

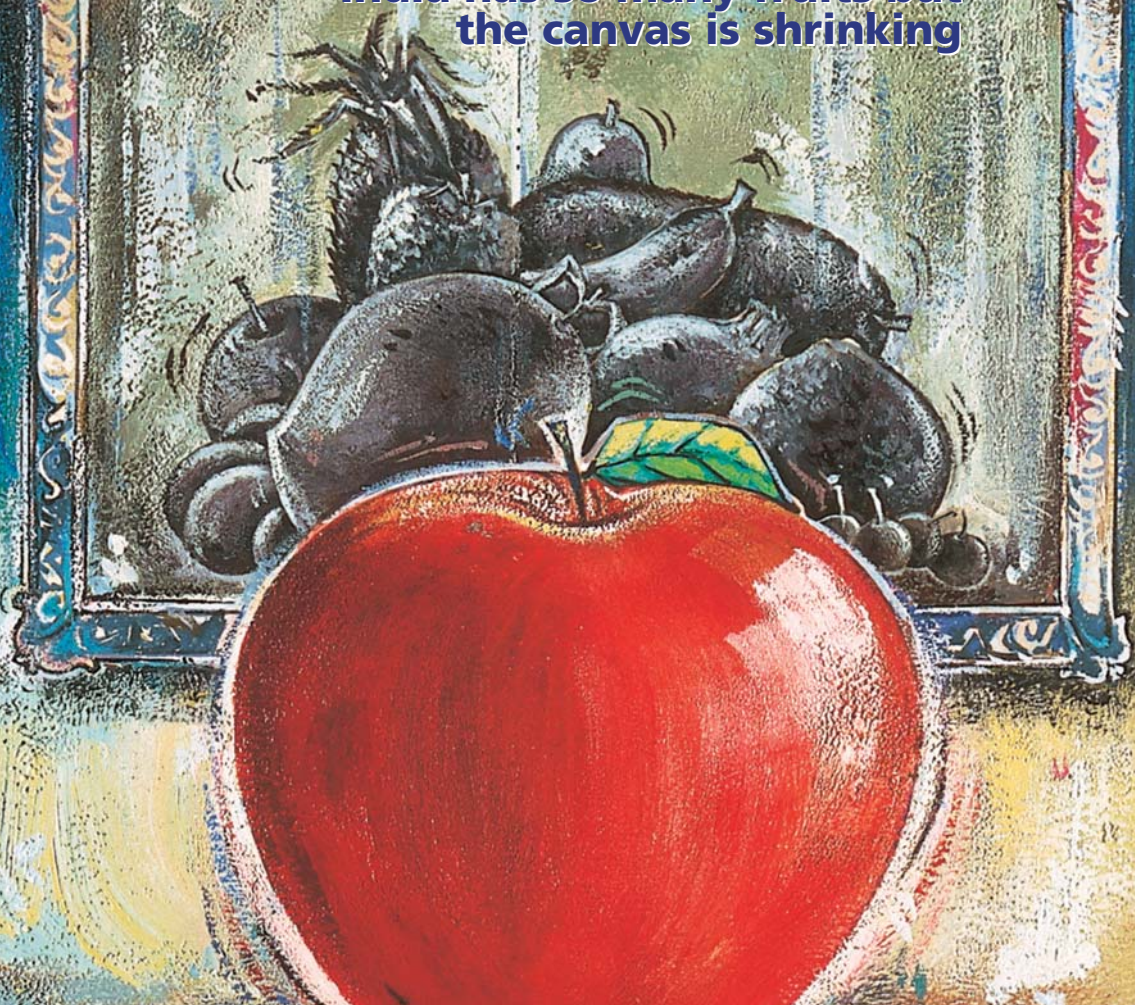
Down To Earth

Rs 20.00

AUGUST 31, 1998

Fading from memory

India has so many fruits but the canvas is shrinking



Swollen Yangtze: floods ravage China
Skin and bones: trade in wildlife flourishes
Sullied land: a nightmare in Vadodara

5

State of India's
ENVIRONMENT
A CITIZENS' REPORT

This book will be read by prominent
industry captains
corporate managers
policy makers
academicians
scientists
environmentalists
activists
politicians

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The Third Citizens' Report (1991) subtitled *Floods, Floodplains and Environmental Myths* kicked up a furious debate on the role of deforestation in floods in the Indo-Gangetic Plains. It is one of the very few books on the changing ecology of the region.

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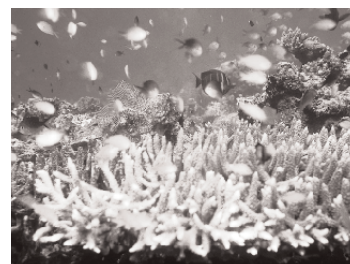
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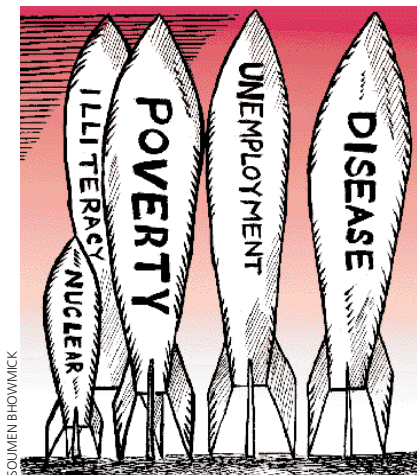
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COVER ILLUSTRATION: RAJAT BARAN



The other bombs

The article on the Pokhran explosion made interesting reading 'Ground zero within' (*Down To Earth* Vol 7, No 3; June 30). I have been a great admirer of your book, *The State of our Environment*, in which there is a chapter on nuclear energy and the pollution it can create. But our criticism of Pokhran II should really start from Pokhran I which was conducted in 1974 when the former Prime Minister Indira Gandhi was in power. All the political parties are playing hide and seek with the recent nuclear explosions. They "celebrate" the technology but condemn BJP government for exploding it. You must also expose the hypocrisy of the five nuclear powers who have amassed nuclear weapons and missiles which threaten the peace and the environment of the entire globe.

Down To Earth must relate the nuclear explosions with other bombs of poverty, unemployment, illiteracy, disease and mortality which are ticking all the time.

SURENDRA PARIHAR
Raipur

Indigenous power

This is with reference to the article 'Making power' (*Down To Earth*, Vol 7, No 2; June 15). It is quite interesting that villagers in Pathanpara, Kerala are no longer dependent on the Kerala State Electricity Board (KSEB) and have

managed to generate 4 MW of power in less than 90 days with an investment of Rs 3 lakh only. They have not used conventional turbine. Instead, they have generated electricity with the help of normal centrifugal pump induction motor.

S L DOGRA
Mumbai

Sane step

Congratulations *Down To Earth* for publishing informative articles. In Amritsar, where I reside, there is a check on vehicular pollution, but vehicles such as three-wheelers, buses, trucks, and diesel operating vehicles have been left out of the preview. These are the vehicles which pollute the most.

Something has to be done so that these vehicles come under the category of pollution-causing vehicles. One step could be that everyone who owns a vehicle, should avoid their use at least once a week. This measure, to some extent, will help save petrol and control emissions.

J S GANDHI
Amritsar

A query

I have been an avid reader of the Campaign Supplement of *Down To Earth*. But all of a sudden I have stopped receiving it. There is no mention in the magazine on why you abruptly stopped the supplement. Could you please tell me why?

ARJUN KARIYAL
New Delhi

Thank you for your interest in the CSE Campaign Supplements. The Supplement was assessed during the Centre for Science and Environment's Annual Review Process in May this year, and it was decided that material from the supplement would be incorporated into the magazine. As a result, you will see a lot more writing from the Campaigns Team in *Down To Earth*. We look forward to your continued support for CSE Campaigns.

The Campaigns Unit
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LEADER

Programmed to kill

Farmers of the world are under attack. A new technology threatens to make them totally dependent on multinational corporations



SEEDSAVERS of crops worldwide face an unprecedented threat. A technology, appropriately called the 'terminator technology', has been creating waves in agricultural circles since March. So much so that it has jolted the normally somnolent agriculture ministry of the government of India into some sort of action.

On July 17, minister of state for agriculture, Som Pal, replying to a question in the Rajya Sabha, stated that the government had imposed a ban on the import of seeds containing the terminator gene. These seeds stay alive only for one generation. This means that the farmer then has to buy expensive patented seeds each time he sows the crop. If a better seed is available in the market, the farmer can only avail himself of it if he pays every time, or else, the farmer is denied the fruits of the progress made in research laboratories. Tough luck.

In March, the US Department of Agriculture (USDA) and a company, Delta and Pine Land Company, were awarded a US patent for a technology they had developed. The technology makes it possible to genetically alter a seed in such a manner that it will not germinate if planted a second time. Currently under testing for cotton and tobacco, the technology has the potential of being applicable to other seeds as well. In other words, if a seed with this gene is planted, the crop and seeds from the harvest, saved and used for sowing the next season, will not germinate.

Patents have been applied for in 78 countries, most of them in the South. India's name has not been included. The patent is broad and applies to seeds of all species, including those genetically altered within the laboratory. Still to be perfected, the technology poses a threat to the environment and biodiversity.

The technology is also programmed to annihilate a tradition being followed by farmers everywhere. Ever since humans tamed wild edible plants and began cultivation, farming communities have been saving seeds from one harvest for the next. Based on experience and instinct, farmers all over the world, more so in the world's poor countries, have improved varieties literally in their backyard. Women play a significant role in this process. So possessive are they of these seeds, especially in societies where this practice still exists, that the seeds are often hidden from the rest of the household and used only for sowing and not consumption. It was this saved seed which came to the help of Africa in times of drought when all crops were wiped out. New high-yield varieties have been possible only through biodiversity obtained from marginal farmers. The terminator technology will curtail this kind of experimentation, severely reducing biodiversity as well as the indepen-

dence of farmers.

According to a Canadian non-governmental organisation (NGO), that first spread the word about the technology, up to 1.4 billion farmers in resource-poor countries in the South depend upon farm-saved seed.

Merely a century ago, farmers worldwide controlled their own seed stocks, trading them freely with their neighbours. In the Garhwal hills, for instance, after a few cropping seasons farmers still exchange seeds to minimise the risk of pest and disease attack.

The situation is now changing. With the seeds being patented by companies, farmers have to pay for what has always been theirs.

It is this seed-storing tendency of farmers that has been the source of immense irritation to seed companies. The USDA desires that the technology be licensed to as many seed companies as possible so that they recover their investment. The other side is that the hold over the control of seeds will be tightened. In a show of patriotism, it cites protection of its technology as the motive. It is another matter that the various seeds aimed for protection have their roots in other countries, mostly in the South.

This use of this technology could lead to other problems. Pollen from plants containing these genes could pollinate the crops of adjoining fields. The seeds of this crop will also become sterile. All this would gradually result in a reduction of biodiversity.

Som Pal states that seed import permits will be issued only if the permit issuing authorities are convinced that the seeds do not contain the terminator gene. It is all very well for the agriculture ministry to show some concern for Indian farmers. It is probably easier to ban a product than come out with some legislation that protects farmers' rights. But the Indian government has been known to show a tremendous lack of enthusiasm in protecting the interests of farmers.

If one were to look at the research purely from an academic angle, it is an elegant piece of work, a brilliant concept. However, rather than looking only at the commercial angle and forcing farmers of poor countries to pay for seeds season after season, if the scientists had widened their horizon just a little and applied the same concept to terminate defective genes being passed from one generation to another, such as cystic fibrosis, or haemophilia, their contribution to society would have been invaluable. And the money would continue to pour in. Genetic engineering would have scored a big hit. ■

The enemy within



ENVIRONMENT is one area in which post-independence India cannot be proud of its performance. India has seen a rapid decline in the quality of all its natural resources ranging from land and forests to water, air and biodiversity. Today, it is one of the dirtiest, most polluted and environmentally degraded countries of the world.

In this entire scenario, there have been three small successes over the last three decades but even these have to be qualified. The tiger population began to increase in the late 1970s and 1980s but again has begun to show a sharp decline leading many to argue that it will disappear early in the next century. The forest cover has been maintained since the mid-1980s but nobody really knows how much can even be called a 'forest' as a large part of the forest estate today is made up of plantations. Rural firewood availability has shown an increase but a big reason for this unexpected increase is the unexpected invasion of an exotic species called *Prosopis juliflora* on India's degraded lands from Kutch in Gujarat to Ramanathapuram in Tamil Nadu.

Four small rays of hope have also emerged despite this dismal scenario, generated almost entirely by the democratic character of India's Constitution. The struggle against 'the system' which destroys the environment has grown.

- India's NGO movement, which has its roots in the pre-independence Gandhian movement, has not only grown but has also taken a deep interest in environmental concerns.
- The judges of the Supreme Court have reinterpreted the Constitution to give people the right to a healthy environment, something unprecedented, and have thus promoted public participation in India's environmental governance by encouraging a spate of public interest litigation.
- The people have shown a greater desire to save and regenerate their environment. The villagers of Sukhomajri and Ralegan Siddhi have shown that the

rural economy can be pulled up dramatically by its bootstraps — *which literally no other form of economic intervention can do* — if the people are organised to manage their environment. It is possibly the most heartening aspect of India's last 50 years. Far less talked about than Sukhomajri or Ralegan Siddhi is the effort of over 1000 village communities in Orissa, Chotanagpur area of Bihar, the Bhagirathi valley of UP, and Panchmahals region of Gujarat, to protect government forests on their own. These people, seeing the economic crisis in their lives which had resulted from the ecological crisis that had engulfed them, slowly began to take action. Poor and illiterate people but strong and far-sighted.

- The media has given strong support to the environmental concern.

But the NGO movement has failed to weld itself into a powerful and well-coordinated nationwide movement which goes beyond a group of people fighting projects to a group of people who can change the environmental governance system and its policies. NGOs have built a powerful 'amorphous' movement with a focus on certain heroes and heroines but it has no national institutions of the kind of Greenpeace and Friends of the Earth in the West. The Indian NGO movement remains strong in the political dimensions of the environmental concern but weak in its policy and scientific dimensions. It is unlikely that Indian NGO movement could have caught a creeping environmental concern like global warming which threatens to destabilise the world. A lot of the power of the NGO movement has, in fact, come from local social mobilisation, media and

the courts.

The impact of court orders has remained extremely poor because they have run into a wall of poor environmental governance.

The people themselves are making efforts to the extent they can. But even the best of their efforts are failing to spread because the government is not prepared to learn their lessons. Attempts to replicate Ralegan Siddhi have run into political opposition because the village's leader, Anna Hazare, decided to launch a crusade against corruption. Villagers in Sukhomajri have now created lakhs worth of grass production and a forest that can give them a crore of rupees every year but they are today at their wit's end with the constant interference coming in from the government itself — which wants a large share of the pie — and neighbouring villagers who are being egged on by external agencies.

Overall, the environmental future remains bleak. The only answer lies in the Third War for Independence. The non-participatory, corrupt and incompetent form of governance that the British promoted for their colonial ends, has today reach a state of perfect inefficiency. Therefore post-independence Indians will have to fight a war with themselves to protect their environment, society and culture if they want to control the ravages of economic growth which will be exacerbated by extreme inequality, illiteracy, poverty, an abysmal lack of civil values and growing self-centredness. This is what the Centre for Science and Environment has always called the Big Challenge: The Challenge of the Balance. A struggle not with outsiders but with ourselves. ■

— Anil Agarwal



Indians will have to fight a war with themselves to protect their environment, society and culture from the ravages of economic growth

Indifferent strokes

A four-stroke scooter is all set to hit the market. But in the absence of data, it is too early to tell if it is any different

THE Indian automobile industry seems to be following in the footsteps of two-wheeler manufacturers in Asian countries that have switched over to more eco-friendly machines. But how eco-friendly is this move? Bajaj Auto Ltd, the Indian two-wheeler giant, recently unveiled its new 150 cc, nine-horsepower (HP), four-stroke petrol-driven scooter, christened "Legend". Currently being marketed as the world's first four-stroke scooter, Legend, claims Bajaj, has been designed in compliance with the strict emission standards prescribed for the next century. "It is an eco-friendly vehicle," said Manjeet Kalra, manager (operations) at Bajaj's Delhi office, refusing to give any further details of the new vehicle's emission levels, or a comparison with the company's earlier 7.5-HP, two-stroke models.

Two-wheelers, running mostly on two-stroke engines, have been more than an environmental nightmare in India. Thanks to their inefficient engine design, they have been the central cause of vehicular air pollution. About 25 per cent of the air-fuel mix that goes into a two-stroke engine for combustion remains unburned and goes out with the exhaust. Result: high emissions of

hydrocarbon (HC). Further, incomplete combustion of fuel in these engines also lead to carbon monoxide (CO) pollution. In India, two-wheelers comprise as much as 65 per cent of total vehicular population and account for 60 per cent



of total petrol consumption, according to studies conducted by the Indian Institute of Petroleum. While vehicular pollution comprises 50 per cent to 70 per cent of the total urban air pollution in the country, two-wheelers alone are

responsible for 70 per cent and 48 per cent of the total HC and CO emissions respectively. Will the new scooter make a difference? "Our four-stroke engine meets the 2000 norms much before these are coming into effect," says N V Iyer, general manager (engineering), Bajaj Auto Ltd, Pune. "Legend has been developed by an in-house research and development team," he informs. Iyer says the company does not want to disclose the particulars of the scooter before the launch in view of the competition.

As per the 2000 norms, the prescribed standards for HC and oxides of nitrogen (NO_x) for petrol-driven two-wheelers are 2.0 gramme per kilometre (gm/km). However, the emission standards of HC and NO_x for petrol-driven passenger cars running on four-stroke engines is less than half of that for two-wheelers: 0.97 gm/km. CO levels for two-wheelers and cars will be 2.00 gm/km and 2.72 gm/km respectively. Considering their smaller engine size, the CO standard set for scooters is not at all stringent, environmentalists argue.

As of now, there are no separate norms for four-stroke two-wheelers in India. The government is yet to come out with emission norms for these vehicles. Environmentalists point out that most Asian nations have emission norms for four-stroke two-wheelers, and question their absence in India. S Dutta, the Central Pollution Control Board (CPCB) expert on vehicular pollution, says, "We have not been contemplating specifying separate standards for the four-stroke two-wheelers as of now."

The 2000 norms have been dictated and if need arises, say in the year 2005, to have even more stringent norms, we will definitely formulate them." The norms which have been laid down for the two-wheelers are "very stringent", he adds.

The Union Budget of this financial year permits tax exemption to two-wheeler manufacturers which meet the 2000 emission norms before that date. If the company is hoping to benefit from this provision by introducing Legend, then it must discard commercial secrecy and clearly demonstrate how the new model will be less polluting than the two-stroke models. ■

Not beyond this...

Mass emission standards for petrol vehicles (in gramme per kilometre)

Category of vehicles	CO		HC		HC + NO _x	
	gm/km		gm/km		gm/km	
	1991	1996	2000	1991	1996	2000
Passenger cars	14.3 to 27.1	8.68 to 12.4	2.72	2.0 to 2.9	3.0 to 4.36	0.97
Two-wheelers	15.0 to 35.0	4.5	2.0	10.0 to 12.0	3.6	2.0
Three-wheelers	40.0	6.8	4.0	15.0	5.4	2.0

Source: Central Pollution Control Board, New Delhi

JAPAN / POLLUTION

Sea of chemicals

FISH in the Sea of Japan have been found to have high levels of toxic chemicals such as polychlorinated biphenyls (PCBs) and dichlorodiphenyl trichloroethane (DDT). A team of researchers led by Shinsuke Tanabe, professor at the Ehime University, Matsuyama, Japan, found blackfish, striped dolphins and killer whales with high contents of PCBs.

They found about 400 micrograms

per gram of fat in the body of a whale, which is nearly 4,000 times the density found in land mammals. A microgram is a millionth of a gram.

Tanabe and his colleagues have underscored the need to set up a new framework for international pollution control. PCBs are widely used as insulation for electrical equipment such as transformers and condensers.

However, there are no regulations banning the export of older electrical equipment containing PCBs to countries in Asia, with the exception of large transformers. ■

RUSSIA / NUCLEAR WASTE

Radioactive threat

LARGE areas of western Siberia and the Arctic Ocean are facing threat of contamination by deposits of radioactive salts in a Ural Mountains lake, says Yuri Vishnevsky, head of the Russia's Nuclear Supervision Service. The Mayak nuclear power plant has dumped nuclear waste in the ponds in the region. Consequently, a radioactive deposit has been formed in Karachai lake.

Since its inception in the late 1940s, the plant had been processing plutonium for atomic bombs. In this period, it

dumped tonnes of raw radioactive waste into local rivers. Though Mayak stopped the production of plutonium in 1992, it continues to reprocess spent fuel and is engaged in the dismantling of nuclear weapons.

The radioactive waste in local water bodies has resulted in the formation of a "lens of radioactive salts" in the lake. The formation is moving towards four Siberian rivers at a speed of 80 metres a year, says Vishnevsky. If this deposit is sucked into the water supply of the Riber Techa, Tobol and Irtysh, all of the western Siberia and the Arctic Ocean could become polluted within a decade. ■

NORWAY / POLAR BEARS

Bare facts

SCIENTISTS will soon launch a study on polar bears to determine how chemical pollutants are affecting their health. Researchers from the Norwegian Polar Institute (NPI) in Tromsø, have planned to investigate the effect of high concentrations of polychlorinated biphenyls (PCBs) and the pesticide dichlorodiphenyl trichloroethane (DDT) on the immune systems of bears in Norway's Arctic island of Spitzbergen.

Andrew Derocher of the NPI is planning to tag and study 50 bears. He is worried that the chemicals may be attacking the first line of defence in the polar bears' immune systems.

"We fear the polar bears on Spitzbergen are on the limit of what they can tolerate when it comes to PCBs," he said. PCBs do not break down easily and build up through the food chain. Polar bears and the Norwegian animals are exposed to PCB levels six times higher than their Canadian counterparts. The researchers will vaccinate the bears and examine them six weeks later to see how their immune systems have reacted. ■

US / HEALTH

Perils of the flesh

THIRTY nine men have died so far after taking the anti-impotency drug Viagra, confirms the US Food and Drug Administration (FDA). About 85 per cent of the patients were found to have one or more risk factors related to coronary artery disease. Almost half the victims died within three hours of sexual activity.

According to the FDA, Viagra, which is manufactured by the New York-based Pfizer Pharmaceuticals, is still considered safe. Almost three million prescriptions have been filled since the drug was introduced in March this year.

FDA officials confirm all the victims were men, with an average age of 66 years. Findings show six men had taken nitro-glycerine or a nitrate medication, which is also taken with Viagra. But Pfizer maintains the drug is safe. It believes some patients have died from mixing Viagra with nitrates incorrectly. ■

PAPUA NEW GUINEA / DISASTER

Wave of woe

TSUNAMI waves, the largest 10 metres high, recently crashed into a 30-kilometre stretch of Papua New Guinea's north-western coast, inundating seven villages in the region. Triggered by an earthquake measuring 7.0 on the Richter scale, the huge waves pitched 10,000 people into inland lagoons or swept them out to sea.

The official death count stands at more than 1,300. However, about 6,000 people are missing and feared dead. Government officials have decided to abandon the attempt to retrieve bodies and planned to seal off the area around Sissano lagoon.

Rod West, commander of the Australian army relief efforts, said the worst-

affected areas would be turned into permanent graveyards. "The condition of some of these bodies have deteriorated very much," he said. "The plan is to seal the areas and let nature take its course of natural flushing of the lagoon and the crocodiles and sharks," he added. ■

The day after: tidal waves have claimed thousands of lives in Papua New Guinea



AP / PTI

CANADA / EMISSIONS

Where there is smoke...

THE Canadian government has admitted that it cannot stop transboundary pollution on its own, but at least it can set an example for the biggest polluters. The government officials have agreed to a plan to reduce the amount of toxic mercury pumped out of the region's incinerators and industries.

Studies have shown elevated levels of mercury in freshwater fish across the northeastern US and Canada. The government has warned pregnant women, women of childbearing age, and children to limit consumption of fish caught in certain lakes.

There are also concerns about species such as the loon, which might disappear because of mercury poisoning. Mercury is a metal that causes brain damage and reproductive problems. The metal is released into the atmosphere when coal burns and through incinerators handling medical and toxic wastes.

The state governments in Canada have agreed to eliminate mercury pollution within their own regions, beginning with at least a 50-per cent reduction by the year 2003. ■

AUSTRALIA / HEALTH

Out of control

HUNDREDS of Australians die every year because they do not take asthma medication as directed, warn respiratory specialists. The National Asthma Campaign (NAC) reports that half of the country's asthmatics are not taking medicines as directed. And one in four asthmatics take their medicine only when they feel "out of control".

This has led to an increased incidence of severe attacks, hospital admissions and sometimes even death. The report shows that Australia, with one of the highest asthma rates in the world, has the second highest asthma death rate, with 730 deaths in 1996, down from 964 in 1989.

Experts believe that a half to two-thirds of those deaths were preventable. Christine Jenkins, NAC's chairperson, said that it is disturbing that so many people are not taking preventive medication correctly. ■

MONEYMAKERS

FALLING OUT: Bangladesh-based Grameen bank, the pioneering micro-credit institution, has fallen out with Monsanto, the agro-chemical combine, just a month after agreeing to a partnership to introduce biotechnology to small farming communities in Bangladesh. The first project envisaged demonstration of cotton farming using hybrid cotton to increase yields and reduce cotton imports by the Bangladesh's garment industry. Monsanto produces a patented cotton plant that contains a gene that kills off predatory worms. Several environmental groups fear that Monsanto's technology will reduce crop varieties and increase the farmer's financial dependence on large companies.

**HYBRID CARS:**

Toyota Motor Corp is expected to export 20,000 gasoline-electric hybrid vehicles a year to North America and Europe. The car,

which went on sale in Japan in December this year, is the world's first mass-produced hybrid vehicle, combining a gasoline engine and an electric motor to cut emissions and fuel consumption. It is about the carbon-dioxide emissions of a comparable gasoline engine and has a fuel-efficiency rating in Japan of 28 km per litre.

CUTTING COSTS: Shanta Biotech, the manufacturer of Hepatitis-B vaccine, plans to supply the vaccine at Rs 75 a dose for the public health programme. At present, the vaccine costs Rs 150 per dose compared to the SmithKline Beecham's imported drug costing Rs 400. Shanta Biotech had developed the indigenous vaccine with the financial help of the department of biotechnology. Varaprasad Reddy, managing director of the company, says that the production is being increased from 1.8 million doses last year to 2.5 million in this fiscal year due to increased demand.



IMPROVING EFFICIENCY: Kameshwarnath Malik, a Patna-based oncologist, has developed an agro-based biomass liquid called "Feacksol" that can increase mileage and efficiency of automobile engines by 30 to 50 per cent. The Petroleum Conservation Research Association has recommended the liquid for use in vehicles. Malik claims that "Feacksol" can improve the pick-up of vehicles and reduce noise pollution by about 70 per cent. The product has been launched in Gujarat and is all set to enter the market in south India. Vehicles require one milligram of "Feacksol" per litre of petrol to increase the mileage.

PURE WATER: Ace Hygiene Products, manufacturer of the water purifier, "Alfa", plans to launch its products in Delhi, Bangalore, Hyderabad and Goa. The company has a market share of 11 per cent in the Rs 100 crore water purifier market. Officials say the company will target four kinds of consumers: industrial, domestic, institutional and retail. The product is made up of stainless steel and complies with the World Health Organisation standards.



CHEAPER EGGS: C&M Hy-Line Farms Pvt Ltd, a joint venture between C&M group of Nasik and Hy-Line International of the US,

has launched the W-36 variety of layer bird in Hyderabad recently. Elias M D'Souza, chairperson of the company says that the W-36 variety of layer was selected for the Indian market keeping in mind the tropical climatic conditions, capabilities of the farmers and requirements of the consumers. Increasing W-36 variety of layer is economical as the bird consumes nearly 20 per cent less feed than others and lays over 300 eggs till it attains 72 weeks of age.

THE SOUTH

ASIA & THE PACIFIC

CHINA: Increased pollution levels are the reason behind China facing a terrible water shortage. According to a Chinese scientist, if the trend continues, it could become a

becoming problems because of the over-use of groundwater in some coastal cities like Shanghai and Tianjin. In northwestern China, arable land has become increasingly desertified and sandstorms have become more frequent



River pollution is leading to water scarcity in China

full blown crisis by mid-21st century. Chen Mengxiong of the Chinese Academy of Sciences said many people believe that water supply in the country is inexhaustible and do not try to find ways to improve water management.

