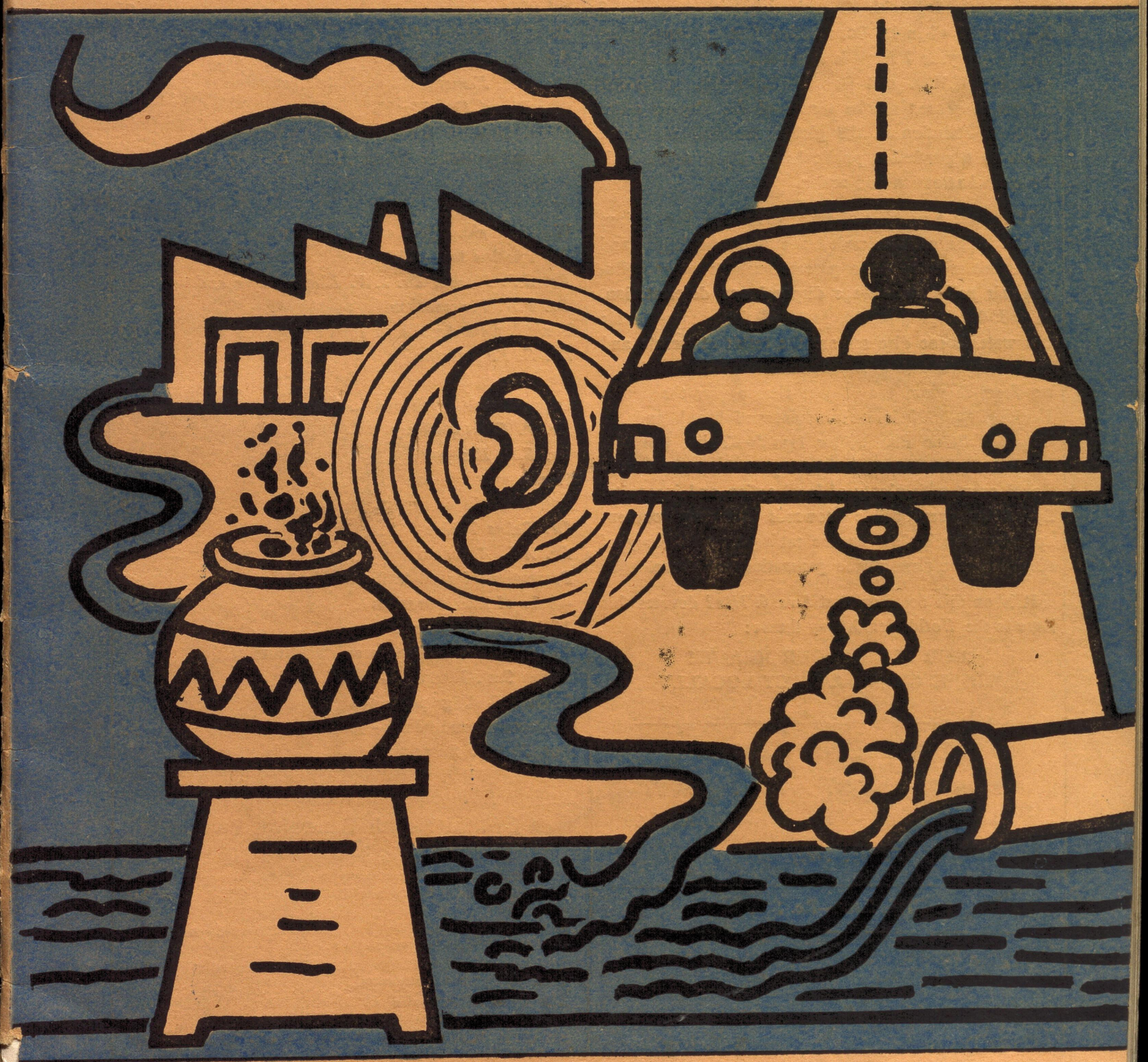
ISSN 0586-1179

swasth hind

vol. 24 no. 3,4

march – april – 1990

ENVIRONMENT AND HEALTH



WORLD HEALTH DAY NUMBER

swasth hind

Phalguna-Vaisakha March-April 1990
Saka 1911-1912 Vol. XXXIV, Nos. 3 & 4

WORLD HEALTH DAY—1990

The World Health Organization was born on 7 April, 1948 when its Constitution first became effective. Every year 7 April is celebrated as World Health Day by W.H.O. and its Member-States. A special subject is chosen as the theme of the Day in order to draw attention at the global, national and local levels to a particular public health issue which calls for special attention and action.

There are a number of problems which have arisen in the wake of accelerated use of technology and consquent modernisation process such as water pollution, air pollution, sewage disposal and deforestation. In the developing world, most of the communicable and water-borne diseases are the result of unsafe and polluted water and other environmental factors. Keeping them in view, the theme chosen for the World Health Day 1990 is environment and health and the slogan is "Our Planet Our Health—Think Globally Act Locally". World Health Day 1990 can be a truly global event with plenty of local action and ingenuity. By being responsible towards the environment and our own health, we are taking care not only of ourselves but also of the generations to come.

It is on this occasion that *Swasth Hind* devotes this issue to the World Health Day theme:

OUR PLANET OUR HEALTH
THINK GLOBALLY ACT LOCALLY

SUBSCRIPTION RATES

Single Copy . . . . 50 Paise
Annual . . . . . Rs. 6.00

(Postage Free)

This Issue—Re. 1.00

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ENVIRONMENTAL PROTECTION IN INDIA

MAHESH PRASAD

A number of initiatives have been taken in the past few years to put environmental protection on firm ground. The responsibility to harmonise environmental protection with development objectives rests with the Ministry of Environment and Forests. It serves as a focal point for the planning, promotion and coordination of various environmental and forestry programmes. The task is sought to be fulfilled through action on diverse fronts such as survey and conservation of natural resources, impact assessment of development projects, incorporation of environmental protection in the planning process, control of pollution, regeneration programmes, legislation, research, extension education, training, dissemination of information and creation of environmental awareness.

ENVIRONMENT includes air, water and land and the inter-relationship which exists among them. Any disturbance to any of these factors has inevitable repercussions on others. Our developmental efforts of the past few decades have undoubtedly, though unwittingly, transformed the environment. It does not, however, mean that all developmental activities must be halted or that we should go back to a simplistic life style. The provision of minimum needs of food, shelter, education and health to our vast masses demands that the basic industries and infrastructures such as agriculture, power, transport, communications, steel, fertilisers, pesticides, cement, etc., be established. One sees no option but to adopt the modern concepts of development, of course, after ensuring that these developmental patterns do not damage ecological balance as damage would not only hamper further development but also result in greater poverty for the poor who depend on the environment for food, fuel, fodder and shelter.

Sustainable development

For the sustenance of a socio-political system aimed at people's welfare, protection of environment is as important as economic development. The two concepts are totally interdependent and form the essence of the concept of 'sustainable development'. Our country's ingenuity and creativity should, therefore, be directed towards identifying a developmental path which is in harmony with environmental considerations.

The responsibility to harmonise environmental protection with development objectives rests with the Ministry of Environment and Forests. It serves as a focal point for the planning, promotion and coordination of varoius environmental and forestry programmes. The task is sought to be fulfilled through action on diverse fronts such as survey and conservation of natural resources, impact assessment of development projects, incorporation of environmental protection in the planning process, control of pollution, regeneration programmes, legislation, research, extension education, training, dissemination of information and creation of environmental awareness. The State Governments, Central and State Pollution Control Boards, the Indian Council of Forestry Research & Education, the Wild life Institute of India, the Botanical and Zoological Surveys of India and a host of other agencies are partners in the activities related to environment protection. A number of initiatives have been taken in the past few years to put environmental protection on firm ground.

Forest conservation and afforestation

Forests play an important role in maintaining environmental stability and in supplying the essential requirements of the people on a renewable basis. Over the years the forests have suffered depletion due to relentless pressures arising from the increasing demand for fuelwood, fodder and timber; inadequacy of protection measures; diversion of forest lands to non-forest uses. and the tendency to look upon forests as a revenue earning resource. Realisation regarding importance of the forests has always been with us, but the first practical step came in the shape of the *Forest Conservation Act*, 1980 which prohibited diversion of forest lands for non-forest purposes, except with the previous permission of the Central Government. Undor this Act, such permissions are generally refused. Where unavoidable for development purposes, permission is given only under condition of compensatory reforestation. This Act has been amended in 1988 to make the provisions more stringent and to enforce penalties even against officers who facilitate violation of this law. As a result of strict enforcement, the rate of diversion of forest land has been brought down to about 16.000 hectares per annum compared to the rate of 1.5 lakh hectares per annum prior to this Act.

Other efforts to conserve forests include promotion of improved energy efficient stoves and alternative energy sources. Modern forest fire control methods have already been adopted by some States to control forest fires.

In 1985 the National Wastelands Development Board was set up to promote afforestation. The objective was to bring five million hectares of wasteland every year under fuelwood and fodder plantations with the participation of the people. The Board has succeeded in afforesting 7.16 million hectares till the end of March 1989 through its programmes on social and agro forestry. While this achievement is substantial, the target of five million hectares per year is yet to be attained. In order to achieve the same, a comprehensive technology mission will be launched shortly. This technology mission will marshal the scientific and technological inputs available in our country to reclaim saline and alkaline lands and other kinds of wastelands to afforest the upper catchment areas of our important rivers and to meet the fuelwood and fodder requirements of the people.

Wildlife conservation

The Wildlife (Protection) Act, 1972, has been amended to prohibit trade in endangered species and derivatives thereof. The National Wildlife Action Plan has been implemented for a rational and modern wildlife management. A comprehensive report. "Planning & Wildlife Protected Area Network in India" has been prepared and released. The scheme "Project Tiger" has been expanded for the maintenance of a viable population of the tigers in India, with 17 Tiger Reserves in 13 States of the country covering an area of 26,643 sq. kms. 67 national parks and 394 sanctuaries have so far been set up all over the country representing 4 per cent of the total geographic area.

Conservation of flora & fauna

A programme for the conservation of flora & fauna and special ecosystems has also been taken up. Seven Biosphere Reserves have so far been set up for preserving genetic diversity. Action plans for preservation of Wetlands and Mangroves have been taken up. A Directory on Wetlands of India has been published. Special attention is being given for the protection of the environment in the development of Andaman & Nicobar and Lakshadweep Islands under the directions of the Island Development Authority, presided over by the Prime Minister.

Revised national forest policy

The National Forest Policy adopted in 1952 aimed at forest coverage of one-third of the total land area of the country. But this could not be attained for various reasons and the process of deforestation continued. This has necessitated a re-examination of the Forest Policy. The revised National Forest Policy was finalised after extensive consultation with the States, experts and all relevant agencies. The salient features of the new Forest Policy are : maintenance of environmental stability through preservation and restoration of ecological balance; conservation of the natural heritage of the country by preserving the remaining natural forests and protecting the vast genetic resources for the benefit of posterity; meeting the basic needs of the people, especially fuelwood, fodder and small timber for the rural and the tribal people and maintaining the intrinsic relationship between forests and the tribal and other poor people living in and around forests by protecting their customery rights and concessions on the forests.

Pollution control

India faces serious problems of environmental pollution. Water pollution from untreated community and industrial wastes flowing into our rivers and streams, increasing use of fertilisers and pesticides, dumping of organic and inorganic wastes, etc., are issues that need to be tackled on priority. Air pollution, long regarded as the bane of industrialised nations looms large over our country.

The main instruments for control of pollution of water, air and noise are the *Water (Prevention and Control of Pollution) Act,* 1974, *the Air (Prevention and Control of Pollution) Act,* 1981, *the Water Cess Act,* 1977 and *the Environment (Protection) Act,* 1986. The Water and Air Acts have been amended in the recent years to make provisions more stringent. The Pollution Control Boards have also taken up systematic monitoring of air and water quality through a network of quality monitoring stations—3-6 for water and 140 for air. Out of the nearly 4000 major and medium polluting industries, more than half have already installed pollution control equipments. Standards have been notified for 26 priority industries. So far 3300 prosecutions have been launched by the Pollution Control Boards against recalcitrant industries.

Ganga action plan

More than two-thirds of the pollution in our rivers is caused by human and cattle wastes. In 1985 the Government took up a massive project to clean up Ganga, the most important river of India. A Central Ganga Authority has been set up and an Action Plan was drawn up for cleaning the polluted stretches of the river Ganga by intercepting, diverting and treating about 900 mld. of the domestic waste water generated along the river to conform to effluent standards. Schemes of low cost sanitation, river front development, construction of electric crematoria etc. have been taken up. 262 schemes have so far been sanctioned under the Ganga Action Plan at a cost of Rs. 258.44 crores covering the States of U.P., Bihar and West Bengal. 50 schemes have already been completed. Extensive awareness and public involvement activities have been taken up involving youth, students and pilgrims.

Need for proper planning

The best course of action to prevent environmental degradation is to take into account all relevant factors at the planning stage of all

development activities. All project proponents are required to incorporate in their projects comprehensive proposals for environmental management. Environmental Impact Statements (EIS)/Environmental Management Plans (EMP) are required in case of developmental projects of sizeable capacity taking into account air and water pollution, impact of flora and fauna, rehabilitation and other environmental factors. The Environment Management Plan will ensure that the environmental impact is kept to the minimum prescribed limits. Environmental Appraisal Committees have been constituted by the Government to examine projects referred to it. Representatives of the project authorities, Pollution Control Boards and other concerned agencies are also associated in the work of the Appraisal Committees.

Research and development

The programme for the promotion of research and development in the areas of environmental science and technology aims at developing strategies to harmonise environment and economic development. Centres of Excellence have been established at Bangalore (ecological research), Dhanbad (mining environment) and at Bombay (ornithology). The Indian Council of Forestry Research and Education is the apex body to guide the research effort of five specialised institutions in forestry research establishment. The Wildlife Institute of India carries on research into various aspects of ecology and management problems of wildlife.

Education and training

Apart from undertaking various R&D activities, training and education of all concerned have been made a must for the protection of environment. The Indira Gandhi National Forest Academy, the State Forest Service Colleges and the Forest Rangers Colleges train the forest personnel in various aspects of forest management. The recently established Indian Institute of Forest Management at Bhopal trains senior forest officers in forest management. The Wildlife Institute of India runs inservice courses for the wildlife managers and also runs a postgraduate course in forest management. The Ministry and the Pollution Control Boards organised a number of courses and workshops to train pollution control personnel. Efforts are being made to open institutes in States to train pollution control personnel.

The National Council of Educational Research and Training has evolved and incoporated in the primary and high school syllabi lessons on environment. The Centre for Environment Education, Ahmedabad has prepared a number of teaching materials to help the teachers convey environmental ideas to the school children. A number of universities have started fulfledged postgraduate courses in environmental sciences.

Awareness campaigns

The Government has also been promoting environmental education, dissemination of information and creation of awareness among all sections of our population through a variety of training programmes, seminars, exhibitions, eco clubs, eco development camps etc. A nationwide 'National Environment Awareness Campaign' has been launched on a continuing basis to create environmental awareness at all levels of the society with the assistance of more than 200 voluntary organisations every year. Centres for Environment Education have been set up at Ahmedabad and Madras. The National Museum of Natural History established at New Delhi promotes environmental awareness through exhibitions, nature study tours, lectures etc. Another museum will be established shortly at Mysore.

Annual awards

Three annual awards—the Indira Gandhi Paryavaran Puraskar, Indira Priyadarshini Vrikshamitra Awards and Pitambar Pant National Environmental Fellowship Award—have been instituted to promote the participation of non-governmental organisations and scientists in the task of environmental protection.

The efforts have already shown visible results. Regeneration of threatened eco-systems and species, increasing afforestation, development of new national parks, sanctuaries, biosphere reserves and above all, a steadily growing popular awareness among our politicians, teachers, students, journalists, urban and rural women and the general public of environmental concerns are some of the achievements. We have to relentlessly intensify these efforts to achieve sustainable development which will enhance both current and future potential to meet human needs and aspirations.—P.I.B. ○

GLOBAL ENVIRONMENTAL PROBLEMS
—An Overview

Global warming and the depletion of the ozone layer could prove to be calamities of the worst kind ever to have visited the Earth in the course of recorded history. If the overall temperature rises, the polar ice caps will start to melt and in turn the level of the world ocean will rise. Countries lying close to sea level will be—literally—in deep trouble. Defences against ocean tides will wipe out decades of economic "development". The global agricultural pattern will be disturbed, threatening the already badly strained food supply system. Some areas further North, for example Siberia, will have rural agro-industry, but the Sahara Desert will march North ! Tropical diseases areas might as well be shifting their geographical position.

THROUGHOUT the history of our civilization doomsayers have never been in short supply. Our age has even found it trendy to be pessimistic. But it is no exaggeration to say that one of the few unifying factors in today's world, cutting across social and political systems, religions, continents and nations, is a growing concern for environmental health and protection of the Earth.

