Cecil J. Saldanha
St. Joseph's College, Bangalore

MANAGEMENT OF THE EARTH: A RESPONSIBLE RESPONSE

The Earth, A Fragile Miracle

The last decades of the 20th century are giving us a peep into an awe-inspiring universe. Manned space ships and unmanned space probes have produced unprecedented portraits of some of the four inner and five outer planets of our solar family. Large array radio-telescopes on earth and the Hubble telescope in space are reaching out to distant galaxies and witnessing to the birth and death of stars. The 'Eye of Science' has given us a stupendous vision that exhilarates man seeking to understand and philosophise about the origin of the universe and its relation to the 'Lord of the Universe'.

There have been profound changes in our vision of the cosmos around us. The Babylonian, Hindu, Chinese and Judaeo-Christian cosmogonies, to mention but a few, have presented the origin and structure of the universe in different ways. Ptolemy in his *Almagest* placed the earth at the centre of the universe. The geocentric concept dominated western thinking for over a thousand years. Copernicus in his *De revolutionibus* (1543) replaced the earth with the sun and gave us a heliocentric universe. Modern instruments and the advances in the physical and mathematical sciences have unlocked several secrets of the celestial bodies. The solar system has been so dwarfed by the discovery of mighty galaxies that the sun and the planets are seen as specs of dust on the outer arm of a whirling Milky Way.

Our increasing knowledge of the Universe has dwarfed the earth on the one hand, but on the other, it has enabled us to appreciate the uniqueness of the planet. Its land surface, derived from primeval *Pangaia*, is a mosaic of slowly drifting plates. The pressures built-up at the fractures between the plates are periodically released, causing earthquakes. Collisions between the plates can also result

in gigantic upheavals. When a chunk from *Gondwana* moved northwards some 60 million years ago, it collided with *Laurasia.* As a result it lifted the bed of the Tethys sea to great heights, forming the Himalayas. This range is still rising due to plate tectonics.

The earth is also a water - drenched planet. Seventy percent of its surface – ninety percent In the southern hemisphere and fifty percent in the northern hemishere is covered by oceans. The water is held together by gravity; it influences our climate by currents and winds with identifiable cycles.

What is even more interesting is the atmosphere around the earth. Its multiple layers – troposphere, stratosphere, mesosphere, thermosphere and exosphere – have well-defined compositions and functions. A particular percentage of carbon dioxide in the atmosphere regulates the amount of solar heat reflected back into space or trapped close to the earth. A layer of ozone between the troposphere and the stratosphere acts as a shield, protecting the earth from excessive ultra-violet radiations. Evaporation from water bodies results in atmospheric moisture and clouds. It is recondensed as precipitation of rain or snow.

The earth is the only known planet that supports life. Early life forms are supposed to have originated in the oceans. They had an anaerobic metabolism, releasing methane as a byproduct. A few million years later, aerobic organisms that could take in carbondioxide and release oxygen by a photosynthetic process made their appearance. These were blue-green algae or *Cyanobacteria.* The photosynthetic activity of billions of plantlets changed the composition of the earth's atmosphere reducing carbondioxide and increasing oxygen.

Some idea of the dimensions of this atmospheric change can be gauged by comparing the atmospheric composition and surface temperature of the earth with those of our nearest planetary neighbours- Mars and Venus, both devoid of living organisms. Venus, at an average distance of 108 million kilometers from the sun, has an atmosphere that is 96 percent carbondioxide, 3.5 percent nitrogen and less then 0.01 percent oxygen. Its average surface temperature is around 450 degrees Celsius. Mars, our other neighbour, at an

average distance of 228 million kilometres from the sun, has an atmospheric composition resembling that of Venus, with 96.5 percent carbondioxide, less than 1.8 percent nitrogen and less than 0.01 percent oxygen. The average surface temperature on Mars is minus 53 degrees Celsius. The earth, orbiting around the sun at an average distance of 150 million kilometers, has an atmosphere with only 0.03 percent carbondioxide, 78 percent nitrogen and 20 percent oxygen. The earth's average surface temperature is 15 degrees Celsius. Such conditions can support the many living organisms inhabiting the earth in a narrow zone near the surface of the earth known as the 'biosphere'.

There is constant interaction between the various factors in the air, in the water and on the land. This has led to a remarkable stability, known as *homeostasis*. Small fluctuations can be tolerated and are being compensated for by a self-regulatory process. So wonderful is the system as to merit for the earth the label 'Miracle Planet'.