He said that a fifth of China's rivers are polluted to varying extent whereas five per cent are seriously polluted. About 70 per cent of the water is used for irrigation which comprises half of the country's total water consumption. A major portion of water has been wasted in China because of a low utilisation rate. Chen said about 70 per cent of China's fresh water may not be available for direct use by the beginning of the next century because of pollution from waste water discharge. At present, about 300 cities are suffering from water shortages and approximately 20 million hectares of arable land is hit by dry spells each year.

Chen said ground subsidence and seawater are

because of improper use of water resources.

KUALA LUMPUR: The science, technology and environment ministry has said that burning can only be carried out during the hottest part of the day, and must be supervised at all times. It has also specified that stringent rules must be followed to carry out open burning.

However, the ministry thinks that burning for shifting cultivation, religious rites, training, disease control and the burning of paddy husks and sugarcane leaves should be allowed. Recently, minister Datuk Law Hieng Ding announced the contents of the draft Environmental Quality (Prescribed Activities) (Open Burning) Order. He said that burning by small farmers in remote areas is also permitted with conditions attached, adding that other type of burning was prohibited. "Open burning for these prescribed activities will also only be allowed if

the Air Pollutant Index (API) is below 100," he said.

Each activity had its own conditions to fulfil and breach of the guidelines will lead to prosecution by the ministry, he said. "For example, those who want to burn paddy husks and sugarcane leaves must first inform the nearest relevant authority, erect fire breakers and monitor wind directions, and can only burn within a limited area," Law said.

The guidelines were for-

mulated after much consultations, he said. According to him, the draft guidelines will be circulated among the state governments and the department of environment to be implemented immediately.

AFRICA

SOUTH AFRICA: Babies born in the Krugersdorp area could suffer severe lung damage or even die because of dust pollution from a nearby mine dump, says Vali Yusefi,

SOUTH ASIA

FIGHT AGAINST FLOOD: The Punjab government in Pakistan has allocated Rs 4.4 million for flood protection arrangements, which will include services of the Pakistan Army. According to Chaudhry Shaukat Daud, Punjab relief and revenue minister, the government had made available Rs 2.8 million to the Pakistan Army for repairing of motorboats and procuring gunpowder that might be used to cause an emergency breach of a river embankment. Police's share in the allocation was Rs 5 lakh for improvement of its wireless system. Rs 4.6 lakh had been earmarked for flood warning.



CLEAN-UP OPERATION: The Sri Lankan government is introducing legislation imposing levy on all ships entering the Colombo port, says the chairperson of Marine Pollution Prevention Authority (MPPA). This came after a recent oil spill at the port. The levy will cover the cost of the clean-up operations. This new law will enable authorities to seize, detain, or fine a ship for pollution. The MPPA had formulated a national oil contingency plan, and its approval would give it power to take action in case of an oil spill. But all these new laws are subject to parliamentary approval.



HEALTH HAZARD: Since April, more than 500 people in Nepal have died, reportedly due to infectious diseases. This has been happening in the remote villages, particularly in northern Nepal. More than 20,000 people in 35 districts are affected by acute respiratory infections, pneumonia and measles. According to the director general of the health department, poverty, unsafe drinking water and lack of sanitation, and ignorance, are the causes of these diseases.

spokesperson of National Department of Occupational Health (NDOH).

According to Yousefi, the high quartz content in dust from a slimes dam in Kagiso Extension-8 causes silicosis, hardening lung cells and rendering malfunction of the lungs. The disease can prove fatal in babies, the elderly, and those prone to respiratory diseases. Hospitals in the area are reported to have witnessed an increasing number of patients with respiratory complaints.

Most of the dust pollution in Krugersdorp comes from an old mine dump being reworked by the West Wits Gold Mine. Until recently it was the biggest dump in the world, with between 10 and 15 million tonnes of sand. Originally covered in grass, the mining has denuded the dump. "We will work with the hospitals in a bid to find the cause. By collecting the details of where people live and where they work we should be able to pinpoint problems," government officials say.

Adriaan Aucamp, spokesperson on mine rehabilitation at the department of mineral and energy affairs, said the dust problem in Krugersdorp had only recently been brought to his attention. "We rely on the chamber of mines for pollution figures, which is obviously not ideal, but my department has no money for the equipment," he says.

LATIN AMERICA & THE CARIBBEAN

LATIN AMERICA: Latin American countries are planning to end the plunder of their genetic sources by the North. At present, Latin America has about 60 per cent of the world's plant species. Coloured cotton from Peru is about to be patented in the

UNITED NATIONS



In the wake of the recent forest fire disasters the world over, Klaus Toepfer, executive director of the United Nations Environment Programme (UNEP), has said that governments, UN agencies, non-governmental organisations and those directly involved in fire-fighting operations must strengthen their cooperation, in order to be better prepared and jointly respond to the growing emergencies of forest fires. He was addressing the fifth Association of South East Asian Nations (ASEAN) ministers meeting on haze in Kuala Lumpur. Toepfer is expected to brief environment ministers on the donor response to a joint appeal for emergency assistance to the region made

by UNEP and the UN's Office for the Coordination of Humanitarian Affairs on the basis of recommendations made by fire-fighting experts.

The United Nations Environment Programme (UNEP) and United Nations Centre for Human Settlements (Habitat), has congratulated the UK government on their Transport White Paper unveiled recently, calling it good news for the global environment. The paper, which puts emphasis on reversing decades of growth in use of the private motor car through a combination of taxation measures and efforts to improve public transport systems, is an important signal to the rest of the world. The growth in use of the private car is paralysing our cities and having a serious impact on both the local and global environment.

us, where it is already being produced — and the rural people who maintained the species for centuries have seen no benefits. An Australian researcher on his way home from Maracaibo, Venezuela, stuffed a few samples of a weed growing along the landing strips into his pockets — and the plant is now grown as summer forage for livestock in Australia.

"But if we want a new kind of grass to fatten up our livestock, we have to import the seeds and pay for the technological development of the species," said Antonio Leone, director of development at the Latin American Economic System (SELA).

SELA advocates a permanent forum for Latin America and the Caribbeans to facilitate consultation and

coordination regarding the use of and access to genetic resources, an idea that authorities from throughout the region will discuss in Bogota, Colombia.

There will be a preparatory meeting for the fourth international technical conference on genetic resources, organised by the UN Food and Agriculture Organisation, to be held in Leipzig, Germany. The Leipzig conference is to come up with a plan of action for research into the preservation and use of and access to biological resources. It will be a golden opportunity for Latin America to stress the weight of its biological wealth.

The Andean mountain range and the Amazon jungle are home to more than half of the world's species of flora and fauna. To date, some 438,000 species of plants of economic and social interest have been registered in the region. The Convention on Biodiversity signed during the 1992 Earth Summit in Rio de Janeiro, recognises natural sovereignty over biological resources while establishing the need for conservation.



SOURIN BHOWMICK

US / FIRES

Blistering heat

FARMERS in the US are having a hard time as they have lost million of dollars following a catastrophic drought. According to reports, the blistering heat has killed more than 130 people across the southern parts of the US. The heat wave shows no sign of abating and the impact on the regional economy is an unmitigated disaster. The worst hit are the states of Texas, the country's top cattle state, which already experienced a terrible drought in 1996, and Oklahoma. Officials estimate the combined drought-related losses in the two states at nearly US \$7 billion.

Keith Collins, chief economist at the US department of agriculture said that the drought is also wreaking havoc in several other southern states, including New Mexico, Florida, Georgia, South Carolina and Louisiana. Gene Hall of the Texas Farm Bureau in Waco, said: "The situation is grim. This had happened in 1996 too. This time I fear a lot of farmers will call it quits." In such a situation, he said, bankers will have to deal with the situation patiently. The Texas agriculture department estimates that ranchers and farmers, particularly cotton producers, already have lost close to US \$1.5 billion. ■

INDIA / HEALTH

Aid for AIDS

INDIA will start clinical trials this year of the anti-HIV drug, AZT, on pregnant women, despite high costs and doubts about its efficacy. The trials will be conducted in Mumbai, Tamil Nadu and Kerala, say officials at the Union government's National AIDS Control Organisation (NACO). The government has identified these centres because of the existing large number of hospital cases reported in these places, said J V R Prasad Rao, additional director general of NACO. The government is also finalising a list of research institutes that would supervise the trials, he said.

The tests are being carried to double-check the success of AZT on HIV-positive pregnant women conducted in countries around the world including Thailand, said D Sengupta, advisor to NACO. He says the

drug, a 'protease-blocker' when administered from six months of pregnancy onwards, reduces the viral load in the mother's blood. ■

Saving the child: a new drug holds promise



AMIT SHANKER / CSE

INDIA

Pesticides can harm unborn children, and an estimated Rs 24,000 crore is needed to fight pesticide-borne diseases, says Suresh Prabhu, Union minister for environment and forests.

Studies show promising signs of huge oil reserves in the Gulf of Kutch off the western coast of the Saurashtra region in Gujarat, says a spokesperson of the Oil and Natural Gas Corporation. The reserves are located about 100 nautical miles off the Saurashtra coast near the famous pilgrim town of Dwarka, Gujarat.

The Union ministry of environment and forests has charged the Karnataka government with wilfully flouting environmental guidelines

while passing a tourist resort at the Nagarhole National Park. The ministry said the diversion of forest land to build the resort "cannot be agreed to" and asked that action be taken against those officials who were responsible for clearing it as it violated various provisions of the Forest (Conservation) Act 1980.

Though the poaching of tigers and leopards has gone up, successive governments have no information on legal action taken against poachers. Official reports show about 102 leopards and tigers have been killed between 1995 and 1997. Of these 87 were leopards and 15 tigers.

The Nanmangalam reserve forest in Tamil Nadu faces a serious threat as human activity is on the rise in and around the forest. While illegal sand

quarrying, vegetation destruction and washing of lorries are reported from the eastern side of the forest, the Central Reserve Police Force (CRPF) reportedly has set up a jungle warfare training camp in the forest.

A sub-committee of the Gangotri Conservation Project (GCP) has been constituted to check the retreat of the Gangotri glacier. GCP director Sushil Kumar will be the chairperson of the sub-committee, which will work out an integrated master plan for the development and greening of the area between Gangotri and Tapovan.

The Bhopal Gas Peedit Mahila Udyog Sangathan has sent a letter to Madhya Pradesh chief minister Digvijaya Singh giving details of several incidents of ground water pollution near the Union Carbide factory in Bhopal.

INDIA / WILDLIFE

Flood havoc

THE usually docile animals of the Kaziranga National Park in Assam, after a month-long desperate attempt to flee incessant floods, hunger and killer villagers, have turned violent. A number of incidents of wild animals killing each other and attacking humans have been reported. Two victims of the desperate animals are currently recuperating from the attacks in state hospitals.

The 435-sq km Kaziranga National Park has been flooded by the water of the Brahmaputra since early June. With their natural habitat inundated, wild animals are fleeing the park to the Mikri Hills in the south in search of food and shelter. But to do so, they have to cross national Highway 37.

Officials put the number of dead animals at 42. Of them, 29 had drowned. The animals are hungry and react violently at the slightest provocation. "We have even stopped use of speedboats to survey the area because the sound scares them and they try to overturn the boat," said Debashish Chakravorty, forest ranger of Kohora Range. ■

INDIA / WILDLIFE

Tribe in distress

AROUND two hundred people of the Kada tribe of the Parambikulam wildlife sanctuary in Kerala have opted to move out to other parts of the district. In a letter to the forest minister P R Kurup, seventy four Kada families have suggested Malampuzha or Kollengode as the sites for alternative settlement.

The tribals are opting to move out because of problems of communication, and livelihood. According to Gangadharan, the village spokesperson, there is only one bus in service there and they have to travel eight kilometres to catch it. Their pleas to the authorities have fallen on deaf ears, he says.

The other problem is land. There is not enough land for cultivation, say the tribals. It is the same old story of crop raiding as the wild animals destroy whatever is planted in the little land they have. Their only source of income is the work provided by the forest department in teak plantations, maintenance of roads, buildings, dams, water holes etc, says Subramaniam, who resides in the village. ■

INDIA / TECHNOLOGY

'Green' furnace

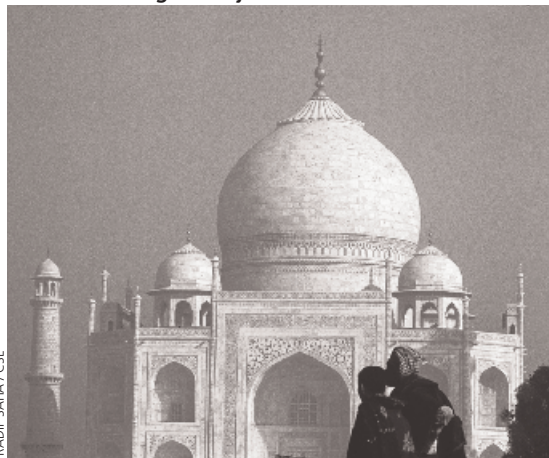
THE National Metallurgical Laboratory (NML) and Tata Korf have jointly developed a clean technology blast furnace at Agra that would lower the sulphur dioxide (SO_2) emissions and fine dust from the hundreds of foundries around the Taj Mahal. The laboratory has developed the technology and transferred to Tata Korf, which is commercialising the furnace among these foundries at Agra.

The SO_2 and suspended particulate matter (SPM) emissions from foundries had been yellowing the surface of the Taj. However, the new furnace does not use coke, the main source of the sulphur and SPM, but light diesel oil and natural gas. The NML cupola has been

found to meet emission norms set by the Central Pollution Control Board. The coke-less cupola is a typical vertical shaft-type blast furnace. The coke produced in India contains high levels of sulphur.

A high-level committee appointed by the Union ministry of environment and forests had found that SO_2 and spm from the foundries were yellowing the white marble. ■

A shot at saving the Taj



PRADIP SAHA / CSE

IN COURT

BANNING OLD VEHICLES: The Supreme Court (SC) has banned plying of all 15-year-old motor commercial vehicles including buses, taxis and auto-rickshaws in the National Capital Territory (NCR) from October 2 this year. The SC has expressed concern and distress at the apathy of the authorities concerned in implementing various directions issued by it from time to time. A three-judge bench, comprising justice A S Anand, justice B N Kirpal and justice V N Khare, also directed the Union petroleum ministry to take effective steps to eliminate supply of leaded petrol in the NCR by September 30 this year.

CONCERN: The Supreme Court (SC) has expressed concern over the reports of considerable encroachments in forest area in Karnataka. It has directed the state government to give district-wise particulars in this regard and furnish the steps taken by it for recovery of the encroached forest lands. The bench, comprising justice A S Anand, justice B N Kirpal and justice V N Khare, has further asked the government to inform the total extent of encroachments as they existed in 1978 and the position of encroachments in 1988-97. The SC directed encroachers not to change the nature of the concerned forests lands while the matter is pending.

WATER DISPUTE: A three judge bench will decide Supreme Court's (SC) jurisdiction on the Inter-State River Water Disputes tribunals. The SC referred the question of its jurisdiction to interfere with the orders of the tribunals to the Constitution bench comprising Chief Justice M M Punchhi, justice K T Thomas and justice S S M Quadri. The reference was made when the Almatti dam dispute was taken up. The Act says that the order of the tribunal will be final. With the exclusion of even the SC, the apex court has to decide the matter of jurisdiction.

FOLLOW UP

Environmentalists have stoutly opposed the construction of the proposed Dharma port in Orissa. According to Banka Behari Das, an eminent environmentalist in the state, the government should not allow the construction of the port, unless it gets specific clearance from the Union ministry of environment and forests (MEF).

Das has sent a letter to Union environment and forest minister, saying that the port lies in the forest range as well as in the Coastal Regulation Zone (CRZ). This is why it becomes necessary to get forest and CRZ clearance from the Union government before taking up the project. The environmentalist has demanded a strict environment impact study for the project. It is because the famous Bhitarkanika wildlife sanctuary (proposed national park) and the Gahirmatha beach known to be the largest rookery of endangered Olive Ridley turtles is located across the site, on river Dharma (*Down To Earth*, Vol 7, No 2).

Environmentalists have charged that the Orissa government is making an attempt to exclude the sanctuary area falling within the proposed port site from the Bhitarkanika sanctuary. Das says that it is an objectionable exercise and even if undertaken would require permission of the Union government. There is a primitive port at the place which had become defunct. Since the old port was non-functional, the government, a few years ago, set up a fishing harbour at Dharma.

The proposed port of Dharma will be at a distance of about eight kilometres downstream of the existing fishing harbour. So it is outside the existing port limit. In such circumstances, Das says, the MEF is the competent authority under CRZ notification and under Environment and Forest laws to give the environment clearance. Earlier, a Biju Janata Dal legislator had objected to the setting up of the proposed port.

INDIA / ENVIRONMENT

New policy

THE Union government is reformulating environmental clearance procedures in order to speed up green clearances for projects. Officials in the environment ministry have completed almost 90 per cent of the work. The new procedure is expected to be ready within a month.

The questionnaire which accompanies the application form for setting up a project is being re-designed. The new

form will exclude redundant information and add categories relevant for the project under clearance like site details, distance from national parks and socio-economic profile of the people living in the neighbourhood.

At present, we get several applications with unnecessary information and the appraisal committees have to invariably ask for additional data, according to ministry officials. Industrialists and environmentalists both are unhappy with the present clearance norms. ■

INDIA / AGRICULTURE

Tapping potential

IN ORDER to tap the potential of unirrigated lands, the Union government is formulating a new national policy on agriculture. The thrust of the policy will be finalised after discussion with states. Som Pal, Union minister of state for agriculture, says that the government would try to reduce disconcerting disparities and imbalances in the

production system.

The policy, a 25-year perspective plan, estimated to cost Rs 758 billion, would be launched to develop agriculture in unirrigated or rainfed areas on the basis of watershed management. Ministry officials say that the perspective plan has already been approved by the Planning Commission and its implementation would begin this year. The plan calls for close cooperation and coordination among all agencies concerned. ■

COMMENT

FIFTEEN-YEAR-OLD
VEHICLES BANNED!



RUSTAM VANIA

Hell and high-water...

...China experiences both as floods imperil the lives of thousands



Remains of the day: a woman looks at flooded houses in China's Hunan province

THE Yangtze river is swollen. Since May 1998, floods caused by heavy rains have affected thousands across 12 provinces in central, southern and eastern China. Gushing waters have killed more than 1,200 people, according to reports. Though floods are an annual affair in this part of China, water levels have risen to an all-time high along more than half of the river's 6,380-kilometre length. This has caused floods of the like not seen since 1954, when 30,000 people were killed. The International Committee of the Red Cross launched an appeal for US \$4.5 million in order to buy rice, wheat, medicines, and water purifying tablets.

Officials say the rate of water flow through China's gargantuan Three Gorges Dam project — being constructed upstream of the industrial city of Wuhan to prevent the catastrophic summer floods — has been unprecedented in recent days. "It's not that the rate has never been this fast, just that it's never been sustained at the present rate for such a long time

before," said the official. Recently, the authorities announced a ban on shipping along the stretch of the Yangtze river.

The Three Gorges Dam may have worsened the situation by contributing to the damage wrought by floods this season, say critics of the dam. Phil Williams, president of the International Rivers Network, an environmental group based in Berkeley, California, said that by lulling residents and officials along the Yangtze into a false sense of security, the Chinese government's exorbitant claims about the dam's future flood control capability may have caused local authorities to neglect maintenance of dykes and other traditional flood-prevention measures along the waterway. "People think what is the point of investing and upgrading the present embankment system if the Three Gorges Dam is going to take care of the problem?" said Williams.

The port of Wuhan, a major industrial city with a population of seven million, has probably been the hardest

hit. Floods here have killed about 140 people and damaged property worth about US \$10 billion. Flood control officials in Wuhan have launched night-long vigils on the city dyke as the Yangtze continues to rise owing to the incessant downpour. Over four million people were mobilised to reinforce the weakened defences that protect the area housing one-third of China's population and accounting for 40 per cent of its industrial and agricultural output.

President Jiang Zemin ordered a "do-or-die" effort to prevent a repeat of the 1954 catastrophe. Crumbling dykes were patched, sandbags and rocks were used to bolster the banks. Authorities have already started deliberately exploding some dykes to divert water into the countryside after the third huge crest in a month ripped past Wuhan threatening the city of Jiujiang and the nearby Hong Kong-Beijing railway line, reported the official Xinhua press agency. In Xianning in the central province of Hubei "11 small dykes were dynamited to divert floodwaters and lower the water level in the main stream of the Yangtze river", Xinhua said.

"The People's Liberation Army has issued emergency orders instructing all officers and soldiers to fight to the death to protect Yangtze river dykes, major cities and the well-being and property of local people," Xinhua reported. Downpours mixed with spells of bright hot sunlight, which could drive temperatures beyond 35°C, worsened the plight of many of the 30,000 people living in plastic and bamboo tents on dykes in the Dongting area, said Arne Jacobson, an official with the Red Cross.

"In the areas where people have been for a long time there was a lot of despair and resignation about the situation and you could really feel the people were desperate," Jacobson stated. Many people have been stranded on narrow patches of high ground for up to 45 days, exhausting meagre supplies salvaged from their wrecked homes and lowering their resistance to disease, he pointed out. He added that though Chinese physicians had managed to stave off epidemics by giving out water purifying tablets and vaccines, stockpiles of medicines were fast running out. ■

Dealing with waste

Laws to regulate disposal of hospital wastes have been framed in India

FOR the first time in India, the Union ministry of environment and forests (MEF) issued a notification on August 1 to regulate disposal of hospital wastes. The notification, called the Bio-Medical Waste (Managing and Handling) Rules 1998, not only lays down the framework for safe disposal of hospital waste but also regulates waste disposal technologies.

The minister of environment and forests, Suresh Prabhu, signed the notification after it remained in cold storage for three years. An expert committee had issued the first draft rules in April 1995. "The rules are radically different from the first draft and they have been formulated after consultations with non-governmental organisations (NGOs), the medical community, citizens' groups and regulatory bodies," says Ravi Agarwal of Srishti, a NGO which has been working on issues relating to medical waste.

The notification insists on environmentally sound technologies of waste management and suggests that hospitals pool facilities to cut costs. It also recommends staggered implementation till 2002, thus giving time for capacity building. Based on the "polluter pays principle", the rules will be applicable to all medical facilities, including nursing

homes and small clinics.

In March 1996, the Supreme Court had ordered all hospitals instal incinerators or alternative technologies to disinfect medical wastes. In implementing the order, hospitals used the single technology of incineration for all hospital wastes, regardless of class and type. This created tremendous problems due to the release of dangerous substances such as dioxins and furans, which are carcinogenic.

The new rules focus on technology and engineering issues appropriate to the requirement of wastes. They call for a simplified, "three-colour scheme" for segregation of wastes and specification of how each kind of waste should be dealt with. The first category comprises infectious wastes such as human tissues, organs and body parts which are classified as yellow. The second comprises items contaminated with blood such as bandages, represented by red. The third consists of plastic and glassware, including syringes, tubings and bottles, denoted by blue.

The first is to be disposed off through incineration and deep burial, the second by autoclaving (high-pressure sterilisation using steam) and microwaving, and the third by simple

disinfecting. Says Agarwal: "This will put an end to the sale of outmoded technologies to hospitals, which are unworkable in the Indian context." ■

Liquid danger

Government agencies acknowledge that Delhi's water is unfit for drinking

"DRINK only the Delhi Jal Board water," advise the numerous advertisements brought out by the Delhi government. Not really. Even the treated water coming through supply pipes is contaminated and unfit for drinking, according to the Central Pollution Control Board (CPCB).

An affidavit filed in the Delhi high court has vindicated the stand taken by environmentalists that water from the Yamuna was heavily contaminated. The report sent along with the affidavit filed by S P Chakrabarti, member secretary, CPCB, says: "The results of micro-pollutants analysed in the samples of raw water and treated drinking water of Delhi at all the four water works, collected on April 20, 1998 indicated presence of pesticides, especially endosulfan..." Endosulfan in raw water at Renney well at Okhla Water Works was found to be 91.59 nanogramme per litre (ng/l), while filtered water had 24.5 ng/l of endosulfan. Total dichloro diphenyl trichloroethane (DDT) in the raw water was 39.55 ng/l, and 29.98 ng/l in filtered water. According to the CPCB, these are above the acceptable levels set by the Bureau of Indian Standards (BIS). Iron, nickel and copper were also in excess of the BIS limits in most of the samples.

The affidavit also states that the Yamuna is still heavily polluted between Delhi and Etawah, the predominant pollutants being organic matter and faecal coliform.

As pesticides mostly come from agricultural sources along the Yamuna river and the West Yamuna Canal, the report suggests that this contamination can only be avoided if Delhi's raw water is transported through a conduit

Hospital wastes pose a serious health hazard



AMIT SHANKER / CSE

pipe/concrete channel from Tajewala, which is further upstream.

A public interest petition filed by B L Wadhwa, in response to which the court had sought the affidavit from the CPCB, says: "Considering that the only action the Haryana government has taken is to sack the state pollution control member for his disciplinary work, we have no choice but to take water from upstream Tajewala." Recently, the Haryana government had sacked the chairman of the Haryana State Pollution Control Board for taking action against industrial units in Haryana.

In another major finding, CPCB and the Central Ground Water Board have shown that the groundwater in Delhi has depleted so much that water from the Yamuna is seeping in and contaminating it. The 36 lakh residents of Delhi, who do not get treated tap water, are also drinking contaminated water coming from the Yamuna. ■

Walk on the ocean

Jupiter's moon Ganymede shows hints of what was once an ocean.

But it is still too early to say whether the satellite supports life

UNUSUALLY detailed pictures taken by the National Aeronautics and Space Administration's (NASA's) unmanned spacecraft Galileo reveal that Jupiter's largest moon Ganymede has geologic hints of an early sub-surface ocean. Also seen was a chain of 13 craters, which were probably formed by impacts from a broken comet similar to the Shoemaker-Levy comet that smashed into Jupiter in 1994. But it cannot be said with certainty if there is life on Ganymede. "We do not know and that's why we are out there looking. You have heat, liquid water, organic matter coming in from impacts from meteorites. The ingredients are all there," said James Head, planetary scientist on the Galileo imaging team.

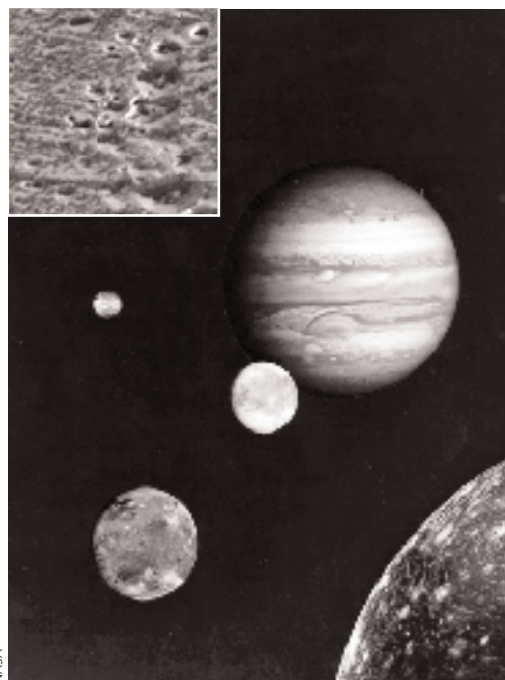
If Ganymede indeed had an ocean earlier, it has long since frozen solid. On Ganymede, "it's pretty safe to skate

at the moment," Head said, adding, "The surface is too cold for the ocean to exist."

NASA released pictures of Ganymede's surface on July 15 at Los Angeles. They were taken in June 1996 and June 1997. The images suggest that icy volcanoes spewed water instead of rocky lava, as on the Earth, Head pointed out. As much of the moon is icy, scientists wonder whether there is a warmer liquid layer beneath.

Earlier data from the Galileo found combinations of oxygen, carbon, sulphur, hydrogen and nitrogen trapped in Ganymede's icy crust. Ganymede is thought to have formed about 4.5 billion years ago. It is about a third the size of the Earth. It is the only moon with a magnetic field. It has a metallic core and a thin hydrogen atmosphere. About half of Ganymede's surface is bright clean ice. The other half is dark, heavily-cratered terrain made up of "dirty" ice and rocks. Scientists are looking for signs of liquid water. "The Galileo images show us quite dramatically that about half of the surface has been renewed by some process that put bright terrain out onto 50 per cent of the surface," Head indicated.

Pictures taken by the Voyager mis-



Tales of the Universe: Jupiter and its moons; and (inset) ice on Ganymede's surface

sions in the late 1970s had led scientists to believe that this was water. The water-spewing volcanoes in the new pictures could provide the mechanism for how the ice was deposited.