It was only in the second half of this century that it dawned on us that Development with a capital D has two faces: nations and individuals may become richer, but factories and cars spell environmental danger. The world-wide "green" movement is evolving very rapidly from a fringe faction into a major force on the international scene. There is a very good reason for this. Not only the quality of life but, in the long-run, the very survival of the species depends on safeguarding our planet. Global environmental problems seem to be taking over from nuclear war fears as the world's biggest headache.

Population growth

The human population reached its first 1,000 million early in the nineteenth century and has never looked back. Today, we number 5,000 million plus, and it is predicted that by the Year 2000 we will have chalked up another 1,000 million. Behind these dry statistics are individual lives, filed in official reports under such euphemisms as "living in deprived conditions". The World Bank defines 800 million people as "the absolute poor"-the equivalent of the total populations of the USSR, the United States and the whole of Western Europe. We can only guess how many millions today all over the globe endure a precarious existence in shanty towns inner city slums, refugee camps and squatter settlements. Their "planet" is a long, long way from being a healthy one. The lack of safe water and sanitation encourages a host of diseases—typhoid, cholera, hepatitis, poliomyelitis, dysentery, amoebiasis.

The fuels burned in the hearth by about half of the world's population as the major source of domestic energy result in between 400 and 500 million people suffering from severe indoor air pollution. Scarce food, overcrowding, perpetual stress, alienation—all this creates fertile conditions for severe mental health problems; suicide is no stranger in the slums.

City slums

The urban poor are caught between the "devil" of industrialization and the "deep blue sea" of underdevelopment; and added to their already crippling burden of infectious disease and malnutrition is a new set of non-communicable diseases commonly associated with hasty industrialization and the indiscriminate use of chemicals.

For the overwhelming majority of them proper housing, piped water,

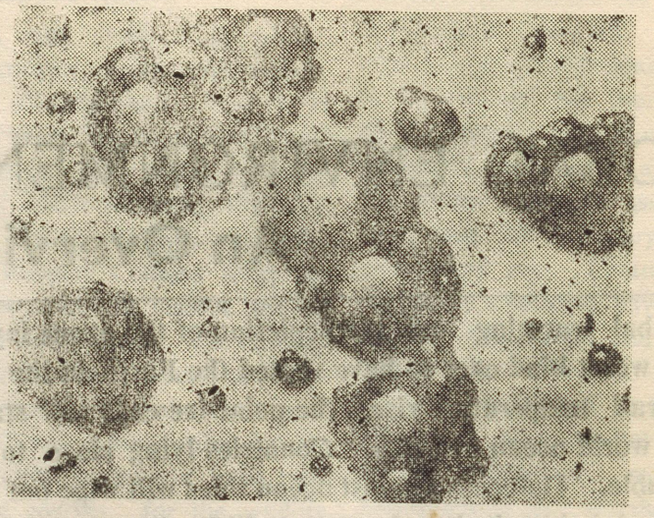
facilities for the removal of household and human wastes, all-weather access roads, as well as health care and education services have a distinctly utopian ring to them. Trapped in the obscure dead-end of the city slums, generation upon generation are stoicly eking out a kind of living.

Malnutrition, that eternal sign of poverty, is one of the most persistent of the health problems of the urban poor. According to WHO, "the energy and protein intakes of some 145 million children under five years old are insufficient." Not merely the shortage of food is to blame but much more complex problems including "inadequate preparation and storage of food, lack of knowledge about nutritional needs in infancy and in childhood and the effects of repeated infectious diseases." In addition, the breakdown of the traditional extended family in urban settlements directly affects the quality and quantity of child care. According to the U.N. data, in Latin America and the Caribbean alone there are 40 million children living on the streets.

Water-borne diseases

Water is essential to life. It is also a major medium for disease transmission including typhoid and cholera. People from the industrialized North for whom diarrhoea is just an unpleasant holiday experience find it hard to grasp that in the Third World five million children die every year from diarrhoeal diseases. The major villain of this global tragedy is unsafe water.

The sheer scale of water-borne diseases is truly staggering. Poliomyelitis, guinea-worm infection, malaria, yellow fever, dengue, river blindness, schistosomiasis—these are just a handful of the more commonly known ones. The bad news is that, throughout the tropics, matters are getting worse, not better. Malaria and other vector-borne diseases previously confined to the countryside have followed the rural-to-urban migrants and found ideal breeding grounds in the city slums. Emergence of urban malaria is yet another vivid example of the fact that developing countries populations are much more exposed, not only to the elements, but even more so to a whole host of maladies which can be called diseases of poverty.



Untreated community and industrial wastes flowing into our rivers and streams have resulted in water pollution.

The ultimate irony is that, not uncommonly, slum residents have to pay heavily for dubious water brought by street vendors while nearby wealthier neighbours are sprinkling their lawns at a rate of 200 gallons per hour.

Chemical transformation

In the countryside itself all is not well. Overintensive agricultural production has dumped potentially dangerous levels of nitrates and other chemicals into the soil and thence into the water. High-yield harvests can only be sustained by covering plants and soil with ever greater amounts of fertilizers and pesticides. Meanwhile, weeds and insects are developing resistance to these chemicals, thus defeating the multi-million dollar efforts that go into research and production of commercial pesticides.

The agricultural sector in developing countries is geared predominantly to local needs. There are some notable exceptions, however, in the form of traditional export crops such as coffee or cotton. These gobble up the lion's share of the pesticides which reach the developing countries—merely one-fifth of global production.

Farmers in Africa use on average 100 times less pesticide per hectare than farmers in Japan. Even so, unintentional poisoning occurs frequently when people handle pesticides without proper precautions or knowledge about the hazards involved. Recently WHO said that "... our estimates show that the vast majority of acute poisonings occur in an 'endemic' manner in many developing countries, with little

attention being paid by the local public health researchers". But in the industrialized North too, harmful residues regularly spill over into foodstuffs and water sources.

Unfortunately, chemical transformations, whether through combustion or from the deliberate release of substances such as agro chemicals, almost invariably cause environmental pollution. Few such pollutants are measured on a regular basis in too few places around the world. Developing countries rarely have adequate facilities to do this, since it often requires sophisticated equipment as well as trained personnel. Serious financial considerations have even forced some countries to sell off land sites on their territories for the dumping of other countries' toxic wastes.

One major source of urban air pollution in the industrialized North is the automobile, now an indelible part of modern culture. Awakening of the environmental consciousness has forced first scientists and then the public at large to take a more critical look at the motorcar. It has been found guilty on all counts. Lead, carbon-monoxide, nitrogen oxides—all these share the blame for blackening the outsides of city buildings and the insides of city dwellers.

Environmental awareness

The direct link between quality of environment and quality of public health is now imprinted on the public's mind more vividly than ever before. Slowly but surely, a chain reaction of environmental awareness has started. Today many newspapers routinely provide their readers with the local air pollution update, specifying "dirtier" districts. Attempts are being made to reduce the harmful pollutants emitted by cars; running them on lead-free petrol, or fitting them with catalyzers to reduce the output of carbon monoxide are two of the possibilities. But even within the European Economic Community it is difficult to get unanimity about what anti-pollution measures will work best.

What about countries with a lesser standard of living? Do they stand any chance of avoiding the pitfalls along the road to development? Well, up to a point. The multi-coloured quilt of the Third World does not lend itself to one single monochrome solution; what is the norm in Rio de Janeiro may not necessarily be perceived as such in Rangoon. Even within countries themselves there are tremendous regional differences. Obviously an industrial area packed with smelters, power stations or steel plants will emit into the atmosphere far more harmful chemicals than a rural one making do with subsistence farming. Local topography and meteorological conditions, even sunlight itself, have roles to play in the intricate interplay of airborne pollutants which results in "photochemical smog", wrapping cities in a blanket of choking haze.

Role of W.H.O.

WHO, together with the UN Environmental Programme (UNEP), keeps a permanent check on air pollution levels through its 170 monitoring sites scattered around the globe. Energy production and consumption are routinely blamed for air pollution. And rightly so. But to suppose that such environmentally clean alternative sources of energy as solar power and wind power will soon overtake the burning of fossil fuels (coal and oil) would be merely wishful thinking. The nuclear power industry is making a come-back in some countries, but its image has been badly dented by accidents and levels of radioactive materials.

The latest WHO data show that 625 million people live in urban areas whose average levels of sulphur dioxide in the air are unacceptably high. In fact, sulphur dioxide emissions worldwide are notching up four per cent per year, which is in line with the increase in world energy consumption. For city dwellers, this means severe effects on the respiratory tract, while extremely high concentrations can be lethal. Meanwhile acid rain results in the defoliation and death of trees, the pollution of lakes which kills off the creatures that live in them, and the infiltration of chemicals into the soil and ground water sources. Acid rain knows no intercountry boundaries, and can be carried by the prevailing winds for hundreds, if not thousands, of miles from the point of origin. The world has come a long way from the pristine air of the Garden of Eden to the Convention on Long-Range Trans-boundary Air Pollution. A brownish layer of Sahara Desert dust which from time to time blankets a large part of Western Europe serves as a vivid example of the long-range action of airborne particles. According to WHO, 1,250 million people unwittingly suffer from too high levels of this pollutant compound, usually much more complex in composition than "pure Sahara dust", it is mostly made up of the by-products of fossil fuel combustion and other industrial activities.

The global air pollution trends clearly show the determination of the industrialized North to reverse the negative course. The last decade saw the decline in sulphur dioxide levels at an annual rate of approximately 5 per cent while, for instance, the Asian developing countries economic build-up is being accompanied by an annual 10 per cent increase. So behind the benign Dr Jekyll of industrialization lurks the sinister Mr Hyde of pollution.

Another character with a dubious reputation is carbon dioxide (CO_2), released in the process of fossil fuel combustion. Plants and oceans have a sponge-like capacity for absorbing CO_2. But in the course of the 20th century the natural equilibrium was disrupted by a gargantuan boost in energy consumption which increased 12-fold between 1900 and 1986. The world's soaring population felled more and more trees, and destroyed more and more forests, for industrial and agricultural activities as well as household needs. There were simply not enough trees to help in digesting the "excess amounts" of carbon dioxide.

The global greenhouse effect started to take shape. A powerful boost to the process was provided by science and technology. Chlorofluorocarbons (CFCs in scientific shorthand) is a long word worth remembering. These are multipurpose chemicals which have made themselves useful as coolants in refrigerators and as propellant gases for aerosol cans. They are widely used in electronics and in plastic-foam materials—for instance in "fast food" containers. Whenever a burger holder is broken, CFCs are set free. At this point they are becoming a menace to the environment for the next 70 to 100 years. Not only do they contribute to the greenhouse effect, they also eat away the vital ozone layer in the upper atmosphere, which protects all inhabitants of the Earth from the dangers of ultraviolet radiation. These rays are powerful enough to damage living cells; apart from causing sunburn, they are thought to be largely responsible for the steady increase in the incidence of skin cancers throughout the world.

Calamaties of the worst kind

Global warming and the depletion of the ozone layer could prove to be calamities of the worst kind ever to have visited the Earth in the course of recorded history. If the overall temperature rises, the polar ice caps will start to melt and in turn the level of the world ocean will rise. Countries lying close to sea level will be—literally—in deep trouble. Defences against ocean tides will wipe out decades of economic "development". The global agricultural pattern will be disturbed, threatening the already badly strained food supply system. Some areas further North, for example Siberia, will have rural agro-industry, but the Sahara Desert will march North! Tropical diseases areas might as well be shifting their geographical position.

It is an Apocalyptical vision—but one that is of mankind's own making, unlike whatever cataclysm it was that caused the dinosaurs to vanish. The bad news is that, in one form or another, global climate change is coming. The good news is that we know about it and can and must benefit from that knowledge. Every little effort helps! This is what WHO means with its slogan for World Health Day 1990:

OUR PLANET—OUR HEALTH
Think globally—Act locally

As we move into the last decade of the century, environmental issues are taking on a new importance on the world's agenda. Back in the 17th century the English poet, John Donne, wrote: "No man is an island entire of itself". Today, we can add "No country is an island entire of itself". We are all under a cloud, and it is a cloud of our own making.—W.H.O.

Message from Dr Hiroshi Nakajima, Director-General, World Health Organization On World Health Day, 7 April 1990

It is now increasingly evident that more and more diseases stem from the degradation caused by man to his own environment. The potential harmful effects of industrial development on our global ecosystem are now better known. Ozone layer depletion, acid rain, climate change, chemical pollution are some examples of the man-made wounds to our planet.

We are at a turning point: warnings of the damage to our health and quality of life are growing louder. An increasing number of people are acting to stop the degradation of our environment.

As Director-General of the World Health Organization, I have chosen the theme of Environment and Health for World Health Day, 7 April 1990.

WHO intends to spotlight the measures that individuals, communities and nations can and must undertake to halt further deterioration of the health of our planet. Our own health and that of future generations depends on it.

I make a solemn appeal for solidarity among industrialized and developing countries. We must find viable options for sustainable development and to protect health everywhere on our planet.

Decisions taken by one country can have repercussions not only for its neighbours, but for all countries of the world.

On the occasion of World Health Day I invite the Member States of WHO, governmental and nongovernmental organizations and all concerned with the well-being of the world to embark on an awareness campaign. We must alert everyone to the dangers of an unhealthy environment and to measures they must take to avert them. The slogan we have chosen

Our planet—Our health
Think globally—Act locally

Influence of Population Growth on Environment

DR A. P. MITRA

Increase in population has varying impact on different countries. For developed countries with large deposits of unexploited natural resources, a growth in population could mean a further increase in productive manpower. But the same is not true for developing countries where pressure on depleting natural resources is already high. Moreover, the continued rising rate of human activities on the ground and in the atmosphere is posing unprecedented perils which would ultimately lead to a disturbing imbalance in the chemical contents responsible for sustaining life on the earth. Dr. Mitra, a reputed scientist, has pointed towards the emerging scenario of the changes in climate which has now become ominous. He holds that science and technology could be used as helpful tools to provide relief to the growing numbers in our country. It is heartening to note that several projects are already under way which monitor floods, classify crops, measure sea temperature and map the wastelands.

IN considering the consequences of population growth on economic development of any country or the world as a whole it might be worthwhile to concentrate specifically on two scenarios: the scenario of today and that of 2050 A.D. I am specifically choosing 2050 because of the importance of a new parameter that must now be added to many others on the habitability of the earth. This new parameter is the global warming due to a number of greenhouse molecules including carbon dioxide, methane, nitrous oxide, chlorofluorocarbons and water vapour, much of which are increasing at a very rapid rate and the matter of ozone depletion by CFCs of which the most dramatic evidence is the antarctic ozone hole. In addition, there are also effects of human activities in heights above the stratopause in the upper atmosphere and the ionosphere resulting from a wide variety of human activities including spacecraft effluents, high power high frequency radio heating and effects of powerline anomalies. We have now learnt to accept the atmospheric environment in its entirety from the ground to many thousands of kilometres and have recognized the fact that the different levels are coupled with each other through flow of matter and energy. Since all of these levels are in some form or other affected by human activities, the requirements of increased population growth and their effects on these levels of the environment and the S&T strategies we adopt in such circumstances become critical.

Pressure on sinking resources

Different countries view population growth differently. For developed countries with large unexploited or semi-exploited natural resources such as Australia, the USSR and to some extent the USA, increase in population is really an increase in productive manpower and is consequently encouraged. For developing countries with limited exploitable resources, per capita availability of land, minerals, agricultural products, energy and housing continue to sink. For India, we have already come from the per capita land availability of 0.60 in 1971 to 0.41 hectare in 1988 and this is expected to reduce to 0.33 in 2001. Large scale deforestation now occurring at the rate of 0.15 million hectares per year would make India virtually forestless in 2050. India's own contribution to the greenhouse effect, around 4% of the global injection, could rise to something of the order of 20%. In the approach paper of the Scientific Advisory Committee to the Prime Minister for the 8th Plan Programmes, it has

been suggested that we should limit the country's population to no more than 970 million by 2001 A.D. (Even this increase would add substantially to the rate of deforestation and to the quantum of anthropogenic and biogenic injections into the atmosphere, apart from the additional demands on conventional resources.

Some key resources and parameters of global environmental interest are given in the following tables below:

Table-1

	World		India	
	1988	2050	1988	2050
Population (millions) . . .	5060	14000 (estimated)	806	2400 (estimated)
Land Area (mha) . . .	13580	13580	328.7	328.7
Per Capita Land (ha) . . .	2.68	0.94	0.41	0.14
Forest Depletion per year (mha/yr)	10	28	0.15	0.45
Total Carbon (Mt/yr) . . .	5000	?	63 (1.26% of world)	

In our view the objectives of science and technology for development are threefold.

