

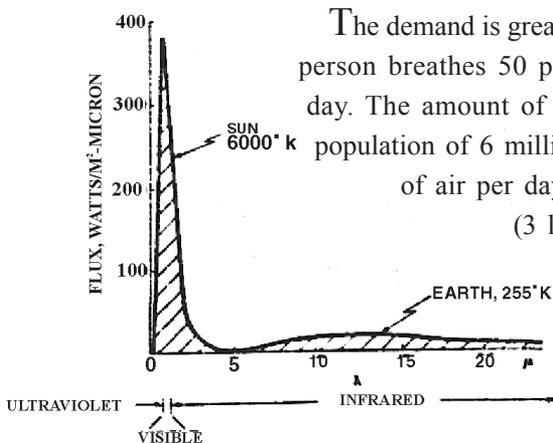
AIR POLLUTION—SOCIAL AND SCIENTIFIC ISSUE

History

**“Be it known to all within the sound of my voice,
whosoever shall be found guilty of burning coal
shall suffer the loss of his head.”**

—King Edward I, ca. 1300

Introduction



The demand is great for clean air. An average person breathes 50 pounds (22 Kg) of air a day. The amount of air breathed by a world population of 6 million is 300 billion pounds of air per day. Man consumes 1.5 kg (3 lb) of food per day.

Thus man takes 15 to 20 times the amount of air as food. This explains why we require pollutant concentrations in air to be in order of magnitude far lower

Thermal radiation to and from the earth.

than the concentration one would allow in food. Air pollutants also ultimately find their way to the water and food we consume.

Air Pollution means the presence in the outdoor atmosphere of one or more air contaminants or combination there of in such quantities and of such duration as are or may tend to be injurious to human, plant or animal life.

Ability to Pollute¹

With the onset of industrial age man's ability to pollute air began to overmatch nature's capacity to purify. Most of early pollution came from burning coal. Today, about 90 per cent of air pollution comes from man-made sources. More than 200 million tonnes of aerial garbage are thrown into the atmosphere each year resulting in an obvious increase in carbon monoxide, sulphur oxide, nitrogen oxide, hydrocarbons, photo chemicals and numerous particles such as smoke, ash, dust and fumes. Air pollution is costly. It ruins vegetation, makes paint peel and discolour, cracks tyres and deteriorates nylon, rusts iron and tarnishes silver, kills cattle, adds to house and clothes cleaning bills and blocks out the sun causing higher heating and lighting bills and more automobile accidents due to reduced visibility. Because high levels of pollution impairs photosynthesis air pollution reduces food production and timber harvests. Air pollution already a serious problem in many cities is becoming worse as urban populations grow and the number of motor vehicles rises.¹

In 1994 United Nations (UN) conference on Environment and Development (UNCED) in Rio de Janerio, Brazil, stressed the need for action about the worsening environmental conditions. The "Rio Earth Summit" set specific goals for environmental improvements. In 1997 a special session of Assembly- "Rio Plus Five" Conference met to assess progress towards these goals.^{6,17,18,20} The conclusions were discouraging. The conditions either were no better, than in 1992 or had worsened.¹²

Air Pollution and Health Hazards

Air pollution kills 2.7 to 3 million people every year—6 per cent of all deaths annually.^{19,21} Nine out of ten deaths due to air pollution take place in the developing world¹⁹ 2.5 million people—almost all in developing countries suffer from high levels of indoor air pollution. Most victims are women

and girls. Indoor air pollution occurs due to burning wood, cowdung and coal for cooking and heating.¹⁹ According to the World Health Organisation 700,000 deaths could be prevented in developing countries annually if three major atmospheric pollutions – carbon monoxide, suspended particulate matter and lead – were brought down to safer levels.^{2,21}

Death from lung cancer are twice as high in air polluted cities, not to mention the incidence of bronchitis and emphysema. Pneumonia, bronchial asthma and common cold are also in the same category. More than 2 million Americans are estimated to be sensitive to tobacco smoking and suffer smoke caused asthma attacks. There is an enormous increase in the incidence of cardiovascular disease and lung cancer which are directly related to smoking. The amount of toxic materials in the air varies geographically depending upon man made and natural sources in a particular area. In a society increasingly dependent on motor vehicles, these are the chief source of hydrocarbon emissions. These pollutants do react under sunlight to form photochemical oxidants that do affect people causing respiratory and conjunctival irritation, particularly with urban smog.

Indian Scene

In India 40,000 people are estimated to be dying annually by air pollution. In most cities in India, air pollution levels exceed the WHO recommendations. Six of India's largest cities - Mumbai, Calcutta, Delhi, Ahmedabad, Kanpur and Nagpur face severe air pollution problem with the levels of total suspended particles (TSP) at least three times higher than WHO standard, city of Delhi is most affected by pollution⁷.