It is very likely that about one billion years into its history, Ganymede had a global ocean, very much like the one that scientists suspect lies beneath the frozen expanses of Europa, another of Jupiter's moons. Europa is one of the main targets of the search for life in the solar system and is the focus of the two-year mission extension of Galileo. ■

Chainsaw and beetles

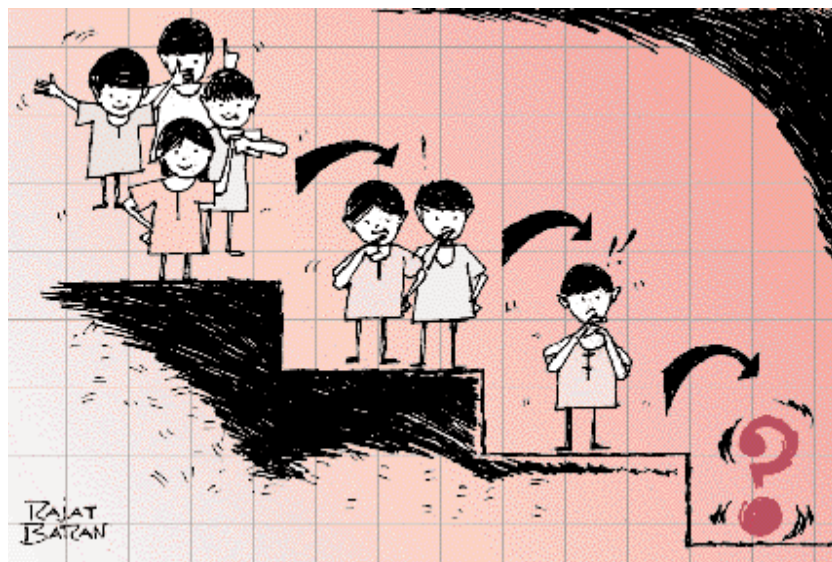
Chicago is preparing to fell a large number of trees to get rid of the Asian longhorn beetle

The Asian longhorn beetle has been spotted in the northern areas of Chicago in the US. The state and the federal governments are planning to fell a substantial number of hardwood trees in order to contain the spread of the tree-devouring Chinese beetle. The beetle was found only once before in the US. In 1996, an infestation in New York state was controlled by cutting hundreds of trees from neighbourhoods in Brooklyn and Amityville. Scientists say that the beetle cannot be controlled by pesticides.

Although scientists are not sure if the present attack will grow into an unmanageable problem, they are taking it very seriously. After an amateur bug collector found the Chinese beetle in a Chicago forest and turned it over to the authorities, scientists have been combing the forests. They believe that the beetle arrived within the last three years as larval stowaways in wooden crates carrying Chinese imports.

Falling count

Dwindling birth rates have become a cause for alarm in Europe



NEVER before have birth rates fallen so low and for so long in Europe as at present, except in times of plague, war and deep economic depression. There is not a single country in Europe where people are having enough children to replace themselves when they die. Recently, Italy became the first country in history where there are more people over the age of 60 than there are under the age of 20. Germany, Greece and Spain will probably reach the same figures this year.

This trend can be seen much beyond Europe. Last year Japan's fertility rate — the number of children born to the average woman in a lifetime — fell to 1.39, the lowest it has ever reached in that country. In the US, where a large pool of new immigrants helps keep the birth rate higher than in any other prosperous country, the figure is slightly below an average of 2.1 children per woman — the magic number needed to keep the population from starting to shrink.

Unlike the US, Europe has been resistant to immigration. Decades ago in Sweden, with its birth rate dwindling, officials decided to try to increase the number of new births by financially supporting family life with rare public generosity. Working couples with small children enjoyed cash payments, tax incentives and job leaves combined

with incredible flexibility to work part-time for as many as eight years after a child's birth.

Sweden spends 10 times more than Italy and Spain on programmes intended to support families. The result was that Sweden recorded the highest birth rate in Europe in 1991. But between 1990 and 1995, the birth rate fell from 2.12 to 1.6. Most people blamed the economy which had turned sour and had forced politicians to trim

the country's benefit programmes.

Even in the developing world, where overcrowding remains a major issue, the pace of growth has slowed down. Since 1965, according to the United Nations population data, birth rates in developing countries have been halved — from six children per woman to three. In the last decade alone, for example, the figure in Bangladesh has fallen from 6.2 children per woman to 3.4.

"Nobody on Earth can tell you what is going on here," says Mac Murray, a philosopher trained in statistics. "Sometimes I think it must be just a blip — we've had them before — and everything will turn out the way we expect it to," he says. "But I do not really believe that. I believe we are seeing a fundamental shift in human behaviour."

In surveys held in Europe, young couples almost always report that they want two children. But they have reservations. "I would like to have a child but my work situation is unstable," says Francesca Casotti, a lawyer in Rome who has been married for nine months. "I am at the office all day and it is difficult to think about having a child. People my age want their freedom," she says.

"People see children as a burden, as an inconvenience. I would like to have a stable job and would like to have more than one child. But economic considerations and time will not allow me to do that," she adds. ■

Auction for wastes

A Commission appointed by the Supreme Court recommends the auctioning of hazardous wastes

A high-power commission appointed by the apex court has recommended the auctioning of zinc ash, waste oil and batteries lying in various ports in the country to firms which fulfil certain conditions. The commission, headed by M G K Menon, was set up following a petition by the Research Foundation for Science alleging that hazardous wastes were being imported from scientifically advanced countries and distributed to small firms for recycling.

However, these units do not have the know-how or equipment for recycling. As a result, the people around these units — located all over the country — are facing serious health risks. In its interim report, the commission, after examining the chemical substances lying at various ports, suggested that the wastes could be auctioned to those firms which had valid authorisation from the respective state pollution control boards for handling wastes under the Hazardous Wastes (management and handling) Rules, 1989. The commission has said that these units must hold consent letters from the pollution control boards under the Air and Water Acts.

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Ultimate survivors

"Extremotolerant" bacteria make a living in the deepfreeze lakes in Antarctica

SCIENTISTS say there is life in the lakes of Antarctica which are perpetually covered by ice. An expedition to the McMurdo Dry Valleys led by John Priscu, a microbial ecologist from the Montana State University, USA, to investigate whatever life forms exist in the Antarctic waters turned out to be arduous, but the findings more than paid the price of labour.

As Priscu and his colleagues began drilling into the 10 to 20-foot-thick layers of ice during their successive trips to Antarctica, they kept hitting a mysterious layer of gravel about six feet down. The irksome debris, which sent their tempers flying, however,

as "extremophiles" — lovers of extremes — these creatures thrive in places where scientists, as recent as 20 years ago, had assumed no life could survive. The new Antarctic microbes, according to Priscu, are "extremotolerant".

For five years, the team of researchers, kept on hammering the gravel layer, often cursing while carrying out the arm-numbing exercise. Finally, they began to study the dynamics of melting and freezing. And in 1993, Priscu decided to study how gases escaped through the ice into the atmosphere and found a greater quantity of certain gases right where the gravel was. The peaks on Priscu's graph



Researchers looking for subsoil bacteria in a lake bed

turned out to be a place where diverse colonies of microbial life lived in little oases. Here, for about 150 days each summer, the ice softens enough and tiny pockets of liquid water form. The temperature in this coldest desert on Earth, when the microbes are active, is 0°C to 1°C. But the optimal growth temperature for these organisms is about 15°C to 20°C. "This is really life on the edge," says Priscu.

This quality makes these microbes different from those found elsewhere in extreme conditions. Known collectively

signalled the presence of certain bacteria busily manufacturing food by photosynthesis, taking nitrogen out of the atmosphere for their use, releasing oxygen and making carbohydrates from water and carbon dioxide. The researchers conducted DNA studies that showed that the organisms had actually originated in land, but may have been blown into the ice cover by the wind. Studies reveal that the microbes grow in the same place every year. "It's not transient," Priscu said.

This discovery could provide a model for how life may have once flourished on Mars and Jupiter's moon Europa, said accompanying commentators Roland Psenner and Birgit Sattler of the Institute of Zoology and Limnology at Innsbruck University, Austria. ■

In safe waters

The industry, Pentagon and the US navy lobby for the ratification of a sea treaty

THE US Navy, oil industry and telecommunication giants are trying hard to take the Law of the Sea Treaty out of the 'deep freeze' as the nation is still to ratify it. The deadline for ratifying the treaty, an international agreement on regulating commerce, navigation and exploration on and beneath the oceans, ends on November 16, 1998. Till now 125 countries have ratified.

The treaty with the proposed Jamaica-based authority on deep-seabed mining in future, if not ratified by the US, will not fetch it a place in the decision-making body of the authority, thus affecting US's future sea-related mining activities. It would also affect its security concerns, as perceived by the Navy which has recently gone public in support of the treaty. Similarly, the oil industry and the telecommunications giant AT & T are lobbying hard in favour of the treaty. Oil industry executives say that they need the treaty to protect offshore drilling rights as well as for passage for tankers. AT & T officials said they need it to give legal protection to the ships that lay and maintain underwater telephone cables.

In 1982, this treaty was rejected by the then president, Ronald Reagan, protesting its provision requiring industrialised nations to share deep-sea mining technology and revenue from mining operations with less developed countries. In 1994, president Bill Clinton signed the treaty and sent it to the Senate for approval. ■

Paint it safe

Researchers at Japan's Marine Biotechnology Institute at Shimizu City are currently conducting sea trials of a new nontoxic paint that prevents fouling of ships' hulls by mussels and barnacles. Made from tribromogranine (TBG), a compound that mussels and barnacles detest, the new paint does not release damaging chemicals into the ocean. TBG is produced by *Zoobotryon pellucidum*, a bryozoan that lives on tidal rocks. A bryozoan is a marine species that form colonies of mossy growths. Mussels and barnacles often settle on the underside of a ship's hull, disturbing the smooth flow of the water increasing drag and adding to the fuel costs. All existing antifouling paints essentially work by killing barnacles and mussels. They contain toxic chemicals such as tin-based compound called organotin. TBG, on the other hand, merely repels the problematic creatures. The developers of the paint claim that TBG is perfectly safe and will have absolutely no negative effects on the marine organisms.

No laughing matter, this

Common garden earthworms ooze nitrous oxide, commonly known as laughing gas. As a greenhouse gas, these exhalations could contribute to global warming, German researchers warned the recently-concluded meeting of the American Society of Microbiology in Atlanta, USA. Carola Matthies and her colleagues from the University of Bayreuth in Germany were surprised to discover that nitrous oxide production was, on an average, five times higher in worm-infested soil as compared to soil without any earthworms. Matthies and her team of researchers believe that the worms account for as much as 25 per cent to 44 per cent of all the nitrous oxide produced in the gardens. "It was indeed a surprise," said Matthies, who believes that the earthworms produce the gas by digesting nitrates and nitrites usually present in the garden soil.

ENVIRONMENTAL SCIENCES

Fade to black...

Coral reefs in the Andaman Sea are losing their colour, owing to extensive bleaching. Experts say global warming is to blame

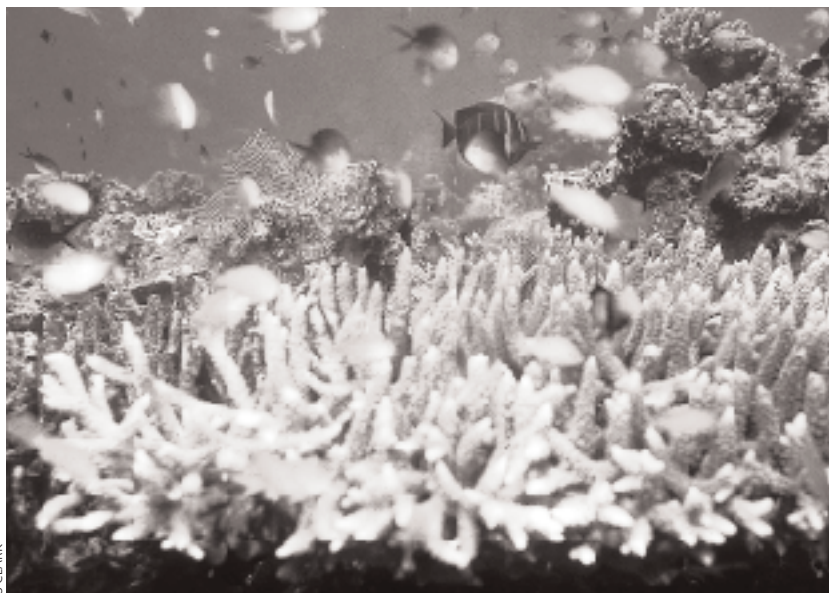
AWE-STUCK tourists look down through the glass-bottomed boat only to be welcomed by an explosion of colours on the ocean-bed. Deep blue, bright yellow, red with streaks of white — colours of the corals.

Welcome to Andaman's Jolly Boy island, where these corals draw a large number of tourists every year. However, very soon, warn experts, this riot of colours may disappear forever.

but "animals of the coral reef community, like a few species of soft coral and giant clams have also lost pigments".

Though a partial recovery has been observed, bleaching of coral reefs remains, nevertheless, a matter of grave concern since the damaged reefs will disturb the delicate ecological balance of the archipelago.

Rich in biodiversity and one of the most biologically-productive marine



Fading colours: global warming is causing corals in Andaman to lose their colours

According to a report prepared by R Soundarajan and his colleagues from the Society for Andaman and Nicobar Ecology (SANE), corals here are in danger, owing to "mass bleaching...in the coral reefs throughout the length and breadth Andaman group of islands". This problem, said the report, has been threatening the corals since early May.

Soundarajan, who is a marine scientist from Port Blair's Central Agricultural Research Institute (CARI), along with his team of researchers, is working on a project to study the state of coral reefs around the archipelago. The project has been financed by Worldwide Fund for Nature (WWF), India. He said that not only the corals

ecosystems, coral reefs are the tropical rainforests of the oceans. Of the 0.6 million sq km of coral reefs in the world, half are in Asia. The niches on the reefs are home to countless life forms that sustain fishing and other activities in a marine economy. In India, these reefs offer a fishing potential of about 0.2 million tonnes. Island economies, such as in the Andamans, depend extensively on them, for fishing as well as tourism.

So why are these corals suddenly losing their colour? Corals, unknown to many, are living creatures. Corals that build reefs — hermatypic corals — host microscopic algae called zooxanthellae in their bodies. The relationship between the two species — the corals

and the algae — is symbiotic, both drawing nutrients from each other for survival. The beautiful colours these corals are known for comes from these microscopic zooxanthellae residing inside them. And coral bleaching occurs when, due to some reason, this delicate symbiotic relationship is disturbed. The zooxanthellae is ejected from the corals, leaving the white calcium carbonate of their skeletons visible.

Though bleaching of corals have been observed as early as 1928, first instances in the Indian Ocean were first noticed in 1991. These then recurred four years later, in 1995. But since early this year, extensive areas — from equatorial Maldives to North Andamans — have been affected. Even corals over six metres beneath the sea surface have not been spared.

And according to Soundarajan and his fellow researchers, a rise in the mean surface seawater temperature (SST) is the central cause of this extensive bleaching. Barbara Brown of Newcastle University, USA, has noticed that over the last 50 years, the monthly mean SST has gone by 0.126°C every 10 years. She has also correlated the mass bleaching of 1991 and 1995 in the Andaman Sea to the high temperatures which were recorded in these years. In the past 10 years, the El Nino phenomenon was responsible for causing widespread bleaching of coral reefs. And thanks to it, the Indian Ocean mean SST also rose by several degrees, said Soundarajan. And this is the reason why corals in the Andamans are bleaching *en masse*.

Scientists at SANE believe that under bleaching conditions, corals lose their growth and reproductive ability. Past cases of bleaching in the Andaman Sea show reefs damaged by increased SST take anywhere between a few weeks and several decades to grow back.

And this means total uncertainty and economic displacement for a lot of people here who depend on reef fishing and tourism. Further, many of the smaller islands here are protected from sea erosion by the ever-growing coral reefs. These islands now face flood threats. The other possibilities are even more frightening. No catastrophe occurs without signs of warning. Maybe coral bleaching in the Andaman Sea is one such sign. And maybe this is Nature's way of telling us that very soon, our planet will be too hot for comfort. ■

Way to oblivion

That's where the Asian sea horses might be headed

ASIA'S once-abundant sea horse population has gone down drastically in recent years, owing to heavy demand for their use in traditional medicines, aphrodisiacs and aquariums, said conservationists. Destruction of their habitat is another major cause for their decline, they say.

"We're dealing with a situation where we still have some time," said Heather Hall of London's Zoological Society. "But now, there is grave cause for concern," she added.

About 40 conservationists, including Hall, and traders in medicinal and commercial products derived from these endangered sea horses and various other marine species met in central Cebu city, Philippines, recently to discuss ways of saving these sea creatures without resorting to a ban on their collection.

Asian nations, including Philippines, India, Vietnam, Thailand and Indonesia, are among the world's largest exporters of live and dried sea horses. No extensive inventory of sea

horse populations exists but drastic declines in catches have been reported all over Asia in recent years, indicating their diminishing numbers, said Amanda Vincent, a biologist from Canada who has done extensive research on these creatures. In the Philippines, for instance, sea horse catches have declined by as much as 70 per cent in some areas, she added. There is no laws in the country that specifically protects these sea horses.

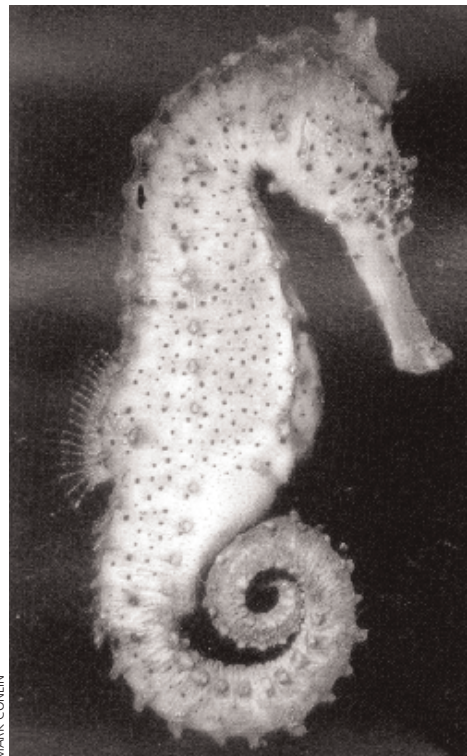
The Philippines supplies about five million sea horses annually to China, Hong Kong, Japan, Taiwan, Singapore and South Korea, with demands that far exceed their supply. Sea horses thrive mostly in shallow warm tropical seas and are unique due to their unusual horse-like appearance, their ability to change colour to avoid predators, and the reproductive role of males, which bear the offspring.

These creatures have been used since ancient times as a cure for a wide variety of ailments, including asthma, stomach aches, colds and tooth aches. They are also used as aphrodisiacs and as charms to ward off evil spirits. An estimated 20 million sea horses are exported to over 40 nations every year.

Vincent said the continued depletion of these creatures will eventually affect the impoverished Filipino fisherfolk who depend on sea horses for their livelihood. She said for the first time, the four-day Cebu conference brought together conservationists, traders and Chinese medicine practitioners to chalk out way and means of protecting the sea horses from a bleak future of impending extinction.

In 1995, Hall, along with several other conservationists and a local environment group, established what they claim to be the world's first sea horse conservation project in Handumon, a sea horse fishing village in central Philippines. She said the project has successfully encouraged most of the Handumon fisherfolk to set up marine sanctuary for sea horses and a few other marine species. The fisherfolk also gather fisheries data and replant mangroves, becoming a model for sustainable marine resource management. ■

Ride to extinction: sea horses are dying



MARK CONLIN

Last tree standing

Remnant forests can affect growth of other trees in the vicinity, claims a new study

TROPICAL forests have been disappearing at alarming rates for the past three decades. Farmers, ranchers and timber industries have denuded millions of acres, and only in the past few years has the resultant damage to the ecosystem has become agonisingly clear.

A new study by botanists at the University of Georgia, USA, now shows that trees left standing in pastures can actually dominate the reproduction in nearby remnant forests, creating what scientists are calling a “genetic bottleneck”. According to the research, the survival of these tropical forests could be far more complex than what was thought earlier. New approaches to conservation strategies may be needed to protect these endangered forests.

“The key is to understand how much genetic movement there is between fragments of a forest,” said James Hamrick, who conducted the study along with his graduate student Preston Aldrich. “When we lose fragments of a forest, we lose genetic diversity. Gene exchange between fragments helps to maintain this diversity.”

Genetic diversity is vital for plants and animals alike. Farmers have, for hundreds of years, bred crop plants as well as farm animals to maintain a healthy diversity of what were, before the 20th century, called traits. Now, with advanced techniques to determine the exact genetic make-up of individuals, scientists have a considerably better understanding of how the genes drift through populations. Aldrich and Hamrick studied a tree species called *Symphonia globulifera* (*S. globulifera*) in a little-examined rain forest area in southern Costa Rica.

S. globulifera is a shade-tolerant canopy tree with bright red flowers which are pollinated primarily by hummingbirds and occasionally by bats that disperse the seeds by eating fruits and then pass them on through excreta at their resting sites. Like many areas in the tropics, the study focused on an area of fragmented forest with a number of *S.*

globulifera trees scattered in the open pasture land nearby. There were neither seedlings or saplings of *S. globulifera* in the pastures, suggesting poor habitat quality for both germination and growth. The question was simple: which trees are the genetic ‘parents’ of the seedlings growing in these forest fragments? Finding the answer would have been nearly impossible even a decade ago. But the sensitive techniques that are now available allowed researchers to determine the exact genetic make-up of individual plants in the ecosystem.

Even then, the problem was daunting since there were more than 800 possible parent pairs. “In trying to tell who the parents are, we had to use the same techniques used in forensic analysis to determine a child’s parents,” said Hamrick. “We were able to do this only because Preston was able to develop the techniques for our specific genetic analysis.” The breakthrough came in

the seedlings in their own patches.

The importance of the discovery lies in the fact that the genetic diversity of seedlings in forest fragment may be relatively small indeed. “If you looked at the number of seedlings superficially, you might say that this is a healthy rate of regrowth,” said Hamrick. “But in truth, the effect is ecologically unhealthy due to the potential for inbreeding in subsequent generations.”

As scientists tell us, inbreeding can be harmful. They have several theories as to why the pasture trees have such an overwhelming impact on gene flow. There is little competition for the pasture trees for sunlight and nutrients, giving them superior abilities to flower and fruit. And then, the abundance of flowers may attract more hummingbirds for pollination. Finally, bats have easy pickings of the fruit and take them from the pasture trees to the forest fragment, where they eat and then pass



TOM MACKIE

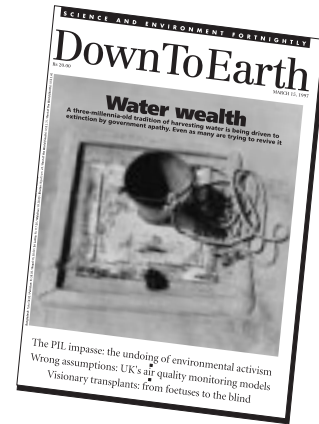
Last of the greens: Remnant forests can influence gene flow in trees

using segments of DNA called microsatellites as specific markers for *S. globulifera*. These markers allowed Aldrich and Hamrick to determine the pedigree for a number of seedlings and saplings in a one-hectare (ha) forest fragment on their 38.5-ha research area.

The scientists knew the genetic composition of all the adults, 42 individuals, in the study area. The results of the genetic analysis were startling. Out of nearly 250 seedlings studied from a single forest fragment, some 68 per cent were produced by adults in pastures — not from adults within the fragments themselves. Moreover, of the seedling produced by pasture trees, 77 per cent came from only two trees. Adults left in the fragment produced less than 5 per cent of

seeds back to the soil.

The study has important implications for conservation and forest restoration and it shows that the impact of deforestation has been far more devastating than the simple removal of individual trees. At least in this species, fragmentation has resulted in the possibility of a serious loss of genetic diversity in this test area. Thus areas that look healthy in terms of regrowth may not be healthy at all over the long term. They may be facing serious future problems due to problems with genetic drift and inbreeding. American farmers already know of the problems this can cause, since they barely avoided a near-disaster because of over-planting of corn with too little genetic diversity in the 1970s. ■



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Size does matter: a huge mound of gypsum and chalk waste (top left) dwarfs the houses of Bajwa township

PHOTOGRAPHS: AMIT SHANKER / CSE

TOXIC TRAIL

A small area in northern Vadodara is cluttered with nearly 200 industries, most of them dealing in chemicals. This has created serious environmental problems. The water is unfit for drinking, the air full of toxins, and the once-rich farmland surrounding the industrial area is now classified as degraded

MANISH TIWARI VADODARA

BAJWA, a village in Vadodara district of Gujarat, looks no different from the other villages that dot the state. But people here breathe toxins, drink contaminated water and have no agricultural land to be proud of, in productivity terms. Over a period of 30 years, this village and the area around has urbanised somewhat, and has been turned into a pollution hothouse with excruciating consequences for the local people. This is a direct consequence of the government turning a blind eye to the industrial waste accumulating for

over 30 years. According to Suren Choksi, a noted Vadodra geologist associated with several companies, there are already over 190 industries in northern Vadodara. And the government continues to give licences for expanding or creating new capacity. These are in fertilisers, petrochemicals, pharmaceuticals, H-acid, and dyes.

In 1969, the Gujarat government appointed a technical committee to look into the increased pollution load of the Mahi and Mini rivers, which flow about 45 km away from the hub of the industrial township that incorporates Bajwa. These rivers had been made

repositories of chemical waste from the industries around. So shocking was the situation that the committee had to suggest the creation of a 56-kilometre long effluent channel to tackle the waste, the first in India. The channel was commissioned in 1983. It passes through 24 villages of Vadodara and Bharuch districts before emptying into the Gulf of Cambay. But barely 10 per cent of the flow reaches the sea, as 90 per cent of the effluent water is taken out by farmers for their fruit and vegetables which end up in markets in Surat and Mumbai, says Choksi. Irrigation pumpsets virtually line the channel.

No toxicity tests have been conducted on the fruit and vegetables grown here.

The Gujarat State Fertilizers Company (GSFC) began operating here in 1967. It simply dumps its gypsum and chalk waste in the area. By now a waste mountain has been created, about 40 metres high, spreading over a 14-hectare area. In the heavy rains this year — on July 6 — the four-million-tonne waste mountain collapsed, sending its toxic slurry into people's homes in Bajwa village. The GSFC's wall that separates the industrial complex from the village did

In Bajwa, total dissolved solids in groundwater are four times higher than permissible levels

not even prove a minor obstacle. The waste is impregnated with heavy metals.

Quite apart from the solid waste mountain, the GSFC has in its complex four huge ponds, two each for gypsum and chalk slurry. This toxic slurry percolates to the groundwater, which people have to consume for living purposes. This contamination of the groundwater is thought by people in the area to be a key factor for their contracting a range of illnesses that were not common three decades ago. The waste mountain that has literally been erected over the years is nothing but the dried slurry of the four ponds. When the watery muck dries, and begins to fly round, GSFC simply piles it up. And thus the mountain which forms the back-

drop for the village that is referred to as the "Kashmir" valley by the people, and the dirty ponds are likened to the famous Dal Lake.

The slurry from the "mountain" getting into people's homes in the rainy season is a near-annual phenomenon. This time it only happened to catch media attention. And people have to clean the filth themselves after it is washed down by the rains. Surveys conducted by reliable and prestigious institutes clearly indicate that toxic impurities such as cadmium, lead and zinc and other heavy metals infuse this waste. It is this which gets into the groundwater and destroys the agricultural productivity of the land here (see map: *Before and after*).

Is this waste hazardous or not? If it is, the situation is infinitely more serious than is thought. But the verdict is not so clear. Are chalk and gypsum hazardous? Rules and laws are ambiguous and unclear. As per Hazardous Waste (Management & Handling) Rules 1989, the waste in Bajwa should fall under Category 16 of Hazardous Waste Rules. According to these rules, if a waste pile generated is more than 200 kilograms per annum, the classification is "hazardous", and the waste has to be managed in "an environmentally safe manner".

This was the advice tendered to the GSFC by the National Productivity Council (NPC) in October, 1997. However, A K Saxena, director (environmental division), NPC, says most of the

hazardous waste rules are "misleading and need to be reformulated". Whether the waste piled up sky high in the Bajwa area is hazardous or not, the Environment (Protection) Act 1986 makes the setting up of a proper hazardous waste disposal site mandatory for chemical plants, which abound in the region. Talking to *Down To Earth*, V V Modi, chairperson of the Modi Committee, constituted recently by the high court to look into pollution problems in Vadodara, suggested that industries in the area needed to take a serious look at this provision. Till today, GSFC is searching for a proper dumpsite to dispose of its waste. According to Choksi, the company will have to soon find a way to remove the waste from the area.