However, sudden and drastic changes have taken place and ended up as catastrophies, especially for the different life forms on the planet. These events are far between. In the last 600 million years, five major extinctions have taken place. During the last mass extinction at the end of the Cretaceous period, the mighty Dinosaurs (made familiar by Spielberg's 'Jurassic Park') were annihilated after dominating the earth for more than 120 million years. Under stress the miracle planet has proved to be fragile.

Man on Earth

New life forms have appeared on the planet after these mass extinctions. The tertiary period that followed the Dinosaurs was one of rapid expansion for mammals on land and fishes in the sea. About 200,000 years ago, an erect mammalian primate, 'Homo sapiens'; appeared on earth. During most of the time since his coming, Man (the 'Homo sapiens') has had a marginal impact on the dominant forces of nature. He discovered fire about 50,000 years ago and could use it to release the stored energy in fuel wood and fossil coal. The invention of the wheel, combined with the domestication of animals, helped humans in locomotion and

transportation. Man also developed agriculture. He reared animals. He manufactured things by his artisanal skills. His paintings left us images that go back several thousand years.

A quantum jump in human activities occured two hundred years ago, when coal, the boiler and the engine ushered in the 'industrial revolution'. The textile mills and the iron foundries, characteristic of this revolution, shifted production from the local guilds to congested factories. Powerful nations scoured the globe for raw materials, dominating weaker nations in their quest. Capitalism and colonialism were the eco-political systems created during this period. Older social structures crumbled; living patterns changed, leaving some better off and many more impoverished.

A further increase in industrial activity was ushered in by electricity, petroleum and the combustion engine. Electricity was 'clean' when compared to coal. It could be distributed over large areas and harnessed for diverse operations. It worked machines, ran locomotives, lighted streets, cooked food and warmed homes. The petrol-driven combustion engine contributed to mass transportation. It also enhanced mobility on land, in the sea and in the air.

The second half of this century has seen a greater spurt in scientific and technological advance than in the entire previous history of man. "Molecular biology, recombinant DNA, nuclear fission, solar power, jets and rockets, space exploration, automation, lasers, television, electronic data processing, systems analysis, super-smart computers and huge-scale design projects - all belong, as widespread phenomena, to the last forty years".

So rapid and so radical is this change that it is creating new life styles, power equations and global strategies. Alvin Toffler has captured the agony and the ecstacy of these developments in his trilogy, *Future Shock* (1971), *The Third Wave* (1981) and *Power Shift* (1990).

These technological changes are indeed remarkable. They have ushered in a century of unprecendented growth. Since 1900, the gross world product has increased more than 21 times, the consumption of fossil fuel 30 times and industrial production 50 times.

A Planet in Peril

There is, however, another side to this success story. Industries need raw materials, either renewable or non-renewable. The manufacturing process needs energy, generally coal-based, oil-based or electrical. The industrial process gives not only a product but also a waste product in liquid, solid or gaseous form. Each of these has an adverse impact on the environment. This impact is local in the initial stages. Coal-mining, for example, has created serious environmental problems in Bihar. Surface mining for iron ore has destroyed large portions of the Western Ghat forests in Goa. Discharge of effluents into the Ganga or Tungabhadra have degraded the quality of water in these rivers. The stack emissions of industries around Agra are damaging the Taj Mahal.

During the last three decades we have realised that not only the local but even the global environment is imperiled. The increased amount of carbon dioxide in the atmosphere is retaining excessive quantities of heat around the earth, leading to global warming, climate change and sea-level rises. Sulphur dioxide and nitric oxide emitted by our industrial smoke stacks are carried across national boundaries, and combine with water to form sulphuric and nitric acids. These mingle with atmospheric moisture and are precipitated as acid rain, destroying forests, acidifying fresh water lakes and leaching fertile soils. Chlorofluorocarbons used in several industries' irreversibly reduce atmospheric ozone to oxygen, thus creating an 'ozone hole' in the shield protecting the earth from ultraviolet radiations. The phytoplankton on the surface of the oceans and nucleic acids in living cells are affected by these radiations. Skin melanoma and eye cataracts have increased in regions around the arctic and antarctic due to the ozone hole.

