

not only safeguard the animals residing outside the National Park, but also protect those which straggle outside the park boundary.

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ACKNOWLEDGEMENTS. The officers at the Department of Forests, Government of Mizoram, the World Pheasant Association and Peter Scott Trust, Dr Rahul Kaul, WPA-SARO, Gurgaon; Dr Anwaruddin Choudhury, RFNEI, Guwahati, Assam and Dr Goutam Kr. Saha, Department of Zoology, Calcutta University are gratefully thanked for their help.

Received 4 September 2001; revised accepted 20 May 2002

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## Arsenic poisoning in the Gangetic delta: An anthropogenic model

Large-scale arsenic poisoning in parts of West Bengal and in Bangladesh has been reported. Creditable work to mitigate the disaster has been taken up by delineation of the arsenic-prone aquifers and by provision of simple indigenous purification set-up for de-arsenification of drinking water in target areas. The 'end of the pipe' mitigation has brought immediate relief, but for a long-term solution and prevention of reoccurrence elsewhere, the issue must be examined at the 'beginning of the pipeline' of contamination.

The situation is as follows: (a) Arsenic toxicity has surfaced only in recent times and no historical record exists concerning any previous observations. (b) The shallow wells and surface waters are not vulnerable, so are the deep aquifers. The intermediate aquifers of 50 to 80 ft depth are considered to be the principal zone of contamination. (c) Demographic survey indicates widespread contamination around the course of the Ganga and its tributaries. The situation is similar around Padma river in Bangladesh. That is, the river course is one cause of contamination. Down south, in the sea water mixing zone, chlorinity dissolves away and dilutes the element. (d) Investigations show that arsenic is associated with ferruginous

coating on quartz or detrital grain surface in the aquifer zone. This means that the coating is a secondary process, precipitated from water trickling down through the aquifer. Arsenic in solution has been brought into the aquifer from outside. (e) Some geologists believe that the volcanics on Bihar Plateau (Dalma Trap, even Dhanjori Volcanics) may contribute the element, since volcanic rocks are rich in arsenic. According to them, arsenic has reached the intermediate aquifer by reworked sand dunes, so common in the Gangetic delta. However, neither has any primary arsenic mineral been reported in the ancient dunes, intermediate aquifers or the *in situ* volcanics, nor have any experiments been conducted to show the possibility of the element leaching out from the volcanics. If the leaching of volcanics and contribution from the ancient dunes are to be believed, such disasters around the vast Deccan Trap rocks, as well as arsenic infestation in ancient times in the present area ought to have been reported. The context of the argument is that arsenic in the aquifers is a recent introduction into the area and is dominantly anthropogenic. The responsibility of the present crisis cannot be brushed aside as mere lithogenic.

It is quite likely that a large amount of arsenic ought to be received by the Ganga basin by way of application of fertilizers, pesticides/herbicides and activities arising out of coal combustion. While rock phosphates carry as high as 10 to 20 ppm of arsenic and manufacture of urea needs arsenic catalyst, some of the pesticides are pure arsenic compounds. Arsenopyrite (FeAsS) is a common accessory mineral in coal and coal is reported to carry between 56 and 156 mg/kg of arsenic. The Czech coal has 1500 mg/kg of arsenic and its burning has caused extensive arsenic dispersion. The leachable arsenic even in pond ash of Indraprastha power plant in Delhi is of the order of 25 mg/kg, when most of the element ought to have been lost to atmosphere during coal combustions and major fraction from ash is lost to supernatant pond water. The two power plants at Indraprastha and Rajghat combined are estimated to contribute annually about 5 to 6 tons of arsenic to the Yamuna from ash-leaching alone. Besides, paints, detergents, metal works, smelting and refining and sewage add to the arsenic content in the Ganga basin. The element being non-degradable, it migrates from a remote corner of the watershed to the discharge

region of the water channel, in this case, the Ganges delta, either in dissolved species or as absorbed ion. The concentration of the element builds up from infinite dilution of a few ions in the place of application (origin) at a remote watershed corner to appreciable concentrations at the delta region by simple cumulative effect, and the relatively arseniferous water trickles down the coarser deltaic sediments and precipitates the element

when the dissolved oxygen is depleted with depth. The precipitation at the intermediate depth prevents contamination of deeper aquifers. However, the mechanism of precipitation is likely to spread both upwards and downwards as the middle aquifer gets saturated. Subsequently, pumping of water remobilizes the arsenic from surface coating of grains, giving the lethal level of the element to drinking water.

The question therefore is: Can arsenic poisoning in Gangetic delta be a consequence of 'Green Revolution' and other anthropogenic activities stated above? Checks and balances have always been a thumb-rule of ecology.

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## MEETINGS/SYMPOSIA/SEMINARS

### **International Training Course on Geoinformatics for Disaster Management**

Date: 12 August–6 September 2002  
Place: Dehra Dun, India

The objective of this international short-term course is to make the participants familiar with the technology and utility of Geoinformatics in disaster assessment, monitoring and management. This course hopes to bring about a basic understanding of the relevant topics for middle-level technical personnel, who are entrusted with the responsibility of disaster management and sustainable natural resource development.

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### **Symposium on Conservation, Restoration and Management of Aquatic Ecosystems – Lake 2002**

Date: 9–13 December 2002  
Place: Bangalore

Topics include: Limnology of lakes, reservoirs and wetlands; Watershed hydrology/Urban hydrology; Ground water and hydrogeology; Monitoring and modeling; Restoration methodologies and conservation strategies; Remediation measures; Integrated management of water quality and quantity with ecosystem protection; Land use, urban planning; Geographic Information

System (GIS), remote sensing; and Sustainable water resources management and water resources policy.

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### **17th National Symposium on Plasma Science & Technology (PLASMA 2002)**

Date: 16–19 December 2002  
Place: Coimbatore

Topics include: Basic plasmas; Plasma processing and industrial applications; Fusion plasmas; Plasma diagnostics; Space and astrophysical plasmas; Waves and plasma dynamics; Dusty and exotic plasmas; Computational methods in plasma.

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