A study conducted in the 1980s by the National Environmental Engineering Research Institute (NEERI), Nagpur, indicates that leachates from the dumpsite may have found their way into the groundwater. K K Shah, a doctor and resident of Bajwa, after an analysis of his well water, confirmed the NEERI finding. Even a study conducted by the civil engineering department of M S University, Vadodara, found evidence of high levels of toxins in the groundwater.

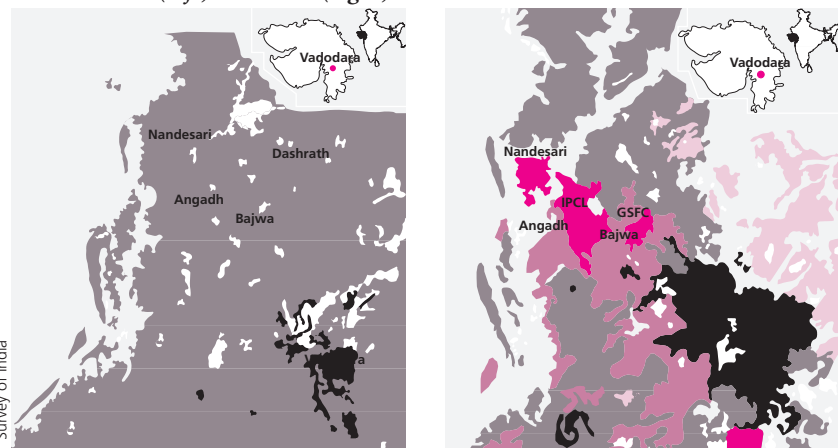
Shah says that many patients in the region suffer from renal, kidney, hypertension, thyroid, gastroenteritis and respiratory problems, and several women have been reported to have abnormal pregnancies. However, the state government has not yet initiated any health study to find out the effect of pollution on human lives.

Recently, the Vadodara Gramya Pradushan Nivaran Samiti (VADPRAN), a non-governmental organisation, prepared a report on the basis of a groundwater analysis in villages near the GSFC plant. It shows that the total dissolved solids levels (TDS) in the groundwater samples collected from Bajwa were as high as 7,700 milligram per litre (mg/l), the permissible limit being 2,000 mg/l (see chart: *Breathing toxins*)

The groundwater is so heavily contaminated that even GSFC is forced to bring water to the company's township from the Mahi river. This water has a TDS level of 300 mg/l. GSFC is also providing water facilities to some villages badly affected from the waste dump. Interestingly, J M Barot, member secretary of the Gujarat Pollution Control Board (GPCB) said, "There is no ground-

Before and after

Generalised land-use map and urban sprawl of Vadodara and its surrounding areas in 1960 (left) and 1988 (right)



Source: Survey of India

SHRI KRISHAN

Breathing toxins

Concentration of air pollutants in villages around the GSFC factory

SAMPLING SITE	CONCENTRATION OF POLLUTANTS (µg/cubic metres)		
	Sulphur dioxide (SO ₂)	Oxides of nitrogen (NO _x)	Respirable Particulate Matter (RPM)
Dashrath	68	69	124
Mumbai Bypass Junction	30	143	129
Channi Junction	37	100	192
Bajwa Octroi Check Post	59	41	249
Bajwa	41	102	209
Karachiya	82	116	189

Air Quality Standards (24 hours average): SO₂ — 80 µg/cubic metres, NO_x — 80 µg/cubic metres,

RPM — 100 µg/cubic metres

Source: National Institute of Occupational Health, Ahmedabad

water pollution in the area due to GSFC." Shah retorts, "If it is potable, why don't GSFC officials drink the same groundwater?"

High levels of groundwater contamination have forced villagers to seal most of the borewells in Dashrath, Channi, Bajwa, Ranoli, Padmla, Karachiya and Undera. "In Dashrath alone, 20 borewells have been sealed. The water is not even suitable for irrigation," says Bhanubhai R Patel, a local politician.

Villagers had earlier demanded that GSFC provide them safe drinking water, but when their demand was not met Shah placed a groundwater analysis report before the Gujarat high court on behalf of the villagers. In an oral order on October 1, 1997, a division bench headed by Justice B C Patel and Justice S M Soni positively confirmed Shah's findings about the presence of cadmium, cobalt and copper in the groundwater. It also took cognisance of the study done by NEERI which reported presence of toxins in the GSFC waste dump. Later, the bench directed the National Institute of Occupational Health (NIOH), Ahmedabad, to carry out a study on the ambient air quality around the GSFC factory. Interestingly, according to Shah, both the judges were soon transferred and the new bench rejected further petitions by the villagers. The villagers have now moved the Supreme Court.

The NIOH study ordered by the court earlier found that the daily average concentrations at Dashrath, Bajwa and Karachiya during November 18-21, 1997 was higher than the air quality standards (AQS: 80 µg/cubic metres for residential area). NIOH also stated that prolonged exposure to this could lead to respiratory problems, exacerbation of diseases in chronically ill persons, sensory and behavioural abnormalities and heart diseases.

Choksi says that till today detailed information is not available about the types of effluents generated by the northern Vadodara industries and their implications for the environment. He also says that some of the factories

in the area release oxides of sulphur into the atmosphere which dissolve during the rains. This rainwater scars plant life in the region. A study conducted by Vadodara Urban Development Authority states that 30 per cent of the mango and *rayan* trees in the high air pollution zones did not bear any fruits. Crops in villages, such as Omkarpura, Ranoli, Damapura, Angadh and Bajwa have been badly hit because of degrading soil fertility and poor quality of ambient air.

Farmers complain that they are not getting buyers for their fruits and vegetables. These fruits ripe and rot overnight because of the poor ambient air quality. "I am forced to sell 20 kg of banana for Rs 6," says Poonambhai Chotabhai Patel, a farmer in Channi village. He puts the blame on air pollution caused by GSFC.

Till today, the industries cluttered in

Villagers have sealed several borewells. The water is not even suitable for irrigation

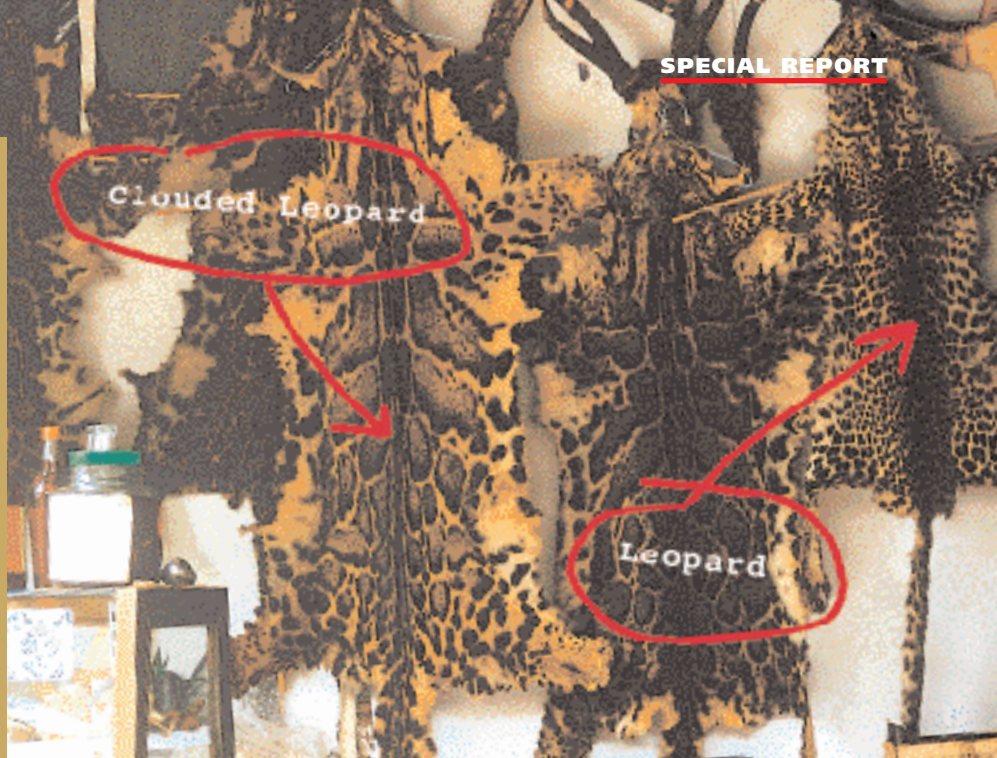
northern Vadodara do not have any disaster management plan. The Modi Committee has recommended four important plans in the area: proper information channel, transporting victims in case of an accident, medical treatment facilities, and rehabilitation centres. Modi says that the industries have been flouting environmental norms for years now, but this doesn't seem to bother GPCB. "If some big disaster takes place, we are not equipped to meet the challenge," he says. A former board member of GSFC says: "A major disaster in this industrial township could prove to be more devastating than Bhopal."

With regard to the GSFC waste, V L Patel, additional general manager, GSFC, says: "At present, the company can only manage the waste in its complex till it gets another dumpsite." Meanwhile, the local administration has ordered GSFC to take all precautions to avoid repetition of such an incident, says Anil Kumar Mukim, district magistrate of Vadodara. ■

A villager in Bajwa waits for clean drinking water



Two small border towns, Tachilek in Myanmar and Mae Sai in Thailand, thrive on illegal trade in animal products. ANIL AGARWAL and SUNITA NARAIN take a stroll through the wildlife black market to give a graphic account of how international laws are flouted openly



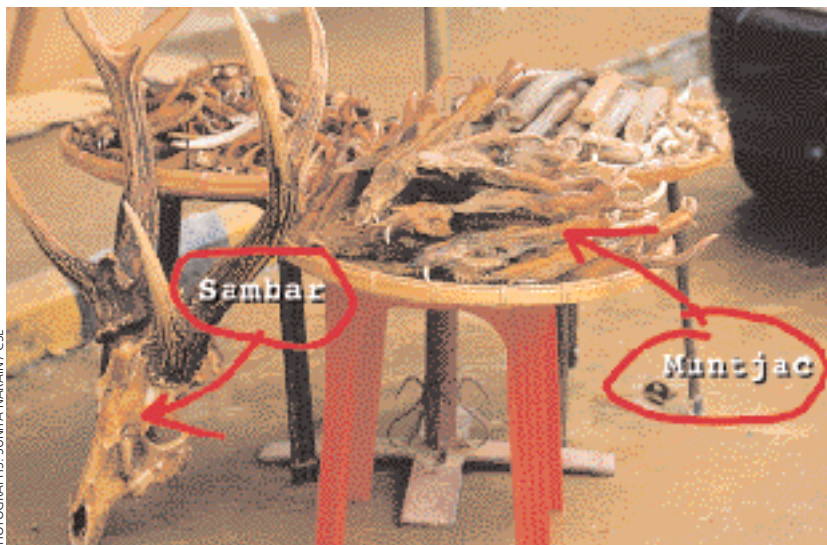
BONE BAZAR



TACHILEK bustles with activity. A busy tourist market, its streets are thronged by buyers, who have travelled many miles to get here. In smuggling circuits, Tachilek is known for selling everything from US-made Marlboros to Chinese fabric. However, buyers flock to this town, not for American cigarettes or cheap Chinese cloth, but for the more exotic merchandise it has to offer. Skins and bones of tigers, leopards, barking

deer — Tachilek sells them all, doing brisk trade in body parts of wild animals that, according to international law, are highly endangered. Tachilek, sharing its borders with Thailand and located in the Golden Triangle region notorious for its narcotics trade, has become an one-stop smuggling paradise and a lucrative route for poachers and smugglers in the illegal wildlife trade.

On display are skins of clouded leopards (*Neofelis nebulosa*), usually thought to be the closest of the living cats to the extinct sabretoothed tiger. Found across the Northeastern Indian range, southern China, Myanmar and Malaysia, this animal has become exceedingly rare and is listed in the Red Data Book on vulnerable Indian animals. Other threatened leopard species such as the *Panthera pardus* and the leopard cat (*Felis bengalensis*) are also sold alongside skins of Royal Bengal Tigers, another endangered species. Three subspecies of this animal are already extinct and at the last count, there were only 3,000 to 4,735 of them in the world. All these species are classified under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and



Flora (CITES) as “rare or endangered and in which trade is not permitted”. But in a blatant violation of this treaty, one can buy a leopard skin here for as little as Thai baht 3,000, roughly Rs 3,000.

Besides skins and bones of large mammals, skulls and horns of Gaur (*Bos taxicolor*), a species that CITES classifies under Appendix II as “a species that could become threatened if trade is not regulated”, and remains of several species of the Asian deer, such as Eld’s deer (*Cervus eldi*), Muntjac, and the Serow are also sold. All these animals are listed under Appendix I.

The bloodied route

Though Myanmar signed the CITES treaty last year, custom officials are unaware of trade restrictions on sale of these animal products. In Mae Sai, Thailand, however, officials are better informed. But when asked how the goods could be “taken” across the border, they good-naturedly suggest landing spots down the Mekong river which separates Thailand and Myanmar. And in Tachilek traders assure the buyers that everything can be carried across the border at night, law or no law. Though agencies tracking wildlife smuggling acknowledge that this is a “hot” area, there is very little information about the wildlife black market here. While governments of the Golden Triangle region claim success when it comes to controlling the illicit drug trade, they have failed to stop the animal smugglers. Insurgents in Myanmar are also said to use this trade to acquire money for arms.

Ivory travels through Thailand to Hong Kong and then ultimately to Japan. Skins, bones and other animal parts are usually destined for use as traditional medicines in Thailand. It is thought that the smugglers often take their booty through Thailand back to China. This is because in this warlord Karen-dominated region of Myanmar, transportation through the country is difficult. Thailand provides an easy transit point to other Southeast Asian countries.

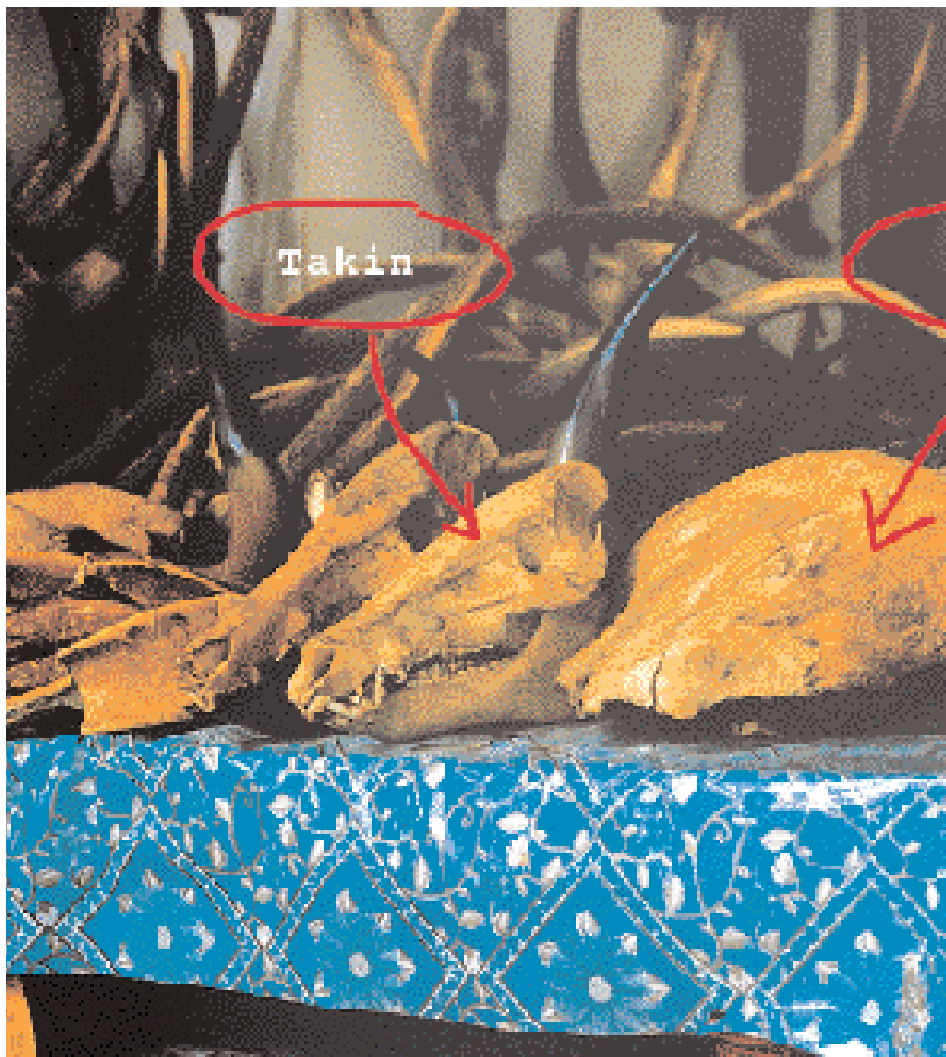
Who manages Myanmar’s forests?

Myanmar, like India, has enough laws to protect its wild animals. The forest department is responsible for managing and conserving almost 16 per cent of the country’s land area. Several laws, such as

the 1902 Burma Forest Act and the 1936 Burma Wild Life Protection Act seek establishment of sanctuaries and forest reserves. In 1994, Myanmar passed a new law, Protection of Wild Life and Wild Plants and Conservation of Natural Areas. A committee, under the minister of “natural areas” and zoological gardens, set up conditions for hunting. The forest department also announced a fine of up to 50,000 Kyat (roughly US \$400) and/or imprisonment for up to seven years for illegal possession, sale or export of protected species or their body parts. The country even passed a notification of the “completely protected” mammals, birds and reptiles. Of course, this list includes what Tachilek sells openly — tigers and leopards.

But Myanmar is a poor country, with its government and people dependent on natural resources for money. It is also a country that has witnessed recent strife and lawlessness, thanks to ethnic insurgency and military dictatorship. The most important source of foreign exchange, needed for guns and

other “essentials”, has always been the nation’s forest resources. Timber, mostly teak (*Tectona grandis*), now equals rice as the largest foreign exchange earner. Since 1988, Thai companies have been given contracts to log large areas. Forest cover has dwindled from 42 per cent in 1981 to less than 20 per cent in



1989, making this one the world's five highest deforestation rates. The forest department also exports live animals like elephants, hill mynas and rhesus monkeys. In 1989, the sale of 23 Appendix 1-listed elephants to a Dutch national created an international controversy. Myanmar argued that the elephants had been bred in captivity, a claim that could not be substantiated. In 1990, the CITES secretariat recommended that import licences for elephants from Myanmar should not be granted, unless proved that the animals were really bred in captivity. Elephant sales, however, have continued unabated, and experts believe that their populations have declined drastically.

Like in any other poor country, people of Myanmar are also dependent on wild animals for their survival. The

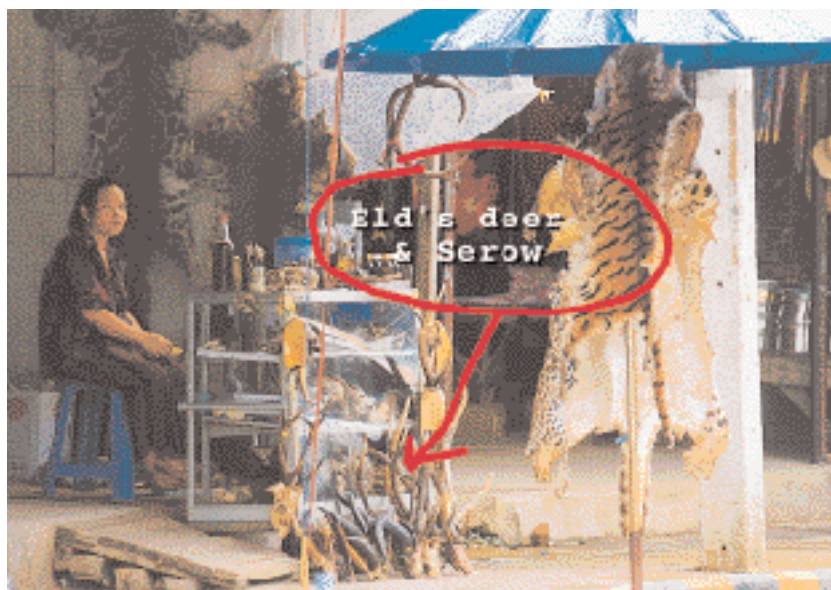
country is well known for its ivory carving. It has the second largest number of elephants in Asia. And though hunting is banned, tusks of elephants that have died naturally can be purchased from the government. Trade in this "government-owned" ivory is legal, and export with certification is allowed.

The most important usage of animal products is in traditional and oriental medicine. Perhaps this is the only health care available to millions in these forested and poverty-stricken regions. Even in Tachilek, modern allopathic drugs are sold alongside traditional Chinese and Burmese concoctions. Traditional Burmese medicine, based on the Ayurvedic system and encompassing some metaphysics of Buddhism, sparingly uses animal products, unlike local Chinese medicines that uses animal

Is enforcement possible?

Given this nationwide dependence on wildlife for money, is it possible to enforce laws protecting these endangered animals? The global conservation community has used "stick and guns" to check smuggling. Under CITES, trade bans have been imposed on rogue nations and illicit products are tracked and confiscated. Enforcement is seen as the key to conservation. Despite global action, smuggling and decimation of endangered animals continues. At the ninth meeting of the Conference of Parties to CITES held in 1995, it was accepted that "despite inclusion of tigers in Appendix I, illegal trade has escalated, and could lead to the extinction in the wild". CITES then recommended steps to place tougher sanctions and develop strategies for eliminating the use and consumption of tiger parts and derivatives in traditional medicines, but to little avail. The last meeting of CITES, held in Harare last year, saw the same hysteria about possible extinction of many species. Trade went underground. And

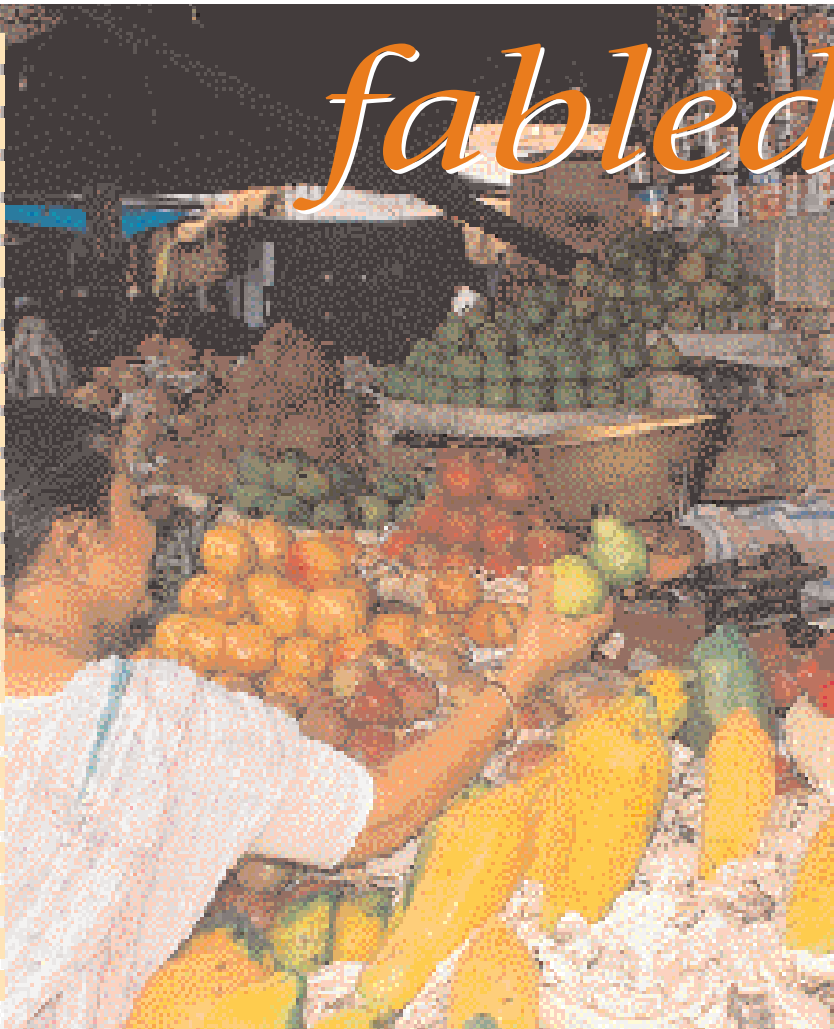
Clearly, the answer to the crisis in the wild is to be found in action that uses local knowledge and most importantly, sees the animals as resources for poor communities. Otherwise, such markets in Tachilek and many other border towns will flourish



parts extensively. Tiger bones are used for strength, python gall bladder for strokes, and wild pig tusk for smallpox. These and many other animal parts are in great demand across the region: the Japanese and the Thais want dried bear gall bladders and tiger bones; South Koreans demand antlers, while the Chinese want everything from pangolin scales and otter skins to swiftlet bird nests and tortoise shells.

the protected tiger, the leopard, the rhino still remain endangered. Clearly, the answer to the crisis in the wild is to be found in action that uses local knowledge and most importantly, sees the animals as resources for poor communities. Otherwise, such markets in Tachilek and many other border towns will flourish. And every smuggling ring that is broken will just be the tip of the iceberg. ■

Taking off from its climatic range — Himalayan to tropical — India has much to offer in terms of fruit diversity. Large varieties of major fruits (mango, banana and citrus, for instance) are native to the land, but countless other types — both major and minor — are also grown throughout India. The bad news is many, many varieties of fruits have already vanished and some are on their way to extinction. Indeed, it is the commercially viable ones that survive well. Deforestation and habitat destruction are also causing genetic erosion of fruits. Though fruits can change the economic lives of a large number of our people, government efforts at preservation are way below par. INDIRA KHURANA journeys from the Thar to the Himalayan foothills to the small state of Mizoram in the Northeast in search of the fruits of nature. But the pursuit left a bitter taste in her mouth and the assessment does not seem to bode well for India's own fruits



fabled

Dwindling diversity

India holds the distinction of being the world's second largest producer of fruits, both major and minor. But many of the fruits native to India are being less and less savoured

Fruits come in all shapes and sizes. Neatly stacked in wooden crates and placed under bright lights, the fruit markets attract buyers from each and every stratum of society. Vendors call out to advertise their wares, mouth-watering delicacies exchange hands for printed pieces of paper as quick deals are struck between haggling housewives and clever sellers. But behind the garish lights is concealed a harsh reality. Even as the market place seems to be teeming with fruits, the genetic biodiversity of fruits in India is being rapidly eroded.

Fed up eating just bananas, mangoes or grapes, you decide to check out if the fruits you relished in your childhood are still available. But there is nothing the market has to offer other than the more common varieties. You ask for *khirni*, and the reply is, "Does anyone buy *khirni* nowadays?" The answer is no different for other lesser-known fruits. By the end of the gruelling session through the market, you're left wondering where all the fruits you grew up with have gone.

India has much to offer in terms of fruit diversity. The country can boast of as many as 50 indigenous fruits. And if you take their wild relatives and allied species into account, the number of native varieties goes up to a whopping 400. Found in diverse climatic conditions (see map: *Fruits of India*), some of the native fruits are mango, banana, citrus, jackfruit, *aonla* (*Embilica officinalis*), *jamun* (*Syzygium species*), *ber* (*Zizyphus species*), *bael* (*Aegel marmelos*), *chironjii* (*Buchanania lanzan*), *ker* (*Capparis decidua*), *karonda* (*Carissa carandas*).... The list is endless.

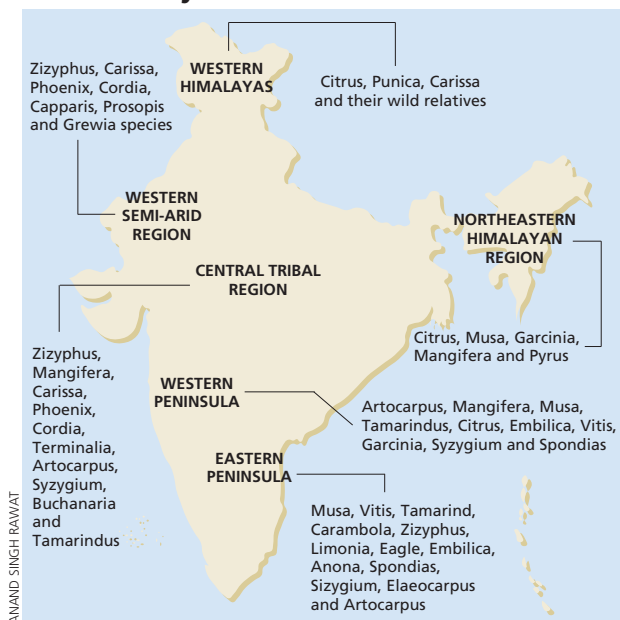
Of these, varieties of major fruits like mango, banana and citrus are grown in abundance in many parts of the country. There are also some commercial varieties — pineapple (*Ananas comosus*) and papaya (*Caria papaya*), for instance — which are not native to the country but are cultivated over large tracts of land.