Acid Rain

Emissions from vehicles and industries are polluting the atmosphere at an alarming rate. The nitric oxide and sulphur dioxide from emissions are converted into nitric acid and sulphuric acid in contact with moisture in the air and gets dissolved in the rain drops as sulphate and nitrate ions to precipitate as Acid Rain. Acid rain quickly erodes top soil of the earth and it's nutrients and has devastating effect on aquatic life. It reduces productivity of microorganisms in nitrogen fixing and decomposition. It hinders photosynthesis in plants and ability of plants to resist pest attacks.

When aquatic life like fish dies, their prey like beetles and larvae become pests in the surroundings. Because of wind motion the sulphur compounds emitted in one location may be removed from the atmosphere in a location many hundreds of kilometers downland. North East India, a region with thick forest cover may be particularly vulnerable to acidic disposition due to the movement of atmospheric pollution with predominant winter winds from South.¹⁶ Cancer causing dioxins found in Canada's Arctic have been linked to specific incinerators and smelters thousands of miles south in the US, Canada and Mexico ¹⁵

Air Odours

Air odours, harmful or not, present aesthetic problems. Congested urban settings, garages, streets, commercial establishments, poorly controlled factories produce poorly combination of odours; wood pulp mills produce sulfur emissions; food processing business such as baking, boiling, fermenting, distilling, canning, smoking and curing, slaughter house operations, animal carcasses infested with maggots and flies give out different odours.^[1]

Good Life

In the past hundred years the industrial gross national product has increased more than a thousand fold. The increased productivity along with technological innovations have contributed to the 'good life'. Good life has demanded a higher price than we are willing to pay. People under estimated their capacity to damage the environment. Municipal and industrial wastes merely had to be thrown away. 'Away' meant forty feet up in the air, a sewage or industrial pipe with an outlet into a stream or river. With the launching of 'Spaceship Earth' the concept of 'Away' has gone forever. It was impressed on everyone that earth represented a finite ecosystem and that there is no 'away'.¹

"I know we've come a long way
We're changing day to day
But tell me where do the children play?"

—*Cat Stevens : Tea for the Tillerman*

Air pollution is a concern not only to sick person but also to healthy

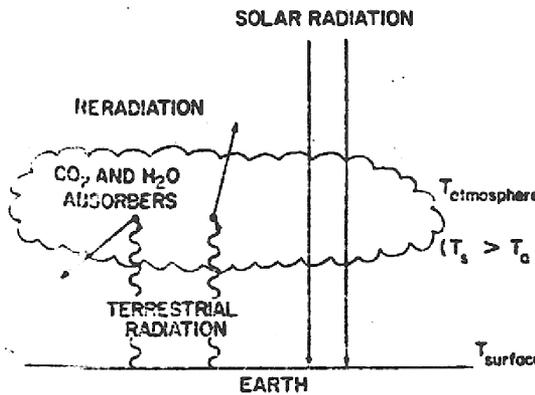
who want to be physically active in work and play. With increasing air pollution the increase in depth and rate of respiration exposes the individual to a greater quantity of pollution factors. The amount of pollutants absorbed increase as such as 14 times. More specifically an average individual at rest will inhale about 8 litres of atmospheric air per minute. During strenuous physical activity, the rate of inhalation may be as high as 115 litres per minute. The respiratory gradient between work and rest may be as great as 14. The Los Angeles School District has found it necessary to curtail playground activities and physical education classes when pollution factors exceed certain levels. "Vigorous and strenuous activities such as running, testing activities and team, dual and individual competition are prohibited during the time the school smog warning or Smog Alert is in effect". It might seem logical to consider curtailing all physical activity because of air pollution!

A statistically significant correlation between the level of oxidants in the air and the rate of assaults in New York city on a day to day basis (June 1, 1971 to May 31, 1972) ¹³ was observed by Robert Jarmon. Dr. Leroy Schieler considers sulfides a cause for suicides. According to him mental depression (and divorce rates, crime and admission to mental hospitals) is related to the levels of hydrogen sulfide pollution in the ambient air.⁵ Individuals in poor mental health are moved towards brink of self-destruction when polluted surroundings add to their misery.

Tobacco smokers and smoking in public places have come under increased social and political scrutiny. Nonsmokers have as much right to clean and wholesome air as smokers have to their so called right to smoke-right to pollute: It is time to ban smoking from all confined public spaces.

