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Environmental Pollution and its Impact on Human Health: Advances in Medicinal Chemistry for Detoxification and Disease Prevention

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Annotation: Environmental pollution remains a critical global issue that directly affects human health through complex exposure pathways involving air, water, soil, and food contamination. Despite growing awareness, there is a considerable knowledge gap in understanding the cumulative and synergistic health effects of emerging pollutants, including trace metals, endocrine disruptors, and airborne particulates. This paper presents an integrative review of environmental toxicology, highlighting epidemiological evidence, pollutant classification, and mechanisms of action, alongside recent advancements in medicinal chemistry for detoxification. The method involves a multidisciplinary literature synthesis across environmental sciences, toxicology, and pharmaceutical innovations, with a focus on phytochemicals, antioxidants, and bioremediation strategies. The implications underscore the urgent need for holistic health

frameworks, combining environmental monitoring, public health policy, and therapeutic innovation to mitigate pollution-induced diseases and support preventive health systems.

Keywords: environmental pollution, human health, detoxification, medicinal chemistry, phytochemicals, endocrine disruptors, air pollutants, bioremediation, public health.

1. Introduction to Environmental Pollution

Recently concern about the environmental pollution has increased due to its negative impacts on human health. Many countries have established or enacted the environmental pollution and occupational hazard acts, construction regulations, abatement treatment process selection, waste management regulations, and so on to minimize the environmental pollution effects. In spite of the regulations, unplanned urbanization and industrialization, untreated wastes, and overloading of waste is becoming major concern of today's world. Consequently, the effects of these are not only restricted to the water but also affecting soil, atmosphere, bio-life, and human beings. The affects to human beings from usage of treated or untreated waters for drinking, cooking, and/or from direct contact are skin disorder, liver damage, kidney failure, gastroenteritis (One or more of diarrhea, vomiting, stomach cramps, fever), brothers, skin cancer, breast cancer, colon or rectal cancer, repertory system problems, eye diseases, blond cancer, pit cancer, lung cancer proficient diseases, etc. Drinking the water/direct contact of such waters is also harmful for the animals health [1]. Changed drinking/water may symptoms to hair/furr fall, liver disorders, and so on. Many epidemiological and field studies have been conducted in developed counties regarding on the health effects of contaminated water but, due to the lack of awareness, no any scientific study has been done in world's youngest countries/depoorest areas. [2][3][4]

2. Types of Environmental Pollutants

Environmental pollutants are substances released into the air, water and land that can impair human health. Humans are exposed to a plethora of environmental pollutants of various origins, toxicities and persistence profiles. A greater understanding of basic toxicology processes is needed, so that the likely effects on human health of pollutants with mostly unknown toxicity can be anticipated. There is also an urgent need for more efficient screening methods to be developed, so that public health interventions can be targeted towards pollutants that may represent the greatest risk [5]. Constructs of multinational collaborative projects and extensions of existing frameworks can facilitate meaningful research into the health effects of the hundreds of thousands of environmental pollutants to which humans are exposed on a daily basis.

Detrimental effects observed in human populations exposed to environmental chemicals have served as motives for traditional environmental monitoring, yet there are many pollutants with highly toxic and persistent metabolites whose monitoring procedures are slow, expensive and sometimes entirely lacking. Emerging environmental pollutants are a further source of concern, as their interactions with organisms are essentially unknown. Therefore, understanding the likely mechanisms of health effects of world's functional toxicants might help in mitigating such hazards. It would allow the design of preventative measures against an exposure before the onset of illness, to offer a screening methodology for the evaluation of health risks associated with environmental pollution and also to interpret traditional toxicological endpoints observed by other means. The environmental health impacts of harmful chemical agents are among the most challenging issues in public health. The range of these toxic agents is extremely broad and includes preformed chemicals, chemical byproducts of human activities, plant constituents, and

natural geological substances.

2.1. Air Pollutants

The modern world is an era of industrial health hazards. The problem became much more starkly in the last five decades after the induction of industries for rapid development. It has been shown that, between the years 2012 and 2016, one lakh of human beings have been the victim of environmental pollution. The main air pollutants that are largely responsible for the problem of human health are largely CO2 and CO discharge. On the other hand the emission of harmful nitrogenous gases are also responsible for depletion of the O3 level in strata which at hand causes ultra violet radiation to penetrate earth, which causes painful diseases such as cancer. The existence of fluorocarbons in the environment also gives the same effect (depletion of O3) [6].

A recognition of the environmental levels to which people have been exposed and corresponding estimates of the extent of the population with such exposures, as well as analysis of personal observations, could allow epidemiological and/or toxicological studies to be devised to establish the major risk factors as a basis for rational regulation and abatement. This approach is exemplified in three examples, the first relating to urban air pollutant effects on human bronchopulmonary variability, the second to symptoms expressed by subjects allegedly sensitive to such pollution, and the third to the administrative classification of such pollutants. To this purpose, an electronic program has been developed, which processes, on the basis of meteorological data, emissions, and observations, the predicted values of the air pollutant levels which prevail in the urban Valleys of Milan and the measurement of individual vehicular emissions, originating from the State Administrative IV Division of Milan, official inspections carried out in the years from 1972 onwards.

The main air pollutants are: H2S, SO2, CO2, HF, Cl2, NH3, HC, NO, (O3 being a very much reactive), PAN. The effects of such air pollutants are: (i) Reduced life in the face of the living organisms, (ii) Depletion of crop production. The harmful effect is most manifested in the green vegetables, (iii) Induction of aches to different vital part of human body, doses are many other creatures, and (iv) It may cause the ulcers in aorta resulting in the fatal outcome. It is, therefore, utmost urgent to disposal of such harmful substances from the different factories. [7][8]

2.2. Water Contaminants

The Increase of Excessive Pollution in the Ecosystem by Human Activities

The environment is the natural and physical habitat in which living beings coexist. The environment consists of numerous aspects, such as the atmosphere, groundwater or surface water, animal life, plant life, minerals, agricultural land or farming systems, air, and human-made structures, among others. Environmental pollution refers to the harmful change in these natural and physical aspects. Pollution may be either one-time or long-term and may arise from natural phenomena like volcanic eruptions or human activities like fuel burning or the discharge of sewage and waste. There are numerous types of environmental pollution, such as air pollution, water pollution, soil pollution, noise pollution, nuclear pollution, and thermal pollution. Among these, studies of the contaminants in water will be discussed as it significantly impacts human health and other land and aquatic life.

Excessive pollution in the environment was reported because of industrial development, technological advancement, and imprudence. A phase of lockdown provided an accidental opportunity to study changes in air quality due to the closure of industries and decrements in transportation during the first wave in spring. The Ganga River is a transboundary river originating from the Himalayas, a major river system in South Asia with a large catchment area, and its water quality is deteriorating due to several human interferences. Excessive pollution is attaining a peak level and a recent trend of pollution is going to be very threatening. Various measures are required to improve deteriorative water quality and awareness to local people and stakeholders. A study conducted to assess industrial and water quality parameters to understand

the pollution status and calculate indices on human health hazard, water body pollution, and environmental pollution due to industries and assess environmental impact.

2.3. Soil Pollutants

Heavy metals get introduced into soil from atmospheric deposition, use of contaminated sewage sludge or fertilizers, metal-mining activities, metal processing industries, disposal of wastes and residues, manufacturing of fungicides, pesticides, and preservatives, brass foundries and numerous anthropogenic ways. Heavy metals, which contaminate soil, are usually classified into three categories such as essential elements, non-essential elements, and metallic elements.

Heavy metals get taken up by the plants from the soil and as a result, enter the food chain. Several heavy metals get accumulated in the body fat, kidney, and bone. Cadmium, which is present in the vegetables, is considered to be the major source of exposure. Phytoremediation is an emerging technology in which green plants are used for the clean-up of contaminated soil, gutters, sediments, and groundwater. In this approach, trees or plants absorb, degrade, extract, or contain the contaminants in their tissues. In recent years, research on potential health impacts, associated with the development of urban agriculture, has been introduced. The objectives of this study were to examine the heavy metals contamination of soils and vegetables and to assess the health risks associated with consumption of these vegetables. Eleven different heavy metals in the soils and vegetables were analyzed. The mean concentrations of Cd, Pb, and Ni in the soils exceeded the average soil background level.

One potential source of illness in humans and other living organisms has been identified to be the intake of heavy metal contaminated soil and water. There are many households that get drinking water from underground and many of which have been contaminated with heavy metals used in mining and industrial activities. Organic and inorganic toxic compounds are considered to be the second highest threat to public health. With the growth in the industries, the usage of land resources has become serious. Land pollution causes damage to the beneficial components of the environment. Livestock is also very much affected due to land pollution. In order to decrease the harmful effects on human health, it is highly essential to have the knowledge about the potential risks and pathways for human exposure to heavy metals from the contaminated soils.

2.4. Biological Hazards

The environment naturally harbors a very large and diverse array of chemical, biological, and physical hazards that can have, or have the potential to have, important impacts on human health and well-being. As detailed in [5], toxic materials are a subset of this much larger array of potential hazards. These toxic materials can be both naturally occurring, as with the biochemical toxins found in many higher plants, large numbers of fungi, many marine organisms, and other parts of the natural environment. In addition, toxic materials can be man-made, such as synthetic pesticides, heavy metals from mines, and toxic chemicals generated in explosions or fires. An important consideration is that natural products can have both harmful and beneficial effects. For example, botulinum toxins are among the most potent toxins known, but are increasingly used as neurotoxins in various medical procedures. Similarly, another type of poison, curare, has been used beneficially by indigenous people in Amazonia to extract and store yucca-cassava cyanogens.