Minor tropical fruits which are basically collected from the wild and eaten by the local inhabitants include *ber*, *bael*,



Fruits of India

Stretching from the Himalaya to the tropics, a whole variety of fruits are found in India



Source: NDPGR, New Delhi

Some reasons for loss the of biodiversity:

- Deforestation and habitat destruction is leading to genetic erosion of fruits. An assessment of 32 indigenous fruits show “medium” to “high” erosion in all fruits. These fruits that were assessed include banana, mango, citrus and *aonla*.
- Collection and conservation of genetic diversity is not a national priority. Though fruits comprise 25 per cent of agricultural exports, only 7.7 per cent of the agricultural budget is allocated to horticulture.
- Even the germplasm that has been collected has not been documented, evaluated or characterised.
- Efforts at exploring diversity within fruits is still at a primary stage.
- Lack of a ready market for most fruits is leading to cultivators shifting to more commercially viable fruit varieties, which are not necessarily native.

Unless we have a fruit policy, what you find in the market today may not be there when you decide to go fruit shopping next.

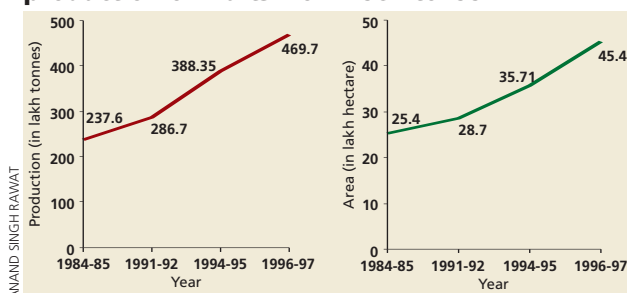
jamun, karonda, aonla, fig (*Ficus carica*), phalsa (*Grewia subinaequalis*) and kokam (*Garcinia indica*). Besides, there are the “under-utilised” fruits like the tamarind which exhibit rich diversity, but are not commercially important. Their cultivation is restricted to small farms, backyards or marginal land which is not suited for commercial fruits. The choice of species also depends on the multipurpose use of the plant.

Fruit diversity is found in abundance mostly in the jungles or untapped regions. However, consumption is restricted to the growing areas due to various factors. For instance, the passion fruit which is in great demand in Mizoram is not seen anywhere else because of the poor communication link the state has with the rest of the country. Some of the fruits found in the wild are yet to be sampled adequately, leave alone marketed. But with no incentive available to the growers to cultivate these lesser-known fruits, several varieties are on the verge of extinction.

Though the area under fruit cultivation and fruit production have gone up over the years, it is at the cost of a number of native fruits. Just a few are being produced, with preference being given to commercially viable ones, not necessarily native. And even in the fruits that are being produced, the varieties are limited (see graph: Growing fruits).

Growing fruits

Increase in area under cultivation and production of fruits from 1984 to 1997



Source: G. L. Kaul, 1997

Different flavours

From major fruits like the mango, banana and citrus to minor ones like *karonda* and *sapthai*, the story is the same: genetic erosion is leading India's native fruits to the brink of extinction

MANGO: Known as the king of fruits, India is blessed with mango diversity. Wild forms of *Mangifera indica* (mango) can be found in the peninsular tract, the evergreen forests in the Northeast and the terai regions. Wild forms of the allied species, *M. sylatica*, are also found in the evergreen forests. Four of the 41 *Mangifera* species are native to India. Dominant areas of diversity are the humid tropical southern peninsular; the Andaman and Nicobar islands; and the humid subtropical region comprising Manipur, Tripura, Mizoram, southern Assam, Chotanagpur plateau, Santhal region in Rajmahal hills, southern Madhya Pradesh and the Thar plateau adjoining Gujarat and Rajasthan.

Besides, Kerala and the Western Ghats form the secondary centre of mango origin in the world. This region boasts of a number of mango varieties known by local names — for instance, *muvandan*, *chakriyan*, *puliyen* and *muttikudiyan* —



and are mainly used for pickles and making other culinary delights.

The number of mango varieties (varieties within a species) found in India is a whopping 1,000, ranging in size from a peanut to a musk melon. Of these, quite a few are unique and several widely grown. Many mango varieties have been made possible by hybridisation, a process that has opened up endless possibilities. Two desired mango plant varieties are grown close to each other. Thereafter, it's a game of wait and watch for a new variety to emerge. Any number of varieties can be hybridised. And often, owners of mango orchards tend to get carried away. The owner of Abdullah Nursery, Haaji Kaleemullah Khan, in Malihabad is a proud owner of a mango tree that has more than 200 varieties on it. Another possibility is grafting, a way of mass propagation, where a cut is made in the twig of the desired variety and is latched on to a "mother plant".

Mango mania

Where have the mango varieties, stolen from orchards or plucked from trees in the backyard, gone?

- The war of words, and weapons, aside, legend has it that during one of the better phases in Indo-Pak relationship, the late Zia ul-Haq sent a crate of mangoes to the late Indira Gandhi. The taste caught Indira's fancy and she immediately sought information on the mango only to be told that it was an Indian variety, *rataul*, cultivated in Meerut, Uttar Pradesh. She promptly sent a return gift hamper to the Pakistani president with, of course, the new-found information.

Today the scene is different: while rataul reigns as the number one mango export to West Asia from Pakistan, it is rarely sighted in India. The plight of other species native to India is no different.

- When Deepika was a child growing up in Pune, holidays meant early morning treks to the nearby hills near Pashan village. At the foothills were mango orchards, and the smell of the ripe mangoes tickled the olfactory sense of people for miles around. Avoiding an encounter with the owner, she along with her friends would climb onto the lower branches, fill their pockets with the fruit and then proceed towards danger-free grounds. But if the owner came close enough, it meant clinging to the tree, hoping they would be mistaken for parrots.

The trees have long since been replaced by a multi-storeyed

residential complex, with "all modern amenities".

- Naimuddin Khan gets nostalgic when he talks of his *khandani aam ka bagh* at Gopamal village in Hardoi district of Uttar Pradesh. "Being next to a small pond, the *bagh* was named '*chota talabwala bagh*'." And by Uttar Pradesh standards, the *bagh* was small with just about 200 trees, says Naimuddin. "But some of the varieties like *nimbua* were found only in our *bagh*," he adds while going into raptures describing the varieties of mango found in his *bagh*. A sample: *nimbua*, small mango with the flavour of lemon; *khatua*, sour when raw, sweet and sour when ripe; *mithua*, sweet even when raw; *kirva*, so sweet that if left on trees it gets infected by insects; *jamuni*, small, taste like *jamun*; *aamin*, a seed planted variety.

"Have you heard of a variety of *dussehri* called *Laila Majnu*? Or *hussnara*, which tastes as good as it looks?" questions Naimuddin. "However, now the trees are old and are slowly falling," he says with sadness in his eyes. No one from the family stays in the village any more. The *bagh* has been handed over on a contract. And memories of childhood summers spent in the orchard are all that is left. *The state of Naimuddin's bagh probably describes the state of other orchards in Uttar Pradesh.*

India has a fair share of fruit varieties native to the country. These include major fruits like mango, banana and citrus which are widely grown, and minor ones like ber, jamun, karonda and aonla, the market for which is yet to be developed

While a 40 per cent decline in mango germplasm collection has been reported, the citrus germplasm that was collected in the 1950s in the Northeast is already lost. Also, many banana species in gene banks still remain uncharacterised



Mango mela: Some mango varieties on display at the Mango Festival in New Delhi

Collection of the genetic resources of mangoes dates back to the 16th century. And credit goes to the Mughal rulers who planted seeds of all the fruits they liked. The Mughal rulers and Avadh *nawabs* in Uttar Pradesh planted a lakh of mango seedlings in some orchards known as *lakhbagh*. Many of these orchards still exist, although in a pitiable condition. Diversity multiplied as the rulers, often fruit fanatics, ordered the good varieties brought by their subjects to be planted in their gardens (see box: *Mango mania*).

The names given to the different varieties have interesting origins, too. The *dussehri* mango is named after the Dussehri village near Malihabad, not far from Lucknow, the mango belt of Uttar Pradesh. Legend has it that the “mother” tree still exists in the village. Some were named after the flavour, some after the shape and a few were dedicated to a lovelorn *begum*. Hence the name *sophiya* (which tastes like *saunf* or aniseed); *karela* (ridged like a *karela* or bitter gourd) and *huss-nara* (fine appearance with an equally fine taste).

In the early 1900s, attempts were made to collect and document different mango species in a systematic manner. However, the collection that currently exists in India mostly contains cultivars which were distributed to farmers as grafted seedlings, leading to the disappearance of the less desirable, usually seed propagated, cultivars. “A lot of mango germplasm with variation in leaf shape, size, orientation, colour, fruit shape, quality and aroma have already disappeared,” says M L Jyothi of the Kerala Agricultural University in Thrissur district. “And the future of what is left is alarming,” he adds. Over the years a lot of genetic erosion has also taken place due to deforestation and urbanisation. Genetic erosion of these cultivars is a serious problem in the whole of Southeast Asia.

BANANA: Acknowledged as the fruit of the masses, banana is India’s most favoured fruit. Available throughout the year, banana sellers are tracked down by buyers — students staying

in hostels, bachelors on their way to a kitchenless residence, and householders in search of nutrition. Available in all shapes and sizes, the fruit is loaded with calcium, potassium, sodium, phosphorous, iron and vitamins. The flower also has medicinal qualities and the leaf is used as an eating plate in many parts of the country.

India is the world’s second largest cultivator of bananas and boasts of several native species. The fruit can be found in various geographical locations — from the sea level to 1,500 metres above mean sea level. Several wild species have been identified in the Northeast region, which, along with the northern peninsular region and the Western Ghats, are major banana diversity centres.

But one-fourth of India’s banana harvests comes from Tamil Nadu. The state cultivates more than 80 banana varieties, the most popular being *malai*, *mondan*, *poovan*, *peyan* and *rasthali*. While gene pools

Bananas at risk

Virus attacks threaten the famed *malbhog* and *virupakshi* varieties of banana with extinction

The *malbhog*, considered to be the finest variety of banana found in Vaishali district of Bihar, is on the road to extinction. Soil infertility, fungal diseases, unscientific farming practices have taken their toll on the quality, and even quantities are down. Currently, only 10 hectares (ha) of land are under *malbhog* cultivation as compared to 100-120 ha in the early nineties.

In spite of the warnings issued by the Banana Research Centre at Hariharpur, Bihar, no precautionary steps have been taken by the government. Farmers don’t want to give up *malbhog* as it is a profitable cashcrop, but monoculture farming technique has depleted the soil of nutrients and resistance to the fungus causing the Panama Wilt disease. The disease has affected *malbhog* as well as other traditional varieties like *alpan* and *kathua*. If prevention steps are not taken immediately, *malbhog* cultivation may be wiped out from the area very soon.

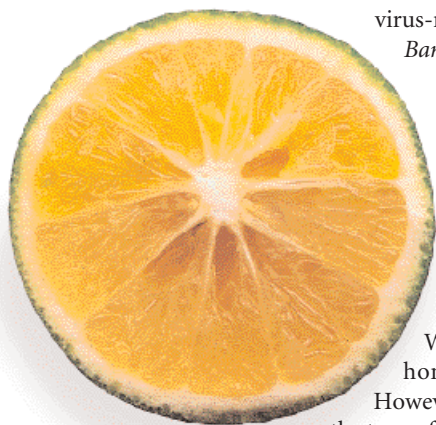
Virupakshi or hill banana of Tamil Nadu is also facing extinction because of a disease caused by the bunchy top pest. In the lower plains of the state, the crop is almost wiped out because of the disease prevalent throughout the year. The disease also threatens other banana varieties growing in the plains. Quoting scientists, *The Hindu* (March 15, 1996) reported that due to the disease the total area under banana cultivation in Dindigul Anna District has shrunk to 1,124 ha in 1996 from 3,204 ha in 1993.



Many fruit species growing in the wild are yet to be sampled. Though rich in proteins and carbohydrates, these fruits are yet to be considered an alternative food source. And are wasted in spite of their medicinal and commercial worth

of bananas grown in South India have been well analysed and characterised, the same cannot be said of those found elsewhere, though several exploratory trips have been made by the National Bureau of Plant Genetic Resources, New Delhi, and its units located in different parts of India.

Although India is a major centre for banana diversity and several attempts have been made in the past to conserve the germplasm in gene banks, a lot of confusion exists because of synonyms (same varieties are assigned different names depending on the geographical location) and the fact that many of the species in the gene bank still remain uncharacterised. There is also a need to find virus-resistant varieties (see box: *Bananas at risk*).



CITRUS: A few citrus species are believed to have originated in India — the major centre of diversity being the Northeast. Parts of northwest India, peninsular region and the Western Ghats are also home to some species.

However, in spite of efforts since the turn of the century to preserve the fruit, genetic erosion is still taking place.

The Northeast is blessed with citrus diversity with as many as 17 species originating here, but whatever germplasm that was collected in the Northeast in the 1950s is lost already. The fruit grows at locations which are 300 to 400 metres above mean sea level. The western parts of Aizawl district in Mizoram and Jampui hill area in north Tripura show rich diversity. *Citrus reticulata*, *C. limon* and *C. grandis* are commonly found in backyards and orchards.

However, monoculture of economically important species is replacing less preferred species like *hatkora* (*C. macroptera*), not popular because of its high acidity and ascorbic acid content. *Sishuphal* (*C. megaloxycarpa*), found in the Jampui hills, is already labelled endangered. "The situation is such now that fruit vendors pass off oranges from other states as that grown in Cherrapunji, when oranges are no longer found there," says A Wallang, Northeast regional programme co-ordinator of World Wide Fund for Nature, India.

MINOR FRUITS: The tribals of Maharashtra have been maintaining the ancient tradition of collecting *karonda* (*Carissa*) from the wild for sale in nearby markets. Resistant to most

diseases, the hardy plant is used for various purposes by the tribals: the branches are cut and used as fences to protect agricultural fields, and dry twigs are used as firewood. The Konkan region boasts of a rich diversity but in the dry eastern regions of Aurangabad, where the population is scattered, the plant's survival is endangered. Unfortunately, according to V S Ghate of the Agharkar Research Institute in Pune, the species have hardly been studied for natural variability and horticultural practices.

Aonla is another minor fruit native to India. However, it may soon get the status of a major crop as the area under *aonla* cultivation is increasing at a rapid pace. Even wastelands are being used for its cultivation. Rich in vitamin C, the demand for *aonla* is on the rise. It is being processed into plant-based healthcare products — *chyananprash*, for instance. Also, it is generating income for tribals engaged in its cultivation.

Minor fruits have not been exploited because there is no demand for them, says K L Chadha, horticulture professor, Indian Agricultural Research Institute. He, however, is the man behind the "*ber* revolution". Chadha studied 67 varieties of the native round *ber* — often referred to as *galagottu*, meaning if eaten, the sourness catches the throat — and came up with a scientifically improved tastier *ber* variety. This also helped augment the economic status of indigenous people who were involved in its cultivation.

"No one can hate this fruit," says Zoramthanga, leader of the Opposition in the Mizoram state Assembly, of *sapthei* or the *passion fruit*. Found in the Mizo hill tracts, its popularity, however, is limited to the state due to lack of transport facilities. Passion fruit juice has a great potential but as of today there are no markets. Villagers in Champhai district were encouraged to grow the fruit. But the nearest processing plant being 300 km away, the cost of transportation was way beyond the farmers' means. In anger, the villagers dumped the fruit in the streets of Champhai.

A variety of the native *ber*, often referred to as *galagottu*



NBPGR

Waiting in the wings

Attempts at conserving fruit germplasm as well as creating a market for lesser-known varieties have been far from satisfactory. Also, a whole lot of fruits are yet to be sampled

Besides diversity in minor fruits like *aonla*, *ber*, *bael*, custard apple, *jamun*, *phalsa*, tamarind and *karonda*, there are other tropical fruits that are yet to be exploited and their genetic base explored and enhanced. These include *barhal* (*Artocarpus lakoocha*), *chironji* (*Buchanania lanzan*), *dillenia* (*Dillenia indica*), *makhana* (*Euryale ferox*), *manasari* (*Mimusops elengi*), rose apple (*Syzygium jambos*), hogplum (*Spondias pinnata*) and tropical almond (*Terminalia catappa*) (see box: *Makhana, more of a medicine*). Besides, there are fruits specific to ecosystems — the Himalaya and the Thar desert, for instance.

The great Indian desert, Thar, is a contradiction. Locally known as *marusthali* — the land of death — this hostile environment, however, has been home to one of the finest biodiversity in India. As the local saying goes, “*Marwar mein, barah kos mein, boli, jeev aur vanaspati thodi badle*” (in Marwar,

every 36 kilometres, the dialect, flora and fauna change), this diversity, extending to fruits, is remarkable. However, the desert awaits people to savour its fruit varieties, and its fruits are in dire need of conservation. (see table: *Desert fruits*).

The Garhwal Himalaya is an important source of wild fruits, growing abundantly along the altitudinal gradient. Though rich in proteins and carbohydrates, these fruits are yet to be considered as a food source. They also have the potential to be commercially processed into jellies, jams, squashes and sauces. This will not only increase the earnings of local communities but also help in conservation. “There are 36 varieties of edible figs, some of which are native, to the Himalayas. These figs could be used to make excellent jams,” says A N Purohit, director, High Altitude Plant Physiology Research Centre at Srinagar, Garhwal. “Of the total 190 *Berberis* (*kingora*) species, 13 are found in India, mostly in

Desert fruits

The hostile environment in the Thar desert has been home to one of the finest biodiversity in India

BOTANICAL NAME	LOCAL NAME	PARTS USED	MEDICINAL USE
<i>Zizyphus nummularia</i>	Jhadber	Fruit edible; leaves used as fodder; wood as fuel	Fruit as astringent; dried leaves for treating cough and cold
<i>Zizyphus mauritiana</i>	Boradi	Fruit edible; wood used to make farming tools	—
<i>Cordia dichotoma</i>	Gonda/lasora	Unripe fruit edible; used to make pickles; ripe fruit fermented to make liquor; leaves used to make trays; bark used to make fibres; wood used as fuel and to make farming tools, furniture, combs	As diuretic and anthelmintic
<i>Cordia gharaf</i>	gondi	Fruits edible	—
<i>Capparis decidua</i>	ker	Fruits used as pickle; twigs as fodder; wood as fuel and to make tools, cart wheels and ploughs	Tender branches used to relieve toothache
<i>Salvadora oleoides</i>	Pilu	Fruit edible; seeds used to make candles and soaps	Leaves and fruit used to treat enlarged spleen, rheumatism and fever
<i>Salvadora persica</i>	mustard	Fruit edible; leaves used as a vegetable, tender shoots as salad; wood used to repel mosquitoes	Lead decoction used to treat asthma and cough; a poultice of leaves is used to treat painful tumors and piles, stem used for dental care
<i>Prosopis cineraria</i>	Khejri	Unripe pods used as vegetables; bark mixed in flour during famine; leaves used as animal fodder, wood used as firewood and to make farming tools	Flowers used to prevent miscarriage
<i>Acacia senegal</i>	Kumat	Gum from the bark used in food and beverage, pharmaceuticals and confectionary; seed to make curry; leaves as fodder	Gum used to treat inflamed surfaces; root to treat dysentery, gonorrhoea and nodular leprosy
<i>Grewia tenax</i>	Gangeran	Fruits edible; leaves used as animal fodder	Decoction of wood is used for treating cough
<i>Grewia villosa</i>	Gangeti	Fruits and leaves edible; stem used for making walking sticks and bows	Root used to cure diarrhoea and small pox
<i>Rhus mysorensis</i>	Dansaro	Fruit and leaves edible; leaves used as fodder; bark and leaves used for tanning leather; wood used as fencing and making tool handles	—

Source: O P Pareek and S Sharma, 1994

An assessment of 32 indigenous fruits to check erosion of diversity has nothing good to state. There was evidence of erosion in all varieties with “medium” erosion reported in 50 per cent of cultivated fruit varieties and “high” erosion in the rest

Fruits of Mizoram: a lost case

It was one of those dreary afternoons in the office of the Samuel Rosanglura, deputy director, department of horticulture, government of Mizoram, till he and his colleagues were goaded to go to their past, and talk about the fruits they ate. It turned out to be an afternoon they would not forget in a hurry

One of the most popular fruits of Mizoram is *sapthei*, or passion fruit, which looks more like a small mauve brinjal from the outside. The fruit is yellowish in the inside and is scooped out and eaten, seeds et al. People talk about the late Rajiv Gandhi's partiality towards the fruit when he visited the state after signing the Mizo accord. But rarely is the fruit found outside the state, which comes as no surprise given the poor communication facilities the state has with the rest of the country.

"Eat one and get hooked," is the phrase used for the *zo balha*, or the Mizoram hill banana. Sweet without being over-ripe and gooey as bananas tend to get. While officials at the horticulture department sing praises of the non-local Cavendish banana, "No other *balha* is as sweet as the *zo balha* that grows in my village Kawnpui, 50 km off Aizawl," challenges Zaihmingthanga, principal of the Aizawl Theological College. Sample the fruit and you will admit, "There is no competition".

Hatkora, an extremely sour orange belonging to the citrus family, is also native to Mizoram and mainly used as a spice or as a cooling drink in summer. The semi-wild variety of the fruit also grows in forests in lower Assam and Meghalaya. The fruit has a ready market in Tripura and Bangladesh. In June, traders come by boat up the Tlawng river to Hartoki village and buy the entire produce from plantations.

In 1996-97, some 300 *hatkora* farmers made Rs 47 lakh from the sale of this fruit.

Interestingly, most of the fruits are named after their appearance or colour or even a story associated with the fruit. *Kawrthindeng* is so named from where it is found,

that is on *kawrs* or the banks of rivulets. Legend has it that when raiders from the plains came to Mizoram, they would rest under the trees on the banks of these rivulets. While they rested, the fruit would fall right on their livers. Hence the name *kawr* (bank of a rivulet), *thin* (liver), *deng* (struck).

Vuakdup is so named because to relish the fruit, it has to be hit (*vuak*) till it is soft (*dup*). *Tuajtit* is a strong favourite, especially among followers of Bacchus, considering that in Mizoram there is a ban on the sale and production of liquor. Small berries of this fruit, deep purple when ripe, are fermented in a pressure cooker for a week. The

more the fermentation, the higher is the alcohol content. "This fruit is no stranger here," says Lalthlamuana of the horticulture department, sporting a broad grin.

Tawitaw, which resembles an egg, is very sweet and a favourite among animals like the barking deer. The deer pay for their sweet tooth — the fruit is often used to trap them. *Theichhungensen* is another favourite of animals like the gibbon. Deep red in the inside and sweet when ripe, the fruit colours the hands red when peeled. It is a potential vegetable dye.

Here, too, deforestation has taken its toll on the fruits. "Many of the fruits I ate as a child are no longer available. I don't even know the English names for them," rues Rosanglura. "Take *vaw-mavapui*, for instance. I have not seen the fruit for



INDIRA KHURANA / CSE



INDIRA KHURANA / CSE

*In the wilderness: Mizoram is blessed with fruit diversity but most of the fruits are not found outside the state, for instance, the *changkak* (above) and *sapthei* (below)*

a long time now," he says.

"I don't even know some of the fruits Rosanglura is talking about," confesses a young field officer of the horticulture department. This just about sums up the state of the fruits in this small state.

Deforestation has taken its toll on the fruits of Mizoram. "Many of the fruits I ate as a child are no longer available. I don't even know the English names for them," says Samuel Rosanglura, deputy director of the state horticulture department

this region,” says R K Maikhuri, scientist at the G B Pant Institute of Himalayan Environment and Development at Garhwal. “It’s unfortunate that the fruits of almost all wild plants which grow in the Himalaya are wasted, in spite of their medicinal and commercial worth. Efforts to improve them are negligible,” he adds.

State of the riches

● Germplasm forms the basis for collection and conservation of any fruit species, most importantly, for future breeding programmes where breeders look for desired traits in a particular fruit. Several attempts at conserving germplasm in gene banks have been far from satisfactory. “This problem is particularly true for fruits from the Northeast,” says Chadha (see box: *Fruits of Mizoram: a lost case*).

An assessment of 32 indigenous fruits to check erosion of diversity that has taken place in the wild as well as in cultivated species had nothing good to state. There is evidence of erosion in all varieties with “medium” erosion in 50 per cent of cultivated fruits and “high” erosion in the rest. As for fruits

Makhana, more of a medicine

Spreading awareness of the medicinal value of *makhana* may help in cultivating a market for this uncommon fruit

The wetlands of Bihar are home to a unique food crop — *makhana* (*Euryale ferox*), the popped seeds of which are a popular non-cereal meal eaten on some religious occasions. “Though the medicinal value of the seeds is documented, the plant has been ignored by scientists,” complains Vidyant Jha of the botany department of C M Science College, Darbhanga. The medicinal properties of *makhana* are on par with lotus (*Nelumbo nucifera*). It is used to cure stomach and circulatory problems, and is believed to increase hormone secretion.

However, conservation of aquatic plants has not been given any preference in India. “Large scale denudation of the Himalayan vegetation is causing repeated floods in north Bihar, virtually rooting out aquatic species like *makhana* and lotus,” says A K Kargupta of the botany department of L N Mithila University, Darbhanga. “Cultivators need to be provided with assistance and the medicinal properties need to be studied. Who knows, *makhana* may find a place in modern medicine?” But being vulnerable to a variety of pests and pathogens, the plant is also being threatened by the indiscriminate use of pesticides, silting of wetlands and the spread of weeds like the water hyacinth.

One reason why *makhana* has been ignored is perhaps because the fruit prefers to burgeon in stagnant and dirty water. Mithilanchal in north Bihar has many rivers flowing through the region. Flooding is a regular feature; therefore, stagnant water pools abound. The crop is grown in more than 2000 ha, contributing to 75 per cent of the total Indian production worth Rs 10 crore (2000 tonne).



Losing colour

Genetic erosion status of some fruits

COMMON NAME	GENUS	NIS	CS	DS	GVS	GES	CP
Aonla	Embilica	2	C	R	H	H	H
			W	R	H	H	H
Bael	Aegle	1	C	R	H	M	M
			W	R	H	H	H
Banana and Plantain	Musa	16	C	W	H	L	M
			W	W	H	H	H
Jackfruit	Artocarpus	19	C	R	H	H	H
			W	R	H	H	H
Ber	Zizyphus	20	C	R	H	M	M
			W	R	H	M	M
Chiraunji	Buchanania	2	C	R	M	M	M
			W	R	H	M	M
Citrus	Citrus	18	C	W	H	H	H
			W	W	H	H	H
Fig	Ficus	75	C	R	H	H	H
			W	R	H	H	H
Tamarind	Tamarindus	1	C	C	H	H	H
			W	W	H	H	H
Indian almond	Terminalia	12	C	C	M	H	H
			W	W	M	H	H
Jamun	Sizygium	75	C	C	H	M	M
			W	W	H	M	M
Karonda	Carissa	12	C	W	M	M	M
			W	W	M	M	M
Ker	Capparis	26	C	C	H	M	M
			W	W	H	M	M
Khejri	Prosopis cineraria	1	W	R	H	M	M
Lasora	Cordia	18	C	R	M	M	M
			W	R	H	M	M
Mahuwa	Madhuca	8	C	W	H	H	H
			W	W	H	H	H
Mango	Mangifera	5	C	W	H	M	M
			W	W	H	H	H
Mangosteen	Garcinia	24	C	R	H	H	H
			W	R	H	H	H
Mulberry	Morus	5	C	W	H	M	M
			W	W	H	M	M
Phalsa	Grewia	43	C	W	M	M	M
			W	W	M	M	M

Source: NDPCR, New Delhi

NIS: Number of indigenous species; CS: Cultivated status (C — cultivated, W — wild); DS: Distribution status (W — widely distributed, R — regional, L — localised); GVS: Germplasm variability status (H — high, M — medium, L — Low); GES: Germplasm erosion status (H — high, M — medium, L — Low); CP: Collection priority (H — high, L — Low)

growing in the wild, 56 per cent are facing “medium” erosion and 44 per cent “high” erosion. The fruits that were assessed include banana, citrus, mango, *aonla*, *amra*, wood apple, *bael*, and plantain, *ber*, fig, jackfruit, *jalpai*, *jamun*, *karonda* and *khirni*. “The genetic erosion of a number of indigenous fruits has been high,” admits Mathura Rai of the National Bureau of Plant Genetic Resources, New Delhi.