Metallic Pollution

Metallic pollution of air constitutes a major health hazard of this century. Toxic effects of lead and mercury are normally highlighted. Lead is now recognised as a major pollutant not only in mining areas, in industries, employing the metal or its salt and in water supplies but also as one of the toxic constituents of automobile exhaust gases in urban air pollution. The development of metallurgical, heavy engineering and various types



of chemical industries has given rise to new and complex problems of health hazards both for workers and the community at large. The impact on human health of the bio-geo-chemical cycling of a metal is determined by its physical, chemical and biological properties. Almost 96% of the total mass of any

organism is made up of oxygen, carbon, hydrogen and nitrogen; while calcium, phosphorus, sulphur, potassium and sodium, chlorine and magnesium make up about 3.6%. The remaining 0.4% is contributed by the so called 'toxic elements' or 'heavy metals' or those elements with a density above 4 g./cm³. From the health point of view some metals-iron, copper, zinc, manganese, cobalt are essential to life process. Some such as barium and aluminum. are not essential: some metals such as tin and arsenic are toxic and some metals like mercury and lead are highly toxic. All metals are probably toxic if ingested in sufficiently large doses. At higher concentrations trace metals become toxic. ⁴

Green House Effect ^{4, 6, 9, 12}

Most of our sources of air pollution are directly related to our need for energy—electrical power use, transportation, space heating and waste disposal. We tend to respond to the problems only after they reach the crisis stage, our lack of idea of global effects of air pollution is unfortunate. These major global effects from air pollutants produced by man and nature are Green House effect owing to CO₂, the effect of particulates on the earth atmosphere, heat balance and the effect of climate change from massive use and dissipation of energy. ⁴

Green house effect is the phenomenon attributed to the rise in global temperature and consequent rise in sea level. Increase in world population, deforestation, exhaust gases of industries and emission from vehicles in the carbon dioxide (CO₂) proportion in the atmosphere leading to increased

global temperature. CO₂ is the inevitable result of combustion process. There is 25 per cent more carbon dioxide in the atmosphere today than there was a century ago, the result of our burning coal and fuel derived from oil, methane, nitous oxide, and chlorofluro carbons are greenhouse gases as well.

Blame it on the Cow, Blame it on the Sun¹⁵

Australian scientists doing an inventory of green house gases came up recently with methane emissions. They trace the source to Australia's cattle which produce six and a half million pounds of methane annually emitted largely through burps. Belching and flatulence in cows and sheep produce an estimated 90 percent of Australia's methane emissions in agricultural sector. Whether it is the cow or the sun's rage we have to face the established bitter facts ¹⁵.

In the last 40 years the ocean surface - the top 1000 feet has warmed on an average of half a degree Celsius. The tropical waters in northern hemisphere have been warming up even faster - in fact, 10 times faster than measured global rate - because tropical oceans retain heat more readily than other seas ⁹.

In the stratosphere CO₂ and ozone dominate. In both regions, as the CO₂ builds up, absorption increases and it is more difficult for terrestrial radiation to get out into space resulting in increase in surface temperature. The glass in a green house is also transparent to short wave length solar radiation. But like CO₂ the glass absorbs the long wave length radiation emitted from inside the green house. The glass also reduces convective cooling of the plants by the outside air and this is the dominant effect-hence the origin of the term greenhouse effect. CO₂ level in air has increased (20.80 ppm in 1901 to 306 ppm in 1997 and 363 ppm in 1998 - the highest level since the time of volcanic activity over 1,60,000 years ago) by one and a half times and is feared to reach 660 ppm in 2025 AD. ¹²

CO₂ solubility is temperature dependent. Consequently initial earth CO₂ atmospheric build up might cause a rise in earth surface temperature. In turn causes release of CO₂ from the oceans as their temperature increases.

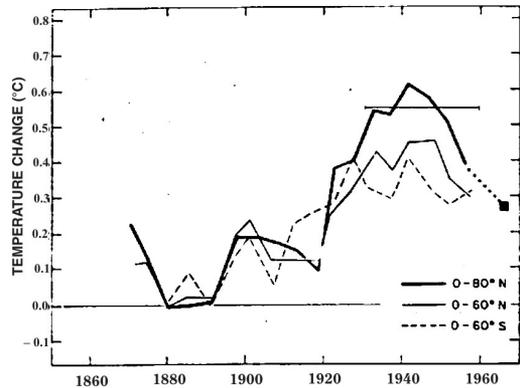
If temperature rise occurs in global surface temperature, some of the ice caps melt and there is a reduction of ice caps and sea level may rise by several meters and wipe out many islands and invade sea shores and

flood coastal cities. The projected earth's surface temperature by 2100 is between 1.0 and 3.5 degrees Celsius and global sea level gradually would rise as much as seven meters.^{6,9}

Effect of Fog

Local pollution takes place in the lowest layer of the atmosphere - the troposphere which extends from the earth's surface to about 16 km. (10 miles), a region where most weather occurs. In the weather phenomenon known as thermal inversion, a layer of cooler air is trapped near the ground by a layer of warmer air above. In this situation normal air mixing ceases and pollutants are trapped in the lower layer. Local topography and the shape of land can worsen this effect. Smog is intense local pollution trapped by thermal inversion.