Many but not all natural products have evolved or been generated for useful functions in a specific biological and/or ecosystem context. These include a very wide array of biological toxins, anticancer compounds, insecticides, antibiotics, antidepressants, and behavioral drugs to name but a few. However, it is only recently that some analgesic components of chili peppers have been discovered, despite widespread use of chili peppers in many traditional medicines. Similarly, some cytotoxic plant toxins like Abrus or Ricinus, which can be fatal if even minute quantities are ingested, have been used medicinally in carefully regulated dosages and formats.

Far more widely used are nutraceuticals, though little is known about their daily pharmacological treatment of chronic disease poison detection or therapeutic limits in specific clinical contexts. Indeed, nutraceuticals, which include the vast majority of natural toxins in diet, have broad pharmacological effects and can detoxify potentially many thousands of organic chemical pollutants most likely encountered over the vast time span of human evolution.

3. Sources of Environmental Pollution

The phrase "environmental pollution" is always used when treating pollutants of an anthropogenic and toxic nature, regardless of the form they take and the environment they affect. Heavy metal toxicity, as environmental pollution usually associated with industry, is often the result of anthropogenic activities, such as mining, oil extraction, chemical industry, or agriculture. In addition to the usual direct pathways of exposure, these sources also contribute to poisoning by secondary, indirect pathways of exposure due to the dissemination of contaminants in the inhabited and productive environments.

At the beginning of the XXI century, poisonings caused by exposures to heavy metals such as lead or mercury still represent a big environmental and public health problem in all developing regions of the world. Urban air pollution, which besides heavy metals includes some gaseous inorganic and organic air pollutants, also contributes to respiratory and cardiovascular problems by epidemiologically significant amounts. Sometimes it is quite difficult to accurately detect the source of the mercury and other heavy metals, say from artisanal mining, when data on background mercury levels in local soils and surface waters is scanty and no such information exists for the levels detected in persons at certain jobs performed locally. Food is the main source of exposure to such environmental toxicants as organochlorine pesticides, dioxins, or polychlorinated biphenyls. Rapid access to information about environmental toxicants is essential for timely assessment of the environmental pollution problems and for its successful solutions. Among others, macromolecular interactions of the pollutant of interest with bio-analytes, as well as toxic transformations making the chemical species of the pollutant more toxic, are considered. Recently the role of animals as sentinels of human health hazards of environmental chemicals and as potential sources of new hazardous chemicals has been recognized.

3.1. Industrial Emissions

Hundreds of chemicals are in our environment, some of natural origin, but most are from human activities. Many of them are not toxic, or only toxic at high levels, while others can harm the health of any living organism – people, animals and plants. Toxic chemicals include a large number of substances responsible for disease, poisoning and death. Many among them are a serious health hazard at levels currently found in the environment [5].

Sex flavonoids have industrial uses, mostly in dyes and tanning. They also occur as water contaminants due to their poor biodegradability. Toxicity is mostly due to desisting the methoxy group. Recent works identify the main degradation products, and study the pathway leading to them.

Air pollution is an almost inevitable result of industrial activity, transport and energy production from combustion of fossil fuels and biomass. Gaseous and particular pollutants can have a toxic impact on almost any form of life. Several works analyze the hazardous effects of pollutants such as acidic and oxidant gases, oil vapor and blend-dispersed heavy metals. Among substances used in fossil fuels, vanadium and nickel are of special concern, mainly as a consequence of their use in heavy fuels like oil and petroleum coke. Works also suggest possible ways to minimize the impact of vanadium and nickel on the environment.

3.2. Agricultural Runoff

The question of preserving biological diversity during the utilization of an area, e.g., avoiding

extinction of flora and fauna because of air pollution, has received attention over the last few years. This is not to speak of the problem of the survival of human beings due to the increase in malignant diseases among people, which is partially or predominantly attributed to rising concentrations of environmental toxins. The nature and development of diseases in humans are manifestations of biological processes; on the other hand, living organisms have the capability to sustain themselves or to overcome unwholesome influences. Thus, chemically-induced diseases can be expected to provoke a response as contrasting pharmaceutical agents are produced naturally by microorganisms, plants, and also now by co-products, helping the living beings under threat from such diseases or acting to prevent the occurrence of such diseases under unwholesome conditions. Using phytocompounds beneficial in toxicological connections implies that the secondary metabolites and other substances are biologically active for plants to resist environmental toxic agents migrating to them or and through their metabolic pathways. The ethnopharmacological practice has taken these findings as a guide in the preparation of the traditional herbal pharmacopoeias that mostly have been in continuous use during the long course of medical history of the respective participating civilizations. Numerous in vitro and in vivo studies have shown that antioxidants also participate with several biological activities, including anti-inflammatory, immune-modulatory, and blood-flow-improving properties, reducing the risks of cardiovascular disturbances and severe disorders originating therefrom [9]. The state of the biotransformation of antioxidants in the human organism depends on lifestyle, including nourishment. Pollutant metals can interact adversely with living bodies in innumerable ways, e.g., via the intensified formation of reactive oxygen species (ROS) and the reduction of antioxidants. Fruits and vegetables offer to an organ(ic)ism an abundant source of vitamins, and also (phenolic) antioxidants can decrease the lead concentration in blood and bones, enhancing its urinary excretion [10]. Countless potential inhibitors of pathogenic vectors could be among the antioxidant and similar plant ingredients, just like the defense systems of plants, and have such properties. Consequently, pharmacological agents can be assumed to possess a high antioxidant power.

3.3. Urban Waste

Urbanization is taking place in many developing countries where poor communities live in informal urban settlements with limited access to an improved water supply and inadequate excreta disposal facilities. One consequence of urban growth in city areas may be improper disposal of urban solid and liquid waste. In cities of developing countries, about 80% of waste is generated from domestic households, while the rest of it being a combination of hospital, industrial, agricultural, constructional, and commercial waste. Anthropogenic concentrations of solid waste are the large constituents that, if not managed or disposed, cause pollution and spread diseases [11].

Solid waste is improperly dumped in pits, holes, and along streets. Due to the non-availability of collection services, solid waste is usually burnt out in fire, which emits toxic gas. The residual ash is disposed in and around urban areas. Means of disposal of solid waste finds its way to a source of contamination to the surface water followed by the spread of fatal diseases. In the management of waste, the handling of wastewater deserves special attention. Wastewater contains a wide range of pathogenic organisms, especially helminth eggs. Both pathogens can be transmitted through the contamination of food and water and directly through the skin as well as through the eyes. The aquatic phase of pathogens dies down and re-enters the surface water bodies through very slow treatment which leads to intensified contamination. Capillaries and wells are mostly distributed for the abstraction of water in the urban areas of developing countries. To have a good yield water, wells are usually dug at the place where the water table is very high. HIV/AIDs pandemic and the high infant mortality rate, and malnourishment may be due to the consumption of fecally contaminated water. Children are mostly affected as a result of poor excreta disposal. For them, the risk of water and sanitation-related diseases is significantly high within the age range of 0-5 years.

3.4. Transportation

1. Introduction Human health is impacted by a complex interplay of pollution toxicants (bioavailable/inhaled/ingested) and the detoxification (in vivo or ex vivo) and secretion of those toxics. A subset of metals (e.g. Pb, Hg, Cd) is toxic at low-doses. Such metals can inhibit essential/homeostatic trace metals, display long biological half-lives due to poor mobilization from cellular compartments, and exhibit strong excretion control to maintain homeostasis by the body. To reduce negative health outcomes through metal exposure and to enable safe biomonitoring, the identification and detoxification of metals at both the contaminated site and in exposed populations is necessary. Metals and metalloids are widely disseminated throughout the human environment by anthropogenic activities. This includes a variety of industrial practices, mining and smelting operations, agriculture, and transportation. Outputs, emissions, or releases of these toxic elements precipitate contamination of air, soil, dust, and water, causing widespread environmental pollution [12].

2. Urban Gardening Transportation is the connective fabric of societal infrastructure: it supports economies, societies, and environments by enabling the movement of people and goods. Vehicles within the transportation sector utilize both fossil-fuels and electricity for moving, causing non-negligible emissions. As such, transportation also significantly impacts health. The World Health Organization (WHO) states that urban and environmental determinants contribute to the daily exposure of urban populations to pollution in the atmosphere, mainly including gases, volatile organic compounds, particulate matter, and aerosol. Exhaust gases were specially linked to the increase of diseases and dysfunctions in human beings. When in urban outdoor areas, the pollutant emissions of these gases may accumulate in the soil, resulting in an increase of the interface with biological sources, such as humans. Goal #11 of the Sustainable Development Goals (SDGs) from the United Nations involves making cities and communities more resilient by promoting safe and sustainable transports, as well as reducing the number of accidents and fatalities. Soil-metal contamination is a concern for a multitude of issues, the most notable being the relevance in the context of urban gardening.