Absence of a central germplasm management system to co-ordinate field gene banks in various places is taking its toll on conservation efforts (see table: *Losing colour*). Confusion over germplasm synonyms — bananas, for instance — is yet to be sorted out. Reliable characterisation of the different species and varieties based on biochemical and genetic parameters are yet to be carried out in the Northeast. A 40 per cent decline in the mango germplasm collection at the Institute of Subtropical Horticulture, Lucknow, has been reported. And if this is the state of major fruits, like banana and mango, the plight of the minor ones may well be imagined.

● There is no delineation between base collections which act as a sort of insurance, and working collections which are used for research and breeding purposes. Unsupported by data giving the profile of the plant collected and subsequently stored, proper utilisation of the data in the future will certainly be a problem.

- Realising the potential of commercial crops, farmers are shifting over to economically viable varieties of fruits, not necessarily native, which have a ready market. This has been observed in the case of the declining citrus groves in the north-eastern states and the old mango orchards of Uttar Pradesh, West Bengal and Andhra Pradesh. Virtually no markets exist for minor fruits besides the place where it is found, and there is no encouragement from the horticulture department.
- The intimate relation between native communities and biodiversity is underestimated, too. Locally useful diversity has not been assessed to promote socio-economic gains to indigenous communities living in diversity-rich areas. Through the decades, these communities have been growing an array of species, gathered valuable information on conservation, use of resources, and have also understood their useful traits. Such information is helpful in assessing potentially useful germplasm, trends in domestication and cultivation of local species. Local knowledge on the use and conservation of native diversity is poorly documented. It not as if only the scientists were responsible for improving the varieties of cer-

tain fruits. Chaddha recalls two varieties of disease-resistant grapes that were developed by indigenous communities in Maharashtra. The *Tas-e-Ganesh* variety of grapes was produced by a farmer. Created from Thompson seeds, the quality of the raisins as well as the shape of the fruit is of high quality. Another farmer from Sangli, Maharashtra, worked on the impressive Russian *Kishmish Chorni* variety using a plant regulator, gibberellic acid and came up with a highly-sought seedless *sharad* grapes. The grapes are much larger, attractive and taste better.

R K Arora, co-ordinator (retd), International Plant Genetic Resources Institute, sums up the current status. “Not all tropical fruits’ diversity is well-collected. Under-utilised species and wild relatives are poorly represented in terms of conservation, evaluation and documentation of what has been collected. Proper assessment of the genetic diversity is not carried out. Maintenance and conservation is a problem. Wild type diversity is being lost due to habitat deterioration, changes in land-use practice and crop diversification programmes. Documentation and dissemination of information leading to better utilisation of information is required.”

Conservation blues

Conservation of fruits may be difficult, but that is no excuse. Preservation of national assets should be given top priority

Conservation is a positive step towards preservation, maintenance, sustainable utilisation, restoration and enhancement of the natural environment with its diversity. However, conservation of fruits certainly needs more government attention than what it currently gets. Research institutes lack funds for establishment of gene banks or to carry out conservation programmes. “Through the years, a large amount of germplasm has already been lost. Though there have been national programmes to collect fruit diversity, efforts have been sporadic. There are still many fruits out there in the wild,” says Chadha. Many traditional and weedy species of

fruits, which are prospective sources of disease resistance, are threatened with extinction.

There are two types of conservation approaches: *in situ* and *ex situ*. Conservation whereby plants are grown in their natural habitat is *in situ* or on site. However, *in situ* conservation is difficult especially in large areas where diversity exists in abundance. An *in situ* sanctuary, especially for citrus fruits, has been established in the Garo hills of Meghalaya. However, horticulturists feel that this is a waste since only one type of citrus fruit is found in the Garo region.

The major conservation approach should be *ex situ* conservation where the seeds are wither-dried and preserved in controlled conditions in field gene banks or in a laboratory where it is grown under artificial conditions. These seeds are then tested for viability by planting them out every few years. The whole idea is to ensure that local cultivars (a cultivated variety of a plant) and wild varieties can be saved over long period of time, and yet be available to breeders when required (see table: *Banking on genes*).

Banking on genes

Location of field gene banks set up to conserve genetic resources of fruits

FRUIT	NUMBER OF ACCESSIONS	LOCATION OF GENE BANKS
Banana	363	Coimbatore, Bangalore, Trichy, Kannara, Kahikuchi, Hajipur, Ranchi, Navsari, Kovvur.
Citrus	451	Chethalli, Bangalore, Rahuri, Tirupati, Abohar, Bhatinda, Yercaud, New Delhi
Grape	1,209	Abohar, Bangalore, Hisar, Ludhiana, New Delhi, Pune
Guava	123	Anantrajupet, Basti, Bangalore, Lucknow, Pune, Saharanpur
Jackfruit	66	Trichur, krishna Nagar
Mango	1,106	Bangalore, lucknow, Pairia, New Delhi, Sabour, Sangareddy, ranchi, Saharanpur, Vengurla
Papaya	107	Coimbatore, Bangalore, New Delhi, Pune
Sapota	27	Coimbatore, Dharwar, Navsari, Periyakulam, Rahuri
Pineapple	24	Trichur and Jorhat
Others	435	Bangalore, Jodhpur, Ludhiana, Dapoli, Trichur, Hyderabad, Ranchi, Basti, Faizabad

“Not all tropical fruits’ diversity is well-collected. Under-utilised species and wild relatives are poorly represented in terms of conservation, evaluation and documentation of what has been collected”

The share of the finances allotted to agriculture is hardly commensurate with the needs. While fruits comprise 25 per cent of India's agricultural exports, horticulture has been allotted only 7.7 per cent of the agricultural budget in the Ninth Plan

Seeds of most tropical fruits are recalcitrant — that is, they are no longer viable after the drying process. Storing plants by multiplying them by vegetative methods is a more tedious process and success is not guaranteed. Biotic and abiotic stresses coupled with an apathetic attitude towards conservation have already taken their toll on a large gene pool of the few citrus species that are native to India. Also, monoculture of economically important species is threatening the existence of many lesser known species.

Some national attention to genetic resource activity has resulted in the development of some commercially cultivated varieties, but more needs to be done. Also, the government should be made aware of fruit diversity being a part of national wealth. Collection and conservation of genetic diversity as well as improvement of species to increase economic value should be a national priority, feels Chadha. The department should try to repeat the *ber* revolution with other less preferred fruit species too.

Some of the reasons for loss of Indian fruit diversity are:

- deforestation. A lot of genetic erosion has taken place due to deforestation and urbanisation. Wild varieties of cultivated fruits existing in forests and other rural areas are important sources of germplasm which can be tapped for improving cultivated varieties. These varieties are mostly disease-resistance, pest-resistant, have a better colour, taste, flavour, and longer shelf life. Clearing of hedgerows which once served as diversity banks, and land off its natural vegetation for construction of dams, roads, railways and houses are mainly responsible for genetic erosion.
- commercialisation of a few varieties of a few fruits, many of them not even of Indian origin. Owners of orchards or large plantations are switching over to these varieties. This has been observed in the case of the declining citrus groves in the north-eastern states and the old mango orchards of Uttar Pradesh, West Bengal and Andhra Pradesh.
- changing food habits leading to changing demands is resulting in a greater demand only for few varieties.
- conservation of fruit diversity is not a priority research area.
- share of the finances allotted to agriculture is hardly commensurate with the requirements, even with the export that fruits earn. For the Ninth Five Year Plan, horticulture has been allotted 7.7 per cent of the agricultural budget, while fruits comprise 25 per cent of agricultural exports. "We could definitely do with some more resources," says Chadha.
- proper genetic assessments leading to effective utilisation of tropical fruits have not been carried out.
- specific ethnobotanical studies have not been carried out, nor have locally useful diversity been assessed to promote socio-economic gains to rural communities.



Preservation of banana species through the tissue culture technique at the National Bureau of Plant Genetic Resources, New Delhi, the largest gene bank in the world

- efforts at exploring diversity within fruits is pitiable. This includes the search in fruits like citrus, banana, mango, tamarind, *ber*, *aonla*, *karonda*, *jamun* and *ker*.

Solutions at hand

The need to conserve the genetic diversity is even greater now, given the low number of cultivated types and the rapid genetic erosion in the diversity existing in the wild. Conservation strategies are required for protection of all the major and minor tropical fruits through the *in situ* and *ex situ* approach. This could be done by:

- stepping up of germplasm exploration, collection and conservation centres.
- characterisation, evaluation and documentation of the conserved germplasm.
- intense research on protocols for conservation, identification and characterisation of the species.
- setting up of a central germplasm information system backed by a network with data in store.
- pressing for financial assistance from the government.
- developing a market, especially for lesser-known fruits.

As of today, some genetic diversity still exists in fruits owing to the large geographical area, diverse climate conditions and nature of origin. However, given the government's apathy towards the survival of fruit varieties as well as a host of other factors, there is no guarantee that the scenario will improve or not deteriorate in the near future. Many of the fruits savoured by the children of the sixties and the seventies, leave alone earlier generations, are not seen any more. Take *phalsa*, for instance. Gobbling a handful of *phalsas* into your mouth and relishing the tangy taste while allowing your mouth to turn red is just one of the many memories associated with fruits of yore. And as for *khirni*, when was the last time you saw it in the market? ■

Educating the underprivileged

A review of our educational and training policy is desperately needed to educate tribals, the backward classes and the poor



PRADIP SAHA / CSE

NEERU NANDA

THE goal of universal education eludes India even though there is now a primary school in practically every village. The rate of dropouts continues to be over 50 per cent. The greatest casualty in the failure of our education system has been the girl child — whether in terms of enrolment, retention rates in primary school or even participation in higher education relative to the overall enrolment rate.

The residential schools

When it comes to effective education of children from the backward, rural or tribal areas, special efforts within the present system have been invariably geared towards the residential school pattern. State governments have set up a large number of tribal hostels and ashram schools for tribal children in Madhya Pradesh and Andhra Pradesh. Navodaya Vidyalayas, set up in almost every rural district in the country, constitute the latest government venture in this field.

Non-government organisations (NGOs) have set up high-quality renowned residential schools for tribal and backward rural areas such as the Ramakrishna Mission in Along (Arunachal Pradesh) and Deoghar, Bihar, the well-known girls boarding school, set up by the Sarda Mission, for tribal girls of Tirap district (Arunachal Pradesh), 18 Vivekanand Kendras, also in Arunachal Pradesh, Christian Missionary schools in the tribal belt of Chotanagpur and Banasthali Vidyapeeth, Rajasthan. The Christian missionaries have done yeoman service in educating tribal girls in the north-eastern states. Banasthali girls are today doing well in many spheres in that region.

The ground reality of the average elementary school in rural, tribal and backward areas is grim. A close look at a case study of a tribal district in Andhra Pradesh can help us understand the problem.

The Andhra experience

The state of education in the Adilabad district of Andhra Pradesh, 30 years

after Independence, offers a unique message. The state government has made commendable efforts to educate Gonds by setting up ashrams (boarding schools). Investment has also been very high. In 1979, Furer Haimendorf — who has written the book, "Tribes of India" — did a survey of all the tribal areas in Andhra Pradesh. He found 399 ashram schools (26,746 students), about 2,000 primary and upper primary schools, (about 40,000 students), 75 high schools (about 3,630 students) and six junior colleges (305 students). The annual budget in 1978-79 was Rs 56,340,000. Yet, 36 years later, only five Gonds and two Pardhans had obtained University degrees. In the village Marlavai, after being 34 years in operation, this system has produced only 11 literate adults among the villagers.

Only few children made progress beyond the fifth standard (see graph: *Growing down*).

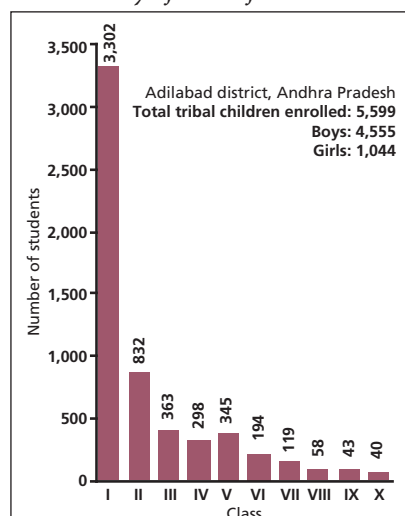
Due to the inability to cope with exams, most of the students have failed to get admission to colleges. Even for

training in mechanical skills, this programme was a failure. Though job reservations for tribals exists, the qualified manpower is limited or is unavailable. In 1977, altogether six tribals were enrolled in the district Industrial Training Institute (ITI) though Singareim Collieries operated there and regularly imported labour for skilled jobs from other districts. While in 1977 there were 17 vacancies for ITI certificate holders in the employment exchange, there were only two tribal candidates available.

What are the reasons for this failure? Haimmendorf suggests that the problem lies in the web of socio-economic backwardness in which these tribes have historically been invested. However, unwilling non-Gondi teachers, uninter-

Growing down

The dropout rate of children rises dramatically after the first class



rested in the pupils and the social milieu to which they belong, have also largely contributed to the lack of success of tribal schools and high dropout rates among Gondi children.

Schools in Adilabad district have very poor infrastructure, poor transport facilities, no residential quarters for the teachers, and there are no houses available for hire. In fact, the disincentives for non-rural and non-tribal teachers are so high that large scale absenteeism has to be accepted as part of the educational scenario in these tribal districts.

The hope of enlightenment

Let us take two extreme cases — that of the Afro-American child in an inner city

The greatest casualty has been the girl child — whether in terms of enrollment or higher education

school in an urban metropolis in USA and a Gondi child in a remote poverty-stricken village in Adilabad. The common dilemma shared by the children of these apparently dissimilar systems is that the school holds out no hope or prospect for the underprivileged child in both. The social systems offer no hope for the child, there are few or hardly any occupational models for success and often a negative image of the child as a slow learner, indisciplined or otherwise “unteachable” is also projected in the teaching community. This image gradually percolates to the mindset of the child. The medium for this percolation is the teacher who acts as a bridge between society and the child, a sort of a conduit who interprets the child’s future in relation to the child’s present.

The Adilabad experiment of 1943

Haimmendorf developed a scheme where he sought to educate tribals by picking up all the few available semi-literate Gonds who were systematically trained to teach. They were taught the three ‘R’. For Gondi to be taught in the first two classes, simple primers were developed in the Devangari script. Since teachers had no formal qualification, stress was laid on in service training (the fashionable slogan of the New Educational Policy today). All the teachers had to undergo an annual one month training course. Supervision was

close and constant.

By 1951, the Marlavai Training Centre which began with the training of five semi-literate Gonds had produced 95 teachers, five village officers, one revenue inspector, five clerks and seven forest guards. Sadly, this system was superseded after Independence, not only by the introduction of Telugu, but more importantly by the enforcement of teachers training degrees as an eligibility condition which ensured that no tribal could be selected to teach his own people. Only non-tribals could come and teach the illiterate Gond with little success, given the barriers of language, social and cultural milieu and utter backward condition of the area.

In 1977, when Haimmendorf made his second research on the benefits of education for the Gonds, he found only 37 tribals of Adilabad district had received enough education to enter government service. Of these, only three had managed to complete BA/BSC, while three failed in BA/BSC. Not a single one was a government teacher. A majority of them had just managed to pass the secondary school certificate. And this was not recognised as a qualification for teaching. Had these 26 Gonds of Adilabad district been given an initial and ongoing intensive investment in training they might have done wonders for educating Gondi youngsters, even within the parameters of isolated

High dropout rates among tribal children is because of poor infrastructure, poor transport facilities and lack of residential quarters for teachers



schools with poor facilities and leaking roofs. Besides the obvious basic advantage of sharing a common socio-cultural milieu, these young men would have been symbols of hope for the children, role models whom they could emulate and strive to follow.

Non-formal Education: the post 1986 scene

It goes to the credit of former Prime Minister Rajiv Gandhi that as a part of his continual efforts to modernise India, he forced the bureaucracy to take a serious look at the failures of the educational infrastructure. This in itself was a great achievement of the New Education Policy of 1986, and the best strategy adopted was to open up the system to voluntary effort so as to provide room and scope for innovation in the hope that flexibility will lead also to new systems.

Non-formal education (NFE) is an accepted bureaucratic jargon in the ministry of human resources development. But the break with the past has yet to come. Greater importance needs to be given to the NGOs who are working in this field. Proper documentation is the need of the hour and a concise and comprehensive evaluation of their performance has yet to be undertaken. Institutions undertaking non-formal education projects could absorb and benefit from a higher level of funding. The best project executed by the Rajasthan Government has been jointly funded by the Government of India and Swedish International Development Agency (SIDA).

The Rajasthan state government has taken a pragmatic and measured view of the special problems of state schools in poverty-stricken areas where teacher absenteeism is rampant and village responses to the schools apathetic. The blueprint drawn up for the Shiksha Karmi Scheme is almost identical to the Gondi experiment of 1946 in Adilabad. It also has a parallel in the extremely successful strategy devised by Bunker Roy for night schools run by the Tilonia School of Social Work in Rajasthan for school dropouts and children of grazers and peasant families.



Girls have a higher dropout rate than men

In Tilonia, school dropouts who have passed only the eight or 10th grade are employed as barefoot teachers. They are trained to generate social awareness towards the village environment and rural issues amongst the students by involving every possible resource in the village—policepersons, postmaster, nurse, patwari, bank manager, village head who explain how systems work (or do not work) for them.

Though job reservation for tribals exists, the qualified humanpower is limited or is unavailable

The Shiksha Karmi scheme has now completed a decade since its inception, covering about 2,000 village primary schools in over 70 blocks spread over 29 districts of Rajasthan. Taken both in terms of economy of investment as well as the spread of beneficiaries, this scheme is far more effective than residential schools would have been for the spread of primary education.

While the Navodaya Vidyalayas have an annual student population of over one lakh students in the whole country, the Shiksha Karmi project benefits about 1,20,000 children in a single state.

In the sphere of non-formal education the Bangladesh Rural Advancement Committee (BRAC) is the largest and most efficacious example of world-wide fame operating 30,000 non-formal schools, manned by hand-picked teachers (most of them women) who have just passed the eight or 10th grade and are selected from the community and are intensively trained and supervised in their posts.

While BRAC spends more than government on supervision, the overall expenditure is the same since village resident teachers can be paid less and they also derive satisfaction from the status with which the post is invested. The achievements of the school dropouts in terms of minimum levels of learning are quite remarkable, particularly when these are compared with the standard of instruction and student achievement in the state primary schools often located in the same village.

Quite in contrast to the general feeling in government circles in India that schools need proper infrastructure for optimum functioning, the BRAC schools are run in thatched huts in one or two rooms rented or offered by locals.

Teach for America

A remarkable experiment has recently been started in USA by a highly motivated young woman, Wendy Kopp.

The Teach for America programme specifically aims at recruiting brilliant undergraduate students who will be motivated to give two years to teaching in the worst and least privileged schools of America. Thus it operates within the existing educational set-up of state schools and seeks to improve them from within, basically by attracting teachers with motivation and a passion to teach.

So far the Teach for America programme has succeeded in placing 3,700 motivated young persons in schools, only because many American states accept non-licensed, untrained teachers.

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The pitfalls of 'trained' teachers

Do we really need graduate BED qualification or 12+2 years training for teaching at the primary school level? The Gond Education Scheme, as far back as 1946, demonstrated impressive levels of student achievement which are not being matched by the Shiksha Karmi programme and BRAC. In both cases the teachers selected have not gone beyond class ten. Both schemes operate in a very large area.

All this would only go to prove that a one-time degree in education can be matched, if not bettered, by lesser duration in service training supervision which is ongoing and continuous. Hence, it would be a misrepresentation of either the non-formal BRAC, Shiksha Karmi model or even that of Teach for America to consider it as anti-teacher education. What is being questioned is not the need for teacher training but the conditions under which it is imparted and the exclusivity that has crept into the system.

The fact that the teacher and the teaching profession is a real role model for tribals can be proved. When a manpower resources survey was undertaken in the Adilabad district in 1977 by the Cultural Research and Training Institute, Hyderabad, tribal students in various boys hostels were asked for career preferences.

It emerged that a significant major-

The 50th year of Independence is for us a year of soul-searching and serious evaluation

ity of 64 per cent wanted to become teachers, and about 83 per cent hoped for employment in Adilabad district, preferably near their home villages. This is a very strong motivation which we could not encash because of our faulty policies, our emphasis on long duration teachers training, BED (after graduation) or two years basic teacher's training after plus two.

Arunachal Pradesh started with a policy of employing every matriculate/higher secondary student in the territory either as a teacher or as a village level worker. The absence of the colonial heritage and the special protection accorded these territories under the constitution again worked in their favour.

Due to absence of political clout, the adivasis of other tribal areas could not derive similar benefits in their states, where the infrastructure is dominated by better educated non-tribals who benefit most by recruitment strategies. These districts thus get non-tribal teachers who do not want to teach tribal students. The tribals are willing to learn but cannot come up because the system rejects them and with them, the hope and future of their brethren.

What is to be done?

Education for tribal people and remote rural areas will really start looking up when the National Council for Teachers Education and CBSE work out a vocational training course of two years duration, so as to qualify young persons to teach in elementary schools after the plus two exam (12th grade).

In Italy, a course called the School Magistrale gives a four-year elementary teachers training to students who have completed eight years of compulsory schooling. The NCTE or National Council for Teacher Education recognises and plans for a plus-two vocational course for pre-school teachers even though no such course has so far been started. But it is a recognised qualification for pre-school teaching only. During the writer's tenure as Director, Navodaya Vidyalayas, this option was considered and dropped because there would be no job prospects for the students in their home districts. Anganwadis workers in tribal areas and villages get a pittance of Rs 250 which is not a living wage for tribals students who have managed to complete plus two. Hence, while NCTE provides the qualification for job of pre-school teachers, the job market does not exist in the rural areas where the students belong. (This kind of mismatch is true of practically all the vocational courses offered so far at the plus two level).

The 50th year of independence is for us a year of soul-searching and serious evaluation. There is still a great deal to be done for the poorest of the poor whom Mahatma Gandhi never lost sight of, for whom, in fact he wanted the whole structure of government to be tailored. Though we are nowhere near that ideal, significant numbers of educationists, managers and bureaucrats have already moved ahead on new paths in this direction in alliance with dedicated NGOs. The time has come to break out of the colonial mindset and to think, not radically, but pragmatically, to plan with passion and to dare to deviate. ■

The author is Education Secretary, National Capital Territory of Delhi

Spreading wisdom

The success story of Arunachal Pradesh

The success story of education in Arunachal Pradesh has been narrated by Furer Haimendorf. The socio-economic and political strength which Arunachal tribes enjoy has no doubt been the rock on which the edifice was founded and on which it subsequently grew. The strategy they adopted was based on the residential school pattern (for middle and secondary and higher secondary level).

However, the Arunachal model was low cost, and suited the socio-culture matrix of tribal society. Stipends for mess fees were paid directly to the students and it was left to them to get together and manage the mess by sharing all the duties of the kitchen (including the task of fetching firewood from the jungle). This was a purely indigenous and pragmatic strategy that saved the state administration a lot of bother, not to mention the saving in establishment costs.

Arunachal Pradesh has always been a protected area since Independence while it was also spared the colonial intrusions of the past. Political power vests with the tribals. Hence, the average tribal child in Arunachal Pradesh has a future to look forward to. On the other hand, the average Gondi child so far has little to look forward to except for the bleak, bitter struggle to survive.

Charting the Universe

It is our passage to billions of light-years into space. The Sloan Digital Sky Survey's electronic camera, mounted on a 2.5-metre telescope in New Mexico, USA, captured its first images of stars, galaxies and quasars on the nights of May 9 and 10. Merely one per cent of the data from the first night of observation drew gasps at a press conference held at the American Astronomical Society in San Diego in June when the images were unrolled. Sloan's first glimpse of the Universe was so overpowering that Michael Shull, astrophysicist at the University of Colorado, Boulder, thought it could only be a computer simulation. "Oh this is data?" asked a surprised Shull. The Sloan is a collective effort of eight universities and other institutions. It will collect images of about 200 million objects over the coming five years. "Not only are we wall-papering the sky, but our machine is doing six rolls at once," said Michael Turner, the project's spokesperson (*Science*, Vol 280, No 5371).

Matter unknown

Pierre Sikivie, physicist at the University of Florida in Gainesville, USA, says that rings of invisible matter are spreading out from the centre of our Galaxy like ripples on a pond. The last of these passed the Sun about 900 million years ago, and the next is due in 350 million years. "The rings could shake up the comet cloud around the Sun, causing cataclysmic events on the Earth," he points out. Most of the matter in the Universe is dark (it cannot radiate energy as light). As the gravity of our Galaxy pulls in matter from surrounding space, dark matter would suffer a different fate from visible matter. "Collisions between particles of ordinary matter allow it to convert its energy of motion into heat and settle into a thin disc at the centre of the Galaxy," he explains. "But dark matter cannot shed this energy and flies back out again like a pendulum" (*New Scientist*, Vol 159, No 2141).

PHYSICAL SCIENCES

Supermagnetic stars

Scientists discover stars with magnetic fields some million billion times that of the Earth

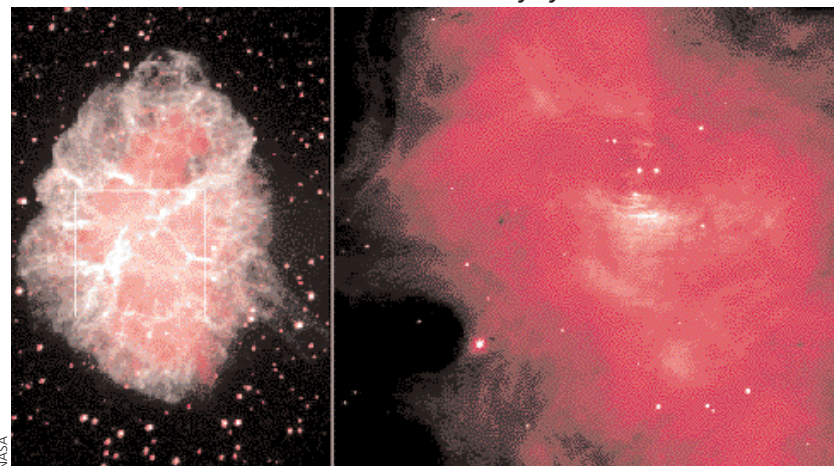
NEUTRON stars are rapidly rotating stars composed predominantly of closely packed neutrons. They emit rapid, regular pulses of radiation (usually at radio frequencies, and are known as pulsars). Since 1967, when the first pulsar was discovered accidentally, a lot of research has gone into neutron stars. One of the several end states of stars, these objects have very peculiar properties. They have enormous densities — some hundred thousand billion times that of the Sun — while their size is about 20 km. With such huge densities, they are also the most rapidly rotating objects in the Universe. Adding to the list of these extreme properties is the discovery of the highest magnetic fields ever observed. A team led by C Kouveliotou of the Space Science Laboratory, Huntsville, USA, has announced the discovery of a x-ray pulsar which has a superstrong magnetic field, some million billion times that of the Earth (*Nature*, Vol 393, No 6682).

To understand the significance of their discovery it is essential to back-track a little. Neutron stars, being so small, are impossible to see directly. However, they have several manifestations by which their presence can be inferred. The most common are pulsars or pulsating radio stars. When a star reaches the end of its life as a regular or

main sequence star like the Sun, one of the ways it dies is through a massive explosion called supernova. Sometimes, the remnant of a supernova is a neutron star, which is rotating rapidly, at times as much as a 100 rotations per second. This rapid rotation and the presence of very high magnetic field generates particles moving at enormous speeds. These particles give out radio waves which are observed as pulses at regular intervals by radio telescopes. The source of the energy in a pulsar is the rotation of the star. Several thousand pulsars have been observed with periods ranging from a few seconds to milliseconds. One such pulsar is in the Crab nebula, itself a supernova, recorded in the 11th century by Chinese astronomers.

Scientists argue that neutron stars with bigger magnetic fields also exist, and have termed them magnetars. A pulsar's source of energy is the rotation, whereas in a magnetar, it is the decay of the magnetic field. Kouveliotou and his team have discovered one such candidate in another class of mysterious objects called gamma ray bursters. Gamma ray blasts are among the most enduring puzzles in astronomy, and are observed randomly in the sky about once a day. They are mysterious in their distance and their source of energy. A particular class of such bursts, soft gamma ray repeaters,

The Crab nebula was discovered in the 11th century by Chinese astronomers



emit multiple, brief and intense bursts of low energy gamma rays.

Soft gamma ray repeaters are very rare. Two have been associated with supernova remnants. A new repeater discovered by astronomers is one with a period of 7.47 seconds and a slowdown rate of about a thousandth of a second per year. It has an unimaginably high magnetic field. To top it all is the announcement of the discovery of a source with 89-second pulsation. If this report is also confirmed, then it would further boost the theory of magnetars having very high magnetic fields and longer periods.

