

CHANGING FACETS OF ENVIRONMENTAL ENGINEERING

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ABSTRACT

This paper entails the environmental challenges faced by environmental engineers, scientists, enlightened legislators and aroused public in the past and present. The mistakes that were committed and their impact on the future environmental issues are highlighted. Possible solutions both in terms of technological and human resource development are suggested.

ENVIRONMENTAL CHALLENGES OF THE PAST ERA

(1) Water as a Vehicle of Disease Transmission

Traditionally, environmental engineers were concerned with the control of epidemics of waterborne diseases. Water so essential for human health care can be scourge for human health if contaminated.

At the middle of the 19th century, the causative agents of many diseases like cholera, typhoid, dysentery, etc. were unknown. Prevalent at that time in the medical community was the miasmatic theory that attributed the epidemics to poisons in the air emanating from the "bowels of the earth". However, it was Dr. John Snow, Physician to Queen Victoria, who demonstrated the variety of his hypothesis which are lessons to us today. As per Snow (1855), "*the most terrible outbreak of cholera to occur in the United Kingdom took place in Broad Street, Golden Square and adjoining streets where within 220 metres of a popular well, more than 500 fatal attacks of cholera occurred in 10 days. The persons who did not live in Broad Street but carted water from Broad Street pumps died of cholera*".

This study was the first confirmation that cholera is waterborne and the handle of the pump was removed so that the contaminated water did not become a scourge for human health. This is the first recorded implementation of an appropriate measure to prevent the transmission of waterborne diseases. This action was taken significantly decades before the germ theory of diseases was "scientifically" established.

The introduction of filtration and chlorination around the turn of the century virtually eliminated waterborne enteric diseases in the industrialised world. The confidence reposed in modern filtration and disinfection is so much that many cities in the United States elected to take water from polluted water resources because they were lower in cost, even when options for higher quality water were available. Many developing countries also followed suit. However, the higher risk in these cities from human frailties has led to many instances of serious outbreaks of diseases despite the presence of modern filtration and disinfection facilities - New Delhi in 1955 with more than 50,000 cases of infectious hepatitis was an example.

As we were thinking about handling the waterborne diseases, another health-related environmental issue namely transmission of cancer through water route cropped up in the middle of the 20th century.

(ii) Water and Cancer

The great industrial revolution that followed World War II introduced into the world, the environment, and into water resources - surface as well as ground waters, thousands of synthetic organic chemicals. Most of them

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were designed to be highly toxic to troublesome biota and other fellow creatures and designed also, for economic reasons, to be conservative in the environment for producing long-lasting effects. These anthropogenic chemicals and pollutants were new to biological systems of the environment and remained for a long time. Until the publication of famous "*silent spring*" by Carson in 1962, the society was totally ignorant of consequences of introducing such chemicals into the environment. These anthropogenic organics got bioconcentrated and biomagnified through eutrophic food chains to reach ultimately man. The presence of DDT in his blood, even in mothers' milk highlighted what type of environment we are handing over to our younger generation. Around the 1970's, the USEPA found hundreds of organic chemicals in drinking water sources, a high percentage of which were believed to be carcinogenic to animals.

Another critical issue that was first recognised by Joshua Lederberg, Nobel Prize geneticist in 1969 had sent shock waves in society. He noted "*we are so much accustomed to using chlorine that we tend to overlook its toxicity*". Chlorine with such a reactivity may eventually reach and react with DNA causing mutagenicity. Following this in 1974, Rook, in The Netherlands, demonstrated that chlorine was responsible for producing trihalomethanes (THMS), which are carcinogenic to animals.

ENVIRONMENTAL ISSUES OF THE PRESENT ERA

The scope of environmental engineers and scientists has expanded many folds over the past few decades. The issues we face today are the same ones that we had encountered more than 25 years ago at the first Earth Day celebrations in 1970. Many of the large cities continue to be smoke-laden, our beaches polluted by oil spills, and many of our rivers and lakes still suffer the effects of poorly treated sewage and industrial wastes. We have, however, made progress in terms of lower emission rates per capita and per unit economic activity. Most of the cities have cleaner air and most lakes and rivers are more fishable than they were two decades ago.