— Social Welfare (food and water, shelter, health and literacy)
— Self-reliance (technological, economic and strategic)
— High Science and Technology (frontier level areas)

To translate research into economic growth and social welfare, one would need to have:

Strategy for resource allocation
Manpower development
Extension and transfer facilities
Strategy for managing technological changes

A key element for resource allocation is mapping and mobilization of all resources, i.e., natural, human and institutional, as in the scheme given in Table-2.

Table-2

Resource Mapping & Mobilization

Resources

Natural	*Human*	*Institutional*
Land, Water, Air	S & T Knowledge	Money
Plant & Creatures	R & D Creativity	Information
Energy	Production Skills	Infrastructure
Industrial Raw Materials	Management Capabilities	
Environment		
Coastal Zone Management		

Drinking water mission

Several Social welfare oriented tchnological missions are now in progress. In all of them, certain inputs of science have already been applied and long-term scientific research is also planned or has already been taken up. These provide testing grounds to evaluate the effectiveness of application of scientific research in social welfare programmes. I will examine only one of these at this point the drinking water mission.

Currently the number of villages without safe drinking water is 1,62,000 and the population affected is 200 million. Even if we accept the mission objective of providing 40 litres per day per capita safe water for these 200 million people it means additional provision of 8000 million litres of drinking water per day through cost effective technologies. In this context, two special parameters need to be kept in view: the first concerns the decrease in the per capita availability of utilizable water as population increases and the second the uncertain scenario of precipitation with global warming over the Indian subcontinent in the mid 21st century. For immediate application several S & T inputs have been provided: finding water, testing of water, upgradation of the water quality, use of sea water and development of instrumentation of various kinds. For the programme to be really effective, there should be serious attempt to reduce cost per unit of the instruments used for source finding or for water treatment. Consider for example the question of desalination. We have had quite a few years of activities by several agencies (CSIR, DAE, DRDO) and the involvement of public sector organization like BHEL. Desalination plants at demonstration level are currently available in a number of locations and as a part of the drinking water mission over 100 such plants are under construction. But costs are still high and the membrane efficiency needs to be improved. There has already been some progress in this area with the use of improved cellulose acetate but the total package improvement needs to be taken up on a mission mode.

There are other dimensions to the problem of water availability. The most important thrust should be on a long-term estimate on the changing pattern of rainfall in the context of global warming. Estimated warming is between 3 to 5°C as a global average Model predictions show an increase in overall precipitation between 7 and 11%. The largest changes will occur between

30°N and 30°S. Over the Indian subcontinent, more rain is predicted. There are two sets of empirical data giving indications of precipitation under such conditions: a very gross picture of the period 4000-8000 years ago when the world as a whole was warmer by about 3°C and an analysis of data for the last few years, choosing 1937, 1938, 1943, 1944 and 1953 as the five warmest years and 1964, 1965, 1966, 1968 and 1972 as the five coldest years; the difference was 0.6°C. For India there are important predictions in both these analyses. The first showed that much of India, especially the southern part, had large precipitation. The second showed that while there was decreased precipitation over the USA, most of Europe and Russia, there was increase in precipitation over India and the Middle East. The increase in India varied from a few per cent along with the eastern coast (also in Bangladesh) to almost 100 in north west. However, there was decrease in southern India and in the north around Delhi.

Impending danger of imbalance

Until the 60's carbon dioxide was the primary and dominant greenhouse molecule. There has been a major change since then. Other greenhouse molecules have come into the picture: Methane, nitrous oxide, ozone and chlorofluorocarbons. These are also found to be increasing relatively rapidly in the recent years. The consequences are that these non CO_2 molecules add to the greenhouse warming by a quantity almost equal to that of carbon dioxide alone. There is, therefore, need for stepping up our efforts in the direction of containing effects due to these changes.

The urgency comes from the recognition that Earth and its atmosphere, its climate and the various components of the Earth System that sustain life have been changing since the beginning of the industrial age, because of human activities, but the changes have now become ominous. Examples are the warming of the global climate, sea level rises, the Antarctic ozone hole, desertification, flood and soil depletion from indiscriminate and unplanned human activities. We have also recognized that there are limits to the habitability of the Earth, and its ability to support life.

To Indian scientists the programme in this area is important in many ways. The global climatic changes affect all countries, including India (although different regions are differently affected) and since our dependence on the monsoon system is more critical, one must understand the interaction of a gradually warming atmosphere with the factors controlling monsoon dynamics. Secondly, we have seen large depletions of ozone in the Antarctic and the beginning of a hole in the Arctic. If depletions spread elsewhere and the already thin ozone layer over the Indian subcontinent becomes thinner, a good part of India will be subjected to heavy doses of UV-B radiation. There are two effects of such large dosages: skin cancer and effects on plant species. The latter may have serious consequences on the agricultural systems. Thirdly, India is a major contributor to the global problem: through biomass burning, slash-and-burn agricultural systems, existence of large paddy fields and cattle population. In 1982, biomass burning in India injected 190 million metric tons of C or 13% of all developing countries.

Another important aspect is the changing climate. Evidences are mounting to show that concentrations of several greenhouse molecules are increasing: 1% per year for methane, 0.25% for N_2O, 4% for CFMs, 0.5% for CO_2. Over the decade 1975-85, CO_2 has increased by 4.6%, CH_4 by 4.6%, CH_4 by 11%, N_2O by 3.5%, F 11 by 103% F 12 by 101%. The dispute is no longer whether concentrations of these climatically important minor species are increasing, but on how much and on what effects can consciously introduced constraints bring about.

Hazard of coastal erosion

A disturbing consequence of the warming is global sea level rise. A global warming of 1.5 to 5.5°C is modelled to cause a sea level rise between 20 and 165 cm with profound influences on habitation pattern. Such changes are already underway: sea levels are rising by 10 cms a century. A preliminary work by our scientists shows that for India a rise of this size would make the Lakshadweep Archipelago most vulnerable; the east coast of India with its lower coastal slopes and higher cyclone frequencies will have increased storm surge damage; the belt between 12°N and 18°N on the West coast will be least vulnerable but the region south of the belt will have increased storm surge damage; the belt between 12°N and 18°N on the West coast will be least vulnerable but the region south of the belt will have increased coastal erosion.

There are implications on the entire agricultural system: not only due to changes in temperature and precipitation, but through high CO_2 concentrations is likely to increase the growth and yield of C_3 plants by 10-50% (and of the world's 20 major crops, 16 are C_3 plants).

India is well equipped for such a programme. Remote sensing technology is in an advanced stage. A network of 3 rocket ranges and the balloon facility are advantages. Systems using unmanned data collection platforms and a central processing station through satellites have been introduced. The technology for collecting, processing, archiving, accessing and exchanging data is

(Contd. on Page 70)

THE URBAN EXPLOSION AND GLIMMERS OF HOPE

The health and well-being of literally hundreds of million of men, and especially women and children, are threatened by an urban population explosion in the developing countries of Asia, Africa and Latin America.

By the year 2000, there will be 60 cities with populations of five million or more, and 45 of them will be in these developing continents.

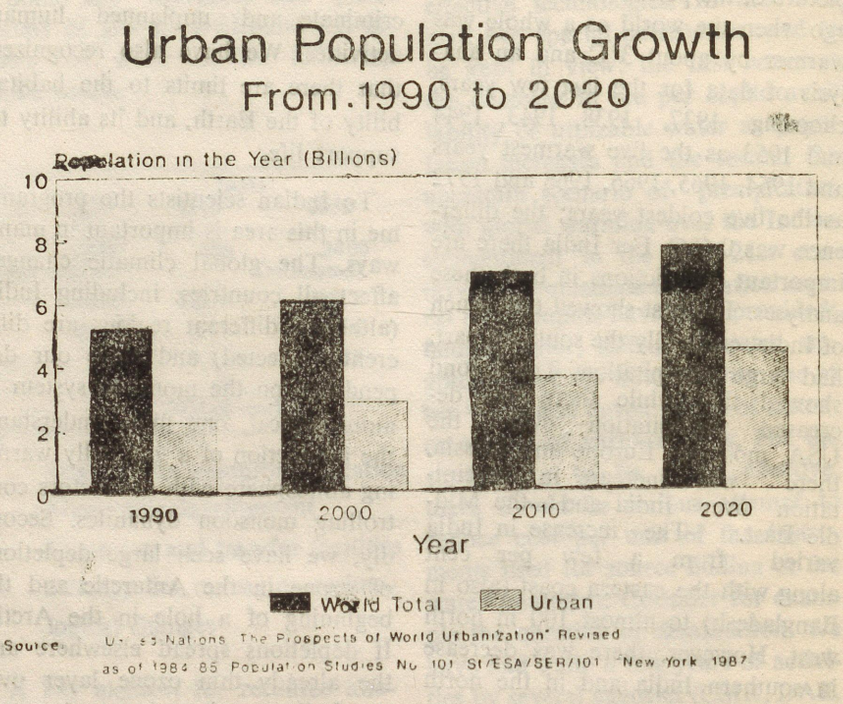
But that dry statistic conceals a tragic situation.

One hundred million human beings are homeless, and another 100 million are street children. In many Asian, African and Latin American cities, up to 50% of the population live in slums or shanty towns. A quarter of them have no access to safe water and 40% lack safe sanitation, while 30% of their solid waste goes uncollected. In half of these cities, air pollution exceeds internationally-accepted levels and causes serious and sometimes fatal respiratory diseases.

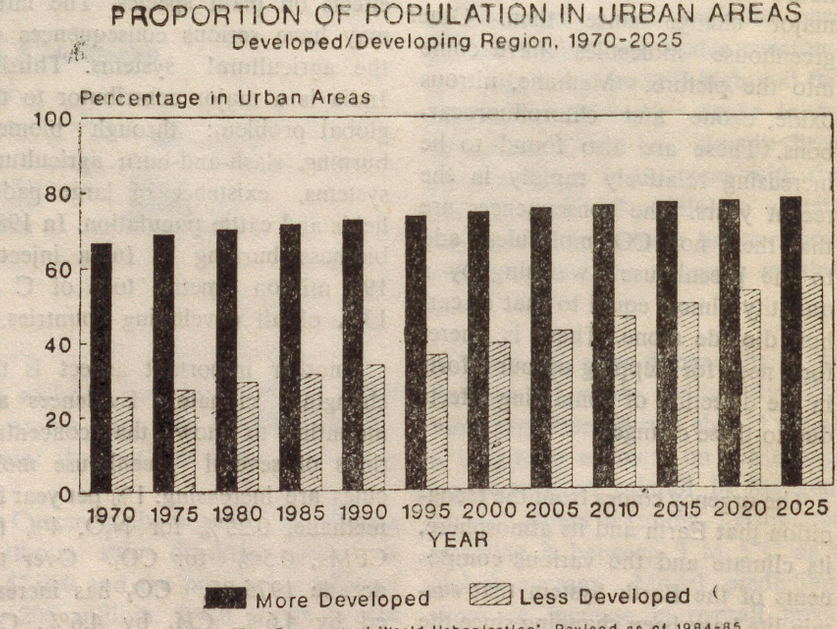
"Unfortunately, urban basic health services are often under-planned, under-funded, under-managed and do not reach out to the neighbourhoods and households of the urban poor," says Dr Iraj Tabibzadeh, who is responsible for WHO's urban health programme and national health systems and policies.

"A proper approach to improving health should reflect the community's own preferences, its commitment, its capacities and its involvement. This requires a political process which will allow community participation in all planning and strategy-building and which makes policy-makers accountable to the community. It would also require a shift away from the goal of unconditional economic growth towards that of improving the health and welfare of all citizens, especially the poorest."

What is needed to improve health in crowded cities?



Source: United Nations. The Prospects of World Urbanization" Revised as of 1984-85 Population Studies No. 101 ST/ESA/SER/101 New York 1987



Source: United Nations. "The Prospect of World Urbanization" Revised as of 1984-85 Population Studies No. 101. ST/ESA/SER/101. New York. 1987

Continues the WHO urban specialist; "Safe water, reasonable housing and sanitation, and adequate family income are essential. So are basis nutrition, particularly for mothers and children, the universal availability of simple oral rehydration, and an immunization programme with a very high level of coverage.

"We must never forget that women and children are the least protected of the poor and destitute in cities. Immunization coverage in urban poor areas is lower than in rural areas, and infectious diseases spread much faster in slums and shanty towns. The infantile mortality rate is pathetically high in many developing world cities. So is the death rate for mothers during childbirth. Children who are born in slums or squatter settlements are 40 times more likely to die than other children before the age of five.

"An active role for women is just as important as community participation for efforts to improve urban health. Given the status of women in many developing countries, this is not always a simple matter."

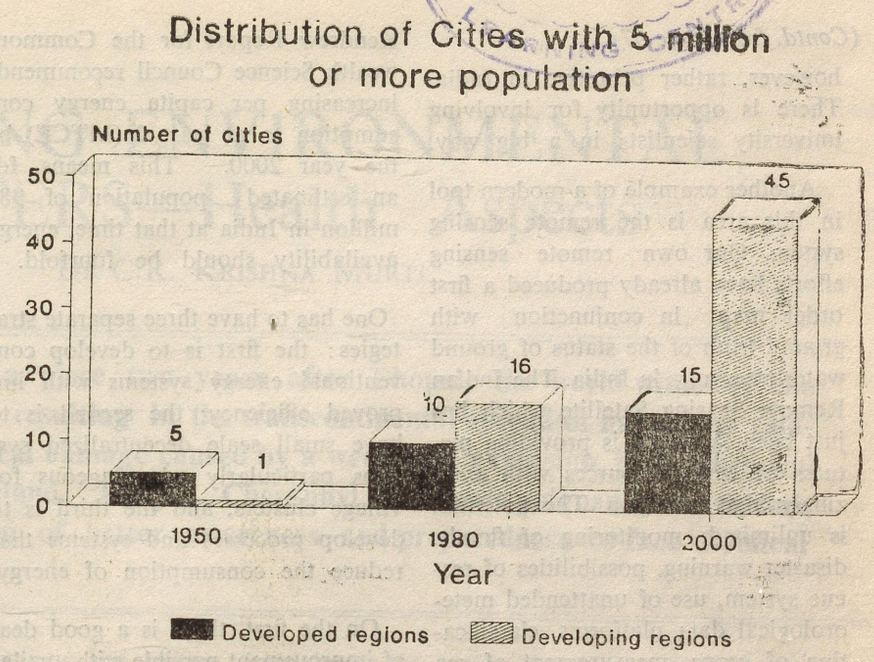
All these elements add up to a sensible, effective urban health improvement programme. They are encompassed in Primary Health Care (PHC) which WHO and UNICEF have so energetically advocated.

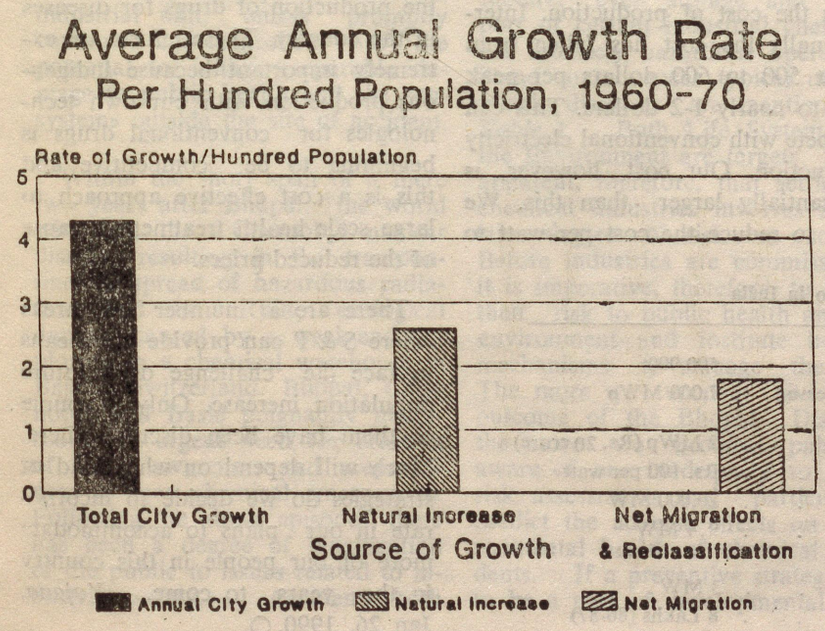
"Because PHC is based inside the community", remarks Dr Tabibzadeh, "it is an appropriate entry point for an effective strategy that aims at improving the basic health needs of the urban poor."

He pointed to one widely-held misconception about the rapid growth of urban populations: "It is not the rural exodus, the rush from the farm to the city that explains it. In many cities of developing countries that have already reached a high level of urbanization, migration accounts for less than 40% of urban growth. The rest is due to births in the city."

A look at population growth predictions gives an idea of what this will mean on a global scale. Between 1990 and 2010, the world's population will rise by 50% from 5.2 billion to 7.8 billion. The urban population will more than double from 2.2 billion in 1990 to 4.5 billion in 2010. Of the 20-year increase of 2.6 billion, 2.3 billion or 88% will be urban. Put another way, this means that urban dwellers who are about 43% of the world's population today will constitute 57% in 2020.