The astronomers are now waiting to measure the changes in the periods of the two sources as these slowdowns will provide important clues to the nature of the source. They will also wait for the detailed x-ray spectra which will be soon obtained by a satellite. But it is clear that the presence of such high magnetic fields in objects in our Universe will force us to change the way we have understood the evolution of stars. ■

QED

Non-discoveries are also important in particle physics

PARTICLE physics is a peculiar field. The theoretical consistency of various models predicts the existence of several particles which have to exist to make the theory work. Some of them can be seen, but some remain elusive. Magnetic monopoles (a single electric charge having a spherically symmetrical field) belong to the latter. They have been predicted by almost all reasonable theories of particle physics but have never been seen. Now, we have another report from Fermilab, USA, reporting the non-discovery of monopoles. This is important as it puts new limits on the mass which the monopole may have.

Electric charges come in two varieties, positive and negative, which can exist separately. But magnetic charges always come in pairs: north and south pole. One cannot separate the two by any means. However, under certain conditions a single magnetic charge may exist. This was first proposed by the English physicist Dirac, but was soon forgotten as it was never seen. Renewed interest in the matter was sparked by the



CERN PHOTO

Splitting particles: scientists work on the Cern accelerator in Geneva

discovery that certain unified theories of physics, which purport to unify all the interactions, can only be consistent if magnetic monopoles exist. What is more, if they exist, then they could help explain some of the deepest mysteries, such as why electric charges always come in multiples of the charge of the electron.

These objects are believed to be created in the Big Bang and hence one should be seeing the relic monopoles in the Universe. Scientists have been looking for monopoles in many different places. From cosmic ray collisions, to their tracks in geological deposits, the search has been wide. But never has a monopole or its trace been reported. The theory also predicts that they can be created in high energy collisions in accelerators.

This is precisely where Greg Landsberg of Fermilab looked. He studied the data from the collisions of protons and anti-protons in the Tevatron, the world's largest accelerator. The millions of collisions that were analysed failed to show any traces of monopoles. Disappointing that the result is, there is a silver lining. The search puts a new limit on the monopole mass, which should be 1,600 times more than the mass of the proton. Researchers may get lucky when the next generation collider at Geneva is operational in 2007. Till then, monopoles will remain a theoretical curiosity. ■

Bye bye silicon

How microelectronics might take to carbon

SILICON is quintessential to microelectronics. Since the first transistor, silicon has been the element of choice in the manufacture and fabrication of the chips which form the heart of all microelectronics. But now, Sander J Tans and his collaborators at the Delft Institute of Technology, the Netherlands, have reported the fabrication of a transistor made from a single large molecule of carbon. If the promise holds out, then carbon may well replace silicon as microelectronics' element of the next millennium (*Nature*, Vol 393, No 6680).

It was in the mid-1970s that the use of single molecules was first proposed as electronic devices. The field never really took off due to technological difficulties in making electrical contact with single molecules. But recently, with the development of nanotechnology and the need for greater miniaturisation, the field has got a fresh impetus.

The key advance was the realisation that one can make tubes by rolling graphite sheets. These tubes can be both metallic or semiconducting, depending on the structural details. The use of metallic tubes for single electron transistors was reported last year, but it is for the first time that semiconducting tubes have been used for devices.

Using a silicon substrate, a single wall nanotube was attached to three platinum electrodes. This created a field effect transistor, comprising the single carbon nanotube and two metallic electrodes. Various studies carried out on the device confirmed its operation as a transistor with the desired characteristics. This is obviously the first step in developing carbon-based devices.

One expects to see diodes and other devices based on carbon nanotubes soon. Given their miniature size and properties, these devices would be much faster than conventional silicon devices. If the fabrication and doping techniques of carbon nanotubes develop adequately, there may well be a revolution in the field of microelectronics in the next century. ■

A nose for stress

The world's first drug to work by smell is to begin clinical trials later this month. Kiotech, a UK-based biotechnology company, has applied for approval of a drug to alleviate anxiety. The company is developing a family of odour drugs that, claim company spokespersons, will relieve anxiety, sleeping disorders and even weight loss. These new drugs, the company explained, activate certain receptor cells in the nose that translate smells into brain signals. Kiotech has appointed Pharmakopius, a British contract development company, to oversee an application to the Medicines Control Agency for approval of its first drug, Osmone 1, the anxiety reliever. The company estimates that the licensing of Osmone 1 will be pretty expensive and can take up to two to three years. By proving its medical efficacy, Kiotech hopes to position Osmone 1 in the pharmaceutical mainstream rather than the alternative health market.

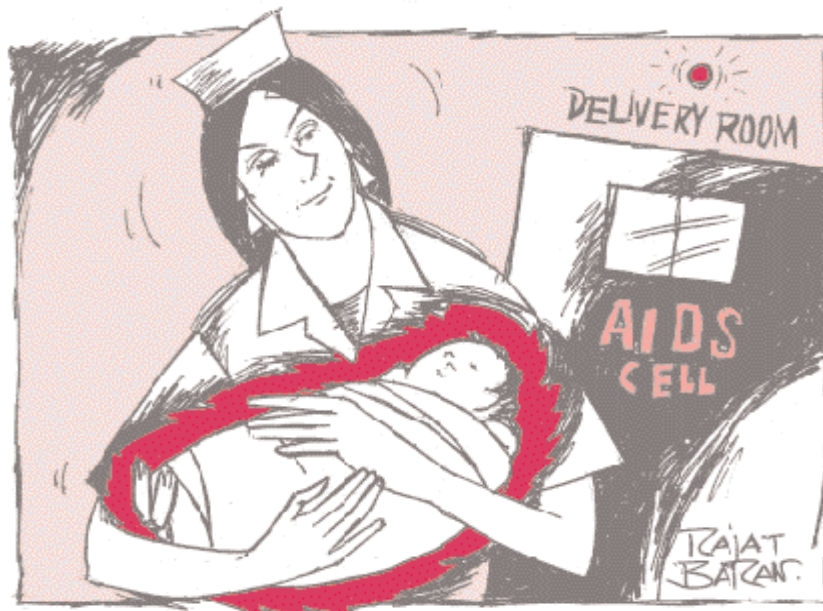
TB faces threat

The US Food and Drug Administration (FDA) has approved rifapentine (Priftin) — the first new antituberculosis (anti-TB) drug to be licensed in 25 years. Rifapentine is indicated for pulmonary tuberculosis but must be used in conjunction with other anti-TB drugs. It is expected to increase patient compliance because it has a shorter treatment course than conventional drugs. Current treatment regimens for active pulmonary TB require at least six to nine months of treatment with at least three drugs, which usually include isoniazid, rifampicin and pyrazinamide. In certain recalcitrant cases, treatment can even go on for over a year. Because the regimen is complicated and lengthy, patient compliance is problematic and treatment errors are common. Like rifampicin, rifapentine is given twice a week for two months in the intensive first phase of the treatment along with the standard antituberculosis drugs, isoniazid, pyrazinamide and ethambutol. However, in the next four months, only one dose of rifapentine per week is sufficient.

HEALTH & MEDICINE

Hope of deliverance

Elective caesarean delivery, combined with an antiretroviral drug, can slash chances of infected mothers transmitting AIDS to their babies



ONE of the biggest threats that we face as we take the last few steps towards the new millennium is from acquired immunodeficiency syndrome, or AIDS. Spreading more rapidly than the proverbial wildfire, this universally-feared disease infects over 16,000 new victims every day. And in developing countries, the situation is worse. With health care facilities still in their infancy or altogether absent, many of these nations do not seem to stand a chance against the infection that has, within a short span of time, rivalled some of history's worst epidemics.

Though AIDS awareness campaigns in these nations have helped to a small extent, problems still thrive. And the biggest of them is preventing the deadly disease from being transmitted from AIDS-infected mothers to their newborn children.

A recent study by French experts, however, offers some hope. According to the study, pregnant women infected by the AIDS-causing human immunodeficiency virus (HIV) can dramatically reduce the chances of transmitting it to their newborns.

This, the study explains, can be done by having elective caesarean delivery while undergoing treatment with the

antiretroviral drug zidovudine.

The prospective cohort study, the release of which was timed to coincide with the 12th world AIDS conference in Geneva, involved over 2,500 children born to mothers with HIV-1 infection — a variation of the feared virus.

The researchers, led by Laurent Mandelbrot of the Paris-based Cochin-Port Royal Hospital, found that of the 133 children delivered to HIV-infected mothers by elective caesarean section and in the presence of zidovudine prophylaxis, only one child was born with the virus. In contrast, among those mothers not receiving zidovudine treatment, the method of delivery made little difference to the rate of HIV transmission (*British Medical Journal*, Vol 317, No 7150).

The team found that among the 1,917 mothers who did not receive the zidovudine treatment, 17 per cent transmitted HIV-1 to their infants. Results varied among 902 mothers who received zidovudine treatment, depending on method of delivery.

Of the mothers undergoing an emergency caesarean delivery due to certain complications, 11 per cent transmitted the virus to their babies. And among mothers giving birth vaginally, seven per

cent transmitted HIV-1.

For over four years zidovudine has been known to reduce perinatal (the latter half of foetal development) transmission of HIV.

In 1994, the AIDS Clinical Trials Group showed that a treatment regimen of zidovudine reduced perinatal transmission by up to an amazing 70 per cent.

Last February, the US Center for Disease Control and Prevention announced that transmission rates could be drastically reduced by a treatment regimen shorter in duration and less expensive than previously accepted. The impact the method of delivery has on transmission rates has been a topic of controversy.

Several studies show an increased risk of transmission associated with rupture of membranes before the onset of labour or more than four hours before delivery. Conversely, the conditions of events related to delivery — such as the length of labour, use of instruments for delivery, and episiotomy (a minor operation to facilitate childbirth) — seem to have little or no relation to transmission. Although caesarean section is one method for prevention of HIV transmission from mother to the foetus, Mandelbrot said “the decision should be made on an individual basis”. “Because it has been known for several years that transmission occurs mainly at the end of pregnancy and during labour and delivery, elective caesarean section has already been recommended by many obstetricians in Europe, but was not a part of an consensus statement or official policy.

Until this year, evidence was quite contradictory,” Mandelbrot said. “Unfortunately, caesarean section for the prevention of HIV transmission is not feasible, and even potentially hazardous, in several developing countries,” he added.

A new initiative to reduce HIV transmission from mother to child in the developing nations was announced by the joint United Nations (UN) programme on HIV/AIDS earlier in July this year.

The US medicine giant Glaxo Wellcome said it will provide an initial supply of the drug and thereafter offer preferential pricing to the UN agency partners. Other aspects of the initiative include early access to adequate care, counselling and HIV testing. ■

Think happy thoughts

It could be for your own good

New evidence suggests that those who look on the bright sides of things live healthier and longer than their gloom-and-doom counterparts. For years, research has shown that optimists weather coronary bypass surgeries better and also live longer with HIV, the dreaded acquired immunodeficiency syndrome (AIDS) virus. But optimism not only helps those who are down and out, it is deemed good for healthy people as well.

When under tremendous, unrelenting stress — in this case, the first semester of a law school — students who were optimistic about doing well had more T-cells and natural killer cell activity than they had before the beginning of the semester. These immune factors, which help thwart infection, showed little change in the pessimists.

The findings strengthen the notion that thoughts and feelings can affect the immune system, said Suzanne Segerstrom, an assistant professor of psychology at the Lexington-based University of Kentucky and the lead author of the study (*Journal of Personality and Social Psychology*, June 98).

Other research has found that the more stress people experience, the more likely they are to get colds.

The new work raises the possibility that optimism may, in fact, help people from falling ill during those tiring days, says Segerstrom. “This study provides an important link in the optimism literature: immunological data,” said Janice Kiecolt-Glaser, a professor of psychiatry at Ohio State University College of Medicine in Columbus, USA. Kiecolt-Glaser and her husband Ronald Glaser, study how stress and emotion affect the human immune system.

The study followed 90 healthy students just before they started law school through the mid-

dle of their first semesters, a notoriously-stressful period. In the beginning, blood tests revealed that all of the students had comparable levels of T-cells and natural killer cell activity. These measurements were repeated after about eight weeks to see whether they had changed.

Meanwhile, each student filled out questionnaires that gauged two kinds of optimism: dispositional optimism, the students’ expectations about life in general, and situational optimism, their expectations for success in law school specifically. Though situational optimists also tend to be dispositional optimists, the relationship is not perfect, said Shelly Taylor, a co-author and psychology professor at the University of California, Los Angeles.

“Some immediate social factors can give you a sense of optimism about your situation, like whether the things in your environment give you hope or not,” she said. “But dispositional optimism has a moderate genetic basis and is not easy to modify. By the time you are 25, you’re not going to affect dispositional optimism a whole lot.”

The number of T-cells rose by 13 per cent in the situational pessimists but dropped by three per cent in the situational pessimists. Natural killer cell activity was up 42 per cent in the situational optimists but increased by just nine per cent in the situational pessimists. Segerstrom said that she was not surprised that situational optimism



was more closely tied to the immune system than dispositional optimism, because it reflected the students' attitudes about the stressful situation at hand, law school. The study left two questions unanswered. One is why the optimists' immune system got stronger once the pressure was on. The research team suspected that the optimists had healthier habits and attitudes than the pessimists, that they perceived less stress, had less intense mood disturbances, exercised more and avoided smoking and alcohol.

But while the optimists did have these healthy traits, as measured by questionnaires assessing health-related traits, only mood and stress had any bearing on the immune system measurements, and it was small. "This suggests that there's something we didn't measure about optimism that explains the immune system effects," Segerstrom said.

The other question is whether the immune system factors went up enough in the optimistic law students to reduce their risk of contracting colds or other infections. Though comparable increases have affected the course of illness in immune systems were weakened by poor health, it is not known whether they would have any effect on healthy people, Segerstrom said.

Perhaps the most encouraging news from the study is that the brand of optimism that proved key is not a hardwired personality trait, but something that pessimists can adopt with a little help, say psychologists. ■

thought to have symptoms severe enough to interfere with daily activities, and some 10 per cent face symptoms so severe that they are considered "disabling".

The symptoms associated with PMS range in severity from compulsive behaviour such as cravings of certain types of food or alcohol, to migraines and exhaustion. From mood swings to child battering, there are about 150 recorded symptoms of PMS. Patients, however, report only 30 to 40 multi-symptom complaints during a single cycle.

Experts believe the body's inability to properly metabolise fatty acids causes these syndromes. The resultant build-up of unmetabolised fatty acids alters normal cellular functions causing these physical and mental syndromes. In its more severe manifestations, women are unable to maintain jobs or even relationships because of cyclical anger. In some, PMS is so severe that it induces strong feelings of suicide. Experts now have an idea as to the functioning of PMS-related disorders. PMS resembles symptoms of alcohol or drug withdrawal (*Nature*, Vol 392, No 6679).

The culprit could be the same in both cases — increased levels of a protein that blocks a neurotransmitter from calming the brain. Near the end of a menstrual cycle, the female body produces copious amounts of progesterone, a hormone. Two weeks before menstruation, however, progesterone levels plummet. A team led by Sheryl Smith of the Allegheny University of the Health Sciences in Philadelphia, USA, found rats which experienced this hormonal

plunge had similar symptoms.

Now, Smith thinks they may have discovered how this works. To mimic the conditions that lead to PMS, the researchers fed rats large doses of progesterone and then abruptly stopped the dosage. After being denied progesterone, they found, the rats produced increased levels of a protein called alpha 4 subunit. This protein is a receptor for GABA, a neurotransmitter that reduces anxiety. Because people suffering from alcohol or Valium withdrawal tend to have high levels of alpha 4 subunit, Smith's group suspected that the protein might somehow prevent GABA from maintaining mental peace. To see if alpha 4 subunit is really responsible for disturbing this mental peace, the researchers injected a chemical that prevented alpha 4 subunit production. As soon as the protein levels had dropped, the rats regained their calm, supporting the researcher's theory.

Blocking alpha 4 subunit production may some day be an effective treatment for PMS, alcohol dependence, and perhaps even for people who simply feel stressed, says Smith. Karen T Britton, a psychiatrist at the University of California, San Diego, agrees: "This is exciting, because it shows that there is a biological foundation to the symptoms of PMS which may lead to pharmacological treatments in the future," she says, "but there is still a ton of work to be done." In fact, the commentators predict that Smith's work may eventually help us unravel the differences between men and women as far as anxiety and mood disorders are concerned. ■

Highs and lows

Science now has a way to prevent premenstrual syndrome

PREMENSTRUAL syndrome or PMS is an inseparable part of every woman's life. Involving both physical as well as emotional symptoms, it occurs regularly in relation to the menstrual cycle. PMS, according to experts, usually sets in about five to eleven days before the menses and subsides either with menses or shortly thereafter. It can occur with apparently normal ovarian function (regular ovulatory cycles). An estimated 70 to 90 per cent of women are affected by PMS during their child-bearing years. Over 30 to 40 per cent of them are

Medical science can now tackle PMS-related depression



AMIT SHANKER / CSE

Looks good, smells better

The idea of aroma-emitting television sets is being extended to Websites by Ricoh of Japan, which wants to equip both television sets and computers with devices that would eject smells that will go with the programme or website that the user might have chosen. Ricoh says Web pages could carry data or pulses which trigger a mechanical device inside the computer or television to crush capsules of certain aromatic agents — and odour masking agents, so that one smell does not mix with the next. For instance, a site on forestry should smell of trees ...surf to an oceanographer's site and you will get the whiff of salt water. Passionate e-mails, of course, could release posh perfumes.

Show the way, ALF

People with poor eyesight or severe memory problems could soon be a lot more streetwise, thanks to the Auditory location Finder (ALF) — a wonderful invention being developed by a team at the Edinburgh-based Napier University's Transport Research Institute. The ALF uses short-range radio beacons to put its users in contact with a computer centre, which then sends them a voice message telling them where they are and where to go. The information includes street names, junctions, pedestrian crossings and routes to the nearest bus stop. ALF also has the provision to recall the last known whereabouts of someone who may have gone missing.

True grit

A programmer at Sandia National Laboratories in California has recently patented a machine that can mend holes in the road automatically. About the size of a single-decker bus, the Rapid Road Repair Vehicle, as it is called, scans the road using an array of sensors on its bumpers. When it detects a pothole or a crack, it first cleans up the area with a high-pressure air hose, then proceeds to vacuum up any debris. A filling material, such as aggregate, is then tamped into place with a fast sealant and dusted with grit to provide grip.

INDUSTRY & TECHNOLOGY

Flying high and low

Small wonders from our scientists: ultra-small aircraft that will fly into hazardous areas and bring back data

NEWS from home: Indian aeronautical scientists and engineers are working on an ambitious project called Micro Air Vehicles (MAV) to produce aircraft that will not be much bigger than the palm of our hand. These "palm-top" planes will be crucial in operations which would require them to fly to spots where no man has gone before, inaccessible natural disaster sites for instance. Scientists often have difficulty in collecting data after, say, an earthquake has struck a certain part of the country. These MAVs, they hope, will be of immense help in gathering information about the causes and parameters of quakes and other natural disasters for studies aimed at minimising damage in the future.

In a paper presented at a recently-held conference on aerospace in Hyderabad, Andhra Pradesh, V J Sundaram, advisor to the Bangalore-based Aeronautical Development Agency, said that getting reconnaissance data from risky areas will just be a routine affair now.

Disaster managers can get precise

information on cyclones, fires, floods and gas leaks from the very core of these catastrophes using these tiny bird-sized planes that will fly into otherwise-hazardous zones and fish for data. The MAV project is all set to revolutionise aerodynamics in India, said Sundaram.

Though current technology — using satellite images, low-flying aeroplanes and helicopters — meet the requirements to a certain extent, but several blind spots still remain.

These miniature palm-top planes are just 15 centimetres (cm) in length, have an operating range of five kilometres (km) and can fly continuously for about half an hour. The MAVs, details reveal, can fly at speeds of up to 40-50 km per hour and reach an altitude of 100-200 metres. Their payload, depending on what mission they are on, will include reconnaissance, surveillance cameras and sensors of various types — chemical, biological, acoustic or even nuclear radiation detectors.

"Integrated efforts of aeronautical, mechanical, electrical, electronic and chemical engineers required for the proper implementation of this project are now underway," Sundaram said.

The MAVs will be driven by pulse jets and conventional propellers. Small electro-motors or alcohol-powered micro engines will run the five-cm propellers. Pen-sized pulse jets with carbon composite tubes acting as combustion chambers, can also be used for faster travel.

Sundaram pointed out that in order to tackle higher winds and gusts, robust control will be essential. He said that the developers of the MAV project are currently considering remote-controlled rudders and carbon dioxide jets. Silicon accelerometers based on the micro electro mechanical system (MEMS) technology



and quartz microgyroscopes will be used for the basic position and altitude-sensing units.

For handling sudden gusts, the planes should have greater drag and less lift. Drag is the wind resistance an aircraft experiences when moving forward, while lift is the force that keeps it airborne. Sundaram said the scientists will be exploiting the engine exhaust to skirt this hurdle.

To make these more aerodynamic, scientists plan to incorporate the fuel tanks and combustion chambers into the main airframe as in missiles. Wings made of silicon will serve as energy sources while the fins will double up as communications antennae. Electrical power can be generated from lithium batteries and fuel cells, Sundaram explained.

The final hurdle that now faces the MAV is its payload. Reconnaissance and surveillance systems will probably use MEMS, MOMS (micro opto mechanical systems) and microelectronics to produce two-cubic-cm micro-imaging systems. These images can then be stored in dense three-dimensional memories based on the rugged biological molecules like the photo-sensitive bacteriorhodopsin. MEMS technology will produce the required chemical sensors.

"Integrating all these concepts will throw up a miniature version of the conventional aeroplanes. Isolation of heat, vibration and electromagnetic interference in the system has to be implemented carefully," Sundaram told the delegated attending the conference. "India has the required resources to make a mark in the emerging area of MAVs," he added. ■

Smooth operators

Tiny snake-like robotic appendages that worm into the human body and perform complicated operations. That's surgery of the future

GIVE it another decade, and the robot will gather enough medical knowledge in its microchips to perform complex surgeries on human patients. And the process, according to doctors and scien-

tists, has already begun. Over a decade ago, medical experts developed something called laparoscopic surgery — in which instruments are inserted through small incisions. Till date, surgeons have used it wherever possible. This form of surgery has several advantages: patients are less traumatised, require shorter hospital stays, and heal considerably faster than they would if they had undergone conventional surgery. Yet, despite these benefits, laparoscopy is a pretty challenging affair for most surgeons. "They find it difficult," says Shankar Shastry, electrical engineer at the University of California, Berkeley, USA. "It's like operating with chopsticks."

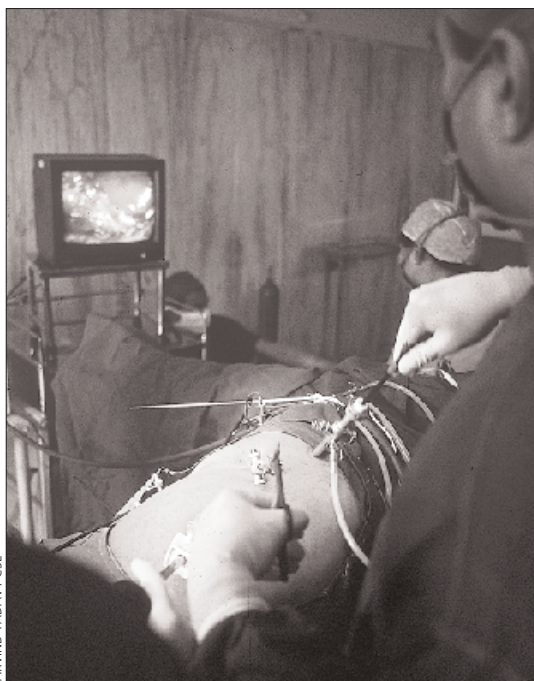
It's an apt summing up. The laparoscopic instruments are mainly limited to scissors, staplers — to close incisions or attach blood vessels — and graspers to manipulate tissue. The instruments enter the body through a long tube; a video image from a minuscule camera called an endoscope poked through another incision guides the surgeon.

For a relatively simple procedure like gallbladder removal, the tools work well enough. Surgeons, however, cannot use the instruments for complicated operations like suturing and knot-tying. Because of these limitations, says Shastry, most operations cannot be performed endoscopically. "We would like to do something like a colectomy laparoscopically because there is less trauma for the patient. These people are already pretty sick, and if you then press them to undergo a traumatic operation, they could die. But it is not a good idea to staple both ends of a colon together, and that is the reason minimally-invasive surgery isn't done," he says. "And of course, the real prize is to perform a cardiac surgery this way."

Shastry and his team at Berkeley have developed some unique laparoscopic tools, including robotic hands with enough dexterity to tie knots, that

bring surgeons several steps closer to this prize. "The reason you have to cut a person open is to get the surgeon's hands in there," he says. "They like to get their hands around the organs, to palpate them. It's what they are used to. But if you can get little instruments in there that let the surgeons feel as if they are working with their hands in a normal procedure, you don't have to make a big incision."

The Berkeley system consists of a pencil-sized joystick — one each for the surgeon's left and right hands — a computer and right-hand and left-hand end effectors. These are robotic instruments that snake into the patient's body to perform the actual surgery. Each effec-



ARVIND YADAV / CSE

Tiny robots promise to make operations easy

tor consists of a single digit, three to four inches long and less than half an inch wide. It has four joints that rotate, swivel, and swing back and forth and a grasper at the end. The result: a finger that acts like an entire hand.

To operate, a surgeon, who can be in the same room as the patient or at a remote location, uses the joysticks just as he would normal surgical instruments. A computer program translates the surgeon's motions into the movements of the end effectors. The system also has force feedback, which relays to the operating surgeon the repines of muscles and other tissues to his actions. The feedback makes the procedure feel

more like a normal surgery. The research team is also working on tactile sensors that will transmit the feel of the tissue to the surgeon's fingertips.

Surgeons at the University of California at San Francisco Medical Center will soon test the system by performing colectomy on pigs. If it is a success and if the US Federal Drug Administration gives its approval, clinical trials on human could begin early next year. ■

Net profits

Virtual shopping can not only cut down the number of cars on the roads, but reduce vehicular emissions as well

WHEN it comes to greenhouse gas emissions, all our accusing fingers point towards the industries, blaming them profusely for reducing our once-green Earth to a sick, polluted planet. Having thus shifted our responsibilities, we carry on happily with our daily lives, without ever recognising our own share of the blame.

The car we use daily for commuting continues to be the single most important source of carbon dioxide — the main greenhouse gas. And at the rate people all over the world are buying them, most countries will experience a virtual explosion in the number of vehicles on their roads very soon. Disconcerted by this problem and the consequential impacts on the environment, several nations — UK, for example — are considering various possible solutions, "sustainable mobility" being one of them.

People, however, do not necessarily want mobility, sustainable or otherwise. They usually travel for a reason, says an article published in a recent issue of *New Scientist* (Vol 158, No 2136). Take shopping. About a quarter of car journeys in the UK are for shopping or such closely related activities as trips down to the post office or bank. This type of car journeys, says the article, is growing fast, not only in Britain but in urban centres all across the globe. Nearly all the growth in traffic during this decade was the result of the increase in the use of cars for shopping and personal business.

New technology, however, could

NET WORK

Web grooves

Over 14 years ago, more than a hundred companies agreed on a standard way for making music with computers — the Musical Instrument Digital Interface (Midi). Midi player software turns your computer into a virtual musical instrument, as music files tell it — or an electronic instrument connected to it — what notes to sound and in which order. Most modern personal computers, when fitted with a sound card, can play the thousands of Midi files stashed around the Web — and all Macs come with sound circuitry built-in.

You will find a selection of music files in the Electronic Music Forum at <http://computingcentral.com-forums/default.asp?eletronicmusic/index.htm> or you can search for works by your favourite artist or a well-loved tune by following the advice at <http://www.aitech.ac.jp/~ckelly/midi/help/midi-search.html>.

Rock and a hard place

From hardware harmonies to hard rocks. Easter Island is famous for the

ancient civilisation that built massive stone heads and then largely vanished. The unofficial Easter Island site at <http://www.netaxs.com/~trance/rapanui.html> contains everything an armchair traveller could want: pages describing the local culture, the history of the island, and the possible fate of its inhabitants. Adventurous types can also find out more about travelling to one of the world's most isolated spots.

By Jupiter!

One isolated place makes way for another. Jupiter, the solar system's largest planet puts on a good show even when there is not an exotic eclipse going on. The US National Space Science Data Center (NSSDC) compiles information on the planet and the spacecraft that have visited it so far. A link at the bottom of the pages takes you to the main table of contents of the NSSDC's huge photograph gallery. Visit the planet — through the Internet, that is — at http://nssdc.gsfc.nasa.gov/photo_gallery/photogallery-jupiter.html.