Unfortunately, as we made progress in certain areas, new problems have developed that will prove

to be more intractable than those encountered. These new environmental challenges tend to involve less visible pollutants that have longer response times. To cite a few examples - the link between chlorination of water and cancer has created a lot of confusion among environmental engineers. It is significant to note that despite the absence of adequate, hard and scientific proof of this linkage, the new regulations for drinking water quality in the last quarter of the 20th century have been based on cancer risk.

The ubiquity of the electronic media and the spread of news that EPA is urging reduce chlorine use has induced many authorities in developing countries even to abandon usage of chlorine. The resurgence of waterborne diseases in developing countries as a result of reduced use of chlorine in water treatment has become prevalent which the present day environmentalists have to tackle.

The outbreaks of cryptosporidiosis in the highly developed countries are indicators of the reduced dose of chlorine as disinfectant and inadequacy of modern filtration facility to remove the cryptosporidium oocysts. The diarrheal disease caused by this protozoan is prevalent among "immono-comprised" which includes AIDS patients, cancer patients, the very young, the sickly and the elderly.

Another invisible pollutant that we cannot see is radon gas in our houses. The question of how safe are our homes became more pertinent when it was realised that the earth-derived building materials like bricks, concrete tiles and even ground water supplies contain radon which emits radiation that causes lung cancer. While taking a shower, we are exposed to more radon than when reading a newspaper in the drawing room.

The new environmental challenges which are global in scope are carbon dioxide and methane that cause global warming, the chlorofluor carbons (CFCs) that are attacking the protective ozone layer, the carcinogens that have contaminated our ground waters and the lake that no longer supports biota though looks much cleaner than before was sterilised by acid rain.

In the past, we were worried about the automobile emissions and their effects on air quality in cities where we lived. Now, we must consider the impact of some cars on the earth's climate as well as the ozone layer of the entire planet. These pollutants indeed need not

worry about getting visa or entry permits. We have now understood that what we do in our backyard affects the entire ecosystem and conversely what others do affect us. The methane released in the paddy fields of India and Indonesia and bleaching of cattle affects the planet's climate. Further, the newer environmental challenges seem to have longer response times. The hydrocarbon-contaminated soils may require decades to get cleaned up, aquifer contaminated with toxic and hazardous chemicals continue to be a threat to human health, the CFCs emitted today will stay for decades, CO₂ will stay in the atmosphere for centuries and our radioactive wastes will be problematic for thousands of years.

POSSIBLE SOLUTIONS

The purpose of this paper is not to create panic but to take stock of the situation and suggest possible solutions. Environmentalists are often mistaken as revolutionists - but it is not so. He is a professional trying to find out solutions for the environmental challenges.

The most recent cryptosporidiosis outbreak in the industrial countries may be controlled by drawing the water from a relatively cleaner source than a polluted

one and more importantly, protection of the water shed is to be underlined.

The global problems need really local solutions rather than global solutions. The reduction in carbon dioxide emission can be achieved by turning our attention towards non-polluting technologies such as solar-thermal systems for heat and electricity, wind electric systems for electricity generation, and biomass for portable fuels. Research in these areas should be encouraged particularly in the Caribbean region.

The complete elimination of ozone-depleting CFC should be aimed at, as against the Montreal declaration for 50% reduction in CFC use by 1998. Development of new refrigerants and improved thermal insulation that do not use CFC should be encouraged.

Encouraging reforestation and the halting of deforestation can go a long way in reducing the carbon emission. Urban reforestation is an effective way since not only carbon can be sequestered by trees themselves, but the resulting shade can reduce urban temperatures and decrease air-conditioning loads.

The future habitability of our planet will be determined by actions taken by this generation, which is alive today. Let us as well play our part. ■