"In Latin America, Asia and parts of Africa, tens of millions of people are living in appalling urban squalor with little hope of education and medical attention. How do you provide health care against such odds, especially for the poorest and the most disadvantaged?" Dr Tabibzadeh asks.—W.H.O.





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however, rather primitive in India. There is opportunity for involving university scientists in a big way.

Another example of a modern tool in this area is the remote sensing system. Our own remote sensing efforts have already produced a first order map in conjunction with ground truth of the status of ground water reservoirs in India. The Indian Remote Sensing Satellite which has just been launched is providing pictures of earth resources with amazingly high precision. The potential is unlimited: monitoring of floods, disaster warning, possibilities of rescue system, use of unattended meteorological data platforms, classification of crops, measurement of sea temperature; changes in land use, and finding snow cover. Over 100 disaster warning systems have been installed in specially chosen cyclone prone areas of Andhra Pradesh and Tamil Nadu. A satellite aided search and rescue programme has been deployed and wastelands have been mapped.

Consumption of energy

Energy is another area where we have to devise strategies to meet the demands of population growth. For India and other developing countries, the annual per capita consumption of energy is low, roughly of the order of 0.1 to 0.5 tonnes of coal equivalent (MTCE), in comparison to 7.0 (MTCE) for Australia and 5.6 for the U.K. The Sir John Kendrew Report for the Commonwealth Science Council recommends increasing per capita energy consumption to at least 2 (MTCE) by the year 2000. This means, for an estimated population of 986 million in India at that time, energy availability should be fourfold.

One has to have three separate strategies: the first is to develop conventional energy systems with improved efficiency; the second is to have small scale decentralized systems particularly advantageous for village clusters, and the third is to develop processes and systems that reduce the consumption of energy.

On the first, there is a good deal of improvement possible with available scientific knowledge and technologies. The second strategy is one on which we have placed major emphasis by having a separate department in the government.

A summary of present achievements in this area is given in Table 3.

Cost of production

The problems of expanding this area are several. The main one concerns the cost of production. Internationally the cost has fallen from about 500 to 600 dollars per peak watt to nearly 1-2 dollars. This can compete with conventional electricity production. Our cost, however, is substantially larger than this. We have to reduce the cost per watt to make this technology viable in this country. There is also need to upgrade considerably our SPV production capability. This would mean substantial research efforts to increase the efficiency of single crystal photovoltaic cells and also pursue vigorously the current efforts on the use of amorphous silicon and polycrystalline technology.

Solar thermal use is still very limited. The suggestion of the Kendrew Committee for a 5 MW *STEC* plant needs serious consideration. Such systems are feasible because of advances in the development of low cost materials and thermal mechanical systems. The other primary areas for future initiatives could be anaerobic microbiology wind and solar systems.

With our present population. health is a major problem, though substantial quantitative changes have been brought about, the average life expectancy has increased, infant mortality has been reduced and several communicable diseases have been controlled either fully or partially. ICMR, CSIR and several public and private sector systems are working increasingly effectively in the production of drugs for diseases in the country. These efforts are extremely important because indigenous production with our own technologies for conventional drugs is beginning to be competitive and this is a cost effective approach to large scale health treatment because of the reduced prices.

There are a number of areas where S & T can provide the means to face the challenge of a future population increase. Only a couple of them have been discussed here. Much will depend on what kind of strategies do we decide to incorporate in our plans to accommodate more of our people in this country in the years to come. —*Yojana*, Jan 26, 1990. ○

Table-3

Non-Conventional energy scenario in India

A	SPV	
	No. of villages	500,000
	SPV production needed (on 25% villages served by PV systems)	7,000 MWp
	Current Capacity	2 MWp (Rs. 20 crore)
	Price	Rs. 100 per watt
B	Wind energy Potential	20,000 MW
	Achieved (mid 1988)	9.4 MW
C	Other systems	
	Biomass conservation	3 MW
	Family based biogas plants	8 Lakhs (86-87)

MANAGING ENVIRONMENTAL DISASTERS—Health Aspects

DR C.R. KRISHNA MURTI

Within the short span of a mere two years after Bhopal, the world witnessed the Chernobyl nuclear disaster resulting in the transcontinental spread of hazardous radiations and the Rhine ecological damage caused by a week-end explosion in a chemical warehouse in Basle, Switzerland. Bhopal, Chernobyl and Basle poignantly underscore the urgent need for creation of better awareness and preparedness to face chemical emergencies.

THE World Health Organization defines disasters as situations of unforeseen, serious and immediate threat to public health and disruption of human ecology. Considering the dimensions of their impact on human health and ecology, a number of chemical accidents which have occurred in the last three decades culminating in the Bhopal tragedy of December 1984 would qualify to be brought under the above WHO definition of disasters. Furthermore, Bhopal bears ample testimony to the fact that accidents even if they take place within an industrial unit, unless promptly contained and controlled, have the potential to inflict irreparable damage to public health and the ecosystems outside the site of accident.

Within the short span of a mere two years after Bhopal, the world witnessed the Chernobyl nuclear disaster resulting in the transcontinental spread of hazardous radiations and the Rhine ecological damage caused by a week-end explosion in a chemical warehouse in Basle, Switzerland. Bhopal, Chernobyl and Basle poignantly underscore the urgent need for creation of better awareness and preparedness to face chemical emergencies. Following the above episodes, there has been a degree of sensitization of the public to issues related to industrial safety. Accidents both minor and major, have begun to receive wider notice in the media and led to the initiation of some action by Government to prevent them.

It is recognized that accidents, though avoidable, are inherent to the hazardous nature of chemical industries. Thus, many processes adopted in chemical industries have the potential to give rise to "unanticipated events" that can lead to "uncontrolled releases with devastating effects". Apart from accidental releases during their manufacture, even storage and transport of certain industrial chemicals are intensely hazardous operations. Some consequences typical of chemical disasters are mentioned in *Table* 1. Both Life Systems and the Environment are targets. It is apparent, therefore, that setting up chemical industries involves a certain degree of risk to society. Before industries are commissioned it is imperative, therefore, to assess their risk to public health and the environment and institute built-in mechanisms to manage the risk. The more we uncover the tragic outcome of the Bhopal Disaster, the more we become painfully aware of our inadequacy to make risk assessments and particularly, predict the adverse effects on environmental health of chemical accidents. If a preventive strategy has to be a part of developmental programmes, we must without any further loss of time improve our capabilities to perceive the risks and establish a comprehensive safety audit system.

Towards greater understanding of the mechanism of chemical accidents.

Our existing knowledge of chemical disasters concerns primarily with the mechanistics of failures. The fault-tree analysis procedure followed extensively by plant engineers permits a retrospective accounting of defects in design, in materials of construction of processing equipments, their operation and maintenance. Understandably, this procedure is exceedingly useful in updating the safety system and in developing guidelines for factory safety. Attempts have been made of late to introduce concepts of human behavioural psychology into the framework of Fault-Tree Analysis or Systems Failure. Inculcating a high degree of discipline based on knowledge of the hazards and consequently, constant updating of the skills of those responsible for production, storage and transport of chemicals are priority needs of the component of human resource development for industrial safety.

In order to assess the risk to health of hazardous chemicals we

TABLE-1

SITUATIONS TYPICAL OF CHEMICAL DISASTERS

Leak of corrosive material (e.g. Oleum) or toxic chemical from a reaction vessel, storage tank or carrier	→	Land, Water bodies, Life Systems
Explosion and fire ball formation mediated by explosive and inflammable gases (solvents, LPG)	→	Installations, Property, Life Systems
Release of highly toxic materials (smoke, fume)	→	Life Systems, Environmental Compartments, Ecosystems.

need, however, a different kind of approach and additional inputs from certain frontier areas of biomedical, environmental and social sciences.

Health hazards of chemical processing industry

Many essential organic chemicals needed unavoidably by the Health, Industrial, Defence and Consumer sectors are produced today by a technology deploying a variety of highly reactive and hazardous intermediates. The varied type of reactions undergone by methyl isocyanate—the villain of the piece in the Bhopal Tragedy—enables us to produce a large number of useful chemical entities. It must be remembered, however, that the very same property can also lead to a biological outcome the magnitude and nature of which are largely unassessed. Although we know a good deal of the acute effects produced by such hazardous intermediate chemicals (nearly a dozen used globally by the chemical industry), we have only a very limited understanding of their long-term health effects. Phosgene, yet another highly toxic industrial chemical, was inhumanly used in World War 1 as a war gas. The long-term effects of the gas on the soldiers who survived became evident only 30-40 years after exposure in 1914-1918.

It may come as a shock to many that essential information on antidotes for methyl isocyanate or phosgene is still not available. Even after the first few days of the Bhopal Disaster by which time the majority of deaths had taken place and several thousands were seriously ill, reliable information on the toxicity of the implicated chemicals was not forthcoming from industry. If it had been made available at that critical point of time it could have helped in the immediate clinical management of the gas victims. Even in its absence, the action initiated by the medical community which had to deal with the victims in Bhopal was indeed "heroic" although, it must be admitted, the management was one based on an *ad hoc* or arbitrary approach rather than one backed by scientifically documented information. If such information had been readily available at least some lives could have been saved and the sufferings inflicted on the survivors mitigated.

Air pollution effects of chemical disasters

Respiratory system—Most of the recent chemical disasters involved the escape of toxic materials into the ambient air as the main event. With the air getting poisoned, the *respiratory system* of the exposees becomes the primary target with eyes and skin ranking next in importance. The pollutants released in massive quantities induce adverse effects directly or after absorption and transformation within the lung. The net result is an overall toxic stress which ends up in respiratory failure and death and permanent injury to the respiratory system of many survivors. The long-term effects include functional disturbances or inadequacy of performance of vital organs and general disability. Infections of the upper respiratory tract are exacerbated. The respiratory organs also become more susceptible to infections and allergenic activation.

Eyes: Effects on the eyes are a temporary or partial loss of vision and more particularly premature cataract formation. In many such premature cataract cases, it may be necessary to resort to corneal transplantation. The most serious injury to the skin in chemical exposures is first degree burn, acne or prolonged sensitization reactions.

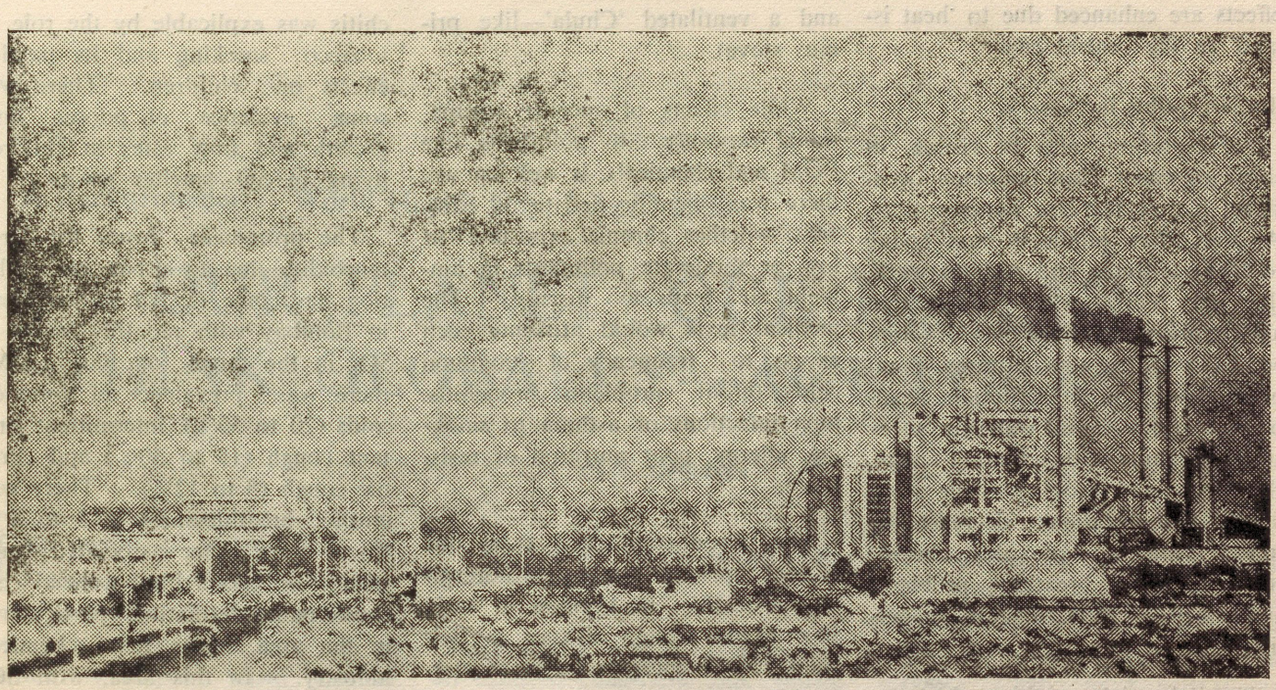
Lungs, Liver, Kidney, etc: Other systemic effects of absorption of intensively toxic chemicals through the lungs are noticeable in the blood forming processes and in functions of the liver and kidney. Abortion can be induced in pregnant women. Structural

(*contd. on page 81*)

TABLE-2

TARGET ORGANS AND GROSS EFFECTS INDUCED BY EXPOSURE TO ACCIDENTALLY RELEASED CHEMICALS

Skin	Irritation	*Liver*	Cirrhosis
	Sensitization		Neoplasia
	Cancer		Carcinoma
Eye	Irritation	*Kidney*	Lithiasis
	Corneal opacity		Prostate Cancer
	Retinal damage		
Lung	Pneumoconiosis; fibrosis. Cancer	*Bone Marrow*	Cancer
Reproductive organ	Infertility	*Immune System*	Suppression
	Germ cell mutation		Alteration
Fetus	Abortion		
	Teratological changes		
Nervous System	Neuropathy		
	Behavioural changes		



AIR POLLUTION AND HEALTH

DR S.R. KAMAT

The annual cost of treatment of pollutant related ailments in Bombay has been worked out at Rs. 400 crores. The question now is not whether a raised air pollution of Indian cities leads to excess health problems but whether urban planners and economists will like to reallocate priorities to improve rapidly growing urban decay to reduce health cost load in the productive technologically efficient sections of the population.

DUE to rapid industrialisation and urbanisation (30% are living in towns/cities now), the problem of industrial and transport pollution has become important.

Even as a domestic pollutant, the role of asbestos (zeolite and tremolite) in Turkey and some villages of Maharashtra is important as it leads to tumours. The role of sand dust combined with strong winds prevailing at high altitudes in Ladakh in its natural environmental exposure, leads to causation of silicosis along with altitude sickness.

The use of inferior (wood) fuel for home heating or cooking, particularly in Himalayan villages, leads to a great increase in chronic bronchitis and its complications. In Kashmir a peculiar form, with lung granulomas and wheezing, occurs. It has been described as 'Gujar Lung'.

With rapid increase in number of automobiles particularly on national highways and large cities of India, significant populations are being exposed to various exhaust gases *viz*: Suspended dust, smoke, CO, NO_2, SO_2 lead and hydrocarbons. These may lead to various specific health problems. This contribution is rising rapidly particularly because our roads (few and small) are cluttered by multifarious obstructions, hawkers, bottlenecks and poor maintenance. In Bombay over 1200 metric tons of pollutants are liberated by vehicles daily which is 60% of the total daily load. In areas around Calcutta and the coal belt of India as people burn coal for many purposes (around homes), the atmosphere is full of high particulate pollution which with NO_2 and sunlight develops into a smog, leading to very poor visibility during winters.

In cities like Bombay, due to added industrial pollution, inversion and smog formation may occur on 100-120 days of the year. These

effects are enhanced due to 'heat island' in the central city.

Imperceptible increase

Air pollution may be visible at times or smelt but on many occasions, it may increase imperceptibly. As the urban public is busy trying to make a living and rush to work, they may feel after a long stay that apparently a tolerance has developed. Certainly new entrants, complain oftener of eye irritation, headache, dizziness, nasal watering, sneezing, discharge with irritating cough, chest pain and choking, while some overt manifestations decrease the raised frequency of colds, chronic cough, sputum, breathing problems and effects on lung function do persist.

The industrial activities which involved an increase in air pollution are boiler based processing industries, leather and chemical processing, power generation (thermal), cotton and mineral processing, mining, refining, fertilizer and dye industries. Having been exposed to various new chemicals at work or by living in polluted cities, this leads to an increase in various ailments and cancer at many sites.

The first evidence of environmental cancer was the excess of prostatics cancer and leukemia in residents around the nuclear reactors. The occupational cancers in processing workers of asbestos, polycyclic organic matter, PVC and dyes is well known but it takes 20 to 50 years for their incidence to show up.

Domestic use of cooking gas, coal or cowdung is shown to liberate a very large load of SPM, NO_2 and hydrocarbons. This in turn causes excess colds and lung infections in children, a reduction in lung growth, excess hospitalisation and bronchitis in adults later: (The solution seems to be cleaner fuel and a ventilated 'Chula'--like primus stove).