The urban, industrial and agricultural wastes are seriously polluting coastal waters. Studies carried out on the waters of Chowpathy Beach in Bombay have shown high levels of sewage contamination. Out in the open seas the shipping lanes are polluted with oil slicks. Oil spills have damaged beaches, killed marine wild-life and affected fishing zones. The Mediterranean and Baltic Seas have become the sewers of Europe due to urban and industrial pollution. Radioactive wastes have been dumped on the depths of

the sea bed. Thus the physical as well as biological functions of the sea are threatened.

The story on land is no better. Larger areas on land are being converted into deserts every year by wrong use. Since India's independence almost one half of our arable land has become waste land.

The Planet Earth, known as the fragile life-supporting miracle, has recently been described as the poisoned planet. Most of this is due to a single species- 'Homo sapiens'. Ecology, the science of managing the earth, our only home, has understandably a high priority today. The Earth Summit at Rio was an expression of a global concern among the nations of the globe.

In an attempt at pinpointing the causes for the present situation, science and technology have sometimes been blamed. There might be some basis for this accusation. The inadequacies of science and techonology might be partially responsible for poisoning our planet.

In the early days of industralisation, the lacunae in industrial technology were many. Waste-products were often more abundant than the actual products. As awareness of the harm done to the environment increased, efforts were made to control wastes and the pollution they caused. It has now become mandatory to set up effluent treatment plants and install emission control appliances. Land rehabilitation has become obligatory in areas where wastes have been dumped, vegetation destroyed and soil fertility diminished. Official bodies have been set up to prescribe standards, and enforce them. A system parallel to the production system is emerging to manufacture pollution control equipment and operate it. Our efforts in India are mostly at this level.

Technological initiatives to reuse or recycle waste products form the next step. The waste products of one industry can often be the raw material for another industry. Thus, the fly-ash from a thermal power plant could be used for brick-making, soil improvement and road surfacing. Similarly, the bagasse from a sugar-factory becomes the source of pulp for the paper-industry.

There are some who look forward to a no-waste technology. While complete waste elimination might seem utopian, new methodologies can go a long way in reducing the pollution load. The right technology must be incorporated from the drawing board stage in the process itself so that all the raw-materials are consumed. We are far from this stage.

Man and the Ecological Crisis

At a deeper level, one looks at man rather than at science and technology as the root cause of environmental degradation. Ignorance, greed, aggression and arrogance are the real foes of the earth found within our own circle and society and perhaps within ourselves.

An inadequate understanding of the natural world and its laws is a potent cause of environmental disaster. Little knowledge is dangerous, either in banning or in advocating the products of modern technology. Human greed, especially the urge for greater profit, leads our planners and producers to take short cuts and promote developmental patterns which have environmentally disastrous consequences. Human aggression, especially when it erupts in armed conflict between nations, has resulted in untold damage. The Gulf War was an example of high technology used for mass destruction. Chemical, biological and electronic wars are now possible. Inspite of the thaw in the cold war, a nuclear conflagration is still a danger that the world cannot ignore.

Human arrogance, based on a misconception of man's scriptural 'dominion' over the earth, seemed to have set him apart from the rest of creation on earth. Today's theology of nature gives man a fellowship with the rest of creation. Some have gone further, suggesting a 'sacramental view' of the earth, which sees the whole of nature as both symbol and instrument of God's activity and presence. The Christian philosophers and technologists have an important role to play in giving man a responsible role in planet management.

References

Calder, Nigel & John Newell. *Future Earth.* London: Christopher Helm, 1988.

Brown, Bruce & Lane Morgan. *The Miracle Planet.* London: Merehurst Press, 1990.

Goldsmith & al. *5000 Ways to Save the Planet.* London: Hamlyn, 1990.

Myers, Norman. *The Gaia Atlas of Planet Management.* London: Pan Books, 1985.

Myers, Norman. *The Gaia Atlas of Future Worlds.* London: Robertson McCarta, 1990.

Russel, Collin. *The Earth, Humanity and God.* New Delhi: Research Press, 1993.

Toffler, Alvin. *Future Shock.* New York: Bantam Books, 1971.

Toffler, Alvin. *The Third Wave.* New York: Bantam Books, 1981.

Toffler, Alvin. *Power Shift.* New York: Bantam Books, 1990.

Tudge, Colin. *The Encyclopedia of the Environment.* London: Christopher Helm, 1988.

Whitefield, Philip. *Our Mysterious Planet.* London. Cassel. 1990.