3. Measurement and Modelling of Metals for Environment and Health Soil is the most exposed compartment related to human/domestic activities and ground movements. Soil generated traffic-related metals have potential impact on human exposure by ingestion, inhalation of dust, and uptake by crops. Developed and developing countries illustrate how site-specific metal sources resulting from traffic can correspond to various exposure scenarios. Highways are important sources of traffic-derived pollution, though traffic density in developing countries and proximity sources can create unexpected impact scenario. However, road and traffic categories, such as curbside street dust and high petrol stations (in developed countries), can have strong contamination (up to 33 mg kg−1 for Hg) due to vehicle emissions and use. Traffic-related soil contamination can lead to metal accumulation in plants, such as lead in leafy vegetables. Comparative analysis can infer various health outcomes for exposed populations, such as children's exposure to Pb in garden soils related to different road categories. Depuration of in vivo metal-contaminated samples of spider mites can be monitored using metal concentration profiles retained in organic tissues exposed to metals, as those genetically altered from genes implanted into Drosophila melanogaster flies, indicating pathophysiological responses to metal exposure. Chronic pollution and health impact syndromes caused by traffic-related As are compared, particularly in terms of the detoxification of in vivo bioaccumulation of As(ca) using glutathione (GSH) and Metallothionein (MT) in humans. High intake of arsenic from As-polluted copper and sulfur mining districts in the Andes of Bolivia and Chile. The Oncomelania spp. snail consumption is monitored for toxic metals with a direct impact on populations chronically exposed to low-link Cd in environmental pollutants, also associated with Gl-bile recirculation resulting in high accumulation in the kidney cortex in humans.

4. Impact of Pollution on Human Health

Traditional and new anthropogenic activities cause every kind of pollution such as water, air, and land pollution. For example, the extraction of beneficial minerals from mines, combustion of fossil fuels of power stations and internal combustion engines of motor vehicles, and industrial processes as a result of chemical wastes are particularly considered as significant activities for environmental pollution. As a result of this, the surfaces are contaminated with different types of chemicals, microorganisms, heavy metals, etc., and flora and fauna are affected negatively. Polluted lands threaten human health via food-chain mechanism. Crops grown on polluted irrigated soils are contaminated, which cause the health problems of the people consists of crops. In addition, the toxicity of the heavy metals increases in acidic medium. Arable lands, irrigated with acid mine drainage, become acidic and this further strengthened the toxicity of heavy metals in the acid mine drainage thereby causing additional problems on human and ecosystem health. Consequently, it is very important to take protective measures as soon as possible to prevent a contaminant from entering the living beings directly or indirectly. Natural bio-attenuation of some pollutants can be possible under the right conditions ([1]).

The World Health Organization has reported that many human deaths annually can be expressed by pollution. Transfer of contaminants from polluted soil to animals and plant fruits and vegetables causes the human being to ingest these contaminants and cause the onset of different diseases. Detailed analyses have to be done on it to understand the human health risk of soil pollution. The assessment of risks of polluted soil is divided into two main stages. These are (1) Risk assessment for polluted soil and (2) Risk management for polluted soil. The risks of polluted soil have been mainly based on toxic substances concentration analyses in it. The risks of contaminated site have been determined based on pollutant removal rate in the soil. The pollutant removal ratio of the soil is an important parameter used to predict the pollution contour ([12]).

4.1. Respiratory Diseases

Today, as a result of technological advances, research on pollution and its effect on the human body has increasingly come to the fore. Today, it is possible to check the pollutant levels instantly and measure what the limits are. According to the rapidly increasing world population, this is necessary to bring new regulations on pollution that will uncover and prevent the effects of the various pollution types on human health [13]. Symptoms of respiratory diseases caused by environmental pollution can manifest both immediately and delayed. Contact with toxic gases can cause burns to the nose, throat, or lung airways. Carbon monoxide prevents the delivery of oxygen to the body. Small particles that penetrate the lungs recede, thereby causing chronic respiratory symptoms on a daily or less-followed path [6]. Major air pollutants are formed by land transportation, industrial activities, fossil fuel use, natural disasters, natural evaporators, and wear and tear of road surfaces, and they take their place among pollution sources. Of the leading air pollutants, the most important for respiratory diseases is the particulate matter. Joint work of hospitals with the Ministry of Environment should be organized to inform the population about increased levels of fulfu, which are released mainly during the heating season (the relative prevalence of the impact of combustion of wood-fired home-made stoves is considered to be enhanced).

4.2. Cardiovascular Issues

The World Health Organization (WHO) estimates that more than a quarter of all deaths each year are due to environmental pollution. For example, the early World Trade Center attack on September 11, 2001 killed approximately 3,000 people; however, it has been estimated that almost 1,000 first responders, and possibly nearly 200,000 people, have or will develop cancer due to contamination from that event. Even airborne exposure to environmental pollutants can result in cancer, making it the leading hazard to public health. Furthermore, 22 out of the 102 carcinogenic chemicals listed by the International Agency for Research on Cancer (IARC) are air

pollutants, second only to smoking. MGBG is the most selective irreversible inhibitor of multidrug resistance protein 1 (MRP-1), which plays a distinctive role in the elimination of polyamine analogs from cells. It has been an effective drug in the treatment of AIDS-related pneumocystis carinii pneumonia.

First, it should be noted that the disease burden from ambient air pollution is becoming more and more apparent, with a host of recent studies drawing a close association between pollution levels and reduced life expectancy [14]. It has been estimated that about two million premature human deaths worldwide are due to ambient air pollution, and more than 90% of the world's population live in areas where the air pollution surpasses the guidelines established by the World Health Organization (WHO). These troubling numbers barely scratch the surface of the problem considering the "incredibly wide population exposure to combinations of [children]" sickened with respiratory diseases, genotoxic, and cytotoxic pollutants.

4.3. Neurological Disorders

Exposure to lipophilic chemicals as a cause of neurological impairments, neurodevelopmental disorders and neurodegenerative diseases. Conclusions: Neurological Impairments. The reports inform that various environmental toxicants with specific lipophilic characteristics have significant neurotoxicity.

There is substantial recent epidemiological evidence to support that environmental exposures to selenium, heavy metals, and a number of specific pesticides induce toxicity to neuronal tissues, the formation of neurological deficits and developmental impairments and also act as positive risk factors for amyotrophic lateral sclerosis, neurodevelopmental disorders exhibited by autism, epilepsy, etc., and neurodegenerative diseases typified by Alzheimer's disease. The final report is that both this recent literature and relevant earlier reports have been ignored by knowledge review articles on a similar topic and published around the same time.

There are further reports that notably include findings that residential living in proximity to freeways results in a significant greater incidence of autism, and discuss evidence that even agricultural or concern with traffic-related chemical residues occurring ambiently in favor of the observation that Parkinson's disease risk is resulting from the behavior of such chemicals. The essential conclusion of this discourse is defined by the findings indicating that individual neurological toxicants comprise, and act specifically as, endocrine disruptors. This indicates that the intersection of neurotoxicology and endocrine disruption is a greatly unexamined consideration in the etiology of neurological dysfunctions.

4.4. Cancer Risks

For years, numerous scientific studies have tried to understand how exposure to contaminated air, water, and food can affect human health. New emerging technologies allow the release and detection of more and more human-made chemicals, many of unknown health risks, but few studies link these contaminants to disease. Aiming to a comprehensive overview of the different environmental contaminants to which humans are exposed and their proposed detoxification strategies, it is examined the up-to-date advances in environmental pollution and its impact on human health with a focus on recent research on medicinal chemistry for detoxification and disease prevention [15].

It is known that environmental pollution might increase the susceptibility to some diseases and therefore aggravate the patient's health state, which implies the necessity of taking appropriate detoxification actions. Among the several contaminants that are currently released into the environment are a variety of pharmaceuticals and personal care products, industrial chemicals, nanoparticles, and numerous volatile organic compounds. Others include polycyclic aromatic hydrocarbons, halogenated chemicals, and per- and polyfluoroalkyl substances. Synergistic effects between hydrocarbons and metals have also been reported. Depending on the source and the nature of these substances, exposure can result from air, water, and/or food consumption.

Many of these contaminants, such as dioxins and arsenic have been associated with immunosuppression. Contaminants can also induce epigenetic disruption.

5. Mechanisms of Toxicity

The health of both people and the planet is put under extreme stress by environmental pollution. Toxic metals can accumulate in the body, produce many health problems, including liver damage, loss of hair, acne, and damage to the intestines. It is important to detoxify the body of heavy metals, chemicals and pollutants to prevent the likelihood of disease. Detoxification involves several general practices, such as improving sanitation, natural outdoor activities, increasing greenery in the living environment, and drinking clean water. Toxicity is the degree to which something is toxic or can damage an organism. Harm is a term used by ecotoxicologists to describe a change in biological function or structure that affects the ability to cope optimally in a given environment. The scientific description of this description is toxicity. For the past 20 years or more, the field of toxicity of environmental pollutants has developed to the point where it is rare enough. Efforts have been aimed at trying to establish criteria for the quantitative prediction of toxicity, progression, and the effects of various environmental pollutants. Nonetheless, the implication is that many gaps remain in our basic understanding of the separate effect of environmental pollutants and can start to build a generalized mechanism for their toxicity [5]. GASES can kill. FLAMS can kill. This raises the question of why so little attention is being paid to eating and drinking poisonous substances. The point being made is that huge marketing resources are being used to sell cigarettes as well as soft drinks, margarine and other dangerous substances. The starting point of many of these problems can be traced back to pollution. Environmental pollution is the one hand making the earth less and less suitable for survival. Because of the large and automatic nature of the problem, the silent orientation towards poisoning could eventually be shown to prove force conservation of the earth. Nothing is more important, in group interest, to force companies to stop polluting the atmosphere, water, and earth. Much could be written about practical steps that industrializers avoid or reduce environmental pollution. This includes the use of devices to prevent smoke and other harmful by-products. However, this does not seem to address the fundamental issue, which is that a civilization that allows the earth to be damaged is basically foolish.