While effects of specific occupational exposure to pollutants like POM and chemicals, is well known, there was scientific debate till early 60's, whether chronic exposure to low or moderate pollutants in ambient air leads to disease. The medical texts would attribute such excess to frequency of common colds, throat problems, bronchitis, lung infections or asthma to smoking, allergy, poor nutrition or resistance.

The introduction of diseases due to high episodic rise in cardiorespiratory deaths in London in early 50's, Meuse valley disaster in Belgium and an increase in burns, dermatitis, anaemia, decay and cancer after Chernobyl in the USSR left no one in doubt that these causes should be prevented.

The recent disaster at Bhopal due to a large leak of methyl isocyanate, stimulated a flurry of scientific, legal and environmentalist activities. Despite the initial deaths of about 2800, there was a continued increase in deaths due to lung fibrosis and bronchiolitis. The problems of legal responsibility, compensation, transnational transfer of technology and economic development have posed protracted difficulties. The chronic lung disease with breathlessness on exertion, tiredness and weakness led to a fluctuating course of crippling lung disability in about 30,000 citizens.

Assessing effects of air pollution

The first studies for assessing the effects of ambient air pollution, were done in the USA and Britain. These showed fluctuating lung function of bronchitics, excess chest symptoms and increase in asthmatic attacks with excess pollution. However, some prevalence of bronchitis was explicable by the role of tobacco smoking and its passive effects on children. There was some evidence of poorer lung growth and flow rates in children living in SO_2 smelter towns.

The prominent proof for large morbidity due to urban air pollution has come out of studies done in Bombay with monthly levels of SO_2 in the range of 100 $\mu g/M^3$ there was prevalence of common colds (20 to 50%), intermittent irritant cough (15 to 30%) and chronic cough (8 to 12%). There was chronic breathlessness in 3 to 8%. There were other associated complaints of eye irritation, headache, chest pain, dermatitis, particularly in the area, with more chemical industry. In this area, with SO_2 level of 60-70 μg there was a similarly high morbidity. At the times, before a switch over in major industries for fuel from coal/furnace oil to clean Bombay High gas and Low sulphur oil, for several months 30 to 50% were visiting doctors for respiratory treatment.

CO inhalation

The prevalence of headache, irritability and chest pain were shown to be related to carbon monoxide pollution. Recently changes in electrocardiogram and anginal heart pain have been shown to result from an excess CO inhalation. Also later excess cough and chest infections are shown to occur at traffic junctions of Bombay.

It has been shown that excess respiratory and other cancers occur in residents around traffic junctions of Bombay city and in areas with high hydrocarbon pollution. The annual cost of treatment of pollutant related ailments in Bombay has been worked out at Rs. 400 crores.

(*Contd. on page 85*)

— A Backgrounder : World Health Day, 7 April 1990

OUR PLANET—OUR HEALTH THINK GLOBALLY—ACT LOCALLY

M.S. DHILLON

THE quality of water that we consume for drinking or for personal and household use, the soil in which we grow our food and on which we dispose waste material, the animals and plants around us, the air that we breathe and the rural and urban setting in which we dwell or work determines to a large extent the level of our physical, mental and social well-being.

In the developing world, most of the communicable and water-borne diseases are the result of unsafe and polluted water and other environmental factors. Over 1.7 billion people throughout the world still lack access to safe drinking water and 1.2 billion do not have adequate sanitation facilities.

It was in this context that the World Health Organization (W.H.O.) has chosen *environmental health* as the theme for the World Health Day—7 April, 1990. The slogan selected is:

"Our Planet—Our Health
Think Globally—Act Locally"

The nature's assets need to be preserved not only for the future benefit of man, not only on grounds of love and compassion, but because every form of manifestation has evolved through the ages and has a particular role in the time-space perspective.

Environment is the aggregate of all external conditions and influences affecting the life and development of an organism. The three-way link between basic health, economic development and the environment needs to be properly understood and recognised.

The saying, "Think Globally, Act Locally" by the French ecologist Rene Dubos is one of the watchwords of appropriate technology for health. It means bringing health care to where it is needed. And in the control of environment and health, the accent is on people's participation, and on their appropriation of the appropriate means to make the environment clean and giving their community another chance at living a healthy life.

There is a growing awareness among our people of the symbolic relationship between the protection of the environment and sustainable development. There is a renowned Chipko Movement in the Himalayas where women prevent the wanton felling of trees by throwing themselves protectively around tree-trunks. Many such environment groups are active.

The memory of Bhopal disaster is still fresh in our minds. Forty thousand kilograms of lethal gas leaked out from a pesticide plant leaving 2500 dead and several thousands crippled. The country is also to address itself to safety measures in high risk industries. The management of such industries must ensure the utmost vigilance in design, operations and maintenance.

Water is vital for life. But the substantial amount of water we use for drinking and other purposes, is neither safe nor adequate. Moreover, clean water is easily contaminated in insanitary environment. Hence, providing safe drinking water alone will not achieve the health benefit unless it is integrated with the improvement of sanitation. Therefore, the United Nations launched the International Drinking Water and Sanitation Decade (IWSSD)—1981-1990 with the objectives of promoting safe and adequate drinking water and better sanitation. The Government is committed to provide safe drinking water to all the villages, assisting local communities to maintain sources of such water supply in good condition and ensuring special attention to water supply for scheduled castes and scheduled tribes.

The Ganga Action Plan (GAP) has been launched to cleanse the river of its pollutants. Its water was no longer considered potable or fit for human use. The pollution of Ganga is not confined to any one or two places on her banks but to some 200 cities and towns on or near her banks. Some of the salient elements of the GAP are the renovation of existing sewers and construction of new ones, construction of interceptors to prevent the flow of sewage into Ganga and renewal and construction of sewage treatment plants.

The indiscriminate and large-scale felling of trees, in recent decades, has rendered the sensitive catchment areas in the Himalayas and other hilly areas vulnerable to soil erosion. What is more alarming is that the area under forests in India is fast decreasing. Forests act as an excellent biological filter. Like a filter, the forests possess the property of attracting the tiny solid particles suspended in the air---the product of industrial waste. By increasing the forest acreage, regulating the composition of species and age-structure of forest-plantations, we will not only be able to halt, but also conserve the atmospheric contamination process of carbon dioxide and restore oxygen which is alarmingly being exhausted.

Environmental education

Human habitat cannot be conceived without a sane and safe policy towards the environment in which they are to flourish. Hence, there is a dire need of environmental education for the people especially in regard to those problems which arise

Lack of safe drinking water and sanitation encourages a host of diseases including typhoid and cholera. It is therefore better to avoid water from ponds, lakes, streams and canals.

Proper disposal of wastes, such as human excreta, animal dung, garbage and kitchen wastes, is an important part of environmental sanitation. Flies breed fast on any garbage. They carry germs into our food and spread disease.

in the wake of accelerated use of technology and consequent modernization process. These include:

Water Pollution.—It is due to discharge of industrial wastes without treatment into water courses, rivers, etc. Industrial wastes may contain acids, alkalies, oils and other chemicals, some of which may be toxic and harmful to health.

Air Pollution.—This is another important problem and is contributed to by industrial, domestic and vehicular sectors. Air pollution is due to the discharge of toxic fumes, gases, smoke and dusts into the atmosphere.

Sewage Disposal.—Lack of facilities for the disposal of sewage leads to pollution of water supply, contamination of soil with parasites, etc.

Environment and health

The first priority for a sanitary environment is a safe water supply—free from disease-causing germs. It is essential to life. The lack of safe water and sanitation encourages a host of diseases--typhoid, cholera, hepatitis, polio-myelitis, dysentery, amoebiasis. These diseases are passed on from man to man when stools and other discharges of patients are washed into water without knowing the consequences.

Your municipality or panchayat may supply pure and wholesome water. But many people depend for their water requirements on

other sources such as, well, stream, tank, pond and lake. These sources may be contaminated with disease-producing germs. And we can protect our health only by making water safe.

Here are a few points on how to make water safe before you drink.

* If you have an open well, take steps to have it cleaned. Disinfect it before use. Fresh bleaching powder is a reliable disinfectant and kills germs in water. It is safer to have your well covered and a pump installed.
* Do not bathe or wash clothes near the well-head.
* Do not have pit latrine or cess-pit latrine or cess-pit within 15 metres of a well, within the cone of filtration, **i.e.**, four times the depth of the well.
* Drain away all the water split near the well.
* Use a common vessel and rope to take out water from the well.
* Do not allow the surface water to get into the well.
* If there is no dugwell, you can have a Hand Pump in the House, where it is feasible.

How to make water safe?

It is, no doubt, difficult to know whether any water is pure and safe. But you can use a few simple methods to purify the water.

Boiling.—Boiling of water for about 10 minutes kills any disease-causing germs it might contain and makes it safe.

Bleaching powder.—Fresh bleaching powder is a powerful disinfectant and kills germs in water.

If you want to treat a small quantity of water—say a bucketful (15 litres)—dissolve thoroughly one teaspoonful of bleaching powder in a glass (250 ml.) of water. Add three spoonfuls of this solution to the bucket of water. Mix it well and allow it to stand for one hour for chlorine to act. Chlorine tablet—a simple tablet of 0.5 g is sufficient to disinfect 20 litres of water.

How to make well water safe?

The volume of water in the well is calculated by the formula:

$$\text{Volume (in Litres)} = \frac{3.14 \times d^2 \times h \times 1000}{4}$$

Where 'h' is the depth of the well (in metres) and 'd' is the diameter of the well (in metres). For 1000 litres, 2.5 grammes of bleaching powder is required to disinfect the water of the well.

Water Storage.—Store water in clean containers and keep them covered. Do not dip your hand when taking out water from these containers.

Water from ponds.—Avoid water from ponds, lakes, streams and canals. If, however, you have to use water from these sources, follow these suggestions.

Strain the water through two layers of cloth and allow the water to stand for a short while. The water can then be purified by using bleaching powder as mentioned earlier or by boiling. Alum may also be used if the water is muddy for hastening the process of sedimentation of inorganic matter.

Environmental sanitation

While safe water ensures health, we also need to keep our surroundings clean. Indeed, environmental sanitation is an important adjunct to public health.

Disposal of wastes.—human excreta, animal dung, garbage and kitchen wastes—is an important part of environmental sanitation. Proper waste disposal system is supplementary to the water supply system. You must, therefore, know how to dispose of wastes:

* Do not defaecate indiscriminately either in the open fields or in the vicinity of your house. Always use a sanitary latrine. This would eliminate the human agency from carrying the human excreta. A sanitary latrine is the only answer to stop flies from coming into contact with stools and thus prevent spreading diseases like cholera, typhoid, dysentery, etc.
* Provide sanitary flush-out latrines, preferably, handflush type, to economise on water use. Connect it into septic tank with a sub-soil dispersion system or a pit.
* Drinking water well or the source of water should always be at a safe distance (15 metres) from the dispersion trench. This will prevent contamination.

How to dispose of refuse?

Disposal of refuse, excreta and garbage plays an important role in health promotion as does the provision of drinking water supply. Here are a few tips for you to keep your environment free from filth and squalor.

* Always keep your garbage tin or can covered. This will help you in keeping the garbage and rubbish away from the pests.
* Place the refuse only in closed containers. And do not throw refuse indiscriminately.
* Keep the refuse away from flies and rats. For, flies breed fast on any garbage. They carry germs into your food and thus spread disease.
* Rats, too, spread disease and cause food poisoning.

Contd. on Page 80

WATER : Toxicological Considerations and Relation to Health

DR S.P. PATHAK, DR J.W. BHATTACHERJEE AND DR P.N. VISWANATHAN

Contaminated drinking water causes two types of risks, immediate acute effects due to bacterial contamination and more subtle challenging situation associated with toxic micro-pollutants over a long period of time. Priority has now been given to the supply of safe drinking water to public under the guidance of the National Mission on Safe Drinking Water for villages.

EVEN though there is about 1500 million cubic km of water (hydrosphere), only 1% is available for human consumption in the form of ground water and different types of surface water bodies of fresh water (Metelev et al., 1980). Water is essential for life and metabolic activities, and if safe drinking water is not available for any community it may affect directly their health status. The factors which make the water unsuitable for consumption are presence of pathogenic micro-organisms heavy metals, chemicals of organic and inorganic nature, radio-active elements and some physical factors above permissible level. Any of these can make a water pathogenic or toxic on prolonged consumption. The water bodies get polluted with one or more of these pollution factors through agricultural land run-off, municipal sewage industrial effluents, unhygienic practices, storage and uncontrolled disposal of various toxic and radioactive chemicals. It has been reported that approximately 80 per cent of diseases in man are water related. In India only about 12 per cent of the population get safe drinking water (Kudesia, 1980).

Microbiological pollution

The microbiological contaminants of drinking water include pathogenic bacteria, viruses, protozoans and helminths particularly of faecal origin causing diarrhoea, cholera, dysentery (bacillary and amoebic) gastroenteritis, typhoid, polio, hepatitis 'A' and different intestinal worm diseases.

The most important water-borne pathogenic bacteria and *Salmonella* sp., *Shigella* sp., *Vibrio cholerae* and enteropathogenic *Escherichia coli*. Most of these organism after getting entry into the gut start producing enterotoxin which can cause fluid accumulation. Certain opportunistic bacteria eg. *Pseudomonas. Acantha bacter, Campylobacter, Aeromonas* and *Flarobacteria* can also be of danger.

Among the water transmitted protozoa, *Entamoeba histolytica, Giardia lamblia* and others. Mostly they survive in adverse conditions as cysts which are mostly resistant to chlorination.

There are many intestinal worms which can be transmitted through water are *Ascaris lumbricoides, Trichuris trichura, Ancylostoma duodenale, Necator americanus* and *Dracunculus medinensis* which causes guineaworm disease *via* water flea (cyclops) as vector (Bhattacherjee & Ray, 1986).

Chemical pollution

Indiscriminate disposal of various industrial and municipal wastes in water bodies impart the chemical pollution of water. These chemical pollutants may be of organic or/and inorganic in nature. Some of these pollutants are non-toxic but many of these are quite toxic and pose serious health problem as well as toxic for hydrobionts.

Agro-chemicals (pesticide)

Large scale use of over 120 pesticides, insecticides, fungicides weedicides, algicides and rodenticides etc. to protect crops and control of disease vector is practised in India. Pesticide residues enter an aquatic ecosystem directly or indirectly through land run-off, spray-drift, rain water, sewage and industrial effluents. The consequences of environmental pollution with residue of pesticide and other agro-chemicals is hazardous to public health and aquatic biota causing toxicity of

different types. Most of them are persistant and exist in the environment for years and cause toxic effects (Jaffery *et al.* 1989).

Inorganic water pollutants

Heavy metals polluting water sources leading to toxicity, is a major problem in India (Chandra, 1982). Environmental accumulation of mercury caused 'Minimata' disease among fishermen in Japan. It affects central nervous system and in excess it causes headache, abdominal pain, diarrhoea, haemolysis and digital tremors. Lead inhibits the enzyme ACA dehydration necessary for formation of leading to anaemia. After replacing calcium, it is deposited in bone and retained in soft tissues like liver, kidney and muscles. Cadmium is nephrotoxic and causes hypertension and cirrhosis of liver. Itai-itai disease has been reported from Japan to be caused by cadmium. It causes neurotoxicity and renal toxicity and acts as a cumulative poison. Chromium is toxic in plants and animals and exists in different oxidation states from Cr+2,+3,+5 &+6. In environment $Cr.^{+3}$ and Cr^{+6} are more common and Cr^{+3} is reported less toxic than Cr^{+6} It binds with B-globulin and is distributed in lungs, heart, brain, liver, testes and spleen. It causes cancer, anuria, nephritis gastro-intestinal ulcerations and CNS effects. Excess of copper (470 mg) causes hypertension, sporadic fever, uremia, coma and even death. It causes pathological changes in brain. Wilson's disease, due to excess copper in water and food, has been reported in Zambia.

Even though Manganese is an essential metal, in excess it causes neurobehavioural effects including limb paralysis, somewhat similar to Parkinson's disease by affecting catecholamines. Manganese in excess causes growth retardation, fever, sexual impotency, muscular fatigue and sometimes blindness.

Fluoride in drinking water above 1.5 mg/L causes mottling of teeth, the dental caries and skeletal fluorosis (ICMR Bull, 1975). Nitrate and nitrite levels are increasing as a result of use of synthetic fertilizers apart from atmosphere, sewage and industrial effluents. Two health hazards are related to consumption of water with excess of nitrate/nitrite, induction of methaemoglobinaemia in infants and the potential formation of intestinal carcinogenic nitroseamines.

