from 16 of the 45 m diameter GMRT dishes. Another major contribution from RRI in the nineties was the so-called L-band feed which covers the 20–30 cm range of wavelengths (which was also used in this paper though the pulsar did not oblige by showing itself at the shorter wavelength).

Pulsar signals are weak, so the Giant in GMRT certainly helped. So did the Metre, because the signals become weaker at the centimetre wavelengths at which some earlier searches were carried out. The list of authors includes David Green of Cambridge University who has relentlessly pursued objects like G21.5 for many years. It is interesting that such a discovery occurs not at the time of observation but after extensive data processing and analysis, often the lot of research and project students. Amit Acharya is the visiting student who had the excitement of seeing a pulsar pop up on the last few days of his project! Finally, this was not the only team hunting for this pulsar. Once the manuscript was on the web, a group from the US got in touch, with their own work done with the Green Bank telescope – and this is mentioned in a 'note added in proof'.

This level of detail comes from my having had a ringside seat both at NCRA and RRI. This piece therefore ends with the statutory warning the author is not unbiased but has a vested interest in the progress of radio astronomy in our country!

R. Nityananda

Disaster alert system

The recent monster tsunamis that struck the South Asian countries including India, and the severe destruction and devastation brought by them, have triggered serious deliberations from many quarters on the urgent need for versatile disaster warning systems in place for India. It is essential to establish efficient means to alert local authorities to put into action the appropriate emergency measures. What India lacks the most at the moment is an instrumented wireless network in place for quick dissemination of disaster alert information to the coastal communities. In this context, Antony Joseph and Prabhudesai analyse (**page 864**) storm surge and tsunami that have struck India in the past and suggest a network that would provide the crucial *in situ* real-time coastal sea level and surface meteorological data input to predictive storm-surge and disaster simulation models. The suggested network would incorporate the ubiquitous cellular phone network to provide the crucial data communication capability. The proposed web-enabled network would facilitate online monitoring of real-time coastal sea-level and surface meteorological events.