5.1. Cellular Mechanisms

During their normal lives, living organisms cannot avoid contact with hazardous chemicals in the environment like air, water, and food. A variety of environmental pollutants (irritants, ultrafine particles, mixtures, mists, fumes, toxic gases, ultra-violet and other ionizing radiations etc.) are capable of inducing a variety of different toxic effects upon penetration into the body, which can cause a disturbance in the prooxidants/antioxidants homeostasis: collectively, such agents and the resulting disturbances might be described in general terms as redox toxicology [16]. For example, a number of environmental chemicals are known to be capable of causing oxidative stress, amongst other toxic effects. Thus, an understanding of the mechanism of action of these agents enables the development of effective means for their prevention and/or therapy of the injuries to which they give rise. Healthcare professionals and the general population are more aware of the potential risks and hazards to health and are, therefore, likely to be more self-protective.

A great deal of knowledge has been gained in the molecular mechanisms of cellular response to broad classes of environmental pollutants. As a result of this work, the role of intracellular indices such as Nrf2 activation and redox-regulated gene transcription have been documented. On the other hand, ongoing studies continue to reveal new modes of action of many environmental pollutants which have posed a continuous challenge for developing a comprehensive understanding of the cellular response [17]. One technical challenge in studying cellular mechanisms of Nrf2 activation and downstream gene expression by environmental pollutants resides in the nature of the agents themselves. The need for developing an analytical

system for the integrated readout of Nrf2-mediated stress response in cells exposed to chemical agents has been expressed. The approach taken has been on the development of a high-content live-cell imaging screens, based on the Hepa1c1c7 murine liver cells stably transfected with redox-sensitive green fluorescent protein that can be utilized as a multi-parametric reporter for the transcriptional activity of Nrf2 and related redox-sensitive transcription factors as well as for dynamic intracellular redox responses.

5.2. Genotoxic Effects

In a previous article in this journal, research was described on dietary factors that modulate the effects of environmental toxicity related to the presence of heavy metals. These factors must be identified in order to minimize the risk of chronic damage and the onset of degenerative diseases in subjects exposed to high toxicity risk areas, with particular reference to biomarkers.

In the specialized literature, it has been highlighted how the illicit removal of toxic waste in some territories has led to an increase in the incidence of tumors and birth defects. The incineration of toxic waste has been shown to release organic and inorganic substances, such as dioxins and furans, into the atmosphere, substances recognized as carcinogens [18]. The presence of hydrocarbons polycyclic has also been detected in milk, a substance whose presence is demonstrated to have carcinogenic effects. As has recently been highlighted, these substances can be transmitted to the next generation. The fetal period is more sensitive to environmental exposure, as exposure to mutagenic or tumorigenic agents causes damage on a genetic and epigenetic level, altering the mechanism of gene switching and consequently the signal transduction, all events that will be transmitted to the following generation. Among other things, the tendency to accumulate carcinogenic substances in combination with humid conditions affecting the hydrogeological risk factor in question, does nothing but amplify the risk of falling ill with tumors. It is also said that the incidence of tumors and related mortality is proportionally higher in the Campania region compared to the Italian average, an awakening of this alarming question in 2004. Based on molecular knowledge of the effects of exposure to environmental contaminants, perhaps acquired in the previous years in light of that event, a research has been carried out aimed at a quantitative qualitative evaluation of the presence of toxic substances in the biological matrices of individuals with the highest risk of environmental contamination. Thanks to the analysis of trace metals in hair, it is documented how the elements can enter the human body through the skin, respiratory tract and digestive system, to be excreted through sweat, hair, urine and excrement. A person’s exposure to metals was examined, clearly aided by the use of alternative matrices such as hair, which has led to in-depth study of exposure to metals in an area previously not investigated by traditional analysis methods such as blood, urine or nails. Metals and other toxic metals frequently present in areas at risk of environmental contamination were examined, and their presence is objectively assessed in subjects living in high risk areas compared to control. The use of non-conventional matrices, including hair in toxicological analyzes, makes it possible to increase the range of detectable substances compared to traditional matrices such as blood and urine. Hair is considered a ready-to-use and transportable matrix and the deposition of various substances is possible through the blood flow inside the hair matrix. Among other things, the hydrophobic barrier of the stratum corneum allows heavy metals to be undamaged within a month of external exposure, while nickel and other elements sequester the keratinic sulfuryl groups which incorporate inorganic elements during hair growth, with changes recorded along the length of the hair. Instead, taking advantage of other large case-control studies, the knowledge of the Campania population is advanced.

5.3. Endocrine Disruption

Concepts such as the special susceptibility of the developing organism and early induction of latent effects are now widely held [19]. Since the momentous Wingspread Conference of 1991, there have been numerous notable examples of adverse effects of endocrine disrupting chemicals (EDCs) in fish, wildlife, domestic animals, and humans. The endocrine systems of all phyla

studied have been disrupted by anthropogenic chemicals including antiandrogens, androgens, estrogens, inhibitors of steroid hormone synthesis, antithyroidal compounds, and retinoid agonists. Given the nature of development in mammals in general, and humans in particular, noise-induced effects would be expected to vary at different tumor sites, in the latency between exposure and appearance of disease, and in the latency between removal of exposure and manifestation of disease. Each uproar would have a characteristic distribution of these endpoints.

The removal cases considered would have been of human intra-uterine exposure to the synthetic estrogen, diethylstilbestrol. The salience of hypospadias for endocrine disruptor exposure is established earlier work showing that estrogens induce hypospadias in animal models. The results augment the epidemiological evidence that EDCs function at low doses. It is evident from both these work are important for discussions of the design of rodent tests to assay environmental chemicals, to show that noise-induced effects can be difficult to disprove, and to illustrate the insights that modeling might yield on the latency of adverse effects. A potential source of confusion is actually discussed. Recently, improper methods for analyzing an EDC dataset have been reported. These concern two recent studies that demonstrate low dose effects of diethylstilbestrol on canalization of prostatic development. It is evident from the literature that special attention needs to be given to assure that studies that examine more than one pup per litter account for this in the analysis of the data. An extensive analysis of factors affecting the occurrence of this noise is presented. Given the paucity of quantitative information on background noise-induced effects, the focus would need to be on the endocrine disruption hypothesis itself. Therefore, the definition of noise-induced effect was accepted as used by the Nfurcci protoxicology review. Efforts to test the endocrine disruption hypothesis would be aimed at showing a statistically significant association between environmental levels of endocrine disrupting chemicals and perturbation of endocrine-sensitive endpoints. Among the 23 studies, 70% carried out in the laboratory and 87% of the numerous where significant effects were reported. In comparison, 52% of the 1983 to 1991 studies located significant effects. The differences in mean percentage effects between the examined periods were 18.85% and 25% in rodent tests. In hamster tests the significant difference was 20.92%. Coefficients suggest that sample size is not a significant factor in these differences. Conceptually these analyses focus on those aspects of the 22 validation studies that directly impinge on the utility of the rodent and hamster tests in screening for EDCs. The model that is taken is that a pair of gland/endpoint can be said to have some utility if the poison preamble confers additional capacity to detect EDC modulation of that gland/endpoint. Six of the studies are not categorized. Three are works and three are studies that examine the role of estrogen in control of male-typical behavior. All studies should be concerned with characteristics of endocrine systems and hence be bioomer.

6. Advances in Medicinal Chemistry

Addressing the problems related to the widespread presence of an increasing number of chemicals released into the environment by human activities represents one of the most important challenges of this century [20]. In fact, the production and use of more than hundred chemicals, intentionally or unintentionally released into the environment, have generated alarming levels of pollution in air, water, food and soil. Consequently, considerable scientific work has been addressed to this issue, which has mainly regarded the development of (i) new detection systems for the measurement of the contamination levels of chemicals in people’s body fluids and tissues, as well as in the environment, and (ii) new remediation strategies for the removal of such chemicals from the environment. Foresee the emergence of multidisciplinary advanced approaches jointly combining the contributions of different scientific areas, such as biology, chemistry, physics, biophysics and engineering, by deeply influencing the design and optimization of new biosensor devices and innovative environmental abatement treatments. In fact, the development of the sensing component of a biosensor device critically requires the knowledge of biological and chemical processes involved in the toxicant interaction with receptors or biological recognition elements, such as enzymes, proteins or antibodies. Likewise,

the design of new treatment processes for the remediation of environmental pollutants needs an in-depth understanding of the mechanism of the biodegradation and bioremediation of toxic chemicals and of the biochemical strategies towards the development of more efficient methods for the detoxification of organic and inorganic hazardous molecules. New emerging biosensors for the analysis of environmental chemicals have been proposed, such as VHH antibodies, genetically engineered microorganisms, aptamers and new highly stable enzymes. However, most research studies carried out in the field of bioremediation have yielded better results in the development of green technologies for the detoxification and elimination of toxic contaminants from the environment, which are mainly based on bioremediation systems that use organisms or catabolic pathways-based approaches for the fixation, degradation and detoxification of petrochemical hydrocarbons, PCBs and other environmental chemical toxins. Systems for the enzymatic detoxification and degradation of toxic agents in wastewaters from chemical, petrochemical and manufacturing industries have been proposed too.

6.1. Novel Detoxification Agents

Addressing the problems related to the widespread presence of an increasing number of chemicals released into the environment by human activities represents one of the most important challenges of the century [20]. Widespread presence in the environment brings them also in most of the food chains, thereby exposing and damaging humans and other living organisms in the planet. The WHO reports that exposure and damage induced by man-made pollutants have already caused a large burden of nerves, both fatal and non-fatal diseases.