SAM ART

soon reverse this trend. History is littered with instances of new technologies replacing the old. Now virtual shopping can replace those weekly drives to the supermarket. All that is needed is a little help from the government. Britain's two biggest supermarkets already have Internet shopping trials. All you do is log on to the Web, surf the virtual aisles, choose what you want to buy and place your orders which are delivered by van.

Virtual shopping has several distinct environmental advantages. One van, for instance, can carry the shopping of up to 15 households and delivers within an eight-kilometre radius of a store. It is far more efficient for one van to deliver to 15 households on a round trip than for 15 cars to drive up to the store. The precise saving depends a lot on geography, but the net reduction in distance travelled could easily be

as much as 70 to 80 per cent, bringing corresponding cuts in pollution.

The government, says Mick Hamer, the author of the article, can help kick-start virtual shopping. On the most basic level, stores and supermarkets can be urged to drop their charges for the service and have a minimum order size instead, roughly equivalent to a carload of shopping. This will ensure that the vans are used efficiently. ■

Self defence

Genetically engineered potatoes and tobacco plants would now save themselves from four major fungal diseases. Matteo Lorito of the Federico II University of Naples and his colleagues have equipped these plants with a gene which helps make a powerful anti-fungal endochitinase. This enzyme digests fungal cell walls and other structures made from the tough biopolymer chitin. The gene itself comes from the fungus *Trichoderma harzianum*, a parasite which attacks other fungi. It was found that about 10 per cent of the altered plants proved resistant to all four diseases, a trait that was inherited by subsequent generations. According to Lorito, this is the first time a gene of fungal origin has been used successfully to fortify plants against fungal diseases. Earlier, botanists have loaded plants with plant genes which make anti-fungal enzymes, but these provide only weak protection and usually only work against one fungal species. *T. harzianum* overcomes these limitations as it makes a powerful chitin-digesting enzyme that is lethal to several strains of fungi (*New Scientist*, Vol 159, No 2142).

More forest cover

Farmers in Haryana have found a novel way to prevent rapid decline of natural forests in India. This method would also help support nearly 500 wood-based industries. They have demonstrated commercial viability of the poplar tree (*Populus*). This tree can reduce pressure on natural forests that are declining annually at a rate of over 15 per cent. After a severe drought in Haryana during 1987-98, farmers uprooted excessively water-drawing eucalyptus plantations and used poplar in the mixed farming system. The tree not only acts as a shelter belt and wind break but also conserves soil and water, control soil erosion and increase water intake capacity of the soil, unlike eucalyptus. In India, poplar is being planted in the northern plains of Haryana, Punjab and Uttar Pradesh, besides Jammu and Kashmir, North Bengal and Arunachal Pradesh.

AGRICULTURAL SCIENCES

Swamped in weeds

A flood-tolerant and drought-resistant weed spreads along the Cauvery delta, badly affecting agricultural production



SUPARNA DAS

Ipomoea carnea: cause for concern in Cauvery delta

S RAJENDRAN

THE spread of a weed called *Ipomoea carnea* in the Cauvery basin is obstructing water flow and posing a threat to agricultural production. The weed has covered the entire stretch of Cauvery — from Coorg district, the birth place of Cauvery in Karnataka, to Nagapattinam district, where it enters the sea in Tamil Nadu. This drought-resistant and flood-tolerant green plant spreads much faster than other weeds such as *Parthenium* (congress grass) and nut grass. It obstructs water flow and causes water logging and consequently affects agriculture. At present, the weed is threatening about 10 lakh hectares (ha) of land along the fertile Cauvery delta.

Government officials and farmers are putting in maximum efforts to wipe out *Ipomoea*. The root of the plant spreads on the top soil, survives on wet and dry lands, roadsides and rail lines. As flood irrigation is practised in this

area, *Ipomoea* is carried through channels and spreads faster to the fields.

Ipomoea has already taken root on an estimated 2,000 kilometres (km) land stretch in the Cauvery delta. According to A Sambantham, Thanjavur's deputy director of agriculture, all the five tributaries of Cauvery — Vennar, Vettar, Cauvery, Vadavar and Arasalar — have been completely covered by *Ipomoea*. Accumulation of silt and mismanagement of water bodies have become a common feature in this area and hence unknown plants and weeds, like *Ipomoea* and water hyacinth, have flourished.

T Murugaian Mazavarayar, a progressive farmer at Keeza Uloor in Orathanadu Taluk, says

that his land is constantly waterlogged due to *Ipomoea* overgrowth. Following this, about one ha of ADT 36 paddy plant worth of Rs 30,000 was waterlogged in mid-1996. "We could not harvest even a single paddy straw," Mazavarayar says. The weed is a nightmare for fish-breeders too as it grows fast and covers water bodies like tanks and ponds. This is the reason why yield is declining in the region. *Ipomoea* does not spare the dry areas either. In west Thanjavur, near Sengipatti, 24 ha Kada Eri (tank) and 70 ha Rayamundan Eri have been completely encroached by the weed.

Tank water is the main source for irrigation in drought-prone districts such as Pudukottai and Ramanathapuram. *Ipomoea* invades not only water bodies but also cultivable fields and marginal lands, says S Chandrasekharan, director of Renaissance, a non-governmental organisation (NGO), based at Pudukottai. This NGO, with the co-operation of the local community,

removed *Ipomoea* in the entire Talanayar block of Nagapattinam district and a part of Pudukottai district.

The weed invades arable fertile regions quickly by sucking nutrients. An integrated method is being worked upon to remove the weed from the Cauvery delta. S Kunjithapatham, former joint director for agriculture, says that the area covered by water hyacinth has been surpassed by *Ipomoea* in Cauvery delta. An estimated Rs 8 crores have been allocated for removing *Ipomoea* in Thanjavur, Thiruvavur and Nagapattinam district during 1997-98, he says.

K V Sundaram, assistant director of agriculture in Pervurani taluk, has devised a method to get rid of the weed. A portion of the *Ipomoea*'s bush is removed and a group of 10-15 labourers cover it and roll it like a mat. Not more than Rs 5 per square metre is paid per labourer. If the labourers are organised and work at the community level, the weed can be wiped out from the entire Cauvery basin within a week's time, says Sundaram. He says that it is easier to remove the weed from the wet land as the soil is loose. The dried leaves and twigs are used as fuel in firewood-deficit areas.

Poor people in rural areas collect the weed for fuel. But the smoke that is emitted irritates the eyes. The School of Energy Management at Bharathidasan University, Tiruchirappalli, is examining the usage of *Ipomoea* as a source of energy.

Scientists have found that *Ipomoea* compost contains sufficient nutrients like nitrogen, phosphorus, potassium. Five-and-half tonnes of decomposed manure is sufficient for one ha of wetland paddy cultivation. Scientists at Soil and Water Management Research Institute of Tamil Nadu Agriculture University, Thanjavur, say the preparation of *Ipomoea* compost does not involve too much by way of technical and financial inputs. Chopped pieces have to be placed in a pit with 100 grams of *Pluerotus* fungus for better decomposition.

Says K Krishnamurthy, former vice chancellor of University of Agricultural Sciences, Bangalore and an expert in weed sciences, every plant has some useful property. Congress grass that was earlier considered to be a dangerous non-native weed, has today, proved to

be a good source of raw material for cardboard boxes. In the same manner, detailed research is required to find out the useful properties of *Ipomoea*. ■

Speedy destruction

The use of heavy tractors leads to reduced crop production

THE use of heavy tractors can damage the soil and thereby reduce crop yield by 80 per cent, say German scientists. The findings show that ploughing can also damage the soil. Rainer Horn and his colleagues of Kiel University, Germany, have calculated that the average weight of tractors and other agricultural machinery used in the western countries has tripled in the last 28 years.

Horn and his colleagues found that after six passes with a tractor exerting a force of five tonnes at each wheel, the density of small invertebrates such as worms and arachnids, which contribute to soil fertility, fell by more than 80 per cent. The impact could be noticed at depths of about one metre. Following

this, the production of crops went down by nearly 80 per cent.

The researchers say that ploughing breaks up the water-filled channels. These channels are known to give soil its springiness and mechanical strength, to a depth of 30 centimetres (cm). In this process, more of the pressure exerted by a tractor is transmitted to lower layers. Horn and his colleagues have found that these layers are not broken up by ploughing, and so become more and more compact.

They found that plants were unable to push roots into this compact subsoil and suffered more in dry weather because of this. Water cannot penetrate the subsoil, and flows on the surface, thereby increasing erosion. The damage to the subsoil could be reduced by about a third by replacing ploughing with a system known as low tillage, in which the soil is broken up to a depth of only eight cm.

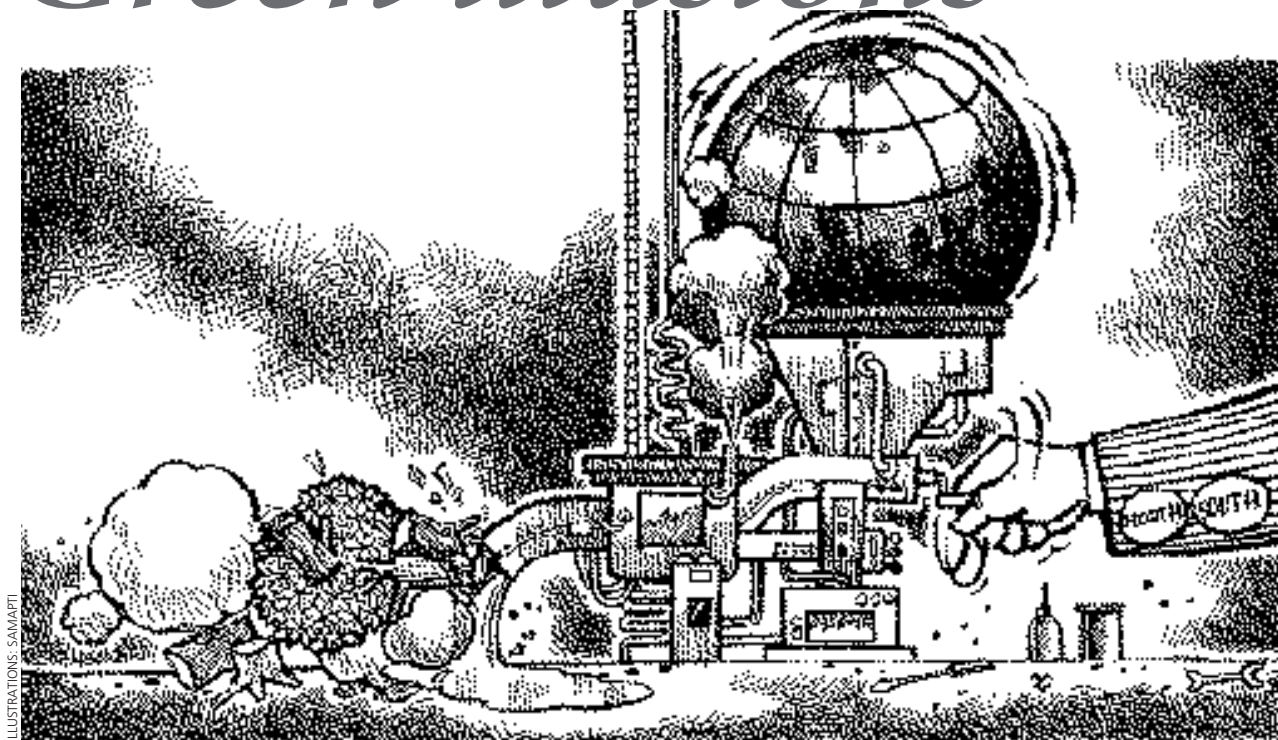
The researchers say that farmers have been using high amounts of fertiliser to compensate for the effects of soil compaction. Some wheat fields have even lost 20 per cent of their yields from compaction, while soil compaction caused heavy damage to about 30 million hectares of soil in Europe. ■

Pressure on the soil: tractors spell trouble



AMIT SHANKER / CSE

Green illusions



Germany is swamped in a controversy about a study which says sustainable development can be achieved only when the consumption of resources is reduced and relations between the North and the South are more equitable

KLEMENS LUDWIG

IN OCTOBER 1995, a study about the future of the industrialised world created a great deal of interest as well as controversy. The publishers of the book were the church-based relief association, Misereor, and the environment protection group, Bund. These organisations do not normally issue public statements. However, making a change from their normal position, they asked the Wuppertal Institute for Climate, Environment and Energy, Germany, for a study on how to extend hospitality to all the people on the planet without jeopardising the natural resource base for subsequent generations.

The fundamental thesis of the study is that we have to regulate our consumption level of natural resources and improve our energy use in order to establish a sustainable relationship with nature.

At the same time, we have to create an equitable relationship between the countries of the North and the South. In the long run, only these two aspects can guarantee sustainable development for the whole world.

In German-speaking areas, the proposals gained a lot of attention and even provoked controversial discussions. English and Italian translations have already been completed. The English translation, "*Greening the North. A post-industrial Blueprint for Ecology and Equity*" is available in many industrialised and developing countries.

Hundreds of reviews, comments and articles on the study were published in leading newspapers and magazines in Germany. The reactions ranged from enthusiastic support to harsh rejection. In the newspapers, the criticism was mainly positive, though many journalists emphasised that the study does not take the economy into consideration in the decision-making process.

Theoretically, everybody agrees that ecology is important, but when it comes to practical steps, many people do not know what to do. The highlight of the study is that it not only argues at the theoretical level, but also shows how the vision of sustainable development can become a reality. Finally, "*Greening the North*" stresses bringing ecology and justice together for the South.

Nature first, humankind later

Negative criticism comes from two very different quarters. Traditional Leftists and feminists reject the study, although their arguments are completely different. Research institutes, closely linked with companies or economic scientists as well as trade unionists, claim that economic growth is the key to progress, even for the protection of nature. They are deeply convinced that people have “dominion over the earth...” and allege that the study looks at the world from the point of view of nature.

Humankind, according to them, is of greater importance than nature. The specific task of people on Earth is to harmonise economy, social complexity and ecology. They feel that they have good reasons to be optimistic about the future, while the study shows a lack of confidence in the ability of people to solve problems. They also argue that the study is against the democratic principles and this might lead to an ecological dictatorship.

Instead of trusting the common sense and the free-will of the people to initiate the changes, the critics voice danger over experts deciding on what people should consume. This is indeed a very sensitive issue within German society. When member of Parliament of the Green Party, Halo Suitold, demanded a restriction of flights in order to reduce carbon dioxide emission, she was heavily criticised, even by her own party members.

A capitalist approach

“We miss one decisive word in the whole study, the word capitalism,” read a line in a statement issued by the Development Policy Action Groups (BUKO). From a Leftist position, this reflects the strongest argument against the study, claiming that the Wuppertal Institute provides solutions only within the capitalistic framework which is directly responsible for the problem. It does not raise the question of political and economic power within the country as well as the international community. Institutions like the World Trade

Organisation or General Agreement on Trade and Tariffs are not questioned.

According to these groups, the study presents a 21st century “soft” capitalism approach which wants to survive on sustainability. Instead of analysing the character of capitalism as the main source of ecological destruction and injustice, the institute only provides some collective visions. Because the study does not go into the roots of the problems, the social and economic dimensions that accompany the necessary changes are completely left out, the critics claim. In the eyes of the Development Policy Action Groups, what the study lacks is not due to a result of the author’s naiveté, but because they are not ready for a fundamental change.

The feminists have also voiced apprehension. Without analysing the situation of women within a patriarchal society, the consequences of the study mainly affect the everyday life of the women. Most of the concrete proposals are a step back for many women, they argue. In the end, the newspaper forum says, the study gives men progressive arguments to relegate women to the home, because all that women have achieved — more time and mobility because of consumer products, fast food, a second car, etc.— can no longer be accepted according to the demands of sustainable development. This dilemma cannot be solved without questioning the patriarchal society.

Feminists say that under the present situation, autonomy of women is superior to ecology. They even claim to be ecologists. The more autonomy individuals have, the argument goes, the less repressive is the society. Only when the repressive structures have been overcome, is there the chance to halt destruction of the environment. Feminists with a leaning to Communism are quite close to liberal economists.

Representatives from Christian organisations, such as the German Catholic Youth (BDKJ), also criticised the study on the grounds that it does not analyse the economic systems which lead to the destruction of the environment, while social scientists say that the study covers the well educated middle-class, but provides no concept for the growing number of unemployed and poor people in the North. For these people, survival is the problem, not sustainable development.

Relying on sustainability

The Wuppertal Institute is very open to the criticism. The authors emphasise that they do not have final solutions, but want to be part of a development which has been initiated by the study. The way to a sustainable economy is long. In a response to the criticism, the authors make it clear that they do not believe in political pressure in order to change the habits of the people.

Instead, they want to convince people and open the eyes for what is possible. However, they openly admit that they do not pay enough attention to women’s questions, the growing number of poor people and the social and economic dimensions of the changes. But they are not willing to give up the basic position that sustainable development can only be achieved when the consumption of resources can be reduced and the relations between the North and the South can be put on a more equal level. ■

Klemens Ludwig is a freelance journalist based in Germany



"Children are affected by lead poisoning"

VEENA KALRA, who is with the department of paediatrics, All India Institute of Medical Sciences (AIIMS), New Delhi, is conducting research to determine the lead levels in blood among children and to identify the source and magnitude of the problem of lead poisoning. She spoke to **SONIA KAPOOR** on how diseases are on the rise due to increasing levels of lead in the atmosphere

On how she began her research about pollutants in the environment:

My main interest has been in child neurology. I was interested in this area because a large number of children in Delhi are exposed to lead.

When we have lead in low levels in the blood, that is around 10 micrograms per decilitre, it does not produce any major symptoms. But it does affect the child's brain development, intelligence, behaviour and his/her performance at school.

Therefore, the effects of lead are very subtle. But when its concentration in the body increases slowly, it produces more recognised symptoms. In Delhi, pollution from vehicles and from the industries are very high. This made me initiate my first project. This project, which was completed in 1994, was funded by the World Health Organisation and was supported by the ministry of environment and forests.

On her first project:

The findings of this study have not yet been published due to some problems. There is no place in Delhi where we could get reliable blood lead level tests done. That was the primary setback. Therefore, it took time to finally conduct the tests to determine the blood lead levels among school children.

We couldn't do it at AIIMS as the instruments were not working. Then we tried the Indian Institute of Technology, and finally we had to go to Central Pollution Control Board (CPCB). It was with their help that we could finally complete our study.

The study was based on a comparison of blood lead levels in school children located in contrasting areas. Two types of school areas were selected. One was where the ambient air lead levels are the lowest recorded by CPCB monitoring data (Siri Fort area) and second was the area where the air lead levels are the highest (ITO) for Delhi. We approached schools in this area and similar age group children were selected for the



AMIT SHANKER / CSE

study. A total of 100 students in each of the category comprised the study group.

On the findings:

My findings reveal that almost 64 per cent of the children had lead levels higher than 10 microgram per decilitre — which is the Centre for Disease Control (CDC) accepted safe limit for lead.

On the analysis of the findings:

We tried to compare the results of the two areas in the study. We found that the lead levels among children near ITO

My findings reveal that almost

64 per cent of the children in

Delhi had higher lead levels

than the accepted safe

limit. This could affect the

enzyme system of our blood,

cause anaemia, affect the

nervous system and lower the

Intelligence Quotient

was higher.

However, even in the other area there was a significant amount of lead in the children. A possible explanation to this would be that one may reside in one place and may travel to another place.

On the sources of lead poisoning:

Lead in the air settles on the soil and vegetables. The other potential sources of lead are solders in lead pipes, certain kinds of taps that are used, water storage systems, and the use of unglazed pottery to store water, milk or curd.

On the target group:

It is certain that lead levels are higher in children. This is because children breathe more than adults. While playing in the soil, they put their hands in their mouth. So a lot of lead gets into their system. Hence they have higher chances of getting lead poisoning into their system.

On the immediate symptoms of lead poisoning:

Lead poisoning affects every part of the human body. Loss of appetite, vomiting, hypertension in adults and kidney problems are the major symptoms. Lead affects the enzyme system of our blood. It causes anaemia, affects the nervous system and lowers the Intelligence Quotient and causes behavioural problems.

On the lack of awareness among doctors:

The most important thing is awareness among doctors. Students should be taught at a very young age about the effects of lead poisoning. If there is awareness at school level, the future generation can stay away from lead poisoning.

On what led her into research:

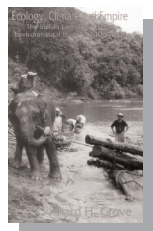
My personal experiences with children's problems and my inability to get a blood lead level test done prompted me to get into research by starting a project.

On her future projects:

We have launched a massive programme to screen about 5,000 children, pregnant women and high-risk groups for lead levels. We initiated the project with the department of science and technology (DST).

DST is buying a lead analyser so that there will always be a permanent facility at AIIMS to test blood lead levels. We have already tested 1,800 children. The study will be completed in a year's time. Apart from this, we also intend to screen police personnel who are always on the road. ■

Blame it on the Raj?



ECOLOGY, CLIMATE AND EMPIRE: THE INDIAN LEGACY IN GLOBAL ENVIRONMENTAL HISTORY, 1400-1940 • Richard H. Grove • Oxford University Press, New Delhi

ARNAB KUMAR HAZRA

IN RECENT years, ecology has emerged as a major research topic and its historical aspect is being keenly analysed. The period between the 17th century to the early 20th century, when most of the nations were under colonial rule, is associated with the exploitation of natural resources. India is no exception. The Indian Forest Act of 1927, in operation till 1980, was extremely exploitative in nature. The 1927 Act was an extension of the 1878 Act, both constituted during the British rule.

There is near unanimity of opinion that any forest policy which sidelines the indigenous people results in greater exploitation of resources. These people have traditionally depended on forests for survival and have also taken the onus of protecting it from various hazards. "Ecology, Climate and Empire" is a book written against this backdrop by Richard Grove, an ecological historian.

The author attributes the occurrence of droughts to deforestation since 1670. However, "the identities and

motivations of these interest groups (read indigenous people) were often deeply intertwined and unified in opposition to colonial conservation policy." Hence the author caters to the outdated notion that infringement by people living in and around forests is the root cause of deforestation. To substantiate his belief, the author says, "Many of the wars between Hindu and non-Hindu groups were specifically framed in terms of disputes about political control of forest regions." However, the author fails to provide an example of where and when such a war took place.

Furthermore, the author states that the "existence of dynamic links between deforestation and rainfall decline" was recognised by everyone. Early examples concerning global climate change vis-à-vis deforestation was an integral part of colonial policy. The author tries to prove this point by linking years of natural disasters with

active environmentalism. For example, he says: "The drought of 1845-47 ushered in... and coincided with important departures in the valuation of the Cape environment..." However, he does not elaborate on the departures and policies at any stage.

The author substantiates his argument by listing various European botanists, activists and those interested in meteorological data. However, individual works or published data in medical journals do not prove that colonial policies were conservationist in nature. The inter-connection between drought and El Niño in the 17th and 18th century and understanding of global climate change getting reflected in the East India Company's thinking is a bit hard to digest. Neither El Niño nor droughts are a recent phenomenon, but active research on this interconnection began only in the 1970s.

The argument at times borders on the realm of mysticism. Roxburg was one such botanist who "actively sought documentary and botanical evidence of these earlier droughts, finding a rich source of material in the

informant whom he refers to as 'the Rajah of Pittenpore's family Brahmen'."

Again, one such person was Moloney, who worked in the Gold Coast and pointed out that deforestation would lead to rainfall decline and famine. So he warns "our Eastern allies" to "put a stop to this unlimited practice of shaving the forest of timber". Grove clarifies that "our Eastern allies" implies the colonial government in India.

So does the author accept colonial exploitation in a subtle way? Ironically, he further suggests that Moloney remained unspecific as to the methods by which "forest conservation may be introduced in West Africa". Again, when the author deals with the 1897 Land Bill in the Gold Coast of Africa, he claims that the bill was "framed on the basis of an Indian forest conservation model". But he does not elaborate any further on the "model".

This brings us to the title of the book, "The Indian Legacy in Global Environmental History". The book fails to give a glimpse of what the legacy was like. Overall, the book is a well-researched piece of fiction. ■



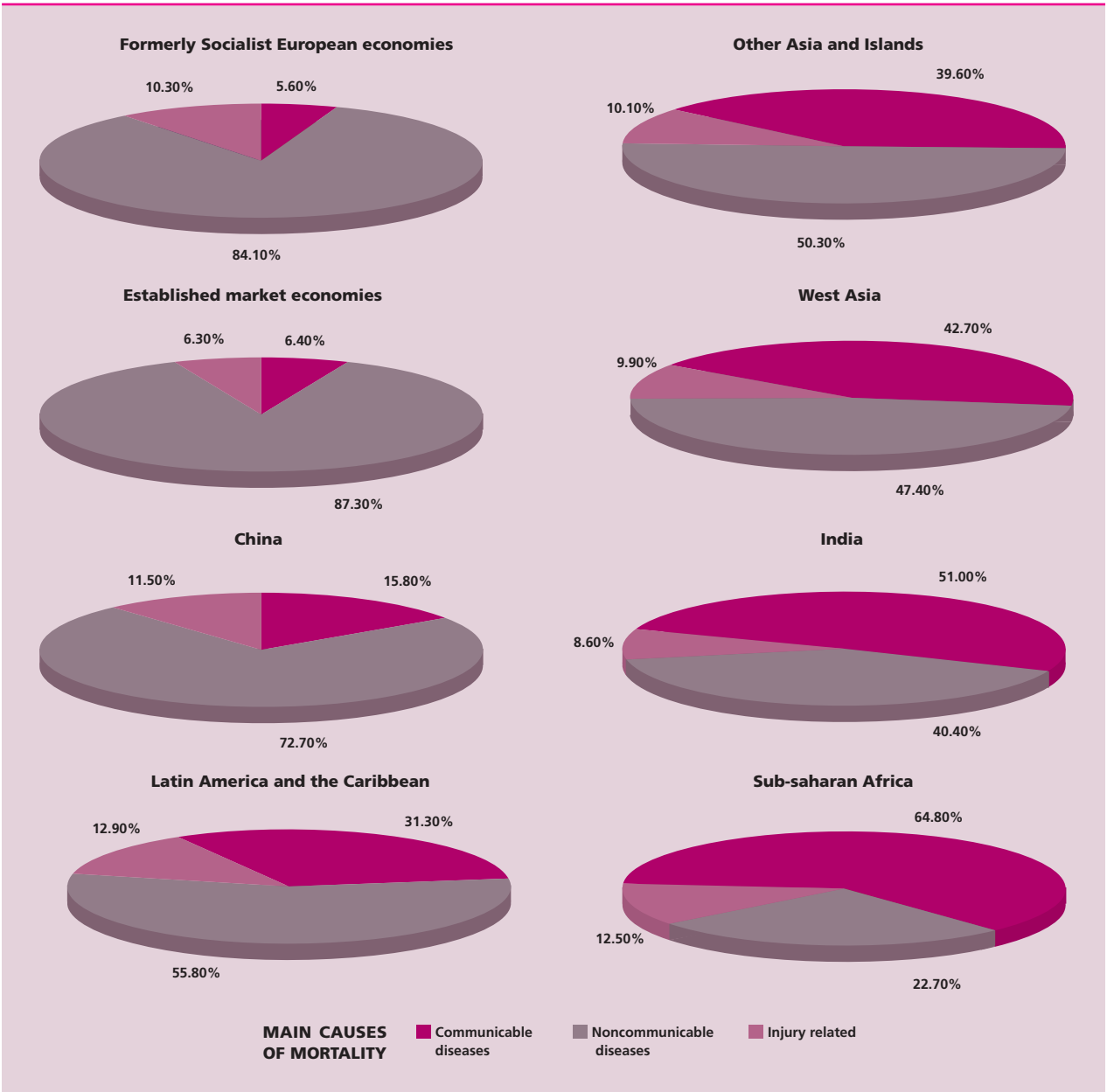
SOUMEN BHOWMICK

Cause of death: poverty

Death and disease are closely linked to economic well-being. The greatest number of people in sub-Saharan Africa or India die due to communicable diseases, which have close associations with poverty and lack of health care. Communicable diseases do not kill so many in the developed parts of the world, such as Europe or North America. These are the findings of a 1996 study, *The Global Burden of Disease (GBD)*, by researchers at the World Health Organisation and Harvard University, USA. The *GBD* study provides estimates for death and disease for 1990 in different regions of the world.

Patterns of death

About 64 per cent of all deaths in sub-Saharan Africa and 51 per cent in India are due to communicable diseases. In the developed market economies such as Europe and North America, the figure stands at a meagre 6.4 per cent. In the formerly socialist European economies, it was even less at 5.6 per cent



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Write to Shyam Pandharipande at CSE for registration and more information.

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