Before the age of the automobiles most smog came from burning coal. In the 19th century London street lights were turned on by noon because soot and smog darkened the midday sky. Powered by sun light oxides of



Trends of hemispheric mean annual temperature for various latitude bands, 1870-1960. (Mitchell, in Singer, 1970a.)

nitrogen and volatile organic compounds react to produce photochemical smog. Smog contains ozone. Ozone irritates respiratory mucus membrane and damages vegetation. When ozone levels are high other pollutants like carbon monoxide are usually present. Smog causes headache, dizziness, breathlessness and mass illness and death. In 1952 in London 3000 people died in one notorious smog event. In 1984 in Bhopal, India when methyl isocyanate released from a factory caused more than 3300 deaths.¹²

Heat

Energy release by man in the form of heat is also a type of air pollution. Cities are warmer than rural areas. Man's energy dissipation also adds to global heating. The build up of particles (Aerosols) probably act to decrease

the ambient temperature to some extent.

Volcanos spew out sulphur dioxide and volcanic ash. Volcanos-pulverised lava rock can darken the sky over a wide region. Unlike pollutants from human activity, naturally occurring pollutants tend to remain in atmosphere for a short time. The earth's forests take up about one third of CO₂ released into the atmosphere. Forest fires not only release more carbon and volatile organic chemicals (VOC) into the atmosphere but also diminish the amount of CO₂ absorbed. As the world warms, vast areas of tropical forests would die out. Major droughts have been projected for sub-Saharan Africa as climatic patterns shift¹⁴. Soils in agricultural region in the Asia, Central Asia and Mediterranean region likely to experience reductions in soil moisture during summer. Huge amounts of arctic fresh water from melting ice cap would make the water less dense and interrupt the "Conveyor belt" effect of North Atlantic Drift, the ocean current that transports warm tropical water from the Gulf stream to Scandinavia and northern Europe - reducing crop yields in these regions.¹¹ Higher CO₂ levels would extend agricultural and forest growth in the short-run but have potentially negative effects on crops and forests in the long run and an additional 350 millions people would go hungry by the middle of this century. ^{3, 8, 10, 11, 12, 22}

Ozone which is rich in stratosphere between 16 kms (10 miles) and 50 km (20 miles) above sea level forms a protective layer by way of absorbing ultraviolet -B (UVB) rays. UVB damages deoxyribonucleic acid increasing the risk of cancer of skin. Several pollutants destroy ozone layer, main among them being chlorofluoro carbons (CFCS) which are used in refrigerants in air conditioners and as propellants in spray can.. CFCS molecules are indestructible until they reach stratosphere. Here ultraviolet radiation breaks the CFCS molecules releasing chlorine atom they contain. Chlorine atoms react with ozone breaking ozone into oxygen molecules that do not absorb UVB. Chlorine acts as a catalyst and a single chlorine atom can destroy upto 100,000 ozone molecules. Protective ozone layer is thinning in the Antarctic region. It disappears completely for a few weeks in the spring every year - 'Ozone hole'. Chlorine radicals already released will be making their way to stratospheres for decades to come. As a result experts anticipate higher incidence of skin cancers and cataract and reduced

yield of food crops. However recently scientists find that chlorine content of the air has peaked and it seems to be declining, because the giant chemical producer stopped making chlorofluoro carbon gases. Scientists expect the ozone hole will close and stay closed.

Magnitude of Problem

Problem of air pollution could be well visualised if one were to estimate the present land area covered by roads in our cities; how much the oceans would rise if the Arctic sea ice were to melt completely or Greenlands and Antarcotics would melt, consumption of oxygen by burning fuel and calculate what effect a change of global temperature of 10 percent would result and their effects on present generation, not to speak of the future.⁴

Remedy

Traditional lack of involvement and concern about environment pollution has to change, the shift should be from exploitation to recycling, from quantity to equality, from 'Private' client orientated law to public and environmental laws. An individual has a right to healthy air. The same individual has the right to be regulated to the ways of majority. On the one hand there is a need for legal controls and on the other hand a requisite for voluntary practice that will make controls less necessary. Self help groups with satisfying relationship with professionals have a large role to play to benefit all concerned.¹

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