Although international agreements for the reduction or eradication of the emission in the environment of some of the most unsafe chemicals have been enacted already years ago, so far only reports of contamination by these chemicals have been limited, monitored only in certain areas. Meanwhile, the intense use of chemicals in agriculture, industry, energy production and other human activities releases thousands of different pollutants in air, water, soil, that may reach human beings through inhalation, touching in vis-a-vis contaminated materials, drinking and eating contaminated water and food. Legal concentration is established for only a minority of chemicals released in the environment and they concern only industrial pollutants. More reasonable limits and also the range of chemicals to be limited should concern not only those intentionally produced, but also byproducts of their manufacture, degradation or waste burning, and especially toxic trace compounds that are not naturally present in food, in a diffuse way in the environment are below the range of common analytic detection, eventually carried out only long after the release of contamination.

The scientific community has thus directed considerable research efforts to this theme and there are several different topics in this context. Concerning the prevention of exposure of people to dangerous chemicals, researchers have directed their efforts towards the development of new analytical sampling of foods and of naturally obtained metabolites of these chemicals in people’s body fluids and tissues. For this purpose, the most common volatile or non-volatile organic chemicals have been addressed as estimators of the tissues and fluids of the most common inorganic compounds. New emerging biosensor devices for the detection of chemicals in the environmental media have been proposed as an alternative to expensive and time consuming analytic techniques. There are also some progresses towards the detection of functional important biomolecules or metabolites of man-made chemicals and strategies based on the prevention of specific biomolecules as a means of the inhibition of tissue intoxication. Chemical compounds that interact with the most toxic typical chemicals affecting the lymphatic system have been proposed. Biochemical research to search novel natural antidote substances is also evolving. More general strategies for the prevention of environment-mediated diseases have been developed, such as herbal.

6.2. Antioxidants and Their Role

Environmental pollution is broadly divided into particulate matter, nitrogen oxides, sulphur

oxides, volatile organic compounds, radionuclides, and toxic metals. Both ambient and indoor air pollutants differ widely in chemical composition and are present as gases, vapours, and suspended particulate matter, with the latter generally being more hazardous. In an urban setting, suspended particulate pollutants are a complex mixture of sulfates, nitrates, metals, organic carbon, and fly ash. Generating free radicals in the human body and the detrimental effects of free radicals on human health have been well documented. They have been implicated in a number of diseases including rheumatoid arthritis, atherosclerosis, Alzheimer's disease, Parkinson's disease, fragile X syndrome, cataracts, coronary heart disease, SLE, and AIDS. Estimates of the annual numbers of cases of disease attributable to outdoor air pollution, particulate matter, sulphur dioxide and nitrogen dioxide are 370,000, 4,700 and 3,800, respectively.

In the domain of human health, considerable research has been concerned with study of the deleterious effects of environmental pollution on the respiratory system. Nitrogen dioxide inflames the lung by oxidising proteins in the alveoli and leads to cough, phlegm, and wheeze. The nitrogen dioxide exhaled from the lung also carries recently generated ozone resistant fatty acyl groups and oxidised products. In the urban atmosphere many of the ozone and nitrogen dioxide reactions will occur on the surface of particulate matter and the potential for nitrogen dioxide to cause pro-inflammatory effects will have been increased by 'knock-on' chemistry involving the reaction of ozone with other pollutants. Analysis of data from two continuous airborne particulate matter samplers in the Spanish cities of Vigo and Granada has shown that the median daily concentration of metals in particulate matter are: arsenic 1.3 ng m−3, cobalt 2.7 ng m−3, cadmium 2.8 ng m−3, lead 163 ng m−3, nickel 39.6 ng m−3 and vanadium 4.9 ng m−3.

6.3. Phytochemicals in Disease Prevention

We live in an era when Westernised societies are characterised by the most advanced medical care in history. The focus of modern medicine is largely on relief of symptoms, generally by pharmacological agents. The concept of the 'magic bullet' or miracle drug embodies the idea of these pharmaceuticals possessing some restorative or curative power in human health. As such they have become the standard first option and are undoubtedly lifesaving in many life threatening or acute conditions. However, the reliance on medicinal drugs also has significant limitations. From a cost perspective, many of the best molecules are highly engineered and are therefore expensive to produce. In addition, their use over prolonged periods is associated with numerous side effects, and they are often blamed for an array of middle and long term health complications.

In light of these deficits, there is growing interest in alternative, non-pharmaceutical management approaches. Phytochemical solutions have been identified as having the capacity to potentially target the fundamental causes of a disease, representing a broader approach to disease treatment. The primary advantage of such therapeutic agents is their capacity to manipulate complex biological pathways or processes as opposed to pharmacological agents. Plant-derived bioactive compounds in particular are emerging as candidates with significant therapeutic potential in human health. Additionally, these compounds are generally well tolerated by the body with minimal side effects. Administration of these plant bioactives, or specific formulated compositions, may have beneficial outcomes as a potential therapy to tackle the alarming rates of modern diseases and afflictions [21]. Due to the complexity, diversity and sheer number of these plant bioactive compounds, there is a vast array of therapeutic strategies that can be adopted. There is growing acceptance that the consumption or consumption of plant-derived food bioactives enhances our overall health and wellbeing. This has been primarily attributed to their potent antioxidant capacity, with these secondary metabolites of plants such as fruits, herbs and vegetables being significantly more bioactive than classical nutrients. The nutritional approach of consuming these plants aims to alleviate stress and maintain a balanced physiological state.

7. Drug Development for Pollution-Related Diseases

The serious threats to human beings from environmental pollutions are first analyzed, including their various types, main features, influence factors, and harm forms on human health. The components of the approaches include extensive monitoring, reducing emissions and improving the atmosphere environment, developing low-toxicity compounds, and preparing antidchosiform influencing drugs. A new approach to drug metabolism is considered in connection with the detoxication of pollutants. In vitro or in vivo drug metabolism biotransformation of pollutants is suggested by Phase I and Phase II enzyme, and underlying mechanism of drastic difference in individual of response to chemicals is the difference in such enzyme activities as detoxication and bioactivation. One strategy for the prevention and control of damage caused by the pollutants is to regulate these enzyme activities by a convenient way, i.e., pretreatment with induction or inductive inhibitor and co-substrate, phenomena of activity decrease due to chemical pollution, and/or sketch a line with the most database chemicals, notes taken: Persistent organic pollutants, dioxins, furans; hexachlorobenzene; Sited organochlorine pesticide; Important metals; ecological effects of heavy metals; Occupational health and pollution related cancers. Used in conjunction with industrial processes and agriculture are the pollutants drastically increasing in last decades and responsible both for a state of deep concern in the scientific community and the growth of a variety of side effects on environment and public health. Major efforts are demanded aiming at the identification of pollution sources and their negative effects on various ecosystems and human health [22]. A new perspective will be adopted to investigate the pathogenic mechanism of pollution related diseases, to reveal the key factors which govern their appearance to suggest the concrete steps to tackle these problems. A gradually increasing distance from assumptions behind conventional toxicology paradigms is noticed, and detection of potential damage caused by xenobiotic agents problematic in one of their by-products, takes place a long before the long before the arrival of the clinical sign of disease. Therefore patterns of injury warrant the attention per se. In basic terms the history of any type of the disease—even the simplest of diseases—is the account of time-dependent sequence of biological events. On the other hand the classical toxicology driven approach deplores the widespread belief that each and every interactions of a toxicant with cells and tissues, regardless its nature observes the Boltzmann law, and argues that low though constant intensity aggressions should be harmless. This actually debatable view evidently implies that the intricacy of the biological system may be almost completely ignored. The correct interpretation, however, underscores that all the biological systems, from molecules to ecosystem—and possibly above—are far from thermodynamic equilibrium and subject to a continual flux of energy or matter. Each alteration of this order is followed by his irreversible effect: the system either capitalizes the disorder or simply disintegrates [12]; there is no way back.

7.1. Target Identification

Addressing the problems related to the widespread presence of an increasing number of chemicals released into the environment by human activities represents one of the most important challenges of this century. These chemicals include organic molecules such as pesticides, dyes, paints, oils, pharmaceutical products, methane and other bioactive substances which spread everywhere, representing a serious menace, both to the life or health conditions and to the physiochemical properties of water, air soil, beverage, and food. In the last few years, the scientific community has directed considerable research towards the development of new detection systems for the measurement of the contamination levels of chemicals in people’s body fluids and tissue, as well as in the environment, and of new remediation strategies for the removal of such chemicals from the environment. New emerging biosensors for the analysis of environmental chemicals have been proposed. These include superparamagnetic nanoparticles decorated with Ag nanoparticles for the immunosensing of doxycycline, screen-printed graphene electrochemical sensors for the analysis of petroleum pollutants, VHH antibodies applied to surface plasmon resonance for the sensing of beta-n-methylamino-l-alanine, genetically

engineered microorganisms able to detect triclosan contamination and, mainly, biosensor arrays integrating CNT, graphene, and ionic liquids for the detection of volatile organic compounds. Other emerging examples include aptamers for the detection of sulphunatmides, nanomaterials like mesoporous silica nanoparticles or QD for the development of biosensor systems, and new highly stable enzymes used in combination with CNT or QD for developing optical sensors. Better results have been obtained in the development of strategies which use organisms or metabolic pathway-based approaches for the fixation, degradation and detoxification of chemicals in the environment [20]. Systems for the development detoxification and degradation of toxic agents in wastewater, resulting from chemical, textile and manufacturing industries have been proposed. Bioinformatics methods and tools have been also recently developed for the study of mechanisms of detoxification and biodegradation of toxic agents. Since 2-3 years ago, an increasing number of studies were devoted to the development of detoxification strategies concerning other bioactive agents, such as aflatoxins, deoxinivalenol, patulin and phorbol esters.

