

Forschungs-gemeinschaft (which funds research projects in the universities), the Fraunhofer Gesellschaft (the equivalent of Max Planck, but for applied science), and other science promotion bodies. The ministry also promotes research and innovation in industry through a number of mechanisms. **Robert Walgate**

## Indian environment Shandi inverted

### Bangalore

Mrs Gandhi's new government seems to have taken the environment to heart, to judge from the spate of decisions since the election at the beginning of the year and the appearance of the environment in the newly published Sixth Development Plan.

In recent years, environmental abuse in India has increased alarmingly. Urbanization, industrialization and river pollution have all conspired to make a mockery of the United Nation's slogan of "development without destruction" in a country renowned for its religious regard for the variety and greatness of nature. The repercussions of this indiscriminate assault on the ecological system are telling:



Barren hill

landslides and flash floods in the Himalayan foothills have caused heavy loss of human lives and property, top-soil erosion and growing aridity in the Ganges plains have had severe consequences for agriculture.

Successive Indian governments during the past 30 years have shown little awareness of the cardinal importance of environmental planning in developmental activities. It was only after Mrs Gandhi's return to power in early 1980 that the environment assumed significance.

Since then, work on the controversial Silent Valley hydroelectric project in the tropical rain forests of southern India has been suspended and the rate of deforestation in the Himalayan foothills has been

greatly reduced.

It is a measure of the growing public ecological awareness that the last session of the Indian parliament witnessed perhaps one of the liveliest debates on the environment. Intervening in the debate, Mrs Gandhi made it clear that the nation must not repeat its earlier mistake of allowing industrial projects, despite their economic importance, to damage the delicate environmental web.

During the debate, a ruling party member, Dr Karan Singh, expressed shock over the "ruthless denudation of Himalayan vegetation by corrupt politicians, corrupt officials and corrupt contractors". He further lamented that even the Ganges had now been contaminated.

Another member, Mr Digvijaya Narain Singh, said that, as a result of top-soil erosion, 90 million hectares — equal to 28 per cent of the total land area — had now become practically barren. He urged that there should be a separate department concerned with land use, forestry, wild life, pollution control, marine ecosystems and the promotion of environmental protection.

This suggestion seems likely to be incorporated into the government's long-term environmental strategy, which will be based on the recommendations of a 14-member committee set up to suggest legislative measures and administrative machinery for environmental protection. The committee, headed by Mr Narayan Dutt Tiwari, deputy chairman of the Planning Commission, has come out strongly in favour of immediate coordinated action at both central and state levels to give environmental protection a crucial place in the country's programmes and policies.

The Indian government is also contemplating introducing a bill on the prevention of air pollution in which would be based on proposals put forward by an expert committee appointed in 1978 to study air and water pollution in the urban areas of India. Air pollution has become a major health hazard in cities such as Bombay, where the content of carbon dioxide in the atmosphere has been increasing by 4.2 per cent a year due to the 65 tonnes of dust ejected into the air each day by industry and vehicles.

**B. Radhakrishna Rao**

## Nuclear fallout Weapons are worst

States with substantial nuclear industries should do everything they can to avoid strategic nuclear attacks. That is one of the inevitably ironical conclusions of a study of catastrophic nuclear radiation releases by Steve Fetter and Kosta Tsipis of the Program in Science and Technology for International Security at Massachusetts Institute of Technology.

The chief objective of the study has been to compare the long-term consequences of nuclear weapons exploded in the air and on the ground, catastrophic releases of radioactivity in reactor accidents and the explosion of nuclear weapons on or near nuclear reactors or reprocessing plants. Although it is recognized that the immediate effects of weapons explosions as distinct from reactor accidents will consist largely of the death of people and the destruction of property, the calculations are aimed at estimating the area of surrounding land that will be unfit for human habitation after an explosion or some other catastrophe.

For the purposes of the calculation, the authors assume that half the energy released in a one-megaton thermonuclear explosion is provided by fusion reactions and the remainder by the fission induced in a surrounding blanket of uranium-238. For weapons burst in the atmosphere, radioactivity from the fission of uranium-238 will be the sole source of long-term contamination, and much of its debris will be distributed by stratospheric processes.

The areas rendered uninhabitable after a nuclear explosion are sensitively dependent on the criteria used for deciding what doses of radioactivity are acceptable. For a ground burst weapon whose debris is spread in the lower atmosphere by a 15-mile per hour wind, the authors calculate that 5,700 square miles of land would be uninhabitable for a year if doses greater than 2 rem per year were considered unacceptable, but that fewer than 50 square miles would be uninhabitable a year after the explosion if 100 rem per year were taken as the cut-off dose.

Inevitably the consequences of the explosion of a nuclear weapon on or near a reactor are more startling. Using the somewhat stringent criterion of a limiting dose of 2 rem per year, the authors conclude that 50,000 square miles of land would be uninhabitable for a year. The destruction of a waste storage facility would have still more horrendous consequences, putting 64,000 square miles out of action for a year. By comparison, the report concludes, the consequences of a reactor melt-down and a subsequent release of radioactivity would be comparatively small, sterilizing only 900 square miles for a period of one year.

The obvious but impractical import of these calculations, Fetter and Tsipis say, is that countries seeking to avoid devastating damage from distributed radioactivity in a nuclear war should either dispense with a nuclear industry or build reactors and reprocessing plants underground. They also point out that because the permanent damage done by a single nuclear weapon detonated on the ground is so much greater than that in the "worst conceivable nuclear reactor accident", it is hard to understand the greater anxiety of the general public about the risks of civil nuclear accidents than with the consequences of nuclear war.

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