Contaminated drinking water causes two types of risks, immediate acute effects due to bacterial contamination and more subtle challenging situation associated with toxic micro-pollutants over a long period of time. Priority has now been given to the supply of safe drinking water to public under the guidance of National Mission on Safe Drinking Water for villages. ITRC is one of the major participants in this campaign and has conducted detailed studies in 13 states (Bhattacherjee, 1986). Detailed water quality studies by ITRC on Ganga, Yamuna, Gomti, Hoogli also helped to identify problems related to toxicants in water.

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Ensuring healthy environment

Everyone has a right to enjoy a reasonably clean, safe and healthy environment and human, health is work. The relationship between the environment and human health is an established fact. Clean air, water and soil are the vital ingredients for a healthy life. Environmental degradation undermines development and damages human health:

* Urbanization and industrialization and the resultant influx of population has resulted in congested settlements, insanitary conditions, insect and rodent problems, giving rise to many illnesses and deaths. Development activities must, therefore, be controlled and well planned. It is ensured that waste products are removed safely.
* Unplanned and hastily planned settlements or squatter settlements are invariably deficient in proper housing and essential services for healthy living. Towns and cities must, therefore, be developed in a planned manner. Residential areas muts be segregated from those meant for commerce and industry.
* Houses must be so designed and constructed as to allow adequate air and sunlight to enter. Where fire-wood, coal or cow-dung cakes are used for cooking, houses must be provided with smokeless chulha and proper ventilation to let out the smoke from the burning fire. Residents should have access to safe drinking water, proper waste disposal and sanitary latrines.

Therefore, the provision of safe water supply coupled with satisfactory disposal of waste is imperative for a clean environment and healthy living.

As we enter the last decade of the century, environmental issues are taking on a new importance. The good news about it is that we know about it and can and must benefit from this awareness. Every little effort helps. ○

(*contd. from page* 72)

malformative changes could be noticed. Thees effects could be directly related to toxic exposure and not entirely due to psychological responses. The mechanism of genetic inheritance could be compromised as evident from many cytogenetic changes. Some of the known adverse effects of exposure to toxic chemicals are mentioned in *Table* 2 (*see page* 72) by way of illustrating the wide spectrum of sequelae of chemical disasters.

In order to mitigate injury and take up intensive treatment it is also essential to know the extent of spread of the toxic cloud released by a disastrous chemical emission. The only way in which this can be achieved is to establish predictive models using computers with inputs from several sources including data banks on meteorology, hazards of chemicals and social services.

Emergency response system

In order to help member governments to face natural disasters such as earthquake, flood, cyclone, drought and others, WHO has set up an Emergency Preparedness and Relief Programme with three objectives:

(i) Prevention and mitigation of the effects of disaster on the health of the affected population.

(ii) Protection and re-establishment of health services and attendant facilities, and

(iii) Prompt restoration of the health standards prevailing before disaster and, wherever possible improving them.

These objectives are equally applicable to a Response System to Chemical Emergencies which has in addition to meet the challenges posed by heavy casualty, large numbers needing detoxication treatment and hospitalization and possibly, shifting to safer locations to facilitate intensive and continuous treatment. The long-term outcome of accidental exposures to toxic chemicals depends on the earliest response to the acute phase and preventive action taken at that point of time such as containment and

TABLE-3

COMPONENTS OF CONTINGENCY PLAN FOR THE CHEMICAL INDUSTRY

Pre-Emergency Phase	*Activities*
Hazard Evaluation	Identify hazards Assess Risk
Prevention	Remove hazards Select Alternatives Control hazards
Preparedness	Plan Emergency Response Decide rehabilitation methods Institute organizational framework Link with Data Bank
EMERGENCY PHASE	
Event	Respond accurately Respond speedily Contain further spread
Follow-up	Gather relevant information on chemicals implicated Institute Epidemiological Studies Monitor environment and public health for delayed effects Document activities, etc.

TABLE-4

PERSONNEL AND ACTIVITIES OF LOCAL CHEMICAL EMERGENCY RESPONSE SYSTEM

Personnel	*Activities*
EMERGENCY PHASE	
Fire Bridge	Rescue, Fencing
Police	Law & Order
Transport	Evacuation
Conservancy	Disposal of dead bodies
Emergency Squad	Decontamination
Poison Control Centres	Detoxication
Doctors, Nurses, Social Workers	First Aid
Morgue/Autopsy	Medical Legal—Tissue Collection
Environmental Squad	Decontamination
POST-EMERGENCY PHASE	Disposal of affected vegetation, food & soil
Civic Services	Water and food supply; Civic amenities
Hospital Services	Intensive Care & Treatment
Epidemiologists	Long term Health Surveillance
Environmental hygienists	Long Range Environmental Surveillance
Occupational	Medical and Occupational rehabilitation
Planners, administrators	Social Rehabilitation
Community leaders	Counselling
Psychological and Legal Counsellors	Claims, compensation

mopping up of areas of residual spills. The medical service component of an Emergency Response System for Natural Disasters is trained to take care of traumatic injury, first-aid and prevention of out-break of epidemics of communicable diseases. In a chemical emergency, the team has, in addition, to deal with specific health problems arising out of massive exposures to toxic chemicals.

Even as the immediate acute phase is being faced, there should be activation of a system to address the challenges posed by the sub-acute and chronic phases and most importantly the rehabilitation phase. Thus the institution of a long-term programme of surveillance of environmental health becomes imperative. The psychological impact of the calamitous event will have to be dealt with by Psychiatric and Community Counselling Centres.

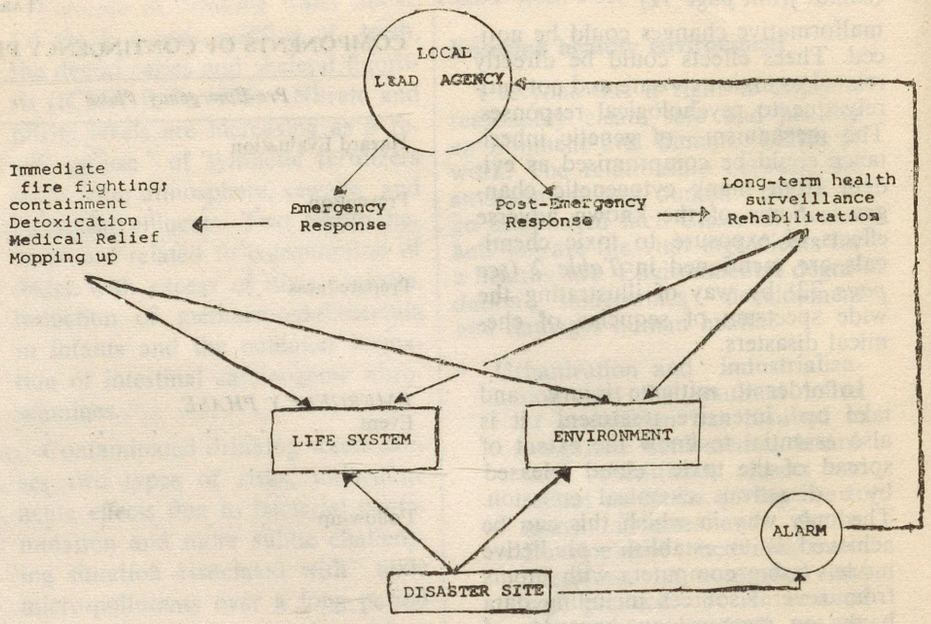

Fig 1. A SYSTEM FOR CHEMICAL DISASTER MANAGEMENT

Bhopal has brought home the urgency of establishing contingency plans for the chemical industry with emphasis on both prevention and mitigation of injury. The components of a contingency plan for chemical industries are mentioned in *Table* 3. The personnel needed and the activities to be initiated by a Local Lead Agency are given in *Table* 4 (*see page* 81). Institutional structures required at ntiaonal and regional levels have to be set up. The scientific disciplines of risk assessment and management, safety evaluation of chemicals and environmental epidemiology have to receive massive support for development of the requisite expertise and trained human resources to carry out the diverse tasks. The creation of Local Agencies to respond to chemical emergencies must be taken up on a high priority. A model for Local Lead Agency is shown in *Fig* 1 and the inputs needed for the effective activation of relief and rehabilitation measures are shown in *Fig* 2.

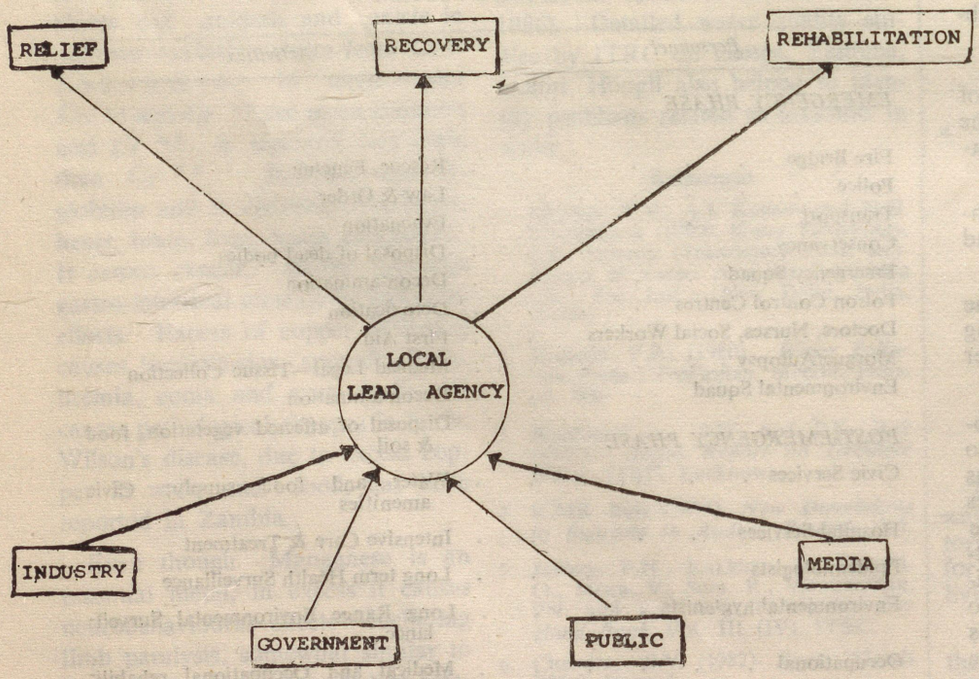

Fig 2. AGENCIES GIVING INPUTS FOR CHEMICAL DISASTER MANAGEMENT

The early creation of a system for Preparedness and Management of Chemical Disasters will be the most fitting memorial to the many thousand innocent people who were killed or maimed in the Bhopal Disaster. ○

TOXICOLOGICAL ASPECTS OF FOOD SAFETY

DR S. KULSHRESTHA
DR DINESH CHANDRA

Toxicological aspects of food safety has attracted the attention in recent years as one of the scourges of man. The growing modern technology and industrialization are the foremost factors responsible for this pollution. They spread the contaminants through a variety of routes and even do not spare our food and drinking water. Therefore, now-a-days a great emphasis is being placed on establishing the safety of food.

GENERALLY, the groups of compounds which are responsible for contaminating our food includes—

1. Naturally occurring components
2. Food additives
3. Production and processing agents, and
4. Contaminants.

1. Naturally occurrnig components

Naturally occurring components of relevance for food safety includes long chain fatty acids, carcinogens, hallucinogens, hormones, antivitamins, glycosides, cyanogenic and cardiovascular amines and nitrates. Though, with experience, man has learned to avoid food with conspicuous toxic effects, *e.g.*, certain varieties of cheese, beer, wines, picked meat and fish, yeast extract as they contain large amount of tyramine, dopa and when given to MAO inhibited patient then displace the large amount of norepinephine from adrenergic nerve endings and results in unpleasant reactions, hypotensive crises and cerebrovascular accidents. Similarly, nitrate present in many vegetables and also used as food additive may get converted into nitrite by microbial reduction thus making the safety of food doubtful.

A toxic compound may be formed from the naturally occurring component of food during the procedure used in food processing. For example, alkali treatment of soya protein has been used to achieve technical desirable properties of protein. Feeding studies in rats have shown that it resulted in renal lesions in the rats. This is because the alkali treatment of soya protein had resulted in the formation of a new peptide lysinoalanine, which was toxic to the kidney. These results raise interesting question concerning the potential formation of new chemicals during food processing.

2. Food additives

The use of additives in food fulfills many purposes, *i.e.*, to increase their palatability and acceptability by the consumer. They are required to preserve, texturize, flavour and colour the food. Different groups of food additives relevant for food safety are—

- Acids, bases and salts, *e.g.*, acetic acid, citric acid, sodium chloride and calcium carbonate.
- Preservatives : *e.g.*, benzoic acid, sorbic acid, nitrite.
  Antioxidants: *e.g.*, ascorbic acid, butylated hydroxy anisole.
- Colours: amaranth and tartrazine.
- Emulsifier, stabilizers and thickeners.
- Flour-treatment agents : *e.g.*, ascorbic acid, chlorine dioxide
- Non-nutritive sweetners : *e.g.*, saccharin.
- Flavour enhancers: *e.g.*, glutamic acid.
- Miscellaneous : mineral oils.

Many additives occur naturally in foods and some food additives are essential nutrients, *e.g.*, sodium chloride and cobalt. But this does not exclude the toxicity with these agents at higher doses. Though cobalt is an essential nutrient but cohalt chloride had caused cardio-

Many production and processing agents affect the safety of food. Food additives are required to preserve, texturise, flavour and colour the food. But this does not exclude the toxicity with these agents at higher doses.

myopathy when it was used as additive in beer to stabilize the foam. Sodium glutamate is widely used as a flavour enhancer and for seasoning of foods. It imparts a salty meaty, flavour to food. Its consumption has been shown to cause Chinese restaurant syndrome in some individuals. Results from some animal studies indicate that it produces neuronal lesions in animals.

The intolerance to food colours has also been reported. Many pharmaceuticals contain azo dyes and there are number of reports when ingestion of these pharmaceuticals containing azo dyes had resulted in exacerbation of asthma or urticaria.

The impurities or transformation products may possess pharmacological and toxicological properties different from those of the parent additive. For example Ortho-toluenesulfonamide is present as an impurity in the artificial sweetener saccharin. The presence of up to 6 gm of Orthotoluenesulfonamide per kg. of saccharin has been reported and has been blamed to cause magnesium ammonium phosphate calculi.

To avoid the risk of toxicity from these agents the concept of "Acceptable daily intake" (ADI) has been given. The Joint FAO/WUO expert Committee on food additives expressed the ADI as the amount of food additive that can be taken daily in the diet, even over the life-time, without risk. It is usually obtained by extrapolation of animal data to man, using a safety factor.

3. Production and processing agents

Many production and processing agents affect the safety of food. These include pesticides, feed additives, medicines, solvents and filtering aids. Compounds which are used as aids in the agriculture production and veterinary drugs can leave the residues in the agriculture products and foodstuffs of animal origin. When chemotherapeutic agents are used in agriculture, the possibility exists that resistant strains of microorganisms may be transmitted

to humans or residues of antibiotics used for such purposes may sensitize the human being for these antibiotics. Therefore, in principle, only those antimicrobial agents which are not used in human beings should be used for these purposes.

The residues of production and processing aids in food, *e.g.*, residues of solvents or filtering aids may have toxic effects on the health. In principle, such residues should be absent from the final food, but the recent improvements in analytical techniques have made it clear that very small quantities of these residues are often present in the foodstuff. Recently, it has been shown that the use of asbestos as a filtering aid in the food industry might result in the occurrence of asbestos fibres in beverages, *e.g.*, wine or beer. Asbestos fibres, if inhaled, are known to cause lung cancer and special tumor called mesothelioma. But, at present, it is not known if the asbestos fibres present in beverages can exert a carcinogenic action and it is now a toxicological problem to evaluate the potential health problems raised by such residues.

4. Food Contaminants

The food contaminants which should be evaluated for food safety include mycotoxine, heavy metals, technical chemicals and packaging material.

The mycotoxins produced by fungi are the important contaminants of food. Fungi producing mycotoxins are distributed everywhere and therefore every foodstuff is potentially susceptible to contamination under conditions favouring fungal growth. As chemical compounds, the mycotoxins vary considerably in structure, and the range of toxic effects attributed to mycotoxins is broad. The best known are the aflatoxins produced by Aspergillus parasiticus which cause liver damage. Aflatoxin B, is a potent carcinogen in several animals. A number of other fungi have been identified as potential toxic contaminants of food, *e.g.*, contamination of grain with ochratoxin A, which is a potent nephrotoxic compound.

There is possibility that food may get contaminated from the release of material in contact with it (*i.e.*, packaging material). Five major classes of food packaging materials are glass, metal, paper, plastic and regenerated cellulose. These contain at least up to 5000 chemicals. Contamination of food by release of tin from inadequately manufactured cans has been reported. Now-a-days special concern has been expressed with respect to the possible release of vinyl chloride monomer from polyvinylchloride containers and wrapping materials as this compound is very commonly used as packing materials and has several undesirable toxic effects. Studies in animals show that vinylchloride is carcinogenic in rats and other experimental animals. Vinylchloride exposure results in liver tumors in man. Indications of liver dysfunction and achroosteolysis have been observed in individuals occupationally exposed to 10=300 ppm of vinyl chloride in the air for up to 25 years.

Heavy metal contamination of food may occur from water pipes, armatures and fittings as well as metallic and ceramic vessels, mincers, blenders, tins and other utensils in food production and preservation. For a heavy metal the chemical compound in which it appears is of great importance to its toxic properties. The metallo-organic compounds of mercury, tin and lead are more toxic, less polar and therefore, more prone to penetrate biological barriers than are inorganic compounds. Well-known example of heavy metal contamination is contamination of drinking water with lead from water pipes. Some heavy metals, *e.g.*, lead and arsenic, formerly gained access to food through their use as pesticides, and even as food additives, *e.g.*, as colouring agents. The use of mercury compounds for seed treatment has caused major disaster due to treated grain being mistakenly used as food.

This information on potential adverse effects of natural food components, food additives and food contaminants gives rise to a great concern about safety evaluation of food. It may be the tip of an iceberg which we are seeing. It stresses the need for more studies to evaluate the toxicity of such compounds before they are marketed and the efforts in the direction to control food contamination so that health hazards due to food contamination could be avoided. ○

(*Contd. from page 74*)

In correlating these morbidities to various other urban factors, it was found that at young (below 5) and older (beyond 45) ages, adult females doing domestic work, slum dwellers and those working in dusty occupations suffer more. In dirty areas, food and water pollution play a role in causing poor appetite, food intake, poor absorption of nutrients, diarrhoea and abdominal pains. In contrast, housing, sanitation have only a small role.

The question now is not whether a raised air pollution of Indian cities leads to excess health problems but whether urban planners and economists, will like to reallocate priorities to improve rapidly growing urban decay to reduce health cost load in the productive, technologically efficient sections of population.

If one does not think of human health alone, one can trace out such adverse effects on fabrics, furniture, paints, structures and precious monuments like Taj-Mahal, Qutab Minar and Lodhi tombs due to air pollution. ○

Occupational Health And Industry

Dr P. Chattopadhyay
Dr S. K. Kashyap

The tremendous technological achievements of the past few decades increasingly expose the worker to newer dangers. It is only since the second World War that there has been a rapid growth of occupational health awareness worldwide. The improvement in working environments has not only been due to intensive experimental and epidemiological research, but more so because of a new trend that has been taking shape gradually over the time: the worker's claim to a better quality of life, fuller support of employers for comprehensive occupational health safety and increasing efforts by Governments to apply far-reaching measures in this field.

The industrial revolution moved workers from the safety of their homes and cottage industries to large poorly illuminated, illventilated factories. The price to be paid in terms of health is inevitable. The consequences of the industrial revolution on worker health was recognized quite early and it was Britain which first developed a system of workers' compensation and adopted the principles of restricting hours of labour, safeguarding the health of the factory workers, exploring the effects of occupation on health and prevention of its ills and accidents. Britain was also the first to bring in state control on industry in the form of the Factory Act in 1833.

Occupational diseases and accidents are one of the most appalling human tragedies of modern industrialization and one of the most serious forms of economic waste, especially in the developing nations' scenario. According to ILO (1971) the best world estimates of fatal injuries at the work place is close to 100,000 annually.

The tremendous technological achievements of the past few decades increasingly exposes the worker to newer dangers. It is only since the Second World War that there has been a rapid growth of occupational health awareness worldwide. The improvement in working environments has not only been due to intensive experimental and epidemiological research, but more so because of a new trend that has been taking shape gradually over time : the worker's claim to a better quality of life, fuller support of employers for comprehensive occupational health safety and increasing efforts by Governments to apply far-reaching measures in this field.

Occupational health problems in industry are primarily due to exposure to toxic substances, dust, mineral fibres, radiation, noise, vibration etc.

Physical hazards

These are due to radiation, noise and vibration.

Radiation—Exposure may be either ionizing or non-ionizing. Ionizing radiation exposure occurs while working with X-rays, in nuclear plants, in uranium mining, some sterilization processes, etc. This type of radiation can lead to health problems like Radiodermatitis, epilation, cataracts, cancer, leukaemia and genetic mutations. Non-ionizing radiation can be from : (a) Ultraviolet radiation exposure from sunlight, sunlamps, black light lamps, high pressure xenon arcs, carbon arcs, plasma torches and welding arcs. The eyes and the skin are particularly vulnerable to this type of radiation, resulting in erythema of the skin and photokeratitis of the eye (welder's flash). Visible radiation (illumination) effects can be due to poor or excessive illumination at the workplace. Excessive illumination can damage the eye—retinal or macular degeneration, visual fatigue or blurring of vision which may lead to accidents. Poor lighting can cause eye strain. Occupations like electronic component assemblers, quality control personnel, jewellers, watch makers and computer operators are more prone to eyestrain. Sufficient and suitable lighting at the wokplace is essential.

Infrared radiation occurs in energy intensive industries like glass and metal industries, in welding and flame cutting and where high temperature electrical components are used. Two different types of effect are observed. The first is heat stress caused by transfer of radiant heat load to the body resulting in discomfort, irritability, difficulty in concentration, heat exhaustion and heat stroke. The second effect is on the skin and eyes, like heat rash, skin burns and skin pigmentation, and retinal burns and glass workers' cataract.

Noise—Increasing mechanization has created the problem of excessive noise at workplaces in many industries. Noise in the range of 4000 to 6000 Hz and above can result in temporary or permanent deafness, tinnitus or mechanical damage to the ear-drum. Non-auditory effects of noise are nervousness, fatigue, interference in speech communication, decreased efficiency, rise in heart rate, respiratory rate, B.P. etc.

Vibration—Vibration in industry is encountered while working with pneumatic tools like drills, hammers, rotary discs, grindstones and many types of machinery. Whole body vibration is encounted in occupations involving movement like driving. The harmful effects of vibration are blurring of vision, loss of acuity, loss of efficiency and discomfort. Hand-arm vibration from use of hand operated tools can result in injury to the joints of the hand, elbow and shoulder. Hand vibration can also result in the fine blood vessels of the fingers becoming increasingly sensitive to spasm (white fingers).

Chemical hazards—are due to exposure to toxic chemicals in the form of liquids, mists, vapours and gases or solids in the form of dusts or fumes. For the harmful agent to exert its toxic effect on the worker, the chemical must come in contact with the body which can be by any of three routes; inhalation, skin absorption, ingestion and/or a combination of these. This exposure can be either through direct handling or environmental exposure which includes spills and leaks. The effects may be either local on the skin or systemic, affecting various organs of the body.

The vast multitude of chemicals used in industry today, give rise to a wide range of health problems. Skin absorption leads to disorders like primary contact dermatitis from contact with strong acids, alkalis, lipid solvents etc. Certain metallic salts of arsenic, mercury and chromium can cause ulceration. Acne formation can take place by contact with cutting oils which are commonly used in most industries. Allergic contact dermatitis or sensitizing eczemas can take place by exposure to Aniline derivatives, dyes, ink, paints, cosmetics, metals like arsenic, chromates, nickel and cobalt, resins, rubber chemicals, etc.

Harmful effects to the lung can result in (i) Acute inflammation resulting from irritating gases or fumes like Ammonia, chlorine, Nitrogen oxides, sulphur dioxide, mercury vapour etc. (ii) Asthma develops as an immunological response to foreign materials which act as antigens *e.g.*, Isocyanates, metals, and their salts like platinum, nickel, chromium, tungsten carbide, and natural resins like colophony which is used in welding and electronics industry, (iii) Pneumoconiosis wherein permanent alteration of lung structure occurs following inhalation of mineral dusts like silica, coaldust and asbestos. Pulmonary fibrosis occurs from exposure to all these dusts and results in Silicosis, Coal miners' pneumoconiosis and Asbestosis respectively. Exposure to Asbestos can also lead to cancer of the lung and peritoneal and pleural mesothelioma, (iv) Byssinosis the lung pathology found among cotton textile workers. It can also occur from exposure to flax and soft hemp.

Peripheral neuropathy can occur from exposure to pesticides, carbon disulphide, mercury compounds, inorganic lead, n-hexane, etc., Substances that may produce toxic organic psychoses include arsenic, lead, manganese, mercury and carbondisulphide.

Exposure to lead can cause nephropathy which may lead to hypertension. Many organic chemicals seem to be associated with cardiac arrythmias. This is particularly so from exposure to the aliphatic chlorinated hydrocarbons such as 1,1,1,—Trichloroethane, trichlorethylene, chloroform, carbon tetrachloride and halothane.

Occupational injuries are common in most industrial establishments resulting from accidents that occur either due to carelessness or because of unprotected machinery. Low backpain is also a very common feature found among industrial workers. This occurs mainly due to improper lifting of loads and improper posture while working.

Psychosocial factors play an important role in worker health, especially in developing countries. Rapid introduction of complex work methods and tools has been associated with psychosocial stresses. The main problems are due to adjustment to rapid changes, economic and social problems.

Protection

Protection of the industrial worker from adverse health effects resulting from his work environment can be done by personal protection, control at source using good hygiene practices and worker education.

Personal protection is used to safeguard people from contact with harmful agents and includes protective clothing as well as equipments like eye and hearing protectors and respirators. Protective clothing includes coveralls, boots and gloves which need to be worn by the workers while handling a wide range of substances. Barrier creams should be used while handling substances harmful to the skin.

Hearing protectors are of two types : Earplugs, which are inserted in the ear canal and earmuffs which cover the external ears. Hearing protectors should be chosen to reduce the noise level at the wearer's ear to below the recommended limit for unprotected exposure to noise, *i.e.*, 85 dB.

Selection of eye protectors depends on the type of exposure hazard. Spectacle type eye protectors can be used to protect the wearer from relatively low energy projectiles like small particles of metal ejected during machining of metals on lathes. More robust goggles or faceshields are needed against high energy projectiles, molten metal, chemical splash, dusts or gases and have to be of an appropriate type for the exposure hazard like chemical goggles or faceshields or goggles for protection against radiation like gas or arc welding and lasers. Respiratory protection can be provided by various types of respirators by different breathing apparatus.

A safe work environment can be achieved by adopting the following measures—

(i) Elimination or reduction of risk by substitution, redesign of process or improved work methods.

(ii) Total enclosure processes which can ensure that the workers do not come in contact with toxic materials. This can be done by mechanization, automation or material handling in confined spaces with gloved inlets.

(iii) Segregation of a process by isolating a hazardous job from the rest of the production line. This can reduce the extent of hazard, thereby making control more effective and cheap.

(iv) Control by ventilation can be through general dilution by providing good workplace ventilation or by local exhaust ventilation.

(v) Suppression of dusts by water sprays and wetting agents. Dust can also be reduced by using electrostatic precipitators.

(vi) Good housekeeping by proper cleaning of the workplaces and proper waste disposal.

Routine environmental assessment should be conducted to assess the efficacy of control measures adopted. Accidents can be prevented by covering machinery.

None of the above mentioned measures can be totally successful unless worker education is imparted. This includes: (i) education on personal hygiene, (ii) awareness of possible hazards of the work processes the workers are engaged in and the precautions they need to take, (iii) Importance of using protective clothing and appliances and their maintenance, (iv) knowledge of actions to be taken in the event of accidents or spills, and training on first-aid.

Ideally occupational health services should be available in all industrial setups. The National Institute of Occupational Health has been set up for research on occupational health problems and their control, and its expertise is available for all interested industries. ○

SETTING UP OF ENVIRONMENT COURTS

The Government has decided to set up Environment Courts to deal effectively and quickly with the cases relating to environment. This is for the first time, that such a court is being established anywhere in the world.

The Government has also decided to introduce a system of direct funding of States Pollution Control Boards through the Centre. Efforts are also being made to get more resources to those Boards so that more effective and timely pollution control measures can be taken up. The World Bank has agreed to pump in 300 million dollars, *i.e.*, about Rs. 500 crores to strengthen pollution control boards, to give loans to polluting industries for setting up treatment plants and to construct common effluent plants in the four States of Maharashtra, Gujarat, Uttar Pradesh and Tamilnadu.

—PIB, Agriculture Newsletter, 15. Feb. 1990.

HEALTH CONCERNS DUE TO INCREASING LEAD LEVELS IN ECOSYSTEM

DR REKHA THAKRE & DR A. L. AGGARWAL

Air pollution problems are getting intensified in developing countries like India as they are competing with developed countries in industrialization. This has resulted in increased emissions of pollutants both gaseous and particulate in ambient air.

Indian climate, described as hot and dry, favours the increase in particulate matter level in the atmosphere. As if this is not enough, most of the anthropogenic activities also contribute towards the particulate contamination in highly significant way and in alarmingly hazardous form. Indian coal which is the major component in production of energy (Thermal) is also high in ash content aggravating the dust problem throughout the ecosystem.

The dust on analyzing for its metallic components has been found to contain appreciable amount of heavy metals which are highly toxic to human health. These heavy metals do not show their impact immediately but they accumulate in the human body and as the resistance power of a person decreases, it starts popping its head. In this paper the impact of lead on the ecosystem has been elaborated. The origin of lead has been traced mostly from auto-exhaust emissions.

TWENTIETH century has been the tremendous rate of industrialization throughout the world. The progress of any nation has been measured by the degree it is industrialized wherein India today ranks seventh in all the countries.

Nevertheless, the negative side of industrialization was not paid due attention till the last few decades. In India, particularly, the percentage of literacy being low, till today, there is a large sector of population which is not at all aware about the seriousness of pollution. In fact, at most times, they even do not know what a pollution is.

Pollution problems can be dealt with the three classes as (i) Air Pollution Control (ii) Water Pollution Control (iii) Solid Waste Management. Even though industries are the major source, other significant sources can be enumerated as domestic and auto-exhaust emissions from air pollution point of view. Air pollutants are further classified as gaseous and particulates.

For the distribution of air pollutants through the ecosystem, climatic conditions play an important role. Indian climate in general can be described as hot and dry. This favours the upliftment of crystal as well as manmade particulate matter in the atmosphere (Table 1). The anthropogenic activities are mostly responsible for the contribution towards the particulate contamination in highly significant way and in alarmingly hazardous form. Indian coal which is the major component in production of energy and additional domestic fuel, is also high in ash content aggravating the dust problem in the environment.

TABLE-1

AIR QUALITY STATUS IN INDIAN CITIES

City	SO^2 $\mu g/m^3$	SPM $\mu g/m^3$	Dust Fall MT/KM^3/ Month
Bombay . . .	20—83	197—284	8—19
Calcutta . . .	28—80	413—517	21—37
Delhi . . .	Tr –39	296 - 481	12 - 30
Hyderabad . .	26 - 27	255 –295	12 - 20
Jaipur . . .	Tr – 17	222 – 379	12 – 16
Kanpur . . .	10 – 25	206 – 344	24 – 35
Madras . . .	10 – 25	106 – 169	8 – 12
Nagpur . . .	10 – 12	169 – 386	8 – 88

Source : *NEERI NAQMN Report* 1985.

These dust particles are mostly less than 20 μm in size which imparts them the property to remain suspended in air for quite a long time. General effects of these suspended particulate matter on the ambient air quality are the impairment of visibility and increase in soiling index.

This particulate matter may be organic or inorganic depending on the generation processes. Inorganic particulate matter mostly consists of cations and anions of all the elements present in geological matrices. With advance of technology and precise instrumentation, it has been possible to detect the microquantity of these elements. Some of these elements are highly toxic to human beings even if present in traces. Lead is probably topping the list in the toxicity of heavy metals.

Sources and levels of lead in the environment

The local, regional and global biogeochemical cycles of lead have been affected by man to a greater degree than those of any other toxic element. In fact, few areas on earth are now free from anthropogenic lead and urban centres can be regarded as hot spots for lead where levels exceed those of pre-technological times by several thousand fold. As a result of worldwide accumulation, especially in urban centres, lead presents a more serious environmental and health hazard than does any other element.

The major source of lead in the environment is the autoexhaust emissions. Lead is added to the petrol to increase the high octane rating and measure for antiknock for smooth and easy running of vehicle. Generally, 0.3 to 0.6 g of tetraethyle or tetramethyl lead is added to one litre of gasoline. During combustion, these lead compounds undergo thermal and oxidative breakdown and reformation with combustion products of gasoline. In addition to this, lead is emitted by industrial activities of man such as smelting, casting, paint and pigment manufacture and printing industry. These industries emit lead in particulate form. It is reported that the lead pollutants in the atmosphere (samples taken near heavy traffic and in isolated location) are predominantly in the form of small particles, with a mass median equivalent diameter of approximate 0.25 microns. Particles of this size may remain air-borne for long periods of time and can be absorbed by respiratory tract.

The levels of lead content ($\mu g/m^3$) in the suspended particulate matter of three Indian metropolies namely: Calcutta, Bombay and Delhi is as follows:

Bombay 0.496 (mean) 1.563 (max)
Calcutta 1.77 (mean) 5.199 (max) and
Delhi 0.35 (mean) 1.5 (max)

Ambient levels of lead in air, water and food samples in Indian continent show wide variation and highly significant quantities as shown in Table 2. Lead intake *via* food is also the major source of lead to humans in India and can account for about 0.4 mg of daily intake, Lead as a constituent of coal and crude oil ranges widely from 0.7-220 in coal to 0.014 to 30.0 crude oil.

TABLE-2

AMBIENT LEVELS OF LEAD IN AIR, WATER & FOOD SAMPLES IN INDIA

	Lead ppm (range)
Air $\mu g/m^3$	0.513 (0.091—1.99)
Food grain (mg/g)	0.69 (0.55—1.05)
Vegetables (mg/g)	0.74 (0.20—1.05)
Fruits (mg/g)	1.7 (1.8—2.5)
Water (mg/l)	0.013 (0.008—0.23)

Biogeochemistry and cycling of lead

Lead specification: Lead can exist in both inorganic form as Pb II & Pb IV and in organic form upto 4 Pb-C bonds. It seems that most of the organometallic lead finds its origin from the volatilization of gasoline additives. About 5% of these additives are emitted uncombusted to air. However, the flux of organometallic compounds is significant only on localised basis while inorganic lead flux is of global importance (Table 3).

Toxicity of Lead: Lead when present in suspended particulate matter finds its way in the human body through nasal openings (Table 4). The amount of this element absorbed or retained is a function of particle size, density, solubility and concentration. Once particles enter the human body, they get deposited on the walls of trachea wherefrom they are absorbed in the blood. This element acts as a cumulative poison. Lead symptoms are referred as plumbosis.

Lead damages liver and kidney and causes mental retardation in children and abnormalities in fetus. Table 6 elaborates major health effects attributed to lead in environmentally exposed populations.

Lead is especially toxic to children and the young ones of other species. A number of recent detailed studies aimed at assessing the health effects of chronic-lead exposures in children have revealed significant

effects on intelligence and on neuropsychological performance. Also excessive lead fallout may adversely affect some aquatic and terrestrial food chains. If nations are to protect their most valuable resources—their children and their environment—it is important to identify possible problems with lead and prevent them, or failing that, identify high risk situations and take remedial measures.

TABLE-3

ESTIMATES OF GLOBAL FLUX OF LEAD TO AIR FROM NATURAL SOURCES (in 10^9gm/yr)

Source	10^9 gm/year
Wind blown dust	16.2
Volcanogenic	6.4
Forest fires	0.5
Vegetation	1.6
Seasalt spray	0.02
Total	23.72

TABLE-4

GLOBAL ESTIMATES OF ANTHROPOGENIC EMISSIONS OF LEAD TO THE ATMOSPHERE

Source	Lead (10^9 gm/yr)
Gasoline & Waste oil combustion	177
Waste Incineration	8.9
Coal Combustion	14.0
Nonferrous metal production	85.0
Iron & Steel	50.0
Wood Combustion	4.5
Phosphate fertilizers	0.1
Miscellaneous	13.3
Total	354.0

TABLE 5

MAJOR METABOLIC FACTORS ASSOCIATED WITH ENVIRONMENTAL EXPOSURE TO LEAD

Metabolic Factor	Effect
Major routes of entry	Ingestion & inhalation
Gastro intestinal absorption %	10
Organs of accumulation	Bone, Kidney & Liver
Major routes of excretion	Urine
Biological half life	20 years

TABLE-6

MAJOR HEALTH EFFECTS DUE TO ENVIRONMENTAL LEAD EXPOSURE

Organ affected	Range of effects reported
Haematological system	Inhalation of AIA-d (d amino levulinic acid dehydratase) and haem synthetase and corresponding accumulation of ALA and FLP (free erythiocyte plrotoporphyrin). At higher levels of exposure reduced haem synthesis & anaemia.
Nervous system	CNS (Central Nervous System) impairment at moderate exposure in children, reflected by inattention, cognitive difficulties, fine motor dysfunction and altered EEG patterns under heavy exposure encephalopathy may arise.
	Effects on the peripheral nervous system (PNS) indicated by reduced nerve conduction velocity.
Renal System	Functional impairment of the tubular region characterized by mild aminoaciduria, glucosuria and hyper phosphaturia. Morphological effects include mito-chondrial damage and intramuscular inclusion bodies. Long-term heavy exposure may result in irreversible nephropathy.

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PREVENTION OF ROAD TRAFFIC ACCIDENTS—Role of Health Services

MAJOR V.M. MALHOTRA

Improved standard of living and population explosion have resulted in rapidly increasing vehicular density on our roads. On the other hand, environment on our roads have not shown corresponding improvements except in few metropolitan cities. The net result of these is an increasing incidence of road traffic accidents, which has emerged as an important public health problem in our country.

Growth of transportation system is a continuous process and is related to economic growth, industrialisation, urbanisation and increase in population.

Road traffic accidents are global phenomena and it is estimated that about 2.5 lakh lives are lost every year in the world due to these accidents. Although road traffic accidents are a major public health problem in industrialised nations because of more number of vehicles and greater vehicle mileage, the injury and fatality rates are higher in developing countries.

Extent of the problem in India

According to a study carried out by National Road Transport Council and Trauma Care Association, at least 25,000 lives are lost every year due to road accidents in our country. India has only one per cent of the total number of vehicles in the world, but accounts for nearly 6 per cent of the total road accidents. The accident rate in India is 34.6 per ten thousand vehicles, while the rates in Western countries vary between 4.8 (Sweden) and 14 (USA).

The road traffic accidents result not only in injuries or deaths but are also associated with various medico-social aspects and economic implications as shown in Table—I.

It is estimated that India loses about Rs. 400 crores every year on account of accidents on our roads.

Causes of road traffic accidents

The causes of road traffic accidents are:

A. Faults of the driver

B. Defects in design or maintenance of vehicles

C. Accident prone road environment

TABLE I

MEDICO-SOCIAL ASPECTS OF ROAD TRAFFIC ACCIDENTS AND THEIR ECONOMIC IMPLICATIONS

	Medico Social Aspects	Economic Implication
A.	Victims are usually young active persons and often earning members of the family.	Economic hardship to the whole family.
B.	Multiple injuries are not uncommon. Head and spinal injuries and multiple fractures require specialised Medical care, prolonged hospitalisation and convalescence.	Cost of Medical care plus loss of man days.
C.	Permanent disability or death.	Loss of skilled personnel due to permanent disability or death plus cost of rehabilitation.
D.	Miscellaneous.	Damage to vehicle, road, bridges etc., insurance and compensation.

Epidemiological investigations of the accidents have shown that in majority of the cases, it is the interaction of the two or all of the above factors which results in an accident. Moreover, human behaviour plays an important role in the aetiology of the accidents.

This concept has been shown in a diagramatic form in figure 1 and few examples (Table-II) will help in understanding the concept.

Role of health services in prevention of accident

Current strategies of prevention of road traffic accidents include intersectoral coordination among various Governmental and non-governmental agencies at national, regional and local levels to plan, implement and evaluate national transport policy which incorporates road safety as its integral part.

There is also need for development of national reporting system, improvement in road environment, incorporation of safety factors in design of vehicles and development of appropriate legislation and its enforcement. Health services have a role to play in all of the above activities, which are primarily multidisciplinary requiring intersectoral co-ordination and community participation. Health services will have more direct role to play, to promote epidemiological studies on the accidents, and in establishment of emergency care services including specially equipped vehicles to provide medical care at the site of the accident and during evacuation to nearby hospital.

Role of health education

Studies in developed countries have established that behaviour of road users is a major contributory factor in large percentage of the accidents. The aim of educational approach should be to bring about behavioural modifications in the road users to prevent accidents as well as to limit injuries.

The target groups for educational programme will include:—

(a) Education of general public through AIR, Doordarshan, posters, print media, observation of road safety weeks and exhibitions.

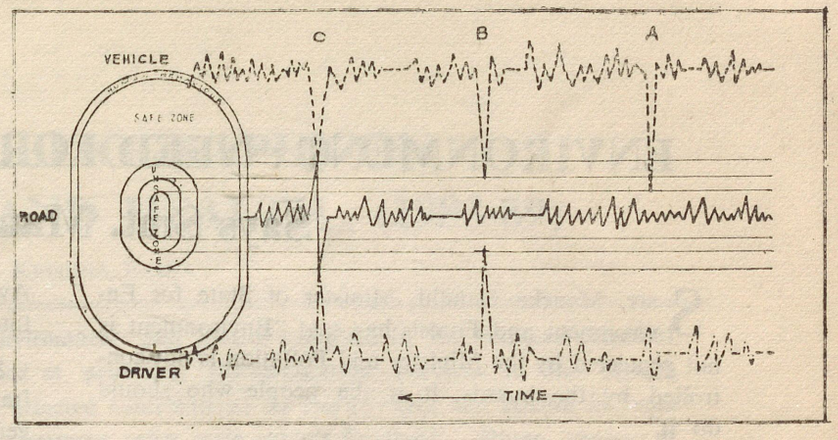

Fig.1. Shows the aetiology of accidents.

(b) Education of school and college students.

(c) Education of special groups, e.g. vehicle drivers, industrial workers, personnel of Armed Forces, etc.

(d) Training of public health personnel, teachers, road engineers, police personnel and social scientists.

Health education messages should stress on

(a) The extent of the problem, its medico-social and economic implications to the victim, family, community and nation.

(b) The benefits of road discipline, use of protective measures, e.g., helmets and seat belts and preventive maintenance of vehicles.

(c) Role of alcohol and drugs.

(d) Principles of First Aid.

TABLE-II

Sl. No.	Accident Scenario	Causation of Accident	Human Behaviour
1.	Mr A is driving a truck on a highway; due to sudden break-down of steering system, he loses control over his vehicle and collides with a tree	Here defect in vehicle has played a major role in causation of accident (Point 'A' in Fig. 1).	Mr A carries preventive maintenance of his vehicle and during one of the inspections detects cracks in the steering system; timely replacement of defective part prevents the accident.
2.	Mr B is driving his car after consumption of alcohol. The right front wheel of the car deflates suddenly. He is unable to react to the sudden increase in 'system demand' and hits into a bullock cart and receives 'dash board' injuries.	In this example, defect in vehicle as well as sub-normal performance of the driver due to alcohol intoxication has resulted in the accident (B).	(a) Avoiding deadly cocktail of drinking and driving. (b) Timely replacement of worn-out tyre. (c) Use of seat—belt.
3.	Mr C is returning from hospital where his daughter is admitted. He is preoccupied and worried. A dog suddenly comes in front of his vehicle and Mr C, in an attempt to avoid accident, skids and receives head injury.	Interaction of sub-optimal driver performance, road environment and inherited instability of two-wheeler has resulted in the accident (C).	(a) Avoiding driving when mentally less alert. (b) Destruction of stray animals. (c) Wearing of helmet.

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ENVIRONMENT : NEED FOR PEOPLE'S MOVEMENT

—Says Smt. Maneka Gandhi

SMT. Maneka Gandhi, Minister of State for Environment and Forests has said "Environment is not protected by the Ministry and Pollution is not controlled by the boards; it is the people who should do it".

She was speaking at a function to observe the first anniversary of the adoption of 'Sunderbans Protocol' on environment protection on 1 February, 1990 in New Delhi.

"As the Minister of State for Environment and Forests, I am not a repair mechanic. I am an architect and you are designers of a harmonial nature," Smt. Maneka Gandhi said.

The day was being observed as the "environment protection day" by the Pollution Control Boards in different parts of the country, including the Central Pollution Control Board in the capital. "The Government and the Boards can only act as catalysts. Law can only play a small part. There is a need for a people's movement", she said.

In a speech delivered with intense feeling and passion, Smt. Maneka Gandhi urged the audience to ponder over her words long after they left to the cosy 'artificial' warmth of their homes. "Change your lifestyle", was her message.

Practical tips

She gave lots of practical tips for the audience to follow in their effort to protect the environment. "Stop smoking, for instance. A weed has been turned into a crop. Stop using plastic, a non-biodegradable material. Like in the United States we will one day be drowned in plastics. So use jute or paper bags. Avoid using all non-recyclable products. Use substitutes for wood, in panelling for instance".

She called upon the people to work within the framework of nature instead of fighting with it. "The very presence of occupational hazards is a telling comment on our lopsided policies which results in the mismanagement of environmental systems."

"For instance, we do not need all this artificial lighting and air conditioning in this FICCI auditorium if the planners cared to build it in tune with the nature. In that respect our ancestors were much more wise than us", she said.

"We should not fight nature. We not only failed to conquer it, but in the process have become sick and our hospitals are full of patients suffering from environment related diseases". She described the swelling slum population as "environmental refugees. We put the life support systems like forests in the hands of greedy contractors who rob the means of livelihood of the rural population".

She stressed the need to look at environment with a "futuristic view". "The natural environment has limited resilience. When its endurance snaps either it breaks down or retaliates. And you have what we call as natural calamities", she said.

Striking feature

Smt. Maneka Gandhi described the Sunderbans Protocol, adopted at the 28th Conference of Chairmen and Member Secretaries of the Central and State Pollution Control Boards on this day last year at Sunderbans, West Bengal, as "beautifully worded and its striking feature is its appeal to all of us".

—M. L. Mehta

Contd from Page No. 93

Improved standard of living and population explosion have resulted in rapidly increasing vehicular density on our roads. On the other hand, environment on our roads have not shown corresponding improvements except in few metropolitan cities. The net result of these is an increasing incidence of road traffic accidents, which has emerged as an important public health problem in our country.

Health services in its march towards the goal of 'Health for All' has to be vigilant about the changing disease pattern brought about by changing social, economic and environmental factors. Road traffic accident is one of the various disadvantages of modernisation and deserves timely and all out efforts to keep health services in 'drivers seat' in its drive toward the goal.

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SMT. KRISHNA BASRA

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STATEMENT ABOUT OWNERSHIP AND OTHER PARTICULARS ABOUT NEWSPAPER SWASTH HIND TO BE PUBLISHED IN THE FIRST ISSUE EVERY YEAR AFTER LAST DAY OF FEBRUARY

FORM IV (See Rule 8)

1.	Place of Publication	New Delhi
2.	Periodicity of its Publication	Monthly
3.	Printer's Name	Manager
	Nationality	Indian
	Address	Government of India Press, Coimbatore (Tamil Nabu)
4.	Publisher's Name	Dr (Smt) N. A. Nath
	Nationality	Indian
	Address	Director Central Health Education Bureau, Directorate General of Health Services, Kotla Road, New Delhi-110 002
5.	Editor's Name	M. L. Mehta, Sr. Sub-Editor
	Nationality	Indian
	Address	Central Health Education Bureau Directorate General of Health Services Kotla Road, New Delhi-110002.
6.	Name and address of Individuals who own the newspaper and partners or shareholders holding more than one per cent of the total capital.	Nil.

I, Dr (Smt) N. A. Nath, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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Dr (Smt) N. A. Nath,
Director

New Delhi
8 March, 1990

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ISSUED BY THE CENTRAL HEALTH EDUCATION BUREAU (DIRECTORATE GENERAL OF HEALTH SERVICES), KOTLA MARG, NEW DELHI-110 002 AND PRINTED BY THE MANAGER, GOVERNMENT OF INDIA PRESS, COIMBATORE-641 019.

No.D—(C)359
Reg. No. R. N. 4504/57

WORLD NO TOBACCO DAY, 1990

"GROWING UP WITHOUT TOBACCO"

"The health consequences of tobacco consumption have always been a cause of great concern to me. WHO may be a late starter, but it is an important partner in the control of tobacco use". It was with these words that Dr Hiroshi Nakajima, Director-General of the World Health Organization (WHO), concluded the meeting of the Technical Advisory Group on Tobacco or Health which met in Geneva from 28 to 30 November, 1989.

This group of experts, charged with advising the Director-General on action to combat smoking, was composed of specialists from 12 countries and territories.

The group reviewed and supported the activities of the WHO Tobacco or Health Programme during the last year and formulated suggestions for the future. The collection of statistical data on smoking-related deaths was identified as a priority, to provide backing, especially in the developing countries, for WHO's continued appeal for the control of all forms of tobacco use.

The support given by the members of the Advisory Group on Tobacco or Health and Dr Nakajima's reiteration of WHO's commitment to the establishment of a tobacco-free society clearly indicate that there will be no remission in the campaign to control smoking and its harmful effects on health. The doubling of the Organization's budget for these activities in the space of a year is eloquent proof of its commitment.

The Director-General of WHO also stressed that "priority will be given to the requirements of the developing countries, paying due attention to their economic concerns" and that "activities aimed at women and children will be emphasized". It will be noted that **the slogan selected for the next World No Tobacco Day on 31 May 1990 will be "Growing up Without Tobacco"**, and attention will focus on the danger of smoking for children and young people.