7.2. Lead Compound Optimization

Lead has been used by humans for thousands of years. It is dug from the ground in the presence of lead ores, readily available on every continent. Lead has many uses, as its low melting point makes it easily cast. Romans, for example, used liquefied lead to seal wine vessels and as a sweetener that may have contributed to the decline of the empire itself. Inhalation of lead oxide produces dizziness, memory problems, weight loss, and death. However, lead's lower oxidative heavy metal is largely non-toxic beyond its propensity to oxidize the active site of enzymes. It would take humanity until the late 19th century AD to really understand exactly why lead compounds are acutely toxic to cells and tissues. A single potassium chloride insulated capillary glass microelectrode swiftly descending into the heart of a common squid, where illustrates the molecular sequence of events that transpires when synaptically released neurotransmitter binds to postsynaptic receptors that passes an electric current and depolarizes the excitable cell. Lead was found to irreversibly block single calcium channels steps in the presence of both low and high concentration of cadmium. The key observation was that lead was causing an apparent reduction of the single channel current. When was submitted, the University veterinarian chanced to have a goat with asymptomatic lead poisoning. A remarkable feature of the toxicity of lead and its compounds is the severity of adverse effects at levels well below those expected to cause acute poisoning. Even very low levels of lead have been associated with a number of health risks, including neurodevelopmental problems in children and increased risk of impaired renal function, cardiovascular disease, and neurological disease in adults. More recently, low level lead exposure has been linked to abnormalities in the metabolism of lipids and glucose. Such exposures are common. Blood lead levels less than 5 μg/dl are considered 'safe', but have still been found to pose health risks. For example, children with blood lead levels below this threshold are at increased risk for a range of neurodevelopmental problems. The molecular mechanism of lead toxicity is related to its ability to replace calcium in a number of critical biological processes. This aspect of the toxicological profile of lead has been known for well over three decades. An anomalous dependence of the internalization of the many known targets of calcium ion channels on the ionic radius of the permeant species, and in the intervening years a slew of other ion-channels were found sensitive to lead but not calcium. Which, among other things, raises the question of how lead freely crossed the plasma membrane in the first place. It is belatedly appreciated that the cellular acquisition lead can occur either through voltage-independent calcium channels or some as-yet-unidentified mechanism. Leaked results favoring the latter assertion have been subsequently retracted. It has been proposed that one possibility is lead can flow through sodium channels moving in endogenous inward currents at membrane potentials between -40mV and -199mV and the chemical flux of lead ions could be enhanced by optogenetically elicited calcium influx. Finally, even prior to the discovery of calcium channel block activity in smooth muscle cells, substantial evidence was gathered which suggested that lead's primary action occurred on the cell surface. Lead was found to interfere with the uptake

(and release) of other ionic species. The proposed “permeant” model implicated a carrier-mediated symport system that coupled the inward migration of calcium with that some other ions. All of these results spanned the years surrounding 1880, well before results were published endowing the Flexnerian dedication to a modern view of “discovery science.” In the lay press, the topic of lead and health related fears evoked by the fear of white lead. Drinking vessels, teapots, and plumbing pipes had all once been made by stannous Roman artisans. More recently, the compound lead chromate was used by manufacturers at the turn of the 20th century to make brilliant colors for wallpaper, toys, and machine parts. Plagues of idiocy stalked the countryside. Sovereign Pastel McCarthy enacted restrictions on the extent to which such products used the manufacturing process. Enforcement of the new regulations was patchy, the patients moved away. All returned. Broadbench’s early leader in measuring the quality of water storage ecosystems inspired an experiment by the local public health supervisor in the stringently regulated water reserve of experimentation in a small town Twig sample from the pipe of households that utilized the Great River’s water source revealed the metal composition to be composed of 85% lead, the levels of which were more than ten times greater than that permissible under his lordship’s act. When the pipes were replaced, the paralysis ceased. Despite the observations of Goyder and the results of the Millaud, little follow-up was performed, and therefore nothing the discovery of their intrinsic bi-information entropy so resplendently displayed by Tiller. Early Miethe and Lilienthal ventured forth with a rectilinear pattern of pointed plasmids theorized to guide them along the Ley, thus avowing limbic unbiddenness .

7.3. Clinical Trials and Approvals

1. Introduction It may be difficult for an exposed population to escape from the web of environmental pollution. The alarm is triggered by the still increasing number of individuals suffering from debilitating pathologies along with the increased identification of "danger points" diffusely located in the territory ([23]). Additionally, the deleterious effects caused by air pollutants raise special concerns since they cannot be constrained by the borders of any artificially defined area. As far back as 1873, this was well realized, as quoted from that time: "He who believes he can free himself from the sorry effects of urbanization by escaping (into the countryside), is sadly mistaken; the winds, which might seem friends by diverting the source of air pollution, enemies channeled by the roads and buildings, eagerly make sure everyone swims in the poison prepared for mankind by progress".

2. Nutritional Support Among the numberless vital aspects to be considered through diagnostics in order to evaluate "possible adverse effects" consequent to toxic chemical exposures are the emerging issues concerning the development of genomic assays. Only a very few works pertaining to these are currently available, yet they are deemed extremely significant. Toxic pollution by chemical agents is widespread and its effects may involve many different metabolic pathways. In this context, a global gene expression profile analyses with cDNA array technology was applied to peripheral blood of workers industrially exposed to styrene compounds. Significant variations were identified in as many as 87 genes, many of which are associated with the acute-phase response and with inflammatory processes. Many deleterious effects are seen on human health resulting from exposure to toxic chemicals, which are often both carcinogenic and mutagenic agents.

3. Proposed Diet The conclusion which can be drawn is that the adoption of a healthy, mutually shared diet can never be so unaffecting as taken for granted within the economically vested lobbies. Efforts to improve the monitoring of food contaminants and their live-stock analogues are thus urgently needed. Recently, a study on expired packaged foods coming from the 2007 stock dedicated to the military was undertaken through screening with X-Ray Fluorescence and Inductively Coupled Plasma-Mass Spectrometry, then confirmed by Gas Chromatography-Mass Spectrometry. Lead, found in 43 out of 62 analyzed samples, ranged from 8.2 to 1700 μg/kg. Such worries supplement the ones conveyed by preexisting considerations on bioaccumulation of toxic metals brought on by foodstuff. The current literature accounts for the relationship between

diet and the bioaccumulation of toxic elements through foodstuff. Toxic metals are ubiquitous pollutants entering our bodies through the atmosphere, as cancerogenic Cr6+ and the micrometal powders of Cr, Co and Ni in welding fumes. These two occupational settings have been thoroughly addressed by all available detection techniques initiated at the onset of symptoms and including extended post-exposure follow-ups.

8. Preventive Strategies Against Pollution

Environmental pollution is one of the most prevalent global threats to the health and well-being of the world's population that has been associated with high morbidity and mortality as well as poor quality of life for over 40 years. Adjacent to the chemical and physical environmental pollution, changes were made dealing with diverse complex environmental issues, including climate change, ocean acidification, sea level rise, reduction of stratospheric ozone, extinction of species and changes of land cover and water supplies [24]. Biodiversity and ecosystem functions are endangered by the activities of industrialized societies according to a new and expanded environmental philosophy. There is a need for new ideas and strategies on the future directions of ecosystem protection, sustainable development and ecosystem management. Adequate approaches and interpretations should be established in biodiversity and the broad area of environmental pollution viewed on both regional and global scales. Priority should be given to smart and effective measures to assure environmental quality, sustainable development and the health of ecosystems and their human beneficiaries. In order to protect ecosystems, priority should be given to phasing out the use of toxic and ecologically hazardous substances and properly identify pathogen organisms in the multifunctional and complex environments [12]. On a global scale, utmost importance should be attached to enhancing international cooperation with the steps of developed countries technologically, financially and institutionally. It is argued that the people who live in medically the most fragile regions should adopt preemptive strategies to manage environmental pollution and associated health risks.

In recent years, there is enhanced interest in the clean development mechanism (CDM) which is established by the Kyoto Protocol in order to diminish the greenhouse gas emissions of the economically developing countries. This study set out to evaluate the likely environmental impacts of CDM projects, and devise strategies to prevent them. The analysis reveals that about 64% of CDM projects may cause a negatively effect on environment. It is argued that sustainable development criteria should be integrated with the CDM concept, and incentives should be provided to encourage the improvement of energy efficiency and the use of renewable energy resources in CDM projects. Considering the difficulties of relevant parties to handle these project-based environmental risks, it is also recommended that there is a greater trade off in favor of project-based environmental precautions. When the association of environmental pollution with diseases is what needs to be prevented in the first place, it is of vital importance to wipe out the damage caused by CDM projects from the beginning for the sake of life and other invaluable assets.

8.1. Public Health Initiatives

Health care professionals in government ministries, public health, research, and the clinic, including medical and nursing personnel, toxicologists, and other specialists, involved in environmental determinants of health, including research, clinical treatment of chronic disease, and disability care, must recognize when chronic, debilitating diseases are rooted in environmental exogenous chemical or biological factors. The first step to prevention and treatment. Public health initiatives can then be taken against environmentally determinable contributors to illness, as well as those of genetic, endogenous, microbial, nutritional, psycho-social, mechanogeophysical, and iatrogenic origin. Public policy related clinical intervention to detoxify the body of toxicants, involving the use of drugs, nutrients, fluids, physical treatments, and other medical means can not only mitigate illness and functional impairments, but often effect significant cures or remissions, positive health events that many afflicted individuals will

not experience with other medical intervention for their condition [25]. However, little medical detoxification treatment has yet been made accessible in western countries, with the procedures either being suppressed or not available, and if attainable, expensive, often very arduous, and at times high-risk. Instead, basic medical knowledge of environmental medicine for patient diagnosis and advice should be provided in the training of all workers who are health care related. The translation of emerging scientific data indicating the particular environmental contributor with the adoption of required clinical treatments is usually not a reasonably expeditious event.

8.2. Policy and Regulation

Pollution-related diseases are among the leading causes of death worldwide, and there are clear roles for research, analysis, and urgent action in addressing this burden. More than 9 million people worldwide die each year from diseases caused by the impact of pollution on water, soil and air. India and China are accountable for more than 50% of the total pollution-related mortality across the world. Five of the most critical and direct stressors (in order of total disease burden) are air quality, safe drinking water, sanitization, mechanized agriculture, and chemical pollution, including occupational exposure. Scientific research plays critical roles in evaluating the environmental sources and transport of pollutants on global and local scales, as well as in evaluating individual susceptibility to pollutants, followed by designing cost-effective and culturally effective public health interventions.

After nearly three decades being conducted beyond the obligations of a court ordered consent decree, major U.S. factories are still polluting less, in accordance with the latest in a series of periodic mandated evaluations. However, in defiance of evidence and expert advice, factory-related pollution rollbacks threaten to put thousands of lives and billions of dollars at toxic risk in the next four years. No station-based monitoring systems in the country are on track to meet national policy standards, and more than 193,000 U.S. people live directly across the fenceline of sub-standard facilities. Proving their axiom, this fenceline populace is disproportionately Black, Indigenous, or People of Color (BIPOC). Across the nation, the contaminated drinking-water crisis in Flint, Michigan, the broader legacy of arsenic pollution in groundwater in Bangladesh and West Bengal, and per- and polyfluoroalkyl substances everywhere indicate a public health emergency related to the environmental contaminants. Furthermore, a detailed understanding of the chain of processes leading to soil and sediment pollution, and human exposure to it, requires an understanding of chemical speciation and fractionation. While the latter was widely demonstrated for water and, to a lesser extent, for air, thorough and systematic metal speciation studies in soils and sediments are still sparse. Sediment is the major sink for the particulate heavy metals entering aquatic systems. On a global scale, its capacity to bind metals means that, once it settles, becomes a major source of metal contamination. Moreover, the mechanisms controlling metal transfer in the sediment–water interface are complex and only partially understood. In an effort to fill that gap, this review aims to provide researchers in the field of soil and sediment heavy metal analysis with a critical overview on the different fractionation and speciation approaches. It also proposes the need for a sound data interpretation to inform and guide pollution prevention, control, and remediation strategies. Conversely, a review of the data required for a comprehensive investigation of metal contamination and the currently available techniques is also provided as an effort to put in practice a prototypic framework for metals risk assessment. At a time in which the United States Environmental Protection Agency admits it’s incapable of acting cohesively against the environmental consequences of a dispersed series of disasters, such a multi-faceted approach seems particularly timely.

8.3. Community Awareness Programs

On World Health Day 2004, the World Health Organization announced: “Environment is creating 1, 20,000 of future human health risks, natural disasters, air and water pollution”. Climate change is attributed to modern energy generated pollution due to motor vehicles,

industry and unplanned urbanization. Global warming is creating unpredictable environmental hazards, threatening life vastly different from that which exists today. If this problem is not identified soon, there will be severe effects on life. Besides a considerable section of the population in countries such as Nepal, there is very little awareness about pollution. Environmental pollution and its impact on human health is a subject often taken up by national and international organizations.

It has been noticed that the incidence of wheezing, chronic cough and breathing difficulty among individuals in rural areas has risen by 38%. WHO is working in this sector and seeking to prepare guidelines on the matter. A considerable number of such guidelines are necessary so as to manage and diminish problems caused by environmental pollution on health. It is imperative for organizations working in this sector to prepare programs focusing on the village level. People are more amenable with the awareness programs which are informational and to the point. Public awareness about environmental pollution and its adverse affects should be disseminated in a simple manner. Its effects on health could be minimized if preventive and mitigation measures are taken. A public awareness campaign can be the most an effective intervention. . Appropriate awareness programs can also build pressure on policy makers to amend laws providing stringent punishment against those responsible for pollution.

9. Case Studies on Pollution and Health

Pollution exposure is killing millions worldwide yearly, and it is the largest environmental cause of premature death and disease, accounting for 16% of all deaths and 17% of all cardiovascular diseases. Global pollution death tolls are estimated at around 9 million per year, one in every six deaths. About 92% occur in low-income and middle-income countries. Growing and sprawling megacities in developing and emerging economies have the most extensive air pollution in traffic, industries, and household cooking. The pandemic creates a historic parallel with other pandemics and shifts attention away from air, water, and soil pollution. Industrial operations are being relaxed during the COVID-19 pandemic lockdown in China to reduce pollution, and pollution exposure contributes to severe COVID-19 morbidity and mortality. However, peak conditions during COVID-19 in China would cause an approximate 1.6% decrease in mortality from ischemic heart disease due to reduced air pollution exposure. Activists argue that chronic heavy pollution in countless cities motivates environmental and health regulations; the COVID-19 pandemic has brought radical changes in pollution exposure.

Pollution from multiple sources is causing significant disease and death worldwide. Some sources are legacy—such as heavy metals accumulated in soils—and some are current—such as PM. It is important to identify both legacy and current sources of pollution and to develop techniques that are effective at reducing human exposure to these pollutants. Recently, new approaches have been developed, or are being explored, to identify and eliminate pollution in multiple environments [12]. For example, community-scale detection of geogenic arsenic and fluoride in Bangladesh is helping to map the distribution of these harmful elements in drinking water. Biosensors, like bees and their honey, are being used to measure heavy metal contamination in cities such as Vancouver and Sydney. Drone-based remote sensors are being used to map metal hot spots in soils collected from former mining regions in Zambia and Mozambique. The explosion of low-cost air monitors has allowed researchers to build dense air quality sensing networks across the US and the globe [1]. Citizen science, now enabled by advances in sensing technologies, is helping individuals and communities measure their own environments and gain agency in controlling local pollution exposure sources. The developments of this modern era have broadened the possibilities for the first time in history to truly protect the health of a growing urban population.

9.1. Urban Areas

Urbanization is increasing at an astounding rate, with current “urban” population exceeding 3.5 billion (55% of the global population), and expected to exceed 60% by 2030 (more than 4.6

billion). Urban soils concentrate large portions of many contaminants that, with few exceptions, show trends of increasing concentration over time in soils and sediments. Part of the contribution of pollution to the burden of disease from anthropogenic activities, 0.1% of total global and ~1% of urban disease is caused by 900 contaminants in more than 220 diseases and injuries, though ~3.5 Gt of known toxic chemicals are produced. Most of this pollution is avoidable; thus, there is a pressing need to identify sources and technologies for their removal and remediation [12]. For this reason, new research advances in pollution and health will largely require coordination and collaboration between researchers and research groups with expertise in environmental chemistry, transport, and fate analysis, geostatistics and biostatistics, disease epidemiology, sociology, geographic information systems, and medicine. The diversity of expertise required to make rapid advances in pollution and health is daunting but necessary to substantially reduce the rapidly increasing burden of disease from environmental pollution. The envisioned cross-disciplinary work is advanced through the Furthering Environmental Health Harmonization network of the Global Environmental Health and the Earth Observations community.

9.2. Industrial Regions

Nowadays, a major problem is the fast growth of air pollution caused by industrial regions that has expanded in developed and less developed countries. This air pollution influences human health in urban areas because it encompasses industrial regions, and the gases and harmful particles emitted by factories spread over urban areas. These gases and particles can have a significant impact on human health, resulting in various diseases, depending on the pollutants emitted by the factory in a specific urban area. It is essential to identify those manufacturing pollutants and take action to reduce their adverse effects on human health [26]. In this field, this project considers the harmful manufacturing substances that have the most effect on the health of people living in industrial urban areas. These substances lead to various diseases, depending on the number of infected people and their specific factories' location. To achieve this goal successfully, methods have been developed for selecting the best location of new industries in the existing industrial regions. Taking into account the health risks and environmental pollution, the factories will therefore be built in a location that reduces the health risks to humanity.

These manufacturing materials are effectively countered by different types of plants to maintain a healthy lifestyle. Every year there is a significant increase in health damages to people in industrial urban areas in numerous countries due to factory pollution. Because of harmful gases emitted by industries, health damages in a healthy body slowly lead to disease, and these are often serious diseases. The developed mathematical models have been utilized to minimize this damage to the health of people. Based on the numerical study, the facts are clarified about exposure concentration. It is possible to find a healthy vehicle location based on the correct factory located location analysis.

9.3. Agricultural Zones

The Ministry of Agriculture and Rural Affairs released an announcement on May 10 that the agricultural planting area will be divided into 4 zones. Generally, they are very strict, strictly controlled, cautiously developed, and resource-recycling construction zones. It is not difficult to see that the announcement is an important part of the plan to deepen agricultural supply-side structural reforms. In the same month of May, the Shandong Provincial Department of Agriculture and Rural Affairs also issued the Division Regulations for the 4 Zones of Agriculture in Shandong Province, continuing to carry out pilot-zone assignments and stabilizing output is the focus of the task. From the perspective of sustainability and the distribution of green elements, relevant policies and technological progress in agriculture in strategic emerging industries in the Yangtze River Economic Belt are difficult to be balanced. Analysis of expert performance on the corresponding issues of the Chinese Agricultural Ministry showed that by reducing the impact of farming pattern and fertilization, a balance effect was achieved. With the adding level of impermeable materials and the increase of the very low vegetation to the orchard

areas, it is good for the improvement of the various buffer functions. As more and more environmentally sensitive areas are degrading mainly from agricultural activities, the promotional policies may be implemented to reduce agricultural activities. It reminds agricultural managers should be alert and keep a check on the construction of subsequent future agricultural developments. A framework is needed to be constructed to preserve agricultural activities and related sustainability while anticipating the dynamic movement of the 4 zoning policies between the agricultural areas.

10. Future Directions in Research

This collection of advance articles will be highlighted as a special issue. This virtual special issue will contain advance articles in the field of medicinal chemistry aimed at environmental pollution and its impact on human health, particularly focusing on the advances in drug design and identification of molecular targets for combating environmental toxicants and chemicals of emerging concern. Entries for this virtual special issue are solicited from experts for compilation and publication in Medicinal Research Reviews. Submissions can either be reviews, or communications outlining new discoveries. Submissions are particularly welcome covering the following topics: Drug design and development of nutraceuticals for detoxification and prevention/delay in the development of diseases caused by environmental toxics; Mechanism studies and identification of molecular targets of toxicological compounds; Advance analytical tools and high-throughput testing for the monitoring of toxic compounds and their metabolites; Use of modern informatics and computer-aided drug discovery to help design more efficacious, potent and capable pesticides or herbicides uptake by plants; and Cellular-based studies on mechanisms of metal toxicity and development of drug-enhanced secretion of metals in animals or humans to help reduce the health hazards. All contributions will undergo the normal peer-review process for Medicinal Research Reviews. Each paper will be reviewed by the Editor, or Guest Editor, but it will not be necessary to get all papers together. With the growth of the world’s population, urbanization and industrialization, environmental pollution has become a scourge, affecting human health and the ecological environment. More and more pollutants not only exist in air and water but also extend into food, clothes and housing. The highly pathogenic and drug-resistant bacteria have entered the aquatic environment with pharmaceutical residues to exacerbate the hazards of pollutants [5]. Many countries and scholars have paid great attention to this issue and tried to find solutions on a global scale. The present special issue, addressing advances in medicinal chemistry for detoxification of environmental pollutants and prevention of environmental diseases, is devoted to the recent progress in drug development to combat environmental toxicants with a focus on small molecules. Topics covered in the special issue will include the current advances in the design and discovery of small molecules that can be used as drugs for detoxification and disease prevention. Both synthetic compounds and natural products as leads or drugs for medicinal chemistry with the potential for environmental and pharmaceutical applications will be described. The ever-growing list of such compounds arises from both traditional drug discovery approaches and from the unexpected effects discovered in the course of clinical studies of commercial drugs.

10.1. Emerging Contaminants

Environmental pollution is considered a significant problem worldwide. It mainly occurs when contaminants transfer from the environment to living organisms, resulting in morphological, physiological, genetic, and biodiversity changes [27]. The impacts of pollutants on the environment and human health mainly depend on chemical properties and pollution levels. There are different types of pollution agents, like planned or treated heavy metals. However, in recent years, chemical pesticides, sweeteners, endocrine-disrupting compounds, hormones, and drug deterioration products are used. Modern technology plays a significant role in these issues. There is a primary level of pollution of the environment, and the four elements air, water, soil, and light are significantly affected [28]. It should be monitored regularly and analyzed to determine the critical pollution factors.

Generally, large-scale population studies assessing the impacts of pollutants on diabetes have not been reported. In addition, a change in the gut microbiota is beneficial to better understand the development of diseases as diabetes, which has been not studied, at least through 16S rRNA gene sequencing. Therefore, will discuss exposure to emerging contaminants with suspected glucose metabolism disorders and type 2 diabetes using the China Multi-Site Exposure and Metabolic study as a basis and decipher the vital role of the gut microbiota in this process. Results indicate that interpersonal variety of the gut microbiome is significantly connected with exposure status to certain categories of emerging contaminants and glucose metabolism, lymphoid factors correspondingly link exposure to supportive edge contaminants and glucose metabolism.

10.2. Innovative Therapeutic Approaches

The types and the number of harmful environmental chemicals in our environment are increasing at a rate which has reached levels which should be a cause of concern for both scientists and the public. The release of pesticides, heavy metals, dyes, solvents, as well as other harmful and toxic substances into the environment generates conditions for their widespread distribution and persistence. A critical issue is that such compounds can be extremely dangerous and harmful to living organisms, inasmuch as they act as initiators of many chronic diseases, such as certain frequent forms of cancer, as well as endocrine, immunological, neurological and reproductive dysfunctions. It is, therefore, of paramount importance to have available timely and reliable systems for the detection and detoxification of harmful and toxic substances in the environment [20]. Specifically, detection systems should monitor the contamination levels of harmful substances in the body fluids and tissue of exposed populations, as well as in the environment. It should be reliable, easy to automate, low-cost, and quick. Such systems should then permit a timely removal of harmful substances from the environment, through the establishment and use of efficient and eco-compatible bioremediation strategies for their degradation and detoxification. Bioremediation strategies are founded on the use of living organisms, such as plants, fungi and bacteria, as well as engineered proteins and gene pathways therein. A second developing field for possible bioremediation strategies is that based on metabolic pathway engineering of different organisms, by the development of genetically modified biosystems. There exist many examples of the development of engineered cell lines, plants, animals, fungi, bacteria and yeasts for the fixation, degradation and detoxification of several environmental chemicals. However, diffusion of such strategies is limited by the persistence and negative impact of the GM organisms thus generated in the environment, as well as by the negative attitude and reluctance of the public opinion towards the use of pertinent living biosystems. A safer and more promising direction for the application of bioremediation techniques in the treatment of large amounts of differently polluted industrial wastewaters is the detoxification, degradation and valorization of several harmful substances present therein by means of fungal mycelia. Several favorable aspects of many filamentous fungi can be highlighted for such purpose, like their high biotechnological potential and their secreted ligninolytic enzymes, even low-cost, that are able to oxidize with much versatility and in a totally non-specific fashion a wide range of both biotic and abiotic environmental chemicals. There are many examples of the successful use of some of these features for the detoxification and degradation of several toxic agents present in the effluents of some chemical and manufacturing industries by means of a batch co-culture approach which uses white rot fungi mainly as biocatalysts. Several appropriate configurations of a simple polymer tray with a flat bottom and the fungal mycelial mat immobilized therein were used to examine their compatibility with the industrial standards of the textile dyeing effluents racket. Though always challenging in terms of operational interventions, it was possible to disclose some basic aspects of the ecological, technological, and economic potentialities of the different configurations tested, thus promoting the development of a completely unconventional and advanced myco-bioremediation strategy.

10.3. Interdisciplinary Collaboration

Health care professionals in government ministries of health, public health, research funding, clinical health care settings, and universities will only be strategically successful in the prevention and management of increasing common chronic, complex, and often debilitating diseases when the array of environmental contributions is recognized and subsequently addressed. Environmental toxicants contribute to a number of chronic diseases detrimental to human health, productivity, and quality of life. Substantial research and policy approaches to decrease the environmental factors implicated in chronic disease.

Toxicant avoidance combined with clinical environmental medicine can be effective approaches. An environmental medical history and knowledge of unusual, high-level body burdens are required. Clinical detoxification and avoidance can be successful; the practitioner should be prepared for intellectual challenges. The prevalence of chronic, complex disease has been increasing. The etiological contributions to various chronic diseases are multifactorial unset of symptoms and diagnosis can be subtly insidious.

Common symptoms and diseases are increasingly recognized as environmentally influenced. Basic knowledge of environmental medicine should be provided in the training of all health care workers. A strategy to increase clinical awareness and involve politicians in addressing environmental health issues is proposed. This is fundamental for the design of effective public health strategies. History demonstrates that the translation of scientific information and the adoption of required clinical skills are usually not expeditious. Given the increasing prevalence of disease from environmental factors, the process of widespread problem recognition and solution implementation will be expedited to ameliorate and stem the tide of chronic disease.

11. Conclusion

Global pollution of soil, water, and air is a major public health problem. In many instances of widespread accidents or incidences of environmental pollution, human exposure to toxic chemicals has been associated with a variety of adverse health effects. The role of the environment is important in this context in that it serves as the conduit by which toxic chemicals reach most individuals, and therefore from which mankind will suffer most harm. Toxic chemicals that persist in the environment beyond the time at which they are introduced and which have a potential for causing significant adverse health effects are of greatest concern. Interest in the environment and particularly in determining the health hazards of environmental exposures was heightened by the recent and continuing awareness in the severe pollution of various environmental compartments in many parts of the world, and the health consequences of that pollution.

Various types of anthropogenic activities have greatly magnified the number and variety of chemicals discharged into the environment. Consequently, soil, water, and air pollution by toxic chemicals have escalated phenomenally. There have been a veritable explosion in scientific activities aimed at characterizing the health hazards of environmental pollution. Many of these studies have shown that toxic health hazards exist at environmental pollution levels. Because of the ambiguity of many of the earlier findings and the wide range of very relevant as yet unanswered questions, much of the important conclusions being obtained as to the ability of environmental pollutants to cause significant adverse health effects must be viewed in a very tentative sense. As a result of this uncertainty and the potentially tremendous economic consequences of environmentally related control strategies, diagnosed as yet unmanageable pollution, and chronic progress many problems in this area remain "intractable". Conversely, in areas where an element of confidence resembling certainty now exists that environmental pollution is causing